ISUZU

CITIPORT



WORKSHOP MANUAL

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Safety information

Repair work

1. General precautions

This workshop manual was created for qualified individuals with specialized technological knowledge regarding vehicle maintenance and should not be used by anyone other than such individuals.

Carefully read the workshop manual before starting work and verify that the correct work procedures and tools are used.

Workshop manuals contain information labeled as "Warning", "Caution", and "Supplement" that is pertinent to the safety of service technicians and vehicle safety that must be read and followed closely.

2. Precautions for before work is started

Prepare the necessary tools, measuring devices, and special tools.

Prepare the parts to be replaced and parts whose reuse is prohibited. Always replace parts with genuine parts.

Service technicians must wear a clean service technician uniform, hat, and safety shoes.

Use covers to prevent damage to the vehicle and seats.

When jacking up the vehicle, place chock blocks at the wheels and use a stand after jacking up to support the vehicle. Use the appropriate safety devices when lifting up the vehicle using a lift.

Disconnect the battery negative terminal before start to work

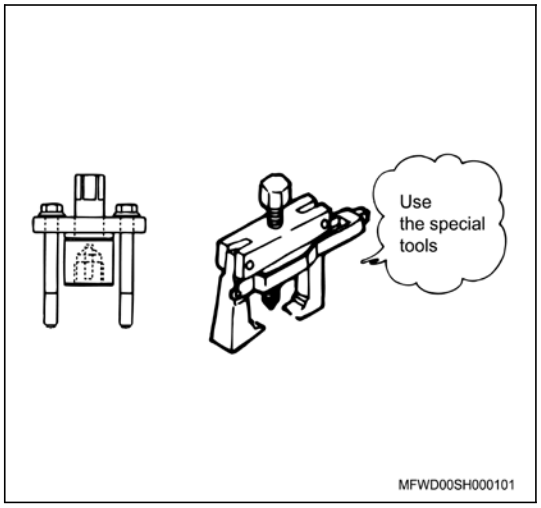
3. Precautions during work

Always remember to perform operations in a safe manner. Perform operations that require 2 or more people in a safe manner.

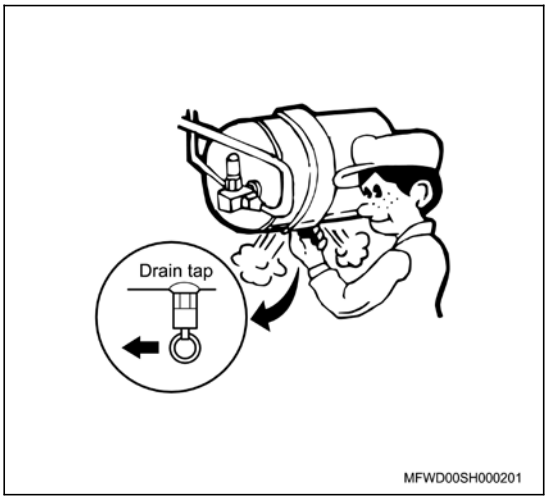
Do not leave the engine running for an extended period of time or perform painting in a poorly ventilated working environment.



Make sure to use the special tools if the procedure requires them for the work.



Remove the pipes and air hoses only after bleeding air from the air tank.



Do not use tools such as wrenches that have lost their edge, hammers with frayed edges, or chipped chisels.

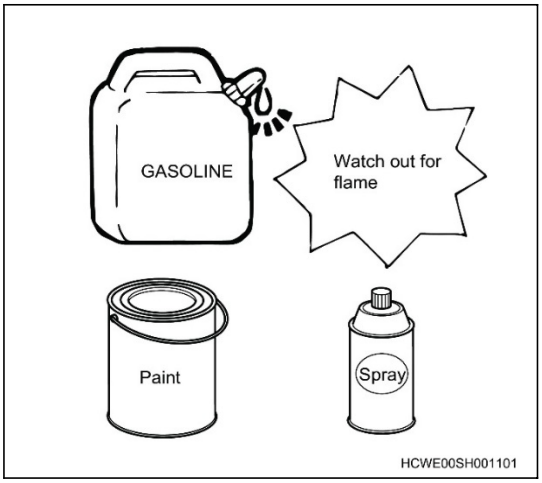


Use of machines such as grinders, cranes, or welding equipment should be performed by a qualified individual

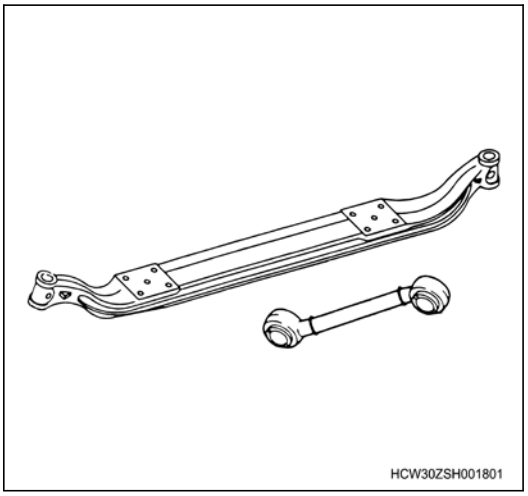
Qualified technician work
When handling volatile materials, take care that they do not catch fire



Handling volatile oil



Because parts for heavy-duty vehicles are extremely heavy, perform work operations by fastening these parts using the appropriate jacks or wires



Quickly wipe away any oil that has adhered to rubber parts to prevent deterioration.

Properly organize any removed parts and prevent any parts whose reuse is prohibited from becoming mixed in.

When reinstalling removed parts, clean the parts as necessary. When applying liquid packing, etc., always remove any oils that may have adhered to the application areas.

4. Precautions during welding operations

Before starting welding operations, disconnect the battery negative cable, and disconnect all control units from their harnesses.

Turn all switches OFF.

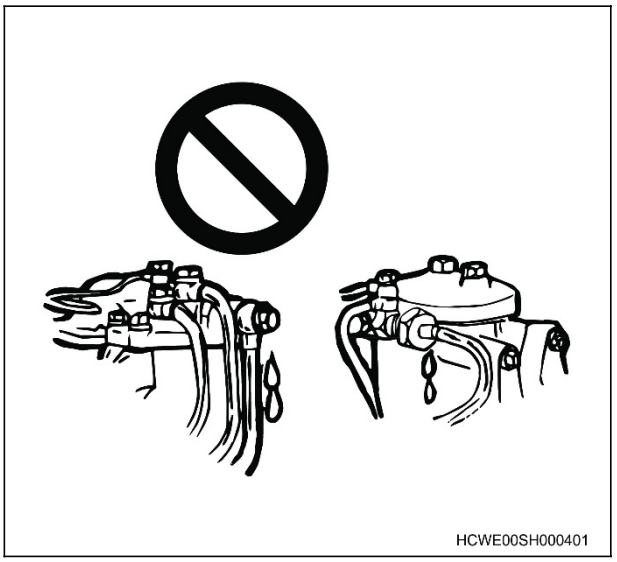
Install the ground connection for the welder as close to the welding area as possible.

5. Precautions for after work is completed

Perform a final check to verify that the problem has been solved.

Post Work Checks

Check to ensure that there is no leakage of fuel, oil, or coolant.



1. Replacement parts and parts number

Replace removed packing, oil seals, O-rings, crimping lock nuts, bending lock nuts, split pins, etc., with new parts.

Make sure to check the supply system and part numbers in the parts catalog as part numbers indicated in this manual may differ from the supply system and are subject to change.

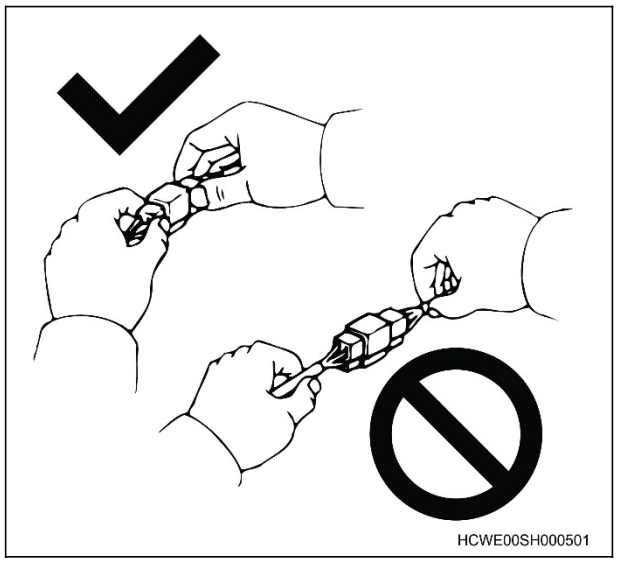
2. Connector Handling

Always check the type of lock connectors being used as there are two types: a type that opens by lifting the release area, and a type that opens by pressing the release area.

When removing the waterproof connector, remove dust or moisture that adheres to the connector by blowing with air, etc.
If dust or moisture enters the connector, remove it before connecting the connector. As for moisture, dry well to prevent rust.

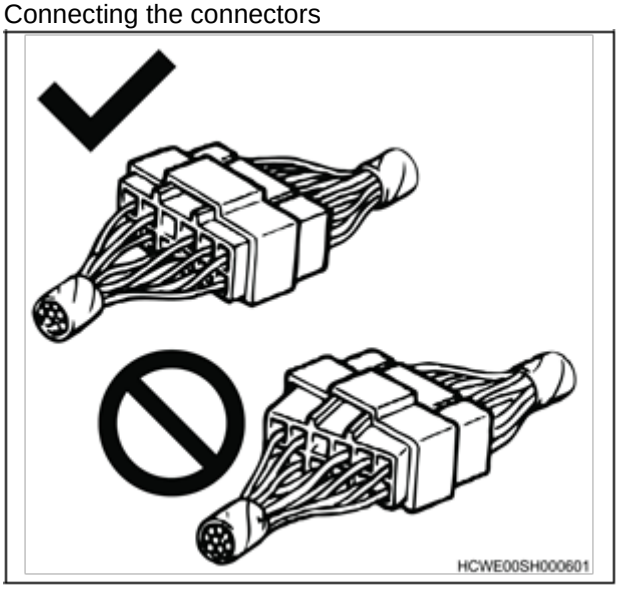
When disconnecting connectors, do not pull on the harnesses as doing so may result in open circuits caused by wires becoming loose.

Handling the connectors



When connecting connectors, securely press in until a clicking sound can be heard

Connecting the connectors



If connectors of the same shape are used for different parts located in close proximity of one another, proper identification of connection locations can be made possible by applying tape of different colors and in different patterns to differentiate the harnesses. When reconnecting connectors, check to ensure that harness corrections are correct.

Electrical parts handling

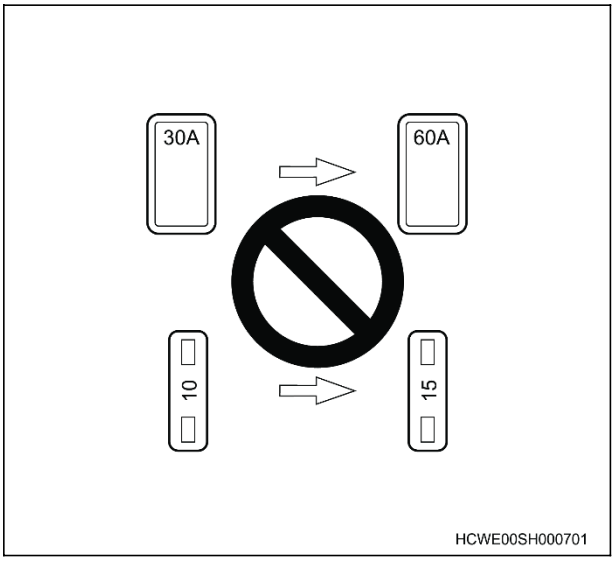
If the fuse blows out, make sure to replace it with a non- defective fuse of the specified capacity after identifying the cause of the blowout.

Using a fuse with a capacity other than specified, wires, aluminum foil, etc., causes a failure or vehicle fire.

Do not replace or inspect fuses if the ignition switch is in "ON" position or while running the vehicle. Doing so may result in an unexpected accident or failure.

When replacing a fuse, install by pushing it in securely to prevent loose connections.

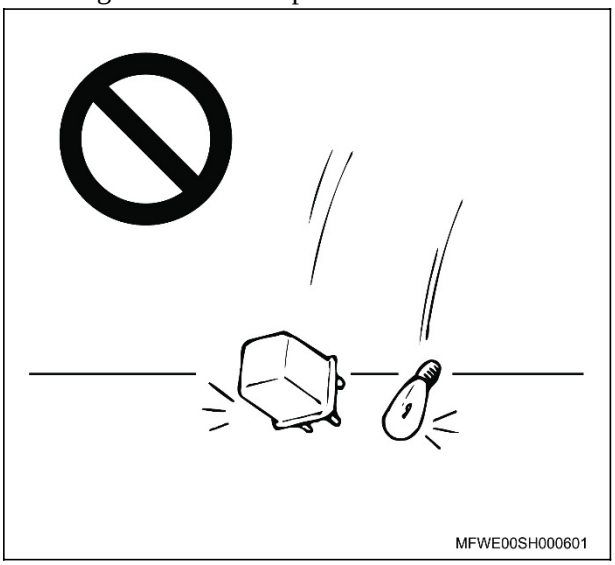
Handling the fuse



When washing the vehicle, cover electronic components with plastic and do not directly apply high-pressured water

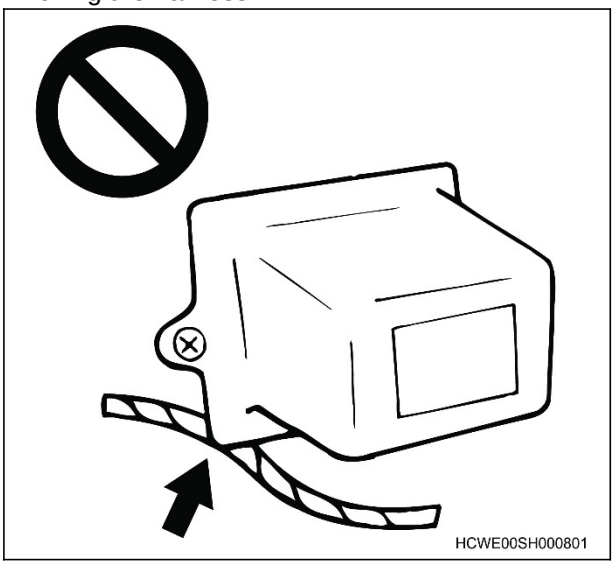
Do not drop or throw electronic components
Handle electronic components with sufficient care, and do not damage the parts by dropping or throwing them

Handling electronic components



When installing electronic components, take care to prevent harness pinching and do not forcibly push components into place

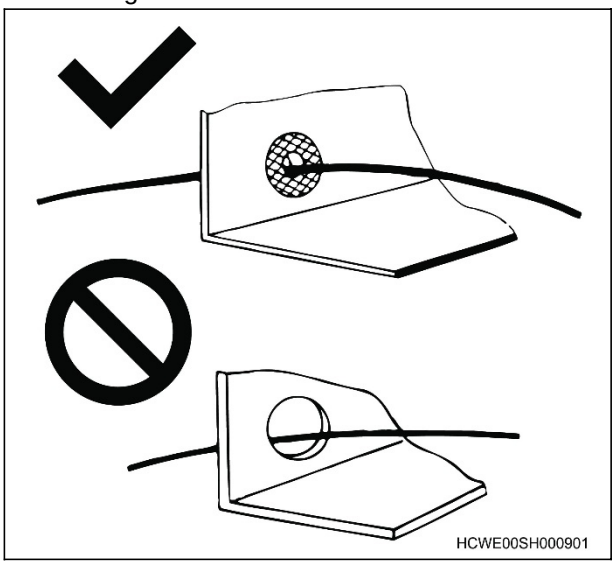
Pinching the harness



When disconnecting harnesses, clean the connectors and ensure the connections are secure.

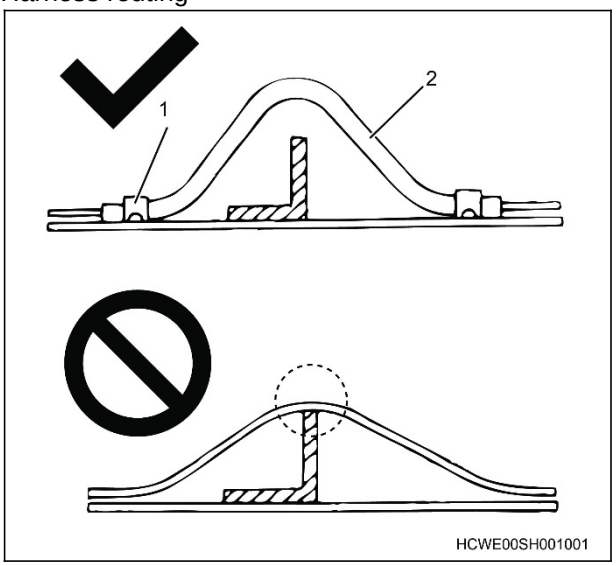
Use grommets or tubes to prevent damage to harnesses that may come in contact with the sharp edges or surfaces of other parts.

Protecting the harness



When wiring a harness by diverting it around other parts, give the harness a sufficient amount of free length, and use a protective tube and clip to ensure it does not come into contact with surrounding parts.

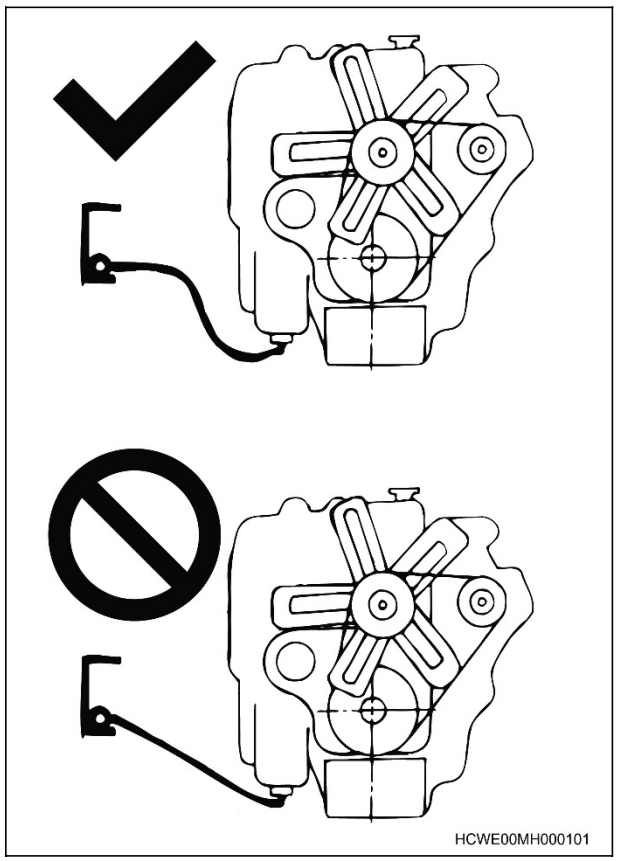
Harness routing



1. Clip
2. Protective tube

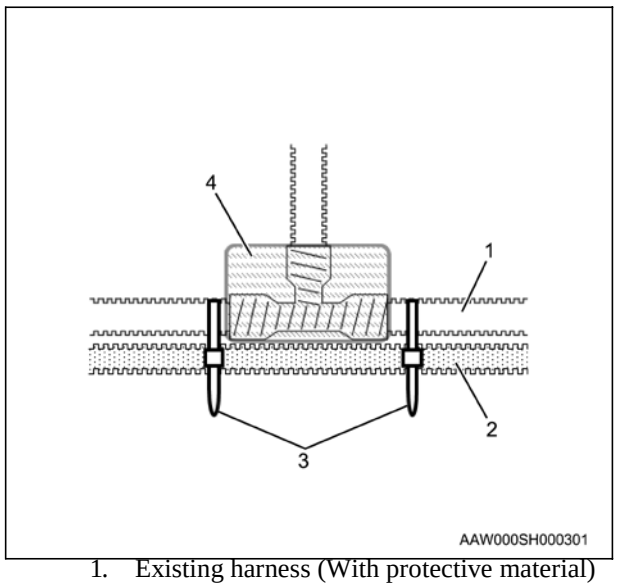
For wiring between the engine and chassis, give the wiring sufficient free length to prevent wear and damage caused by vibration.

Engine and Transmission Wiring



When securing additional wires along existing harnesses, install band clips on the protective materials (corrugated tubes, vinyl chloride tubes, rigid tubes, protectors, etc.) installed on the existing harnesses.

Repairing the harness



1. Existing harness (With protective material)
2. Additional harnesses
3. Band clip for securing harnesses
4. Area where securing with band clips is prohibited

Commercial electronic products

When inspecting or repairing vehicles equipped with aftermarket electronic components such as lights, audio systems, or radios, start work after turning OFF or removing all such parts.

Failure by electrostatic discharge

Because high voltage applied to electronic components due to electrostatic discharge may result in malfunctions, touch a known good ground before inspecting or replacing related parts.

Do not directly touch the connector pins of electronic components or rub them with other parts or covers, etc.

If replacing electronic components, connect the parts to a known good ground while still in their packaged state and then remove them while taking care to prevent the connector pins from coming into contact with the packaging

Contents included in service information

Removal
Includes the removal procedure when repairing parts, devices, etc.

Installation
Includes the installation procedure when repairing parts, devices, etc.

Disassembly
Includes the disassembly procedure when overhauling a unit, assembly part, etc.

Assembly
Includes the assembly procedure when overhauling a unit, assembly part, etc.

Inspection
Includes inspection items for parts requiring inspection to ensure continued performance of parts, devices, etc.
Values are listed for parts whose standard values, setting values, and use conditions have been determined.

Cleaning
Includes the cleaning procedure for parts, devices, etc.

Preparation
Includes the preparatory procedure necessary before removing parts, devices, etc.

Adjustment
Includes the adjustment procedure if adjustment to the setting values or standard values is necessary when performing assembly or installation.

Measurement
Includes the measurement procedure for determining if the installation position of parts is correct, etc.

Drain
Includes the draining procedure for oil, etc.

Refill
Includes the refilling procedure for oil, etc.

Air bleeding
Includes the air bleeding procedure when air bleeding is necessary after changing oil, etc.

Writing
Includes the writing procedure necessary when replacing the ECM or supply pump.

Precaution
Includes the maintenance precautions specific to each item.

Disconnection
Includes the disconnection procedures for wiring, piping, etc.

Connection
Includes the connection procedures for wiring, piping, etc.

Setting
Includes the setting procedure necessary when replacing the ECM, etc.

Replacement
Includes the procedure for replacing parts, changing oil, etc.

Prioritized DTC
Includes DTCs which should be prioritized for each DTC code.

Diagnosis
Includes the diagnostic procedure for troubleshooting symptoms.
DTCs are listed in order of priority.

Repair verification
Includes the procedure for verifying resolution of the symptom by using numerical values, etc., other than the verification that DTCs are cleared.

Functional description
Includes the detailed functional description related to the functional inspection.

Symptom description
Includes the detailed symptom descriptions related to a diagnosis by symptom.

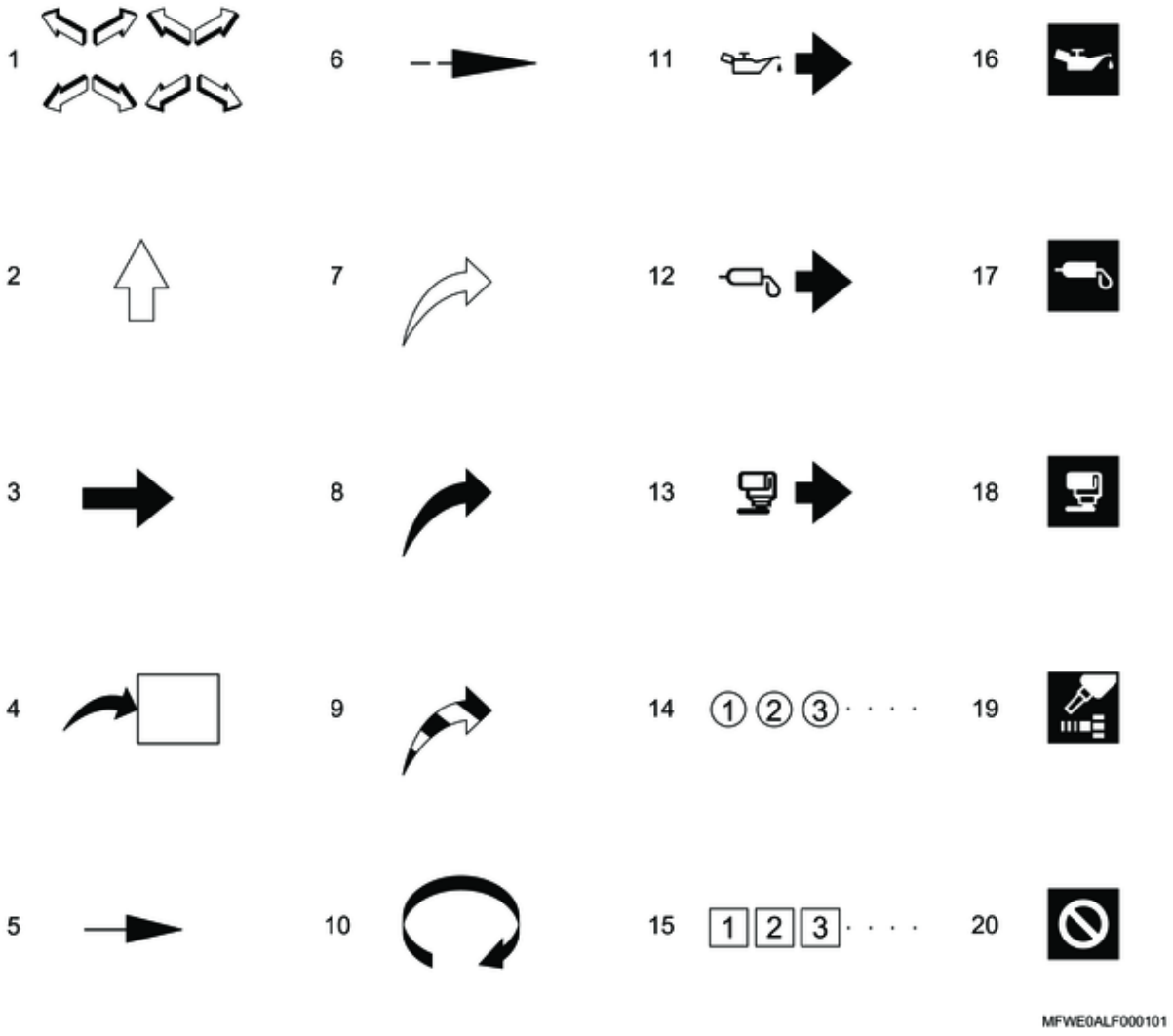
DTC description
Includes the circuit description related to DTCs.

Condition for setting
Includes information related to conditions for setting DTCs.

Action taken when set
Includes the information related to the control actions taken by the ECU, etc., when DTCs are set.

Items related to ETM
Items related to the ETM are described in the instructions on how to view the wiring diagram.

Symbols



1. Vehicle front
2. Upward
3. Operating section or operating direction
4. Detail of a particular part
5. Arrow indicating a dimension
6. Arrow indicating a cross-section
7. Outside air or cold air
8. Gas or warm air
9. Mixing of outside air and gas or mixing of cold air and warm air
10. Rotational direction
11. Apply oil
12. Apply grease
13. Apply liquid gasket
14. Working sequence (Tightening procedure, etc.)
15. Tightening torque (Component diagram)
16. Apply oil / Apply fuel (Component diagram)
17. Apply grease (Component diagram)
18. Apply liquid gasket (Component diagram)
19. Apply thread-locking adhesive (Component diagram)
20. Do not reuse (Component diagram)

Preliminary and post procedures

Preliminary procedures

1) Disconnect the battery cable from the battery negative terminal.

Caution

- **For models without urea SCR system, do not disconnect the battery cable within 1 minute after turning OFF the ignition switch.**
- **For models with urea SCR system, do not disconnect the battery cable within 3 minutes after turning OFF the ignition switch.**
- **The ECM may malfunction if the battery cable is disconnected within the predetermined time.**

2) Raise the vehicle.

Post procedures

1) Lower the cab.

2) Lower the vehicle.

3) Connect the battery cable to the battery negative terminal.

Descriptions in Wiring Diagram

1. Wiring Information

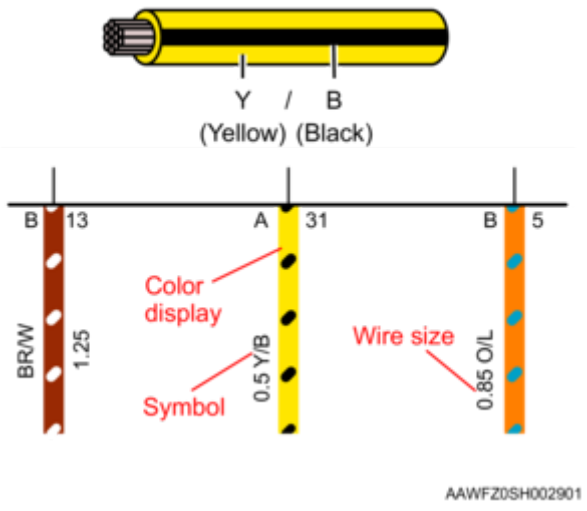
Wiring color and wire size are indicated.

The wiring colors are shown using color indications and color symbols.

The wire sizes are indicated using harness nominal sizes.

Color symbol	Color	Color symbol	Color
B	Black	**LG**	Light green
W	White	**GY**	Gray
R	Red	**P**	Pink
G	Green	**SB**	Sky blue
Y	Yellow	**V**	Violet
L	Blue	**T**	Tan
O	Orange	**BE**	Beige
BR	Brown		

Example:
If 2 colors such as Y/B are shown, it means wiring with a black line on a yellow base.

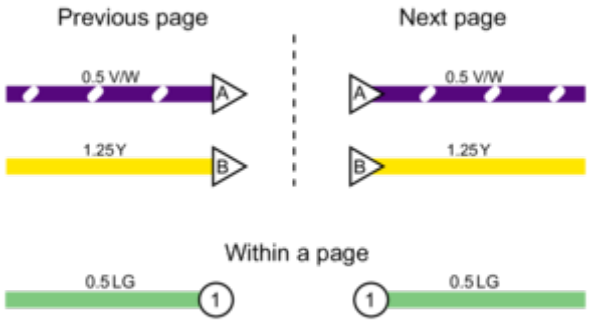


Harness Wire Size Table		
Nominal size	**Cross-sectional area (mm2)**	**Outer diameter (mm)**
0.3	0.372	1.8
0.5	0.563	2.0
0.85	0.885	2.2
1.25	1.287	2.5
2	2.091	2.9
3	3.296	3.6
5	5.227	4.4
8	7.952	5.5
15	13.36	7.0
20	20.61	8.2

Harness Wire Size Table (ISO)		
Nominal size	**Cross-sectional area (mm2)**	**Outer diameter (mm)**
0.13	0.1407	0.85
0.35	0.3436	1.1
0.5	0.4948	1.25
0.75	0.7266	1.4
1.25	1.247	1.8

2. Wiring connection symbol

Shows that the wiring with the same symbol is connected.



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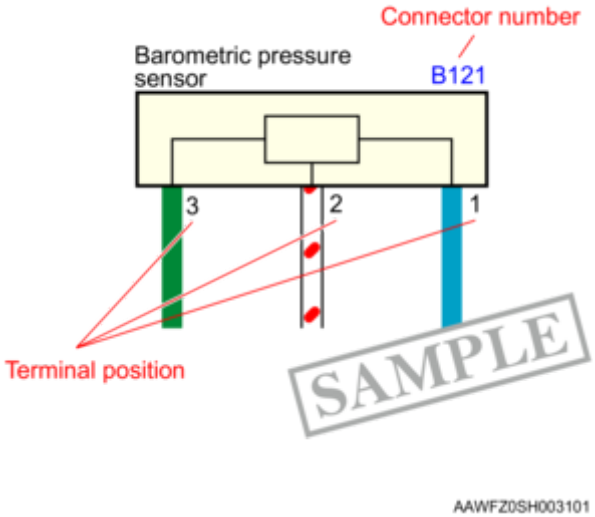
3. Connector

(a) Connector number

When multiple wires connected to equipment (a component) exist within the same connector, the connector number is indicated either inside or outside the equipment, and the corresponding terminal position is indicated next to each wire.



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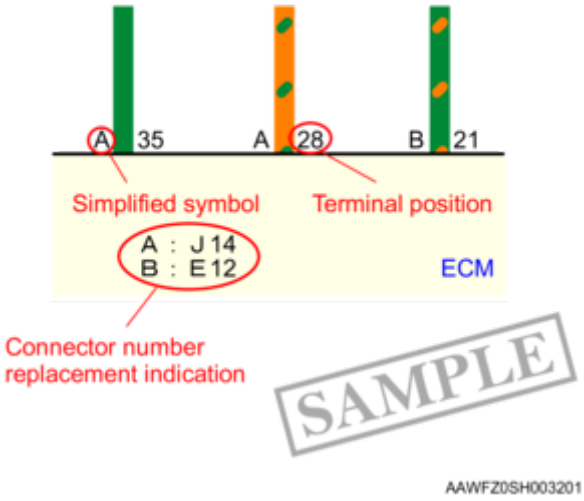
When multiple connectors are connected to a component, each connector number is expressed on the wiring diagram with a replacing simplified symbol.

Example:
A: J14 means that the J14 connector is indicated by the substitute simplified symbol A.



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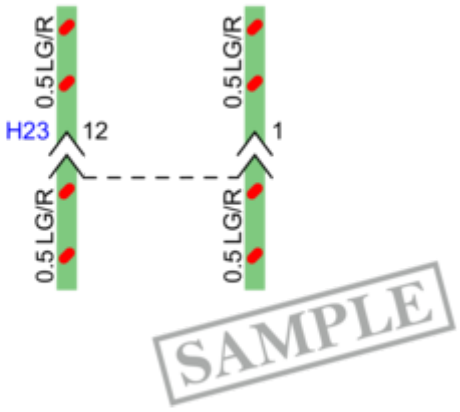
(b) Intermediate connector

Connectors that are connecting wires are indicated.

The groove side indicates female side connector, and the protruding side indicates male side connector.

On the wiring diagram, when connectors are linked with a dashed line (----), it means that they are the same connector.



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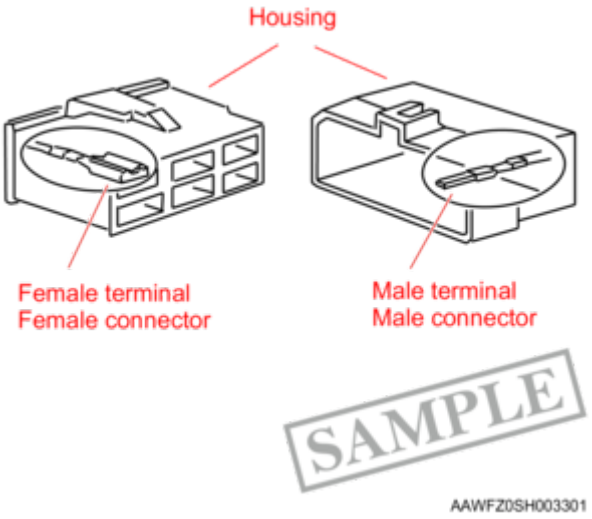
(c) Connector shape and terminal shape

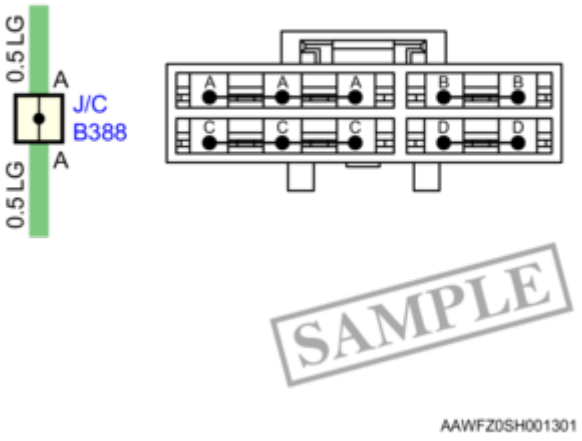
- Female connector……Indicates that the terminals are female.
- Male connector……Indicates that the terminals are male.



(d) Joint connector

A connector in which multiple terminals are collectively connected using joint terminals is indicated.

Alphabets indicate jointed groups (collectively connected terminals).

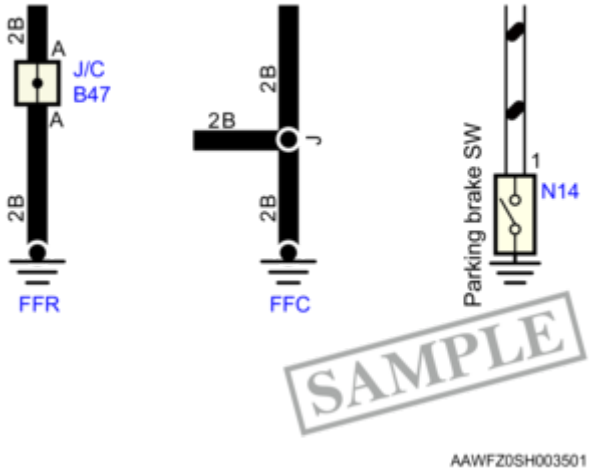


4. Ground Point

Ground positions are described using symbols.

Example:
FFR = Frame front right
FFC = Frame front center

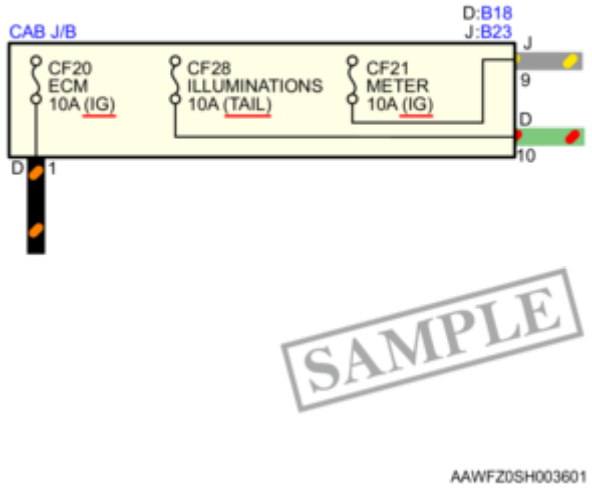
For the parking brake SW, etc., it indicates that a chassis ground is used (the switch itself is connected to a ground).



5. Fuse

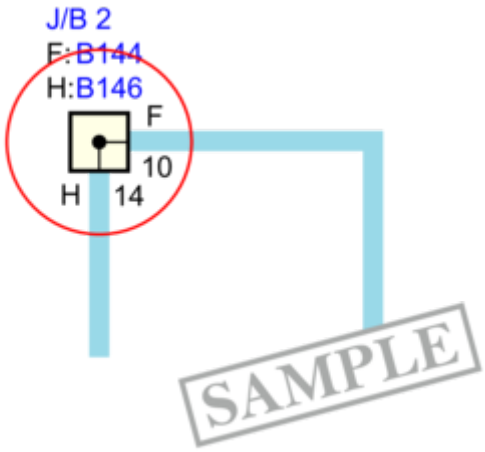
Fuse numbers, names, capacities, and energizing conditions (in parentheses) are shown.

Example
(IG) = Ignition switch energized with IG
(TAIL) = Lighting switch energized with ON



6. Junction block

Internal connections within a junction block which is related to each circuit are indicated.



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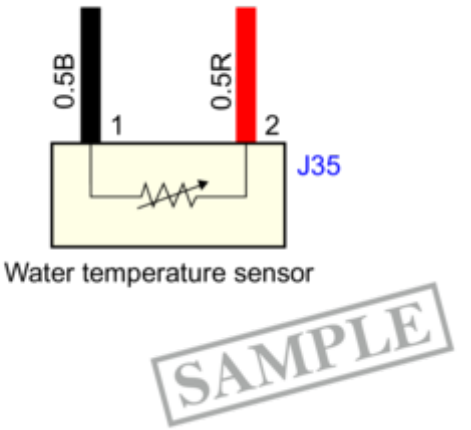
7. Component

Components are shown as frames (yellow inside), and the name of the component is shown either inside or outside the frame.



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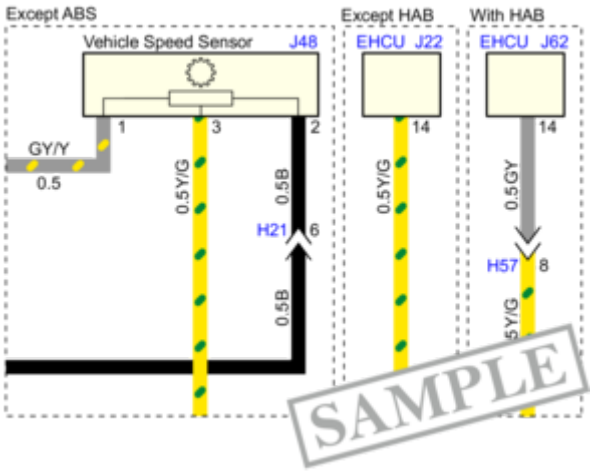
8. Descriptions of specification differences

Differences in wiring diagram due to specification are indicated in a dashed border.



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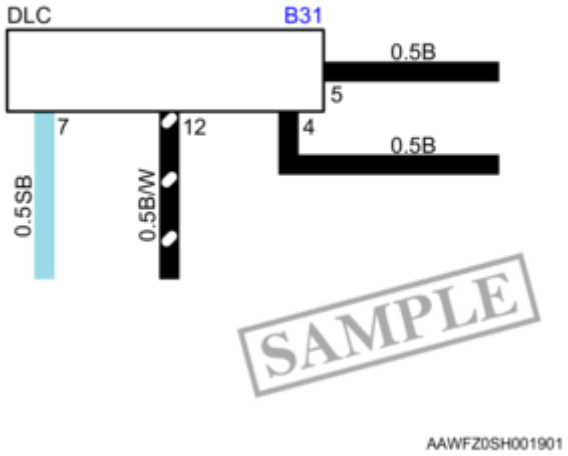
9. External connector

External connectors (DLC, service connectors, etc.), body modification parts, locally procured parts are represented as a frame (white inside).



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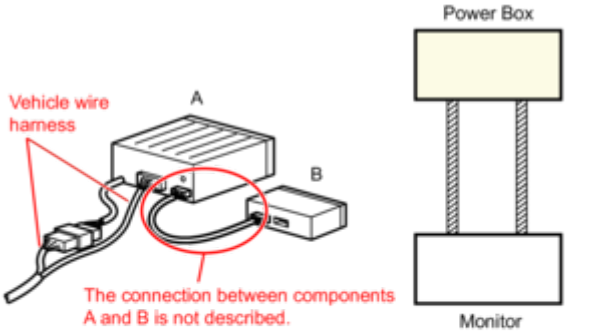
10. Wiring not described

This document describes connections between the vehicle wire harness and each component. Therefore, connections made between components that do not pass through the vehicle wire harness are not described.



SAMPLE

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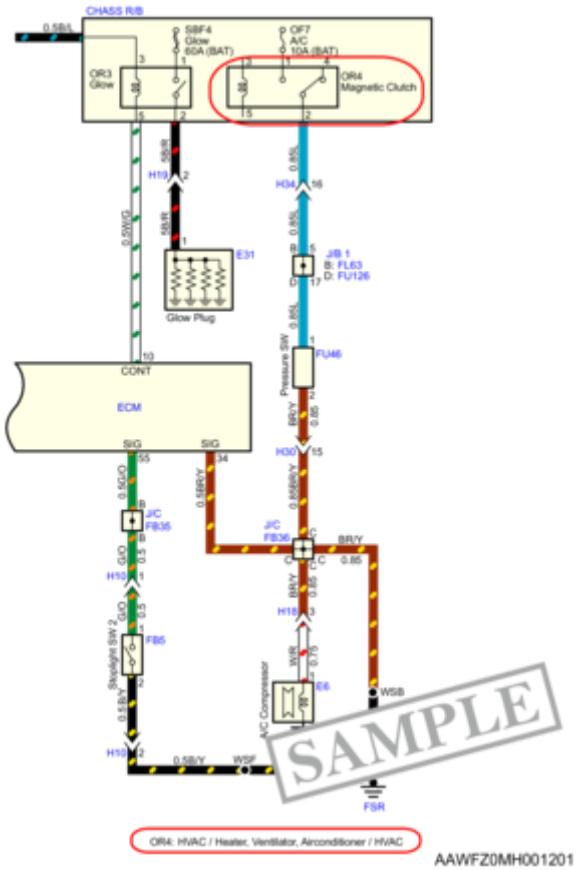
11. Relay

Relay numbers, relay names, and relay internal circuits are shown.

If the relay is not completed in the relevant circuit, a line is added to the connection terminal and the referenced circuit names are indicated on the circuit diagram.



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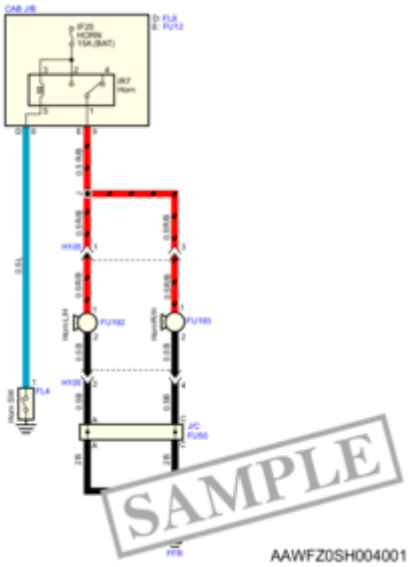
【Relay operation example】

When the horn switch (FL4) is pressed, current flows through pin 3 and pin 5 in the relay, and the coil in the relay is energized.

The contact point is moved by electromagnetism after the coil is energized, and pin 1 and pin 2 are connected.

When pin 1 and pin 2 are connected, power is supplied to the horn, and the horn sounds.

When the horn switch is disconnected, excitation in the coil ceases, the contact points are returned to the original status, pin 1 and pin 2 are disconnected (pin 1 and pin 4 are connected), and the horn stops sounding.

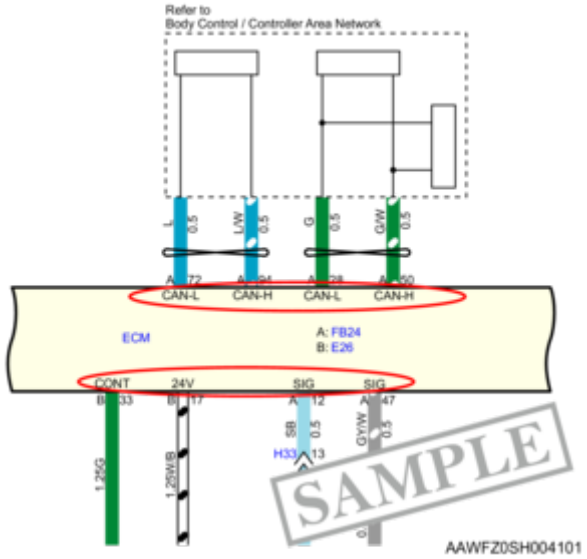


12. Control unit (C/U)

Signal names are indicated on the terminals inside the control unit illustrations.

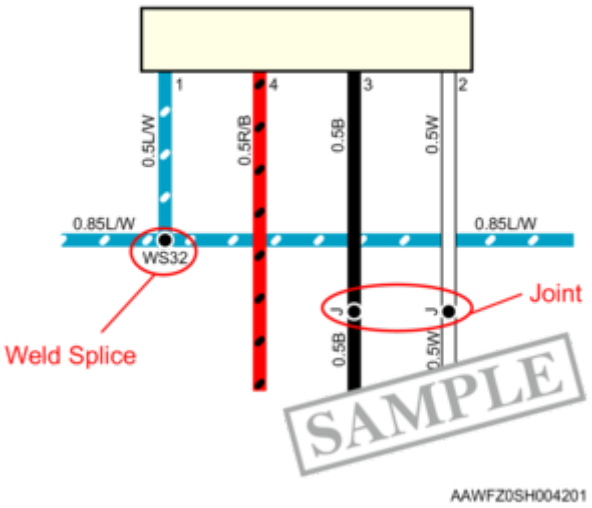
The meaning of the signal names are indicated below.

Signal name	Meaning
24 V	Battery voltage
5 V	Device voltage
GND	Ground
SIG	Signal input
CONT	Coil, LED drive
DRIVE	Motor drive
U, V, W	Three-phase motor drive
CAN-L	CAN-LOW signal
CAN-H	CAN-HIGH signal

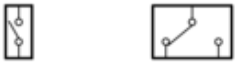
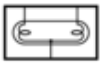


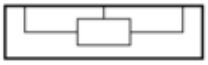
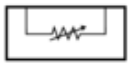
13. Joint, weld splice

If the wiring is joined, the weld splice number is shown on the weld splice and joint terminal, and J is shown at the joint.



14. Circuit Symbols

Meaning of symbol	Symbol
Battery	
Fuse	
Slow blow fuse	
Fusible link (wire)	
Relay	
Switch	
Diode	
Light emitting diode	
Single filament bulb	
Double filament bulb	

Meaning of symbol	Symbol
HID bulb	
Solenoid valve, Magnetic valve, etc.	
Resistor	
Horn	
Buzzer	
Speaker	
Motor	
Magnetic clutch	
Pressure sensor, etc.	
Temperature sensor	

AAWFZ0LF000301

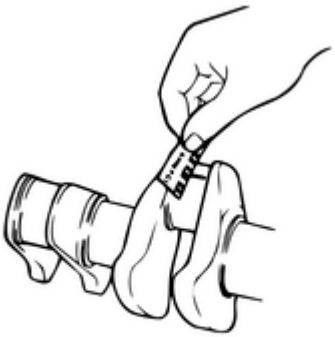
Meaning of symbol	Symbol
Pulse sensor	
Other sensors, etc.	
Intermediate connector	
Joint connector/ junction block	
Joint	
Pair	

Meaning of symbol	Symbol
Twisted pair	
Shield	
Ground point	
Connection between pages	
Connection within a page	
Dedicated line	

PLASTIGAUGE

1. Using the PLASTIGAUGE

PLASTIGAUGE type and measurable range	
Type	Measurable range
PG-1 (Green)	0.025 - 0.076 mm
PR-1 (Red)	0.051 - 0.152 mm
PB-1 (Blue)	0.102 - 0.229 mm

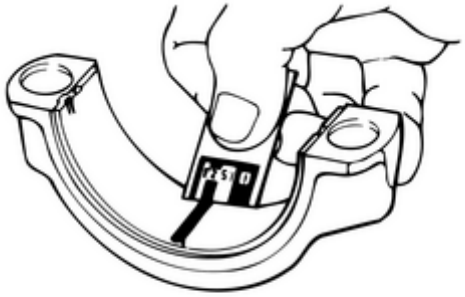


HCW30ASH002101

Method for measuring clearance between connecting rod bearing and crank pin
Clean the connecting rod and bearing, and assemble the bearing to the connecting rod.
Cut the PLASTIGAUGE to the width of the crank pin and lay it parallel while avoiding the crank pin oil hole.
Align the marking on the connecting rod with the marking on the cap, and assemble the connecting rod and cap to the crank pin. Apply molybdenum disulfide to the threaded portion and seating surface of the tightening bolt. Tighten alternately so the cap is tightened to the specified torque.
Gently remove the cap and the connecting rod, and measure the width of the flattened PLASTIGAUGE using the scale printed on the packaging.

Caution

- **Do not move the connecting rod when using PLASTIGAUGE.**



HCW30ASH002001

Method for measuring clearance between crank bearing and crank journal

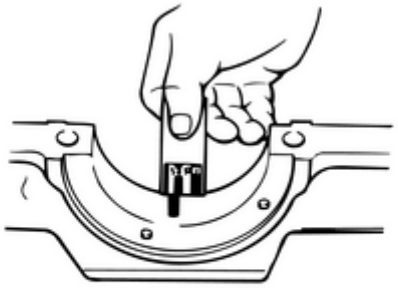
Clean the bearing, as well as the cylinder block and crankcase bearing mounting surfaces, and assemble to the cylinder block and crankcase.

Gently place the crankshaft on the cylinder block, and settle it by turning it approximately 30°.
Cut the PLASTIGAUGE to the width of the crank journal and lay it parallel while avoiding the journal oil hole.

Gently place the crankcase on the cylinder block, and apply molybdenum disulfide to the threaded portion and seating surface of the tightening bolt. Tighten the bolts to the specified torque in order.
Gently remove the crankcase, and measure the width of the flattened PLASTIGAUGE using the scale printed on the packaging.

Caution

- **Do not rotate the crankshaft when using PLASTIGAUGE.**



HCW30ASH002201



HCW30ASH002301

Handling electronic parts

1. Disconnecting the battery cables procedure

1. Models with battery equalizers

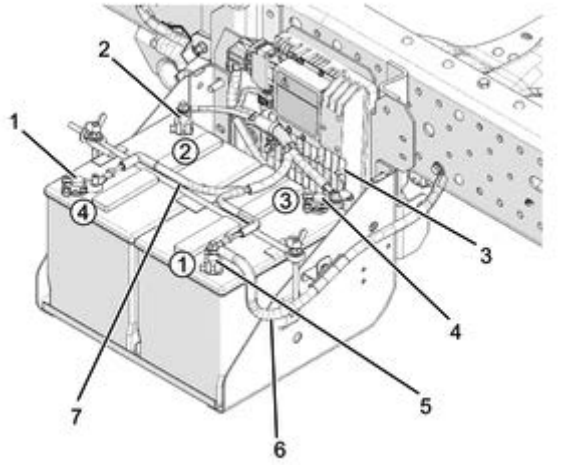
1) Turn OFF all the switches.

2) Disconnect the frame harness and battery ground cable from the battery terminals in the order shown in the diagram.

Caution

- **Do not disconnect the frame harness from the 12 V system side battery positive terminal within 15 seconds after the frame harness is disconnected from the 24 V system side battery negative terminal.**

12 V/24 V



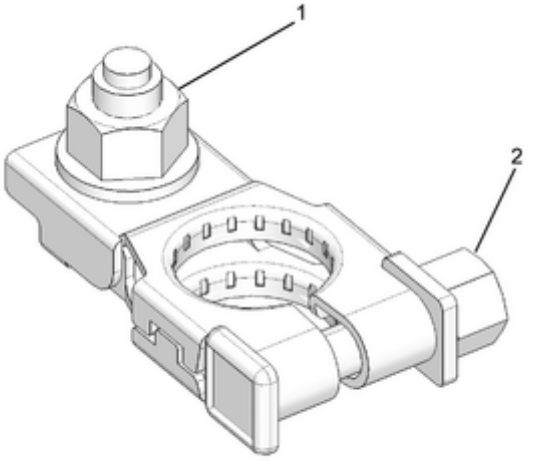
1. Battery positive terminal (24 V system side)
2. Battery negative terminal (24 V system side)
3. Battery equalizer
4. Battery positive terminal (12 V system side)
5. Battery negative terminal (12 V system side)
6. Battery ground cable
7. Frame harness

Caution

- **Because disconnecting the battery positive cable first may cause a short circuit, always disconnect the battery ground cable first.**

Note

- **Install in the reverse order to removal.**

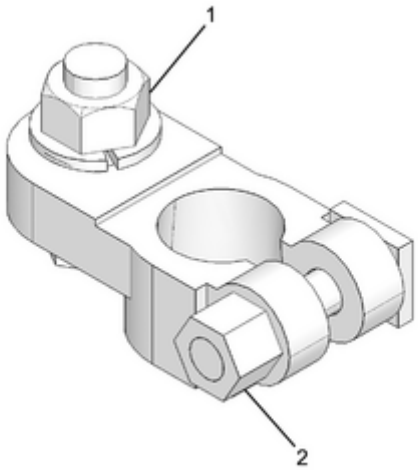


LNWE0ASH000601

1. M8 nut
2. M6 nut

Tightening torque: 10 to 12 N・m { 1.0 to 1.2 kgf・m / 89 to 106 lb・in } M8

Tightening torque: 3 to 6 N・m { 0.3 to 0.6 kgf・m / 27 to 53 lb・in } M6



LNWE0ASH000501

1. M8 nut
2. M6 nut

Tightening torque: 11 to 14 N・m { 1.1 to 1.4 kgf・m / 97 to 124 lb・in } M8

Tightening torque: 3 to 6 N・m { 0.3 to 0.6 kgf・m / 27 to 53 lb・in } M6

Caution

- **Clean the area surrounding the battery terminal, and apply a thin layer of grease to the terminal to prevent corrosion.**

2. Models without battery equalizers

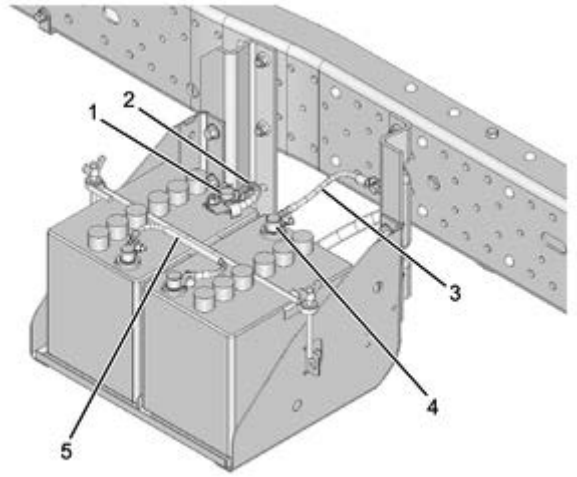
1) Turn OFF all the switches.

2) Disconnect the battery ground cable from the battery terminal.

3) Disconnect the battery positive cable from the battery positive terminal.

4) For 24 V models, disconnect the battery cable from the battery terminal.

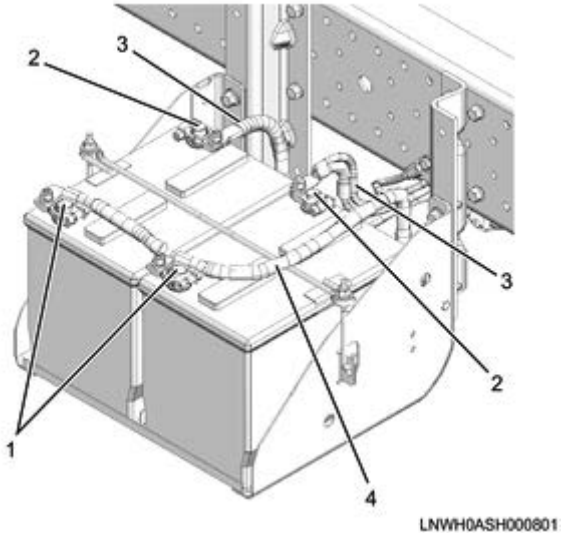
24 V



LNWH0ASH000901

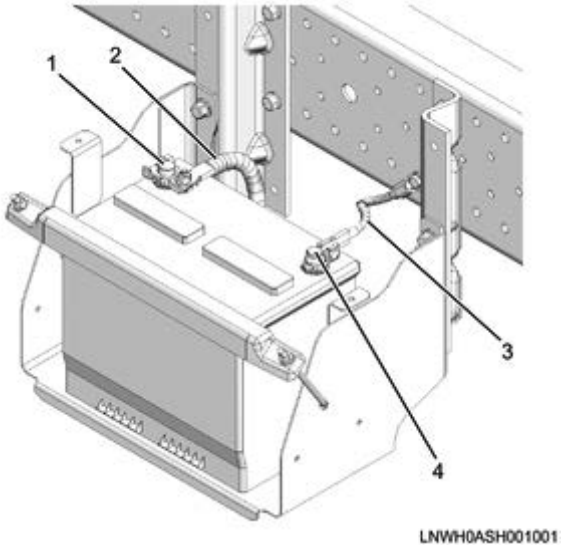
1. Battery positive terminal
2. Battery positive cable
3. Battery ground cable
4. Battery negative terminal
5. Battery cable

12 V (2 batteries)



1. Battery positive terminal
2. Battery negative terminal
3. Battery ground cable
4. Battery positive cable

12 V (1 battery)



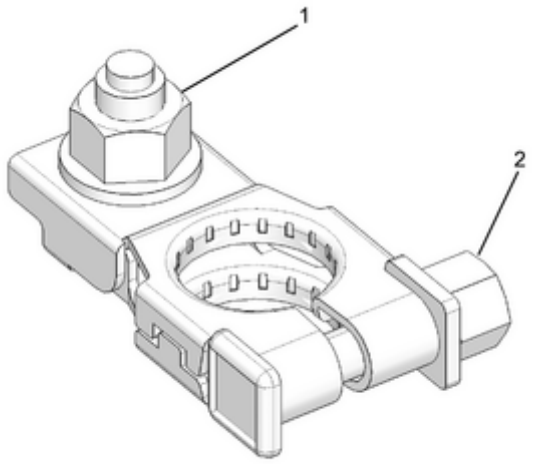
1. Battery positive terminal
2. Battery positive cable
3. Battery ground cable
4. Battery negative terminal

Caution

- **Because disconnecting the battery positive cable first may cause a short circuit, always disconnect the battery ground cable first.**

Note

- **Install in the reverse order to removal.**

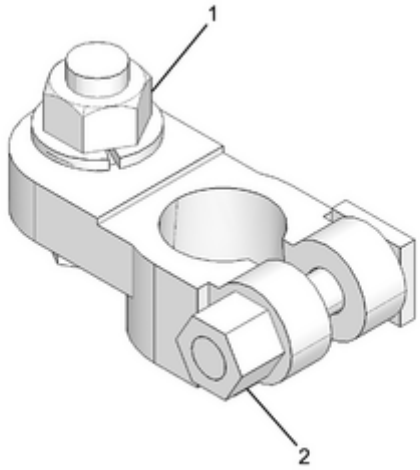


LNWE0ASH000601

1. M8 nut
2. M6 nut

Tightening torque: 10 to 12 N・m { 1.0 to 1.2 kgf・m / 89 to 106 lb・in } M8

Tightening torque: 3 to 6 N・m { 0.3 to 0.6 kgf・m / 27 to 53 lb・in } M6

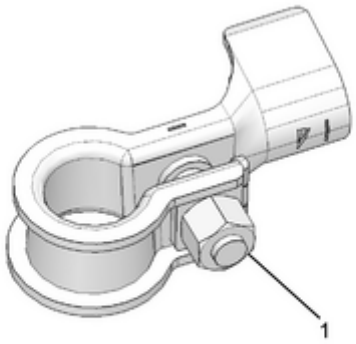


LNWE0ASH000501

1. M8 nut
2. M6 nut

Tightening torque: 11 to 14 N・m { 1.1 to 1.4 kgf・m / 97 to 124 lb・in } M8

Tightening torque: 3 to 6 N・m { 0.3 to 0.6 kgf・m / 27 to 53 lb・in } M6



LNWE0ASH000301

1. Nut

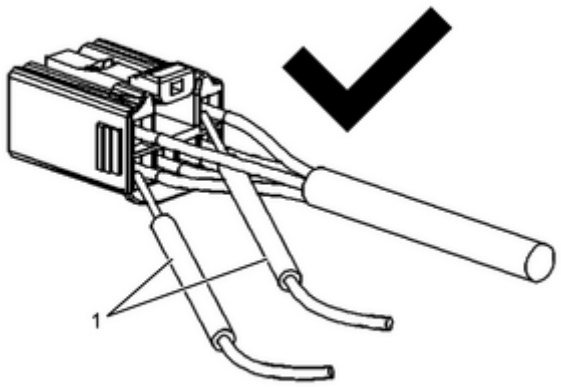
   Tightening torque: 3 to 6 N・m { 0.3 to 0.6 kgf・m / 27 to 53 lb・in }

Caution

- **Clean the area surrounding the battery terminal, and apply a thin layer of grease to the terminal to prevent corrosion.**

2. Connector circuit inspection

Insert the circuit tester probes from the harness side of the connector as indicated in the following diagram, and test for continuity. Upon completion, check the wire and connector for damage caused by the probe.

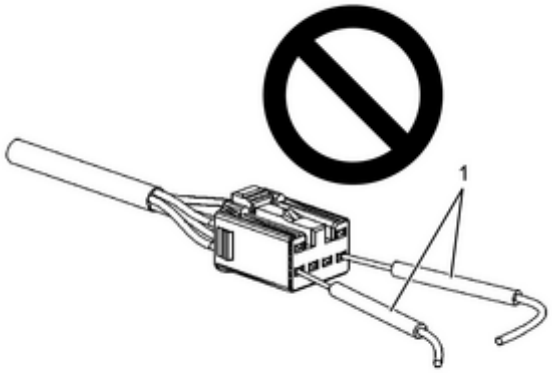


BLWD0ASH000101

1. Probe

Caution

- **Do not insert the probes from the connection opening area of the connector, because this will cause the connector terminals to break.**

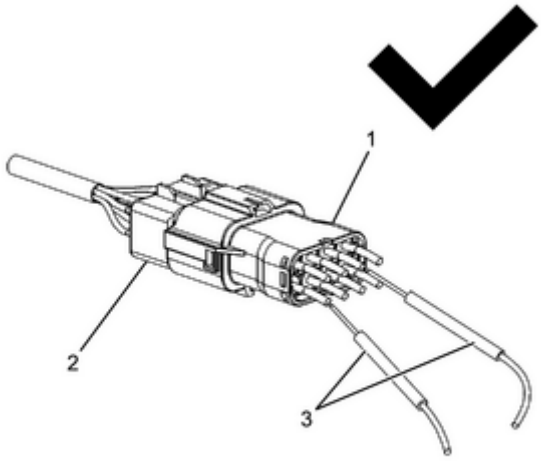


BLWD0ASH000201

1. Probe

Note

- **For waterproof connectors, the probes of the tester cannot be inserted from the wiring side due to the structure of the connectors. Therefore, inspect for continuity as indicated in the following diagram by connecting a testing connector prepared in advance to the connector to check, and connecting the probes of the tester to the harness of the testing connector.**

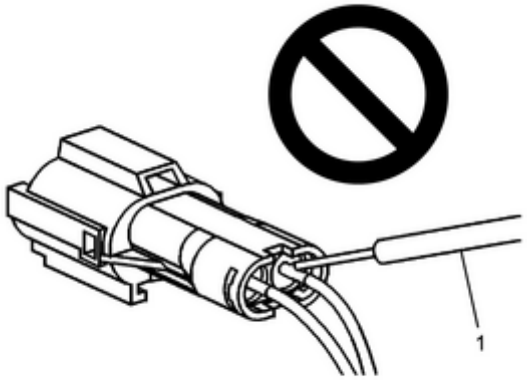


BLWD0ASH000301

1. Testing connector
2. Connector to check
3. Probe

Caution

- **Do not insert the tester probe into the rubber section of the waterproof connector, as doing so will reduce waterproofing capabilities and may result in corrosion.**

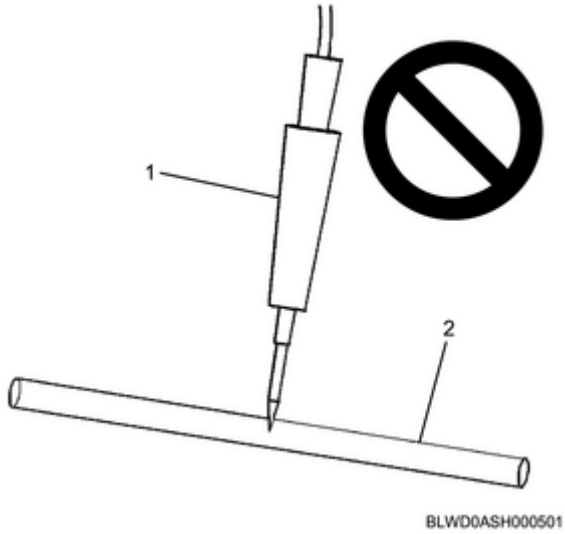


BLWD0ASH000401

1. Probe

Caution

- **Do not use an insulation piercing tester as it may cause the electrical wire to short circuit or corrode.**



BLWD0ASH000501

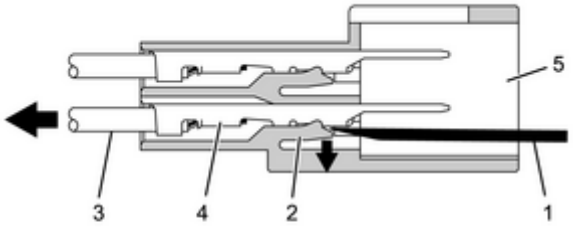
1. Insulation piercing tester
2. Electrical wire

3. Disconnecting connector terminals of built-in lock type

1) Unlock any double-locks.

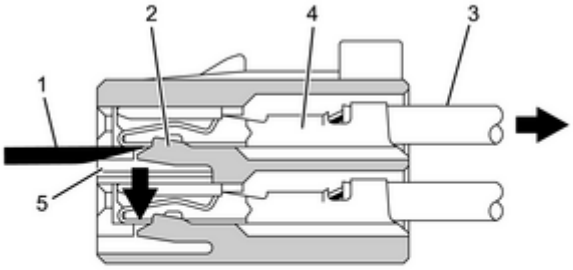
2) Insert a thin screwdriver-shaped metal rod from the connector opening area.

3) Push the metal rod in the direction of the arrow to release the lock, and pull the harness out together with the terminal.



HCW70ASH001701

1. Metal rod
2. Lock
3. Harness
4. Terminal
5. Connector opening area



HCW70ASH001801

1. Metal rod
2. Lock
3. Harness
4. Terminal
5. Connector opening area

Wiring repair

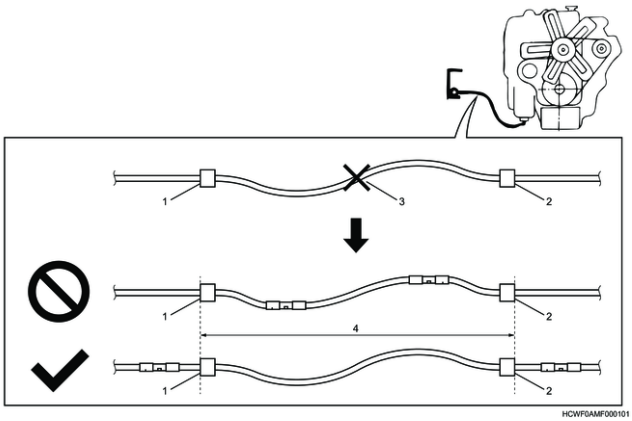
1. Wiring repair precautions

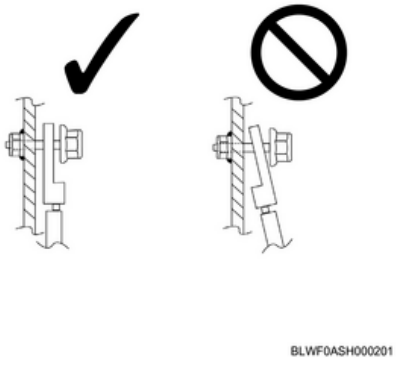
Warning

- **Do not perform battery cable connection repair, because this may lead to a vehicle fire.**
- **Because vehicle fires can be caused by electrical wire connections when wires twist together, or by insufficient insulation processing, be sure to follow the instructions in the workshop manual to perform appropriate connections and sound insulation processing.**
- **Because using a fuse with a capacity other than specified causes vehicle fire, make sure to use a fuse with the specified capacity.**

Caution

- **When repairing the wiring, start work after turning the ignition switch OFF and verifying that the lighting switches, etc., are OFF.**
- **Disconnect the battery cable from the battery negative terminal.**
- **For the battery cable, connect the battery negative terminal after all work is complete.**
- **If the fuse blows out, make sure to replace it with a non-defective fuse of the same capacity after identifying the cause of the blowout.**
- **Connecting the terminal poles and connectors incorrectly may result in component malfunction and damage, so be sure to connect them correctly.**
- **Do not perform connection repairs in areas with bending or runout, or areas that may be at a high temperature.**
- **Do not perform connection processing in areas that move relative to one another, such as the cab-to-frame and engine- or transmission-to-frame areas, etc.**
- **If wiring repair is needed on parts that move relative to each other, replace the whole span of the routing section with extension wiring, and perform connection processing to the parts outside of the span of the routing section.**





1. Fixed to non-moving parts (Fixture on the frame, etc.)
2. Fixed to moving parts (Fixture on the engine, etc.)
3. Damaged components
4. Span of the routing section

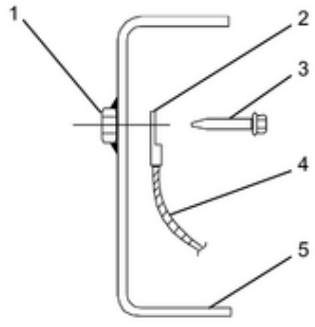
Caution

- **When repairing the wiring, take care not to damage nearby electrical wires and other components.**
- **When performing work, make sure to return the removed terminals, connectors, wiring, and clips to their original positions.**
- **If the clip used for fastening the harness is damaged, replace it with a new one.**
- **If the rubber or plastic coating of a metal clip peels off or has perforations or cracking, replace the clip with a new one.**
- **Because the existing ground point is set in a position that guarantees operation of the various devices, do not move it.**
- **For the ground wire, make sure to use a round terminal and securely fasten the wire to the frame and panel using the ground bolts.**
- **Do not tighten the extension ground wire together with the ground point, because looseness or poor connections may result.**
- **If the ground bolt is damaged, replace it with the specified ground bolt.**
- **If changing the ground point to a weld nut from the tap hole of the frame, use a ground bolt with a lock section long enough to twist more than 2 threads around the threaded portion of the weld nut.**

2. How to install ground wiring

Caution

- **Because the existing ground point is set in a position that guarantees operation of the various devices, do not move it.**
- **For the ground wire, make sure to use a round terminal and securely fasten the wire to the frame and panel using the ground bolts.**
- **Do not tighten the extension ground wire together with the ground point, because looseness or poor connections may result.**
- **If the ground bolt is damaged, replace it with the specified ground bolt.**
- **If changing the ground point to a weld nut from the tap hole of the frame, use a ground bolt with a lock section long enough to twist more than 2 threads around the threaded portion of the weld nut.**



BLWF0ASH000101

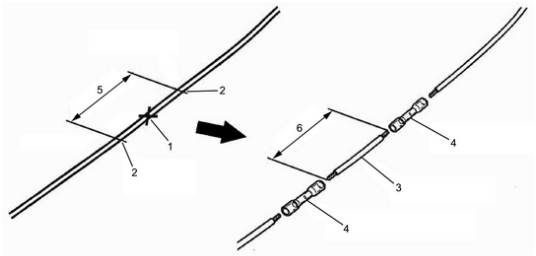
1. Weld nut
2. Round terminal
3. Ground bolt
4. Ground wire
5. Side member

Repair method of damaged wire

1. Electrical wiring connection(Joining)

If repairing a damaged circuit or reconstructing a damaged circuit (separate wiring), cut off the damaged part of the circuit and connect it with the electrical extension wire.

When connecting wires using the specified joint terminal, prepare an electrical extension wire the same length as the cut electrical wire.

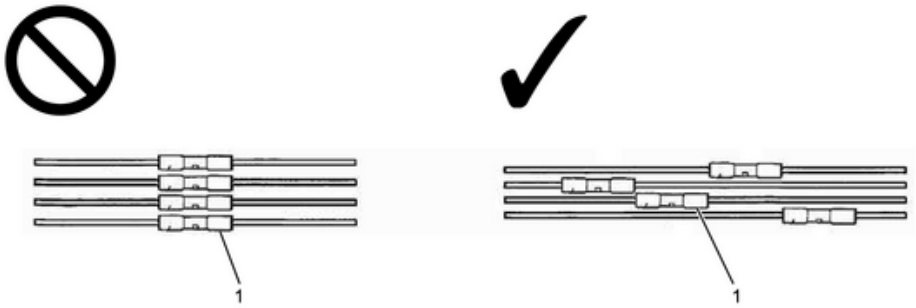


BLWF0ASF000101

1. Damaged components
2. Cut location
3. Electrical extension wire
4. Joint terminal
5. Length of cut location
6. Length of the electrical extension wire

Note

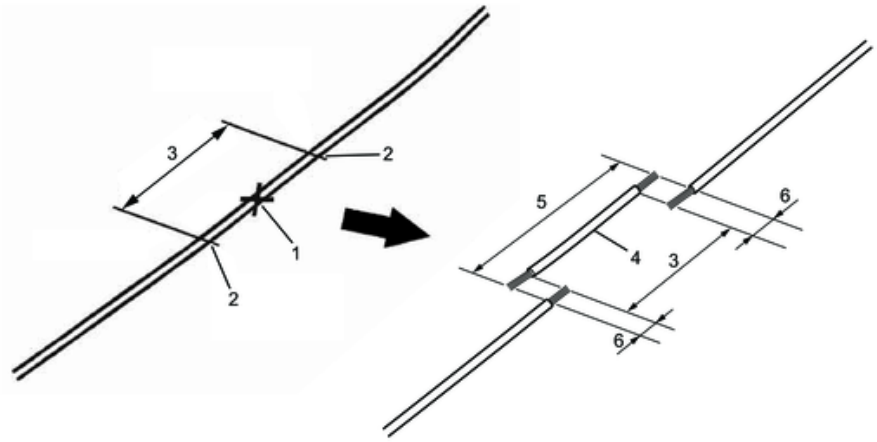
- **When connecting 4 electrical wires or more, connect them by sliding them back and forth without gathering them into the same place.**
- **Even when connecting 3 electrical wires or less, connect them by sliding them back and forth even if they do not fit into the protective material.**



BLWF0ASF000401

2. Joint terminal

If connecting wires using soldering or joint connectors other than those specified, etc., prepare a length of the electrical extension wire equal to the sum of the lengths of the 2 electrical wire strips and the length of the cut electrical wire.



HCWF0ASF000101

1. Damaged components
2. Cut location
3. Length of the wire to be cut
4. Electrical extension wire
5. Length of the electrical extension wire
6. Length of the electrical wire strip

3. Repair method for damaged connectors and components near the connectors

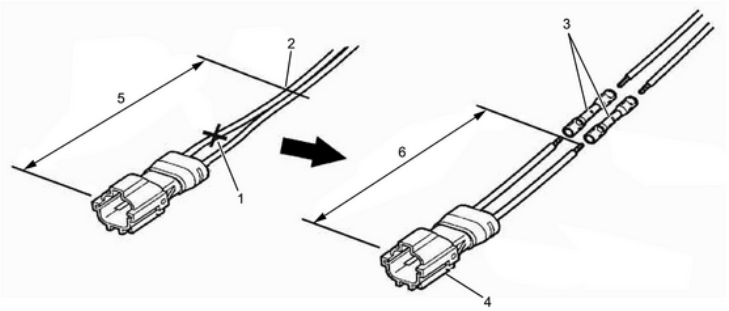
If the connectors or the components near the connectors are damaged, prepare a replacement connector and perform connection processing.

1) For the electrical extension wire and replacement connector wires, make sure the diameters of the electrical wire and copper wire being repaired are the same, and use the same electrical wire color whenever possible.

2) Taking workability into consideration, the length of the electrical wire of the replacement connector should be 100 mm {3.9 in} or more.

3) When connecting wires using the specified joint terminal, prepare a replacement connector the same length as the cut electrical wire.

4) If connecting the replacement connector using soldering or joint connectors other than those specified, etc., the length should be the sum of the lengths of the overlapped bonded sections.



1. Damaged components
2. Cut location
3. Joint terminal
4. Connector
5. Length of cut location
6. Length of the replacement connector

4. Wire splicing method

Connection method using joint terminal (electrical wires with a diameter of 2.0 mm2 or less)

Joint terminal type			
Part number	Electrical wire diameter	Color	Length of the electrical wire strip
897169-4730	0.3 to 0.5 mm2	Yellow	6 to 7 mm { 0.24 to 0.28 in }
897169-4740	0.75 to 1.25 mm2	Red	7 to 8 mm { 0.28 to 0.31 in }
897169-4750	2.0 mm2	Blue	7 to 8 mm { 0.28 to 0.31 in }

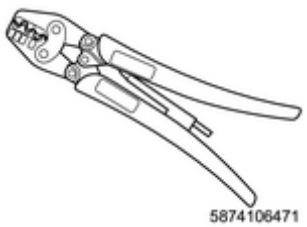
1) Strip the electrical wire repair locations and electrical extension wire.

Note

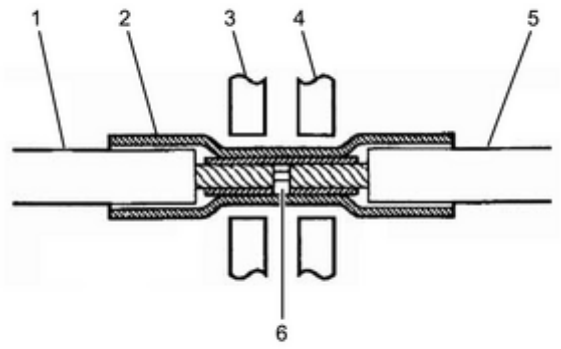
- **Determine the electrical wire strip length based on the electrical wire diameter.**
- **Use a wire stripper of the appropriate length to avoid cutting the core wire.**

2) Insert the stripped electrical wire up to the central stopper of the joint terminal.

3) Pressure bond the joint terminal using the special tool.



SST: 5-8741-0647-1 - terminal pincers

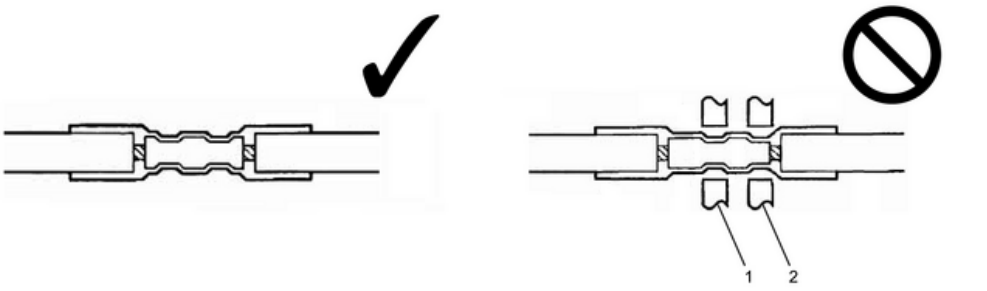


BLWF0ASH000401

1. Electrical wire
2. Joint terminal
3. Pressure bonding tool
4. Pressure bonding tool
5. Electrical extension wire
6. Central stopper

Caution

- **Pressure bond the joint terminal in the correct position as shown in the following diagram.**



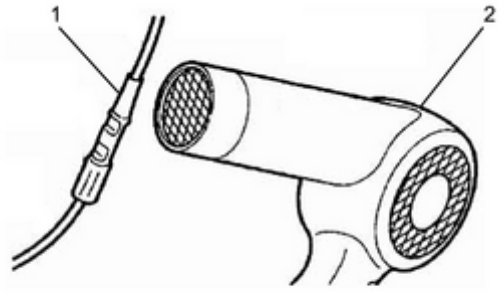
BLWF0ASF000501

1. The center of the joint terminal is pressure bonded.
2. The copper sleeve end section is pressure bonded.

4) Heat the joint terminal surface using a heat gun, and heat shrink the outer tube.

Note

- **Reference heating temperature: 120 °C {248 °F}**



BLWF0ASH000501

1. Joint terminal
2. Heat gun

Note

- **Heat the tube until semitransparent resin seeps out of both ends.**
- **Even if the joint terminal tube is damaged and a hole forms during pressure bonding work, covering the hole with semitransparent resin and heating it will conceal the hole and make the tube sufficiently waterproof, so performing work again is unnecessary.**

2. Connection treatment method using soldering (electrical wires with a diameter of 2.0 mm2 or more)

If there are no joint terminals, connect by soldering or by using commercial terminals, and perform waterproofing treatment using butyl rubber. It is recommended that joint terminals be used if connecting electrical wires with a diameter of up to 2.0 mm2.

Note

- **Because of the possibility of causing open circuits, do not make connections for components with strong vibrations, such as the engine and the transmission, by soldering. Connecting by pressure bonding is recommended.**

Caution

- **Do not connect the following sections.**
  - Sections with bending and relative movement
  - Sections that bear stress
  - Sections that become high temperature

Bonding type	Part number	Purpose
Pressure-bonded terminal	Commercial product	Bonding
Solder	Commercial product	
Butyl rubber	1-82698-2630	Waterproofing
Vinyl tape	Commercial product	Insulation

1) Strip the electrical wire repair locations and electrical extension wire.

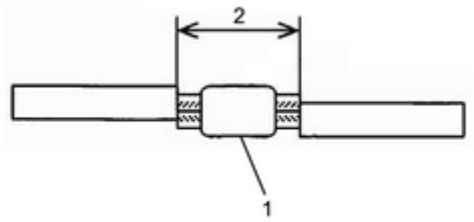
Note

- **For the electrical wire strip length, if there are recommended dimensions for the wiring method, then use those dimensions.**
- **Use a wire stripper of the appropriate length to avoid cutting the core wire.**

Caution

- **Soldering is the recommended connection method for electrical wires with a diameter of 2.0 mm2 or more, but pressure bonding is recommended for components with strong vibration, such as the engine and transmission.**

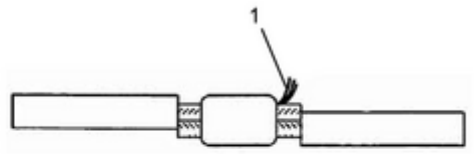
2) Solder the overlapped section of the core wire.



BLWF0ASH000601

1. Soldering
2. Electrical wire overlapping

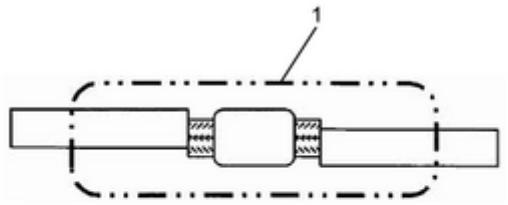
3) Remove the protruding copper wires and solder burrs.



BLWF0ASH000701

1. Protruding copper wire, solder burrs

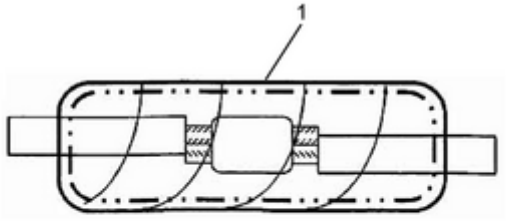
4) Using butyl tape, wrap the electrical wire up to the coated section to waterproof it.



BLWF0ASH000801

Butyl tape

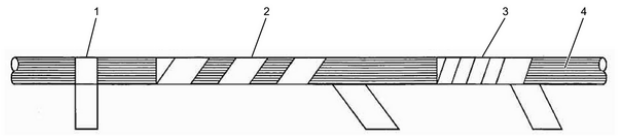
5) Using vinyl tape, completely cover the sections wrapped in butyl rubber to insulate them.



BLWF0ASH000901

1. Vinyl tape

3. Electrical wire binding method using vinyl tape



BLWF0ASF000301

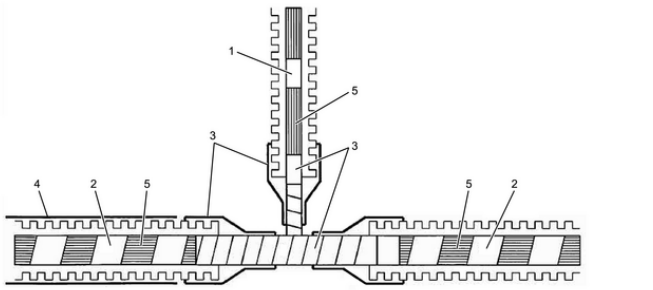
1. Tape layering
2. Staggered taping
3. Half-overlapping
4. Electrical wire

Tape layering
This is a taping method in which the same position is wrapped repeatedly, and is used for bundling electrical wires and for markings.

Staggered taping
This is a wrapping method in which each piece of tape is separated by a space equal to the width of the tape. This method is used to prevent corrugated tubes and the electrical wires inside corrugated tubes from opening.

Half-overlapping
This is a wrapping method in which each piece of tape is stacked such that it overlaps half of the previous piece. This method is used to reinforce electrical wires without protective material and corrugated tube end sections, as well as to prevent corrugated tubes from opening.

Vinyl tape wrapping method



BLWF0AMF000101

1. Tape layering
2. Staggered taping
3. Half-overlapping
4. Tape layering, staggered taping, or half-overlapping
5. Electrical wire

Recommended liquid gasket

1. Using the thread liquid gasket

1. General precautions

Make sure to use liquid gasket with the following product names or equivalent. Follow the handling precautions for the product.

Type	Product name	Manufacturer	Location of use (Reference)
Silicon type (Room-temperature vulcanized)	ThreeBond 1207B ThreeBond 1207C ThreeBond 1215 ThreeBond 1216 ThreeBond 1281	ThreeBond ThreeBond ThreeBond ThreeBond ThreeBond	Engine oil seal retainer Engine oil pan Timing gear case Cylinder head cover Fuel supply pump Water pump Rear axle etc.
Water soluble	ThreeBond 1141E	ThreeBond	
Solvent based	ThreeBond 1102 ThreeBond 1104 ThreeBond 1194	ThreeBond ThreeBond ThreeBond	
Anaerobic	LOCTITE 515 LOCTITE 518 LOCTITE 17430 FMD127	LOCTITE LOCTITE LOCTITE LOCTITE	Engine oil seal retainer Water pump etc.

Caution

- **Do not use LOCTITE 515, 518, or FMD 127 as they are anaerobic and do not provide sufficient effect if there is a 0.25 mm {0.010 in} or larger gap between the contact surfaces of metals.**
- **For areas where liquid gasket is used, completely remove any old liquid gasket from each part and mating part using a scraper, and clean using a shop cloth to remove any adherence of oil, moisture, or foreign material whenever disassembly is performed.**
- **If gasket remover is used when cleaning, waiting approximately 10 minutes after application before performing the cleaning work can improve the workability. However, do not use on plastic parts or painted parts.**

2. Application precautions

Caution

- **Thoroughly apply a liquid gasket with the specified bead width to one side of the contact surface.**
- **Be careful not to excessively or insufficiently apply liquid gasket.**
- **Be sure to overlap the start and the end of the liquid gasket application.**
- **If the workshop manual specifies an application method, follow that method.**

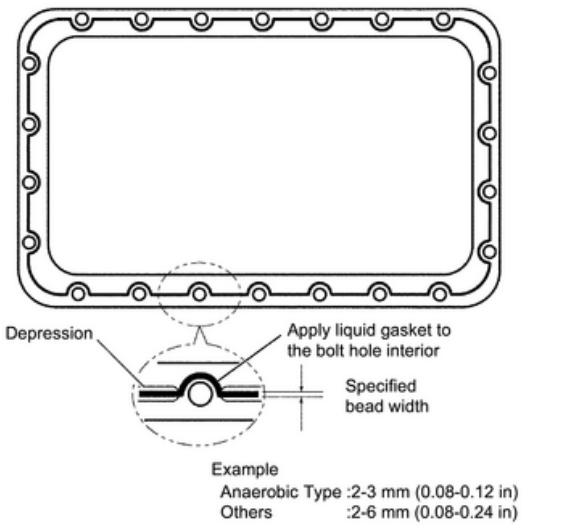
3. Assembly precautions after application

Caution

- **Assemble within 15 minutes of applying the liquid gasket. Also, if 15 minutes or more have passed, remove the liquid gasket and reapply.**
- **Be careful not to misalign the mating parts, and reapply if misalignment occurs.**
-
-

mm (in)

SCREW HOLE	DEPRESSION	JUDGE MENT
1-3 (0.04-0.12)		OK
1-3 (0.04-0.12)	More than 2 (0.08)	OK
		NG



LNWD0BMF000201

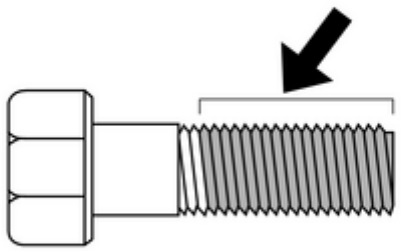
Recommended thread locking agent

1. Using the thread locking agent

Type	Color
LOCTITE 242	Blue
LOCTITE 262	Red
LOCTITE 271	Red

Caution

- **Thoroughly remove dirt, moisture, and grease from the threaded portions of the parts to which thread locking adhesive will be applied.**
  Also, if there is any adhesive residue, remove it with a brush, etc.
- **Before tightening, verify that the cleaned sections are dry.**
- **After tightening, do not apply excessive torque or vibration for at least 1 hour until the thread locking adhesive hardens.**
- **If applying thread locking adhesive to bolts, apply to the fitting section with the female screw.**



HCWD0ASH000701

Abbreviations

1. Abbreviations

2WD, 4 x 2 :Two-wheel drive

4WD, 4 x 4 : Four-wheel drive

A/C : Air conditioner

A/F : Air-fuel ratio

A/T : Automatic transmission

ABDC : After bottom dead center

ABS : Anti-lock brake system

AC : Alternating current

ACC : Accessory

ACG : Alternating current generator

ACL : Air cleaner

ACT : Actuator

APP : Accelerator pedal position

API : American Petroleum Institute

ASM (Assy) : Assembly

ASR : Anti-slip regulator

ATDC : After top dead center

ATF : Automatic transmission fluid

B+ : Battery positive terminal

BAT : Battery

BBDC : Before bottom dead center

BCM : Body control module

BCU : Battery control unit

BKT : Bracket

BRG : Bearing

BTDC : Before top dead center

C/B : Circuit breaker

C/U : Control Unit

CAN : Controller area network

CKP : Crankshaft position

CMP : Camshaft position

CNG : Compressed natural gas

CO : Carbon monoxide

CPU : Central processing unit

DC : Direct current

DI : Direct injection type

DLC : Data link connector

DMM : Digital multimeter

DPD : Diesel particulate defuser

DRL : Daytime running light

DRM : Data recording module

DTC : Diagnostic trouble code

EBD : Electronic braking force distribution

ECM : Engine control module

ECT : Engine coolant temperature

ECU : Electronic control unit

EDU : Engine driver unit

EEPROM : Electrically erasable programmable ROM

EGR : Exhaust gas recirculation

EHCU : Electronic hydraulic control unit

EMI : Electromagnetic interference

EVRV : Electric vacuum regulating valve

ESC : Electronic stability control

EXH : Exhaust

F/B : Feedback

F/C : Fuel cut

FCG : FMS CAN gateway

Fed : Federal (All states except Calif.)

F/L : Fusible link

FLW : Fusible link wire

FMS : Fleet management system

FT : Fuel temperature

FRT : Ft : Front

Gal : Gallon (3.785 L)

GEN : Generator

GND : Ground

GVW (GVM) : Gross vehicle weight

HAB : Hydro-assist brake

HBB : Hydraulic Brake Booster

HC : Hydrocarbon

HID : High Intensity Discharge

HO2S : Heated O2 sensor

HVAC : Heater ventilation air conditioner

IAC : Idle air control

IAT : Intake air temperature

IC : Integrated circuit, Ignition control

ICU : Immobilizer control unit

ISC : Idling speed control

ISO : International Organization for Standardization

ISP : Intake shutter position

ITP : Intake throttle position

J/B : Junction block

J/C : Joint connector

JIS : Japanese Industrial Standards

KW : Type of communication format (Keyword)

L/H : LH Left hand

LCD : Liquid crystal display

LDWS : Lane departure warning system

LED : Light emitting diode

LEV : Low emission vehicle

LHD : Left hand drive

LSD : Limited slip differential

LSPV : Load sensing proportioning valve

M/T : Manual transmission

M/V : Magnetic valve

MAF : Mass air flow

MAP : Manifold absolute pressure

Max : Maximum

MCU : Motor control unit

MIL : Malfunction indicator light

Min : Minimum

MPU : Microprocessing unit

NA : Natural aspirated

NC : Normally closed

NO : Normally open

Nox : Nitrogen oxide

O/D : Overdrive

O2S : O2 sensor

OBD : On-board diagnosis

OEM : Original equipment manufacturer

OPT : Option

OT : Oil temperature

P/L : Pilot light

P/S : Power steering

P-I : Proportion-integration

PCD : Pitch diameter, pitch circle diameter

PCV : Positive crankcase ventilation

PM : Particulate matter

POC : Particulate oxidation catalyst

POS : Position

PTO : Power take-off

PWM : Pulse width modulation

QOS : Quick on start system

QWS : Quick warming up system

R/H, RH : Right side

R/L : Relay

RAM : Random access memory

REA : Rotary electric actuator

REF : Reference

REV : Reverse

RHD : Right hand drive

ROM : Read-only memory

RR, Rr : Rear

SAE : Society of Automotive Engineers

SBF : Slow blow fuse

SCV : FRP regulator

SIG : Signal

SLD : Shield

SOC : Status of hybrid battery charging

SRS : Supplemental restraint system

ST : Starter/Start

STD : Standard

SW : Switch

T/F : Transfer

TCC : Torque converter clutch

TCM : Transmission control module

TDC : Top dead center

TEMP : Temperature

TFT : Transmission fluid temperature

TP : Throttle position

TWV : Two-way valve

VAT : View assist technology

VB : Battery voltage

VCI : Vehicle communication interface

VGS : Variable geometry system

VIN : Vehicle identification number

VNT : Variable nozzle turbocharger

VOL, Vol. : Volume

VSS : Vehicle speed sensor

VSV : Vacuum switching valve

WI : With

W/B, WB : Wheel base

W/H : Wire, harness

W/L : Warning light

W/S : Weld splice

W/O : Without

WOT : Wide-open throttle

Standard bolts

1. List of standard bolt and nut tightening torques

1. Standard bolts and nuts for which no tightening torques are specified

Strength category	4.8 4T		7T	
Bolt head shape	**Hex bolt**	**Flange bolt**	**Hex bolt**	**Flange bolt**
M6 x 1	3.9 to 7.8 N・m { 0.4 to 0.8 kgf・m / 35 to 69 lb・in }	4.6 to 8.5 N・m { 0.5 to 0.9 kgf・m / 41 to 75 lb・in }	4.9 to 9.8 N・m { 0.5 to 1.0 kgf・m / 43 to 87 lb・in }	5.7 to 10.6 N・m { 0.6 to 1.1 kgf・m / 50 to 94 lb・in }
M8 x 1.25	7.8 to 17.7 N・m { 0.8 to 1.8 kgf・m / 6 to 13 lb・ft }	10.5 to 19.6 N・m { 1.1 to 2.0 kgf・m / 8 to 14 lb・ft }	11.8 to 22.6 N・m { 1.2 to 2.3 kgf・m / 9 to 17 lb・ft }	13.5 to 25.0 N・m { 1.4 to 2.5 kgf・m / 10 to 18 lb・ft }
M10 x 1.25	20.6 to 34.3 N・m { 2.1 to 3.5 kgf・m / 15 to 25 lb・ft }	23.1 to 38.5 N・m { 2.4 to 3.9 kgf・m / 17 to 28 lb・ft }	27.5 to 46.1 N・m { 2.8 to 4.7 kgf・m / 20 to 34 lb・ft }	31.0 to 51.7 N・m { 3.2 to 5.3 kgf・m / 23 to 38 lb・ft }
***M10 x 1.5**	19.6 to 33.3 N・m { 2.0 to 3.4 kgf・m / 14 to 25 lb・ft }	22.3 to 37.2 N・m { 2.3 to 3.8 kgf・m / 16 to 27 lb・ft }	27.5 to 45.1 N・m { 2.8 to 4.6 kgf・m / 20 to 33 lb・ft }	30.3 to 50.4 N・m { 3.1 to 5.1 kgf・m / 22 to 37 lb・ft }
M12 x 1.25	49.0 to 73.5 N・m { 5.0 to 7.5 kgf・m / 36 to 54 lb・ft }	54.9 to 82.3 N・m { 5.6 to 8.4 kgf・m / 40 to 61 lb・ft }	60.8 to 91.2 N・m { 6.2 to 9.3 kgf・m / 45 to 67 lb・ft }	68.1 to 102.1 N・m { 6.9 to 10.4 kgf・m / 50 to 75 lb・ft }
***M12 x 1.75**	45.1 to 68.6 N・m { 4.6 to 7.0 kgf・m / 33 to 51 lb・ft }	51.0 to 76.5 N・m { 5.2 to 7.8 kgf・m / 38 to 56 lb・ft }	56.9 to 84.3 N・m { 5.8 to 8.6 kgf・m / 42 to 62 lb・ft }	62.7 to 94.0 N・m { 6.4 to 9.6 kgf・m / 46 to 69 lb・ft }
M14 x 1.5	76.5 to 114.7 N・m { 7.8 to 11.7 kgf・m / 56 to 85 lb・ft }	83.0 to 124.5 N・m { 8.5 to 12.7 kgf・m / 61 to 92 lb・ft }	93.2 to 139.3 N・m { 9.5 to 14.2 kgf・m / 69 to 103 lb・ft }	100.8 to 151.1 N・m { 10.3 to 15.4 kgf・m / 74 to 111 lb・ft }
***M14 x 2**	71.6 to 106.9 N・m { 7.3 to 10.9 kgf・m / 53 to 79 lb・ft }	77.2 to 115.8 N・m { 7.9 to 11.8 kgf・m / 57 to 85 lb・ft }	88.3 to 131.4 N・m { 9.0 to 13.4 kgf・m / 65 to 97 lb・ft }	94.9 to 142.3 N・m { 9.7 to 14.5 kgf・m / 70 to 105 lb・ft }
M16 x 1.5	104.0 to 157.0 N・m { 10.6 to 16.0 kgf・m / 77 to 116 lb・ft }	115.6 to 173.3 N・m { 11.8 to 17.7 kgf・m / 85 to 128 lb・ft }	135.3 to 204.0 N・m { 13.8 to 20.8 kgf・m / 100 to 150 lb・ft }	150.1 to 225.2 N・m { 15.3 to 23.0 kgf・m / 111 to 166 lb・ft }
***M16 x 2**	100.0 to 149.1 N・m { 10.2 to 15.2 kgf・m / 74 to 110 lb・ft }	109.4 to 164.2 N・m { 11.2 to 16.7 kgf・m / 81 to 121 lb・ft }	129.4 to 194.2 N・m { 13.2 to 19.8 kgf・m / 95 to 143 lb・ft }	142.5 to 213.8 N・m { 14.5 to 21.8 kgf・m / 105 to 158 lb・ft }
M18 x 1.5	151.0 to 225.6 N・m { 15.4 to 23.0 kgf	-	195.2 to 293.2 N・m { 19.9 to	-

	・m / 111 to 166 lb ・ft }		29.9 kgf・m / 144 to 216 lb・ft }	
***M18 x 2.5**	151.0 to 225.6 N・m { 15.4 to 23.0 kgf ・m / 111 to 166 lb ・ft }	-	196.1 to 294.2 N ・m { 20.0 to 30.0 kgf・m / 145 to 217 lb・ft }	-
M20 x 1.5	206.0 to 310.0 N・m { 21.0 to 31.6 kgf ・m / 152 to 229 lb ・ft }	-	269.7 to 405.0 N ・m { 27.5 to 41.3 kgf・m / 199 to 299 lb・ft }	-
***M20 x 2.5**	190.2 to 286.4 N・m { 19.4 to 29.2 kgf ・m / 140 to 211 lb ・ft }	-	249.1 to 374.6 N ・m { 25.4 to 38.2 kgf・m / 184 to 276 lb・ft }	-
M22 x 1.5	251.1 to 413.8 N・m { 25.6 to 42.2 kgf ・m / 185 to 305 lb ・ft }	-	362.8 to 544.3 N ・m { 37.0 to 55.5 kgf・m / 268 to 401 lb・ft }	-
***M22 x 2.5**	217.7 to 327.5 N・m { 22.2 to 33.4 kgf ・m / 161 to 242 lb ・ft }	-	338.3 to 507.0 N ・m { 34.5 to 51.7 kgf・m / 250 to 374 lb・ft }	-
M24 x 2	358.9 to 539.4 N・m { 36.6 to 55.0 kgf ・m / 265 to 398 lb ・ft }	-	430.5 to 711.0 N ・m { 43.9 to 72.5 kgf・m / 318 to 524 lb・ft }	-
***M24 x 3**	338.3 to 507.0 N・m { 34.5 to 51.7 kgf ・m / 250 to 374 lb ・ft }	-	406.0 to 608.0 N ・m { 41.4 to 62.0 kgf・m / 299 to 448 lb・ft }	-

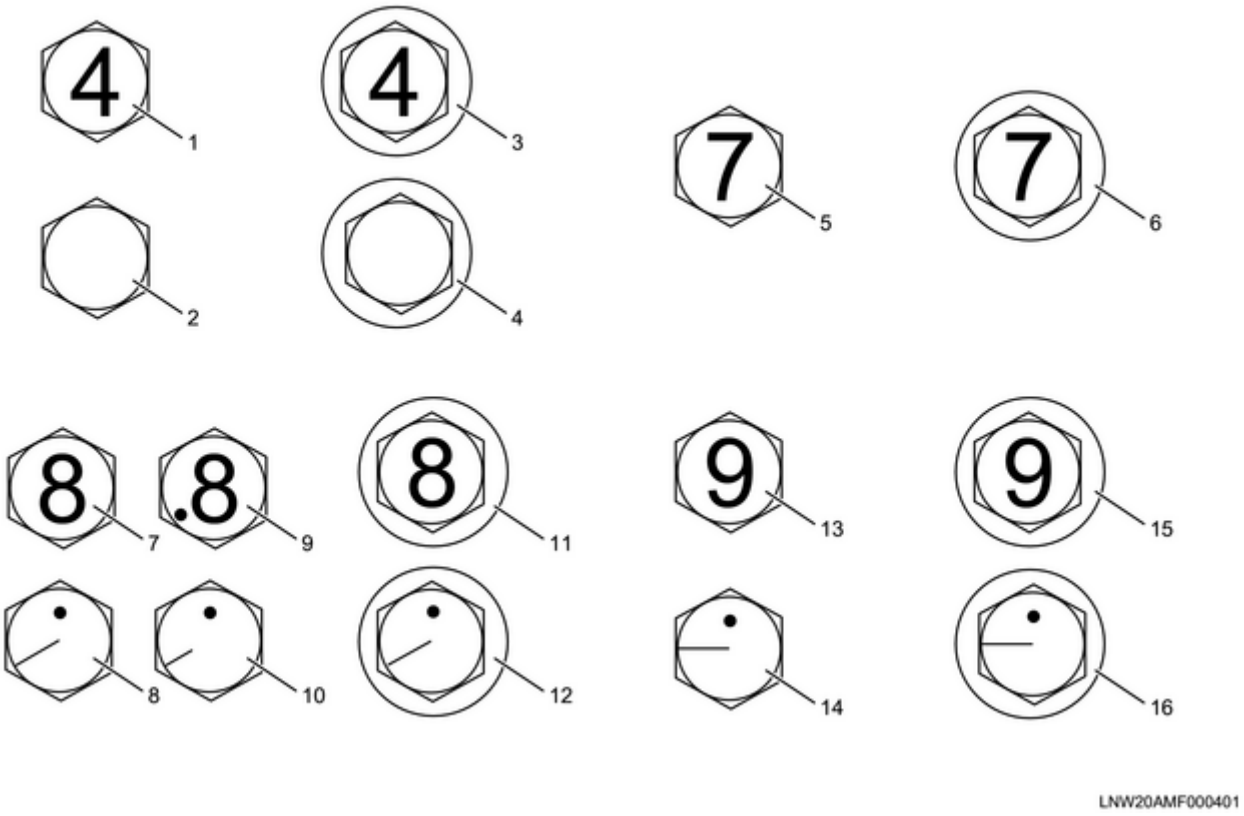
Strength category	8.8		9.8	
			9T	
Bolt head shape	Hex bolt	Flange bolt	Hex bolt	Flange bolt
M6 x 1	5.6 to 11.2 N・m { 0.6 to 1.1 kgf・m / 50 to 99 lb・in }	6.6 to 12.2 N・m { 0.7 to 1.2 kgf・m / 58 to 108 lb・in }	-	-
M8 x 1.25	13.4 to 25.7 N・m { 1.4 to 2.6 kgf・m / 10 to 19 lb・ft }	15.3 to 28.4 N・m { 1.6 to 2.9 kgf・m / 11 to 21 lb・ft }	16.7 to 30.4 N・m { 1.7 to 3.1 kgf・m / 12 to 22 lb・ft }	18.1 to 33.6 N・m { 1.8 to 3.4 kgf・m / 13 to 25 lb・ft }
M10 x 1.25	31.3 to 52.5 N・m { 3.2 to 5.4 kgf・m / 23 to 39 lb・ft }	35.4 to 58.9 N・m { 3.6 to 6.0 kgf・m / 26 to 43 lb・ft }	37.3 to 62.8 N・m { 3.8 to 6.4 kgf・m / 28 to 46 lb・ft }	42.3 to 70.5 N・m { 4.3 to 7.2 kgf・m / 31 to 52 lb・ft }
*M10 x 1.5	31.3 to 51.4 N・m { 3.2 to 5.2 kgf・m / 23 to 38 lb・ft }	34.5 to 57.5 N・m { 3.5 to 5.9 kgf・m / 25 to 42 lb・ft }	36.3 to 59.8 N・m { 3.7 to 6.1 kgf・m / 27 to 44 lb・ft }	40.1 to 66.9 N・m { 4.1 to 6.8 kgf・m / 30 to 49 lb・ft }
M12 x 1.25	69.3 to 104.0 N・m { 7.1 to 10.6 kgf・m / 51 to 77 lb・ft }	77.7 to 116.5 N・m { 7.9 to 11.9 kgf・m / 57 to 86 lb・ft }	75.5 to 113.8 N・m { 7.7 to 11.6 kgf・m / 56 to 84 lb・ft }	85.0 to 127.5 N・m { 8.7 to 13.0 kgf・m / 63 to 94 lb・ft }
*M12 x 1.75	64.8 to 96.1 N・m { 6.6 to 9.8 kgf・m / 48 to 71 lb・ft }	71.4 to 107.2 N・m { 7.3 to 10.9 kgf・m / 53 to 79 lb・ft }	71.6 to 106.9 N・m { 7.3 to 10.9 kgf・m / 53 to 79 lb・ft }	79.5 to 119.2 N・m { 8.1 to 12.2 kgf・m / 59 to 88 lb・ft }
M14 x 1.5	106.2 to 158.8 N・m { 10.8 to 16.2 kgf・m / 78 to 117 lb・ft }	114.9 to 172.3 N・m { 11.7 to 17.6 kgf・m / 85 to 127 lb・ft }	113.8 to 170.6 N・m { 11.6 to 17.4 kgf・m / 84 to 126 lb・ft }	123.4 to 185.1 N・m { 12.6 to 18.9 kgf・m / 91 to 137 lb・ft }
*M14 x 2	100.6 to 149.8 N・m { 10.3 to 15.3 kgf・m / 74 to 110 lb・ft }	108.2 to 162.2 N・m { 11.0 to 16.5 kgf・m / 80 to 120 lb・ft }	106.9 to 160.0 N・m { 10.9 to 16.3 kgf・m / 79 to 118 lb・ft }	115.5 to 173.3 N・m { 11.8 to 17.7 kgf・m / 85 to 128 lb・ft }
M16 x 1.5	154.3 to 232.5 N・m { 15.7 to 23.7 kgf・m / 114 to 171 lb・ft }	171.1 to 256.7 N・m { 17.4 to 26.2 kgf・m / 126 to 189 lb・ft }	160.0 to 240.3 N・m { 16.3 to 24.5 kgf・m / 118 to 177 lb・ft }	176.9 to 265.3 N・m { 18.0 to 27.1 kgf・m / 130 to 196 lb・ft }
*M16 x 2	147.6 to 221.4 N・m { 15.1 to 22.6 kgf・m / 109 to 163 lb・ft }	162.5 to 243.8 N・m { 16.6 to 24.9 kgf・m / 120 to 180 lb・ft }	153.0 to 229.5 N・m { 15.6 to 23.4 kgf・m / 113 to 169 lb・ft }	168.5 to 252.7 N・m { 17.2 to 25.8 kgf・m / 124 to 186 lb・ft }
M18 x 1.5	222.5 to 334.3 N・m { 22.7 to 34.1 kgf・m / 164 to 247 lb・ft }	-	229.5 to 345.2 N・m { 23.4 to 35.2 kgf・m /	-

			169 to 255 lb・ft }	
*M18 x 2.5	223.6 to 335.4 N・m { 22.8 to 34.2 kgf・m / 165 to 247 lb・ft }	-	230.5 to 346.2 N・m { 23.5 to 35.3 kgf・m / 170 to 255 lb・ft }	-
M20 x 1.5	307.4 to 461.7 N・m { 31.3 to 47.1 kgf・m / 227 to 341 lb・ft }	-	293.2 to 440.3 N・m { 29.9 to 44.9 kgf・m / 216 to 325 lb・ft }	-
*M20 x 2.5	284.0 to 472.1 N・m { 29.0 to 48.1 kgf・m / 209 to 348 lb・ft }	-	293.2 to 440.3 N・m { 29.9 to 44.9 kgf・m / 216 to 325 lb・ft }	-
M22 x 1.5	413.6 to 620.5 N・m { 42.2 to 63.3 kgf・m / 305 to 458 lb・ft }	-	424.6 to 636.5 N・m { 43.3 to 64.9 kgf・m / 313 to 469 lb・ft }	-
*M22 x 2.5	385.7 to 578.0 N・m { 39.3 to 58.9 kgf・m / 284 to 426 lb・ft }	-	394.2 to 592.3 N・m { 40.2 to 60.4 kgf・m / 291 to 437 lb・ft }	-
M24 x 2	490.8 to 810.5 N・m { 50.0 to 82.6 kgf・m / 362 to 598 lb・ft }	-	554.1 to 830.6 N・m { 56.5 to 84.7 kgf・m / 409 to 613 lb・ft }	-
*M24 x 3	462.8 to 693.1 N・m { 47.2 to 70.7 kgf・m / 341 to 511 lb・ft }	-	520.7 to 781.6 N・m { 53.1 to 79.7 kgf・m / 384 to 576 lb・ft }	-

Note

- **Those indicated with an asterisk (*) are used for the internal threaded portion of soft material such as castings.**
- **Refer to the following list for the indicators used on standard bolt heads.**

Display on head of standard bolt



1. Hex bolt (4.8, 4T)
2. Hex bolt (4.8, 4T)
3. Flange bolt (4.8, 4T)
4. Flange bolt (4.8, 4T)
5. Hex bolt (7T)
6. Flange bolt (7T)
7. Hex bolt (Thermally refined 8.8)
8. Hex bolt (Thermally refined 8.8)
9. Hex bolt (Non-thermally refined 8.8)
10. Hex bolt (Non-thermally refined 8.8)
11. Flange bolt (8.8)
12. Flange bolt (8.8)
13. Hex bolt (9.8, 9T)
14. Hex bolt (9.8, 9T)
15. Flange bolt (9.8, 9T)
16. Flange bolt (9.8, 9T)

2. Tightening torque for flare nuts

A-type flare nut			
Pipe diameter	HEX	Thread size	Tightening torque*
4.76 mm {0.19 in}	10 mm	M10 x 1.0	13 to 18 N・m { 1.3 to 1.8 kgf・m / 10 to 13 lb・ft } Iron
			9 to 15 N・m { 0.9 to 1.5 kgf・m / 7 to 11 lb・ft } Non-ferrous
6.35 mm {0.25 in}	12 mm	M12 x 1.0	23 to 35 N・m { 2.3 to 3.6 kgf・m / 17 to 26 lb・ft } Iron
8.0 mm {0.31 in}	14 mm	M14 x 1.5	29 to 39 N・m { 3.0 to 4.0 kgf・m / 21 to 29 lb・ft } Iron
10.0 mm {0.39 in}	17 mm	M16 x 1.5	45 to 55 N・m { 4.6 to 5.6 kgf・m / 33 to 41 lb・ft } Iron
C-type flare nut			
Pipe diameter	HEX	Thread size	Tightening torque*
4.76 mm { 0.19 in }	14 mm	M10 x 1.0	13 to 18 N・m { 1.3 to 1.8 kgf・m / 10 to 13 lb・ft } Iron
6.35 mm { 0.25 in }	17 mm	M12 x 1.5	25 to 35 N・m { 2.5 to 3.6 kgf・m / 18 to 26 lb・ft } Iron
			19.6 to 23.5 N・m { 2.0 to 2.4 kgf・m / 14 to 17 lb・ft } Non-ferrous
8.0 mm { 0.31 in }	17 mm	M14 x 1.5	25 to 39 N・m { 2.5 to 4.0 kgf・m / 18 to 29 lb・ft } Iron
			19.6 to 23.5 N・m { 2.0 to 2.4 kgf・m / 14 to 17 lb・ft } Non-ferrous
10.0 mm { 0.39 in }	19 mm	M16 x 1.5	45 to 80 N・m { 4.6 to 8.2 kgf・m / 33 to 59 lb・ft } Iron
			39.2 to 44.1 N・m { 4.0 to 4.5 kgf・m / 29 to 33 lb・ft } Non-ferrous
12.0 mm { 0.47 in }	24 mm	M16 x 1.5	65 to 115 N・m { 6.6 to 11.7 kgf・m / 48 to 85 lb・ft } Iron
			49.0 to 58.8 N・m { 5.0 to 6.0 kgf・m / 36 to 43 lb・ft } Non-ferrous
15.0 mm { 0.59 in }	30 mm	M22 x 1.5	80 to 130 N・m { 8.2 to 13.3 kgf・m / 59 to 96 lb・ft } Iron
			49.0 to 58.8 N・m { 5.0 to 6.0 kgf・m / 36 to 43 lb・ft } Non-ferrous

Note

- **Asterisks (*) indicate that the tightening torque varies depending on the material of the opposing side. Non-ferrous: Aluminum and brass**

3. Tightening torques for PT screws and connectors

Caution

- **Apply a liquid sealing agent equivalent to LOCTITE 575 to the threaded portion and tighten. Do not use seal tape, etc.**
- **The tightening torque for connectors (except brass tapered screws) only applies when the mating side is not made of aluminum (however, it does apply for aluminum air tanks, etc.).**
- **Completely dry and then let air in after tightening.**

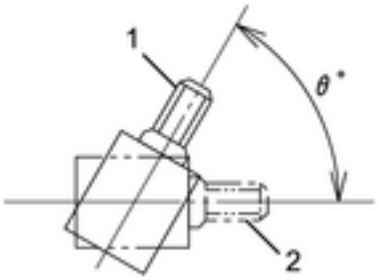
PT screw, connector (Brass tapered screws)	
Thread size	Tightening torque
PT 1/8	2.0 to 14.7 N・m { 0.2 to 1.5 kgf・m / 18 to 130 lb・in }
PT 1/4	4.9 to 15.7 N・m { 0.5 to 1.6 kgf・m / 4 to 12 lb・ft }
PT 3/8	9.8 to 16.7 N・m { 1.0 to 1.7 kgf・m / 7 to 12 lb・ft }
PT 1/2	9.8 to 17.7 N・m { 1.0 to 1.8 kgf・m / 7 to 13 lb・ft }

PT screw, connector (Except brass tapered screws)	
Thread size	Tightening torque
PT 1/8	5.9 to 11.8 N・m { 0.6 to 1.2 kgf・m / 52 to 104 lb・in }
PT 1/4	14.7 to 29.4 N・m { 1.5 to 3.0 kgf・m / 11 to 22 lb・ft }
PT 3/8	29.4 to 39.2 N・m { 3.0 to 4.0 kgf・m / 22 to 29 lb・ft }
PT 1/2	29.4 to 58.8 N・m { 3.0 to 6.0 kgf・m / 22 to 43 lb・ft }
PT 3/4	58.8 to 98.0 N・m { 6.0 to 10.0 kgf・m / 43 to 72 lb・ft }

Elbow-type connector	
Thread size	Tightening torque
PT 1/8	5.9 N・m { 0.6 kgf・m / 52 lb・in }
PT 1/4	14.7 N・m { 1.5 kgf・m / 130 lb・in }
PT 3/8	29.4 N・m { 3.0 kgf・m / 22 lb・ft }
PT 1/2	29.4 N・m { 3.0 kgf・m / 22 lb・ft }
PT 3/4	58.8 N・m { 6.0 kgf・m / 43 lb・ft }

Caution

- **For elbow-type connectors, tighten to the minimum torque in the above table, and then further tighten until the angle is in the correct position.**



LNWA0ASH000301

1. Specified lowest torque position
2. Correct position

CITIPORT CUMMINS MOTOR

ISUZU

ISUZU ACADEMY TECH CENTER

CITIPORT



WORKSHOP MANUAL

Cummins

Introduction

General Information

Cummins Inc. manuals are created to support Cummins® products. For information on components or fault codes not supplied by Cummins Inc., contact the original equipment manufacturer or supplier.

The content of this manual is based on the information in effect at the time of publish. Cummins Inc. reserves the right to make any changes at any time without obligation. If differences are found between your engine and the information in this manual, contact a Cummins® Authorized Repair Location.

About

Cummins® manuals are divided into sections. Each section consists of procedures which are associated with the title of the section.

When viewing a manual online, the sections of the manual are displayed to the left of the procedure display. If a section is clicked, it will expand to show the procedures within that section. To view a procedure, click on the procedure title.

When viewing a printed manual, the table of contents provides the list of sections and their subsequent procedures, with page numbers located to the right.

ANADOLU ISUZU

Last Modified: 20-Feb-2019

General Information

This manual is divided into the same group system used for previous manuals and the Cummins' filmcard system. Section 00 is organized into a logical sequence of engine disassemble/assemble, all other sections are in numerical sequence. Refer to the Table of Contents at the front of the book to determine the section that details the desired information.

The disassemble/assemble sections of this manual is divided into the same group system used for previous manuals and the Cummins' filmcard system.

Section 00 is organized into a logical sequence of engine disassemble/assemble, all other sections are in numerical sequence. Refer to the Table of Contents at the front of the book to determine the section that details the desired information.

Each section contains the following in sequence:

- Table of Contents
- Required Service Tool Listings
- General Information containing the basic service, maintenance, design and revision information necessary to assist in the rebuild of an engine or a component
- Procedure instructions for the disassembly, inspection, maintenance, and assembly that can be required to rebuild an engine; additional procedures that are **not** necessary during **every** rebuild, but can be necessary, are included. These procedures depend on the length of time an engine has been in service and the conditions of the parts.

All the procedures are identified with a name and a number. Each digit in the procedure number has a specific meaning.

The first three digits of the number refer to the specific section that the procedure can be found within the manual. In this example, “001” represents Section 01 - Cylinder Block. This number will range from 000 to 022.

The second three digits of the number are unique and refer to a specific subject. In this example, “028” represents Cylinder Liner. This number will range from 001 to 999.

Refer to Section V for specifications recommended by Cummins Engine Company, Inc. for your engine. Specifications and torque values for each engine system are given in that section.

Note : Discharge of oil or oily water into or upon the water is a direct violation of today's laws. Violators are subject to a penalty of various monetary charges. Dispose of these substances in accordance with standards set by the local enviromental governing agency.


ANADOLU ISUZU
AFTER SALES

General Information

The symbols are used **only** in printed manuals to help communicate the intent of the instructions. Symbols will **not** appear in the online version of this procedure. When one of the symbols appears in the printed manual, it conveys the meaning defined below.

Note : It is possible to have four symbols for each text and graphic combination.

⚠ WARNING ⚠

Serious personal injury or extensive property damage can result if the warning instructions are not followed.

⚠ CAUTION ⚠

Minor personal injury can result or a part, and assembly, or the engine can be damaged if the caution instructions are not followed.

Indicates a **REMOVAL** or **Dissassembly** step.

Indicates an **INSTALLATION** or **ASSEMBLY** step.

INSPECTION is required.

ANADOLU ISUZU AFTER SALES

CLEAN the part or assembly.

PERFORM a mechanical or time **MEASUREMENT**.

LUBRICATE the part or assembly.

Indicates that a **WRENCH** or **TOOL SIZE** will be given.

TIGHTEN to a specific torque.

ANADOLU ISUZU AFTER SALES

PERFORM an electrical **MEASUREMENT**.

Refer to another location in this manual or another publication for additional information.

The component weighs 23kg [50 lbs] or more. To reduce the possibility of personal injury, use a hoist or get assistance to lift the component.

ANADOLU ISUZU AFTER SALES

Last Modified: 08-Feb-2018

General Information

The symbols are used **only** in printed manuals to help communicate the intent of the instructions. Symbols will **not** appear in the online version of this procedure. When one of the symbols appears in the printed manual, it conveys the meaning defined below.

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⚠ WARNING ⚠

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⚠ CAUTION ⚠

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INSPECTION is required.

ANADOLU ISUZU AFTER SALES

CLEAN the part or assembly.

PERFORM a mechanical or time **MEASUREMENT**.

LUBRICATE the part or assembly.

Indicates that a **WRENCH** or **TOOL SIZE** will be given.

TIGHTEN to a specific torque.

ANADOLU ISUZU AFTER SALES

PERFORM an electrical **MEASUREMENT**.

Refer to another location in this manual or another publication for additional information.

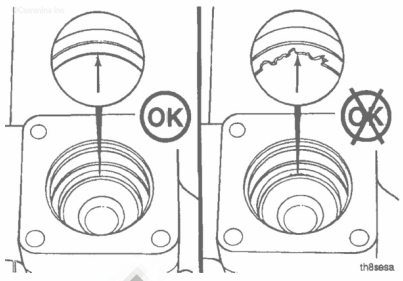
The component weighs 23kg [50 lbs] or more. To reduce the possibility of personal injury, use a hoist or get assistance to lift the component.

ANADOLU ISUZU AFTER SALES

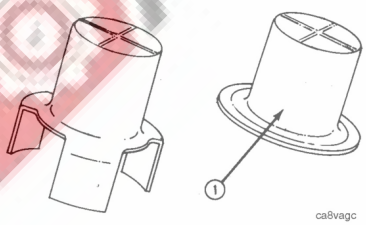
Last Modified: 08-Feb-2018

General Information

Some of the illustrations throughout this manual are generic and will **not** look exactly like the engine or parts used in your application. The illustrations can contain symbols to indicate an action required and an acceptable or **not** acceptable condition.



The illustrations are intended to show repair or replacement procedures. The procedure will be the same for all applications, although the illustration can differ.



ANADOLU ISUZU
AFTER SALES

Last Modified: 12-Mar-2002

Important Safety Notice

Read and understand the safety information and precautions before performing any repair or operating equipment. This procedure contains general safety precautions that **must** be followed to provide personal safety. **Always** follow procedures to mitigate safety concerns.

Work Environment

Follow these recommended practices when servicing products.

- **Always** follow on-site safety requirements.
- **Always** follow local training, certification, authorization, and specific customer requirements. Do **not** work on products unless proper training has been completed to allow safe repair completion. Do **not** operate equipment unless proper training has been completed to allow safe operation..
- Work in a well-ventilated area away from ignition sources.
- If adverse weather conditions are present, take appropriate safety precautions when performing work.
- **Always** be aware of hazardous conditions that may exist in the work environment.

Best Practices

Follow these recommended practices when servicing or operating equipment.

- **Always** wear protective glasses and protective shoes.
- Remove rings, watches, long jewelry, or metallic items.
- Do **not** wear loose fitting or torn clothing, jewelry, long hair, etc.. These increase the risk for personal injury.
- Do **not** perform any repairs, or operate equipment, when fatigued or impaired due to drugs or alcohol.
- **Always** use tools that are in good condition.
- Do **not** work on equipment with the key switch ON or that is running unless otherwise directed by troubleshooting procedures.
- If any work **must** be performed while the key switch is ON or the unit is running, use extreme caution around hot components, moving parts, etc.
- Exercise caution when working on products that have just been turned off. Hot parts may cause burns or ignite or melt common materials.

- Do **not** bleed the fuel system of a hot engine. Contact with hot manifolds or other components can cause a fire.
- Do **not** attempt to rotate the crankshaft by pulling or prying on the fan. **Only** use proper engine barring techniques.
- Do **not** lift components that weigh 23 kg [50 lb] or more. Use mechanical help or seek assistance.
- Exercise caution when working around rotating parts. Rotating parts can cause cuts, mutilation, or strangulation.
- Exercise caution when working on electrical components. High voltages can cause serious injury or death.
- Relieve system pressure as instructed before removing or disconnecting lines, fittings, or related items.
- **Always** test for pressure leaks as instructed.
- **Always** torque fittings and connections to the required specifications. Over or under tightening can damage threads and create leaks.
- **Always** use the same fastener part number, or equivalent, when replacing fasteners.

Perform the following prior to beginning work on any products.

- Shutdown the equipment unless otherwise directed by troubleshooting procedures.
- **Always** allow the product to cool.
- **Always** ensure the product is properly supported by blocks or stands. Do **not** work on a product supported **only** by lifting jacks or hoists.
- Disconnect the battery unless otherwise directed by troubleshooting procedures.
- Disconnect the starting motor, if equipped, unless otherwise directed by troubleshooting procedures.
- Place a "Do NOT Operate" tag in the operator area or near the product controls.
- Become familiar with the tools required for performing the task at hand and how to use those tools correctly.
- Use only genuine Cummins or Cummins Recon replacement parts as instructed.

Personal Protective Equipment (PPE)

To reduce the possibility of personal injury, personal protective equipment (PPE) should be utilized. Various types of PPE are listed below. Use proper judgment to determine which types of PPE are required for a given task. **Always** meet on-site safety regulations for required PPE. Proper maintenance of safety equipment **must** be practiced. Integrity of safety equipment **must** be checked to ensure equipment functionality is maintained.

Eye Protection

Eye protection **must always** be worn. Wear appropriate eye protection based on the task being completed. Types of eye protection to consider are listed below.

- Safety glasses. Exposure to flying particles or debris, chemicals or caustic liquids, gases or vapors.

ANADOLU ISUZU PARTS SALES

- Polarized safety glasses. Working in outdoor or bright lighting environments.
- Over-the-glass safety glasses. Add protection to prescription glasses.
- Safety goggles. Handling caustic liquids or chemicals.
- Shade or arc rated eyewear. Exposure to welding. Use appropriate filter ratings.

Foot Protection

Protective shoes **must always**be worn. Wear appropriate foot protection based on the task being completed. Types of protective footwear to consider are listed below.

- Steel toed shoes. Exposure to falling or rolling objects. Working with or around parts, tools, and equipment.
- Chemical resistant. Exposure to chemicals and other fluids.
- Overshoes and overboots. Add protection to everyday work shoes.
- Foot, toe, and metatarsal guards. Add protection to everyday work shoes.
- Electrical hazard safety toe shoes. Exposure to electrical hazards.
- Leather footwear or shoe protectors. Exposure to welding or arc flash.
- Cold protection. Exposure to cold weather.

Head and Face Protection

Wear appropriate face protection based on the task being completed. Types of head and face protection to consider are listed below.

- Hard hats. Exposure varies. Consider welding, heat, or arc-rated.
- Visors. Exposure varies. Consider welding, heat, or arc-rated.
- Face liners. Exposure to cold weather.
- Face shields. Exposure to liquid splash. Handling caustic liquids or chemicals.

Hand Protection

Wear appropriate type and fit of gloves based on the task being completed. Types of protective gloves to consider are listed below.

- Heat resistant or insulated. Exposure to hot items.
- Flame resistant. Exposure to welding or arc flash.
- Impact resistant. Performing repetitive impact and vibration work. Using pneumatic tools.
- Impervious. Exposure to high pressure fluids.
- Chemical resistant. Exposure to chemicals, fluids, or batteries.
- Cut resistant. Handling sharp objects or tools.
- Cold weather. Exposure to cold weather.

Hearing Protection

When working around operating equipment, appropriately rated hearing protection should be worn. Types of hearing protection to consider are listed below.

- Single use ear plugs.
- Pre-formed ear plugs.
- Ear muffs.

Protective Clothing

Wear appropriate protective clothing based on the task being completed. Types of protective clothing to consider are listed below.

- Flame resistant. Exposure to electrical hazards. Exposure to oil and gas or generator set applications. Performing welding.
- Chemical resistant. Exposure to chemicals.
- High visibility. Exposure to reduced visibility working environments. Working on mining, oil and gas, or sites with large equipment.

Respiratory Protection

Wear appropriate respiratory protection based on the task being completed. Types of respiratory protection to consider are listed below.

- Disposable respirators. Exposure to dust and particles, welding fumes, nuisance odors, nuisance level acid gas.
- Reusable respirators. Exposure to cleaning, machining, welding, sanding, grinding, etc.

Fall Protection

Utilize fall protection if a task is being completed more than 1.2 m [4 ft] above a solid surface. Types of fall protection to consider are listed below.

- Fall harness and lanyard combinations.
- Safety nets.
- Guardrails.

Fuels

Follow these recommended practices when interacting with equipment that uses different fuel types. For information regarding proper handling of various substances, refer to the manufacturer's safety data sheet.

Diesel Fuel

- Protect eyes.
- Protect skin.
- **Always** test for fuel leaks as instructed.
- Do **not** dilute.
- Avoid sparks, arcing switches and equipment, cigarettes, pilot lights, flames, and other sources of ignition.
- Provide extra ventilation to the work area.
- Do **not** troubleshoot or repair fuel leaks while the engine is running.
- If material is spilled, avoid contact and dispersal with runoff, soil, waterways, drains, and sewers. Absorb with sand, clay, or commercial absorbent. Transfer to containers and neutralize the material. Flush spill area with soap and excess water.
- Report spills effecting water source contamination to local authorities immediately.
- Proper disposal is required. Dispose of in accordance with local and environmental regulations.
- **Always** torque fittings and connections to the required specifications. over or under tightening can damage threads and create leaks.

ANADOLU ISUZU AFTERSALES

Gasoline

- Protect eyes.
- Protect skin.
- **Always** be alert for the smell of gas.
- **Always** test for fuel leaks as instructed.
- Do **not** dilute.
- Avoid sparks, arcing switches and equipment, cigarettes, pilot lights, flames, and other sources of ignition.
- Vapors accumulate near the floor. Check the work floor, sumps, and low lying areas for ignition sources before servicing equipment..
- Provide extra ventilation to the work area.
- Do **not** troubleshoot or repair fuel leaks while the engine is running.
- If material is spilled, avoid contact and dispersal with runoff, soil, waterways, drains, and sewers. Absorb with sand, clay, or commercial absorbent. Transfer to containers and neutralize the material. Flush spill area with soap and excess water.
- Report spills effecting water source contamination to local authorities immediately.
- Proper disposal is required. Dispose of in accordance with local and environmental regulations.
- **Always** torque fittings and connections to the required specifications. over or under tightening can damage threads and create leaks.

Biodiesel

- Protect eyes.
- Protect skin.
- **Always** test for fuel leaks as instructed.
- Do **not** dilute.
- Avoid sparks, arcing switches and equipment, cigarettes, pilot lights, flames, and other sources of ignition.
- Vapors accumulate near the floor. Check the work floor, sumps, and low lying areas for ignition sources before servicing equipment..
- Provide extra ventilation to the work area.
- Do **not** troubleshoot or repair fuel leaks while the engine is running.
- If material is spilled, avoid contact and dispersal with runoff, soil, waterways, drains, and sewers. Absorb with sand, clay, or commercial absorbent. Transfer to containers and neutralize the material. Flush spill area with soap and excess water.
- Report spills effecting water source contamination to local authorities immediately.
- Proper disposal is required. Dispose of in accordance with local and environmental regulations.
- **Always** torque fittings and connections to the required specifications. over or under tightening can damage threads and create leaks.

Compressed Natural Gas

- Protect eyes.
- Protect skin.
- **Always** be alert for the smell of gas. Compressed natural gas is typically treated with an odor producing chemical for leak detection. Non-refined sources of natural gas (landfill gas, biogas, coal bed gas, wellhead gas, etc.) can **not always** be detected by smell.

ANADOLU ISUZU AFTER SALES

- **Always** test for fuel leaks as instructed. Odorant can fade.
- Upon entering a room or approaching a vehicle where the smell of gas is present, immediately shutoff all engines and ignition sources.
- Natural gas ignites when there is a 5% - 15% mixture in the air. Asphyxiation can occur when concentration reaches 21% or more.
- Do **not** start equipment or nearby equipment until a suspected gas leak is corrected and the area is ventilated.
- Avoid sparks, arcing switches and equipment, cigarettes, pilot lights, flames, and other sources of ignition.
- Work in areas that do **not** share common ventilation with areas containing ignition sources.
- Store and service natural gas fueled equipment in large, well-ventilated areas, or outside.
- Provide extra ventilation to the work area.
- Natural gas accumulates near the ceiling. Check the ceiling of the work area for ignition sources before servicing equipment.
- **Only** disconnect gas lines in a well-ventilated area.
- Do **not** troubleshoot or repair gas leaks while the engine is running.
- Natural gas ignition systems produce high voltage during operation. Do **not** touch ignition wiring or components while the engine is operating. If necessary, use **only** insulated tools.
- Natural gas exhaust systems operate at higher temperatures than similar diesel exhaust systems. Do **not** touch exhaust components. Do **not** route lines or hoses which deteriorate from heat exposure near exhaust components or in the flow path of the exhaust.
- **Always** torque fittings and connections to the required specifications. over or under tightening can damage threads and create leaks.

Liquefied Natural Gas

- Protect eyes.
- Protect skin.
- **Always** be alert for the smell of gas. Liquefied natural gas may **not** have an odor. Non-refined sources of natural gas (landfill gas, biogas, coal bed gas, wellhead gas, etc.) can **not always** be detected by smell.
- **Always** test for fuel leaks as instructed. Odorant can fade.
- Upon entering a room or approaching a vehicle where the smell of gas is present, immediately shutoff all engines and ignition sources.
- Natural gas ignites when there is a 5% - 15% mixture in the air. Asphyxiation can occur when concentration reaches 21% or more.
- Do **not** start equipment or nearby equipment until a suspected gas leak is corrected and the area is ventilated.
- Avoid sparks, arcing switches and equipment, cigarettes, pilot lights, flames, and other sources of ignition.
- Work in areas that do **not** share common ventilation with areas containing ignition sources.
- Store and service natural gas fueled equipment in large, well-ventilated areas, or outside.
- Provide extra ventilation to the work area.

- Natural gas accumulates near the ceiling. Check the ceiling of the work area for ignition sources before servicing equipment.
- **Only** disconnect gas lines in a well-ventilated area.
- Do **not** troubleshoot or repair gas leaks while the engine is running.
- Natural gas ignition systems produce high voltage during operation. Do **not** touch ignition wiring or components while the engine is operating. If necessary, use **only** insulated tools.
- Natural gas exhaust systems operate at higher temperatures than similar diesel exhaust systems. Do **not** touch exhaust components. Do **not** route lines or hoses which deteriorate from heat exposure near exhaust components or in the flow path of the exhaust..
- Liquefied natural gas is stored in vehicle tanks at extremely cold temperatures. If there is a liquefied natural gas spill, evacuate the area immediately and do not attempt to make contact with the liquid.
- **Always** torque fittings and connections to the required specifications. over or under tightening can damage threads and create leaks.
- Vapors accumulate near the floor. Check the work floor, sumps, and low lying areas for ignition sources before servicing equipment.

Liquefied Petroleum Gas

- Protect eyes.
- Protect skin.
- **Always** be alert for the smell of gas. Liquefied petroleum gas is typically treated with an odor producing chemical for leak detection.
- **Always** test for fuel leaks as instructed. Odorant can fade.
- Upon entering a room or approaching a vehicle where the smell of gas is present, immediately shutoff all engines and ignition sources.
- Do **not** start equipment or nearby equipment until a suspected gas leak is corrected and the area is ventilated.
- Avoid sparks, arcing switches and equipment, cigarettes, pilot lights, flames, and other sources of ignition.
- Work in areas that do **not** share common ventilation with areas containing ignition sources.
- Store and service natural gas fueled equipment in large, well-ventilated areas, or outside.
- Provide extra ventilation to the work area.
- Liquefied petroluem gas accumulates near the floor. Check the work floor, sumps, and low lying areas for ignition sources before servicing equipment.
- **Only** disconnect gas lines in a well-ventilated area.
- Do **not** troubleshoot or repair gas leaks while the engine is running.
- Liquefied petroleum gas ignition systems produce high voltage during operation. Do **not** touch ignition wiring or components while the engine is operating. If necessary, use **only** insulated tools.
- Liquefied petroleum gas exhaust systems operate at higher temperatures than similar diesel exhaust systems. Do **not** touch exhaust components. Do **not** route lines or hoses which deteriorate from heat exposure near exhaust components or in the flow path of the exhaust..

- Liquefied natural gas is stored in vehicle tanks at extremely cold temperatures. If there is a liquefied natural gas spill, evacuate the area immediately and do not attempt to make contact with the liquid.
- **Always** torque fittings and connections to the required specifications. over or under tightening can damage threads and create leaks.

Power Generation Applications

Follow these recommended practices when interacting with equipment in generator set applications.

Power generation applications produce high voltage during operation. When servicing a generator set, the following safety precautions **must** be taken.

- Remove any debris from the generator set.
- Keep the floor clean and dry throughout servicing
- Service access doors **must** be secured in the "open" position before working on enclosed generator sets.
- Use insulated or non-conducting tools.
- Prevent accidental or remote starting. Disconnect the starting battery cables. Disconnect the negative (-) terminal first.
- Isolate all auxiliary supplies.
- Switch the generator set control panel "off."
- Place a "Do **Not** Operate" tag on the control panel.
- Lock the generator set circuit breaker in the "Open" position.
- Activate the manual "Emergency Stop" device.
- Do **not** step on the generator set when servicing, entering, or leaving the generator room.

Aftertreatment

Follow these recommended practices when interacting with equipment that utilize aftertreatment systems. For information regarding proper handling of various substances, refer to the manufacturer's safety data sheet.

Diesel Exhaust Fluid

- Avoid breathing vapor or mist.
- Protect eyes. In case of contact with eyes, flush with water for a minimum of 15 minutes.
- Protect skin. In case of contact with skin, wash with soap and water.
- Do **not** ingest. If ingested, contact a physician immediately.

Diesel Particulate Filter

- Protect eyes.
- Protect skin.
- Avoid stirring up exhaust particulate dust.
- Avoid inhalation of exhaust particulate dust. Wear a dust mask. If respiratory irritation or discomfort occurs, leave the dusty area. Utilize breathing assistance or oxygen if necessary.
- Elevated concentrations of metals in the form of dust, soot, and contaminants are contained in these filters. Health regulations may exist for the materials found in these filters such as Zinc, Molybdenum, polynuclear aromatic hydrocarbons. Potentially toxic materials found in these filters are oxides of calcium, zinc, phosphorous, silicon, sulfur, and iron.
- Proper disposal of the exhaust dust and filter are required. Dispose of in accordance with local and environmental regulations.
- Diesel particulate filter maintenance **must** be completed by appropriately trained personnel.

Selective Catalytic Reduction (SCR) Catalyst

- Protect eyes.
- Protect skin.
- Avoid stirring up exhaust catalyst dust.
- Avoid inhalation of exhaust catalyst dust. Wear a dust mask. If respiratory irritation or discomfort occurs, leave the dusty area. Utilize breathing assistance or oxygen if necessary.
- Do **not** cut open exhaust catalyst assemblies.
- Proper disposal of the exhaust catalyst is required. Dispose of in accordance with local and environmental regulations.

Oxidation Catalysts

Types of Oxidation Catalysts may include, but are not limited to the following.

- Diesel Oxidation Catalyst (DOC)
- 3-way Oxidation Catalyst

When working with oxidation catalysts, perform the following.

- Protect eyes.
- Protect skin.
- Avoid stirring up exhaust catalyst dust.
- Avoid inhalation of exhaust catalyst dust. Wear a dust mask. If respiratory irritation or discomfort occurs, leave the dusty area. Utilize breathing assistance or oxygen if necessary.
- Do **not** cut open exhaust catalyst assemblies.

Common Substances

Follow these recommended practices when interacting with the following substances. For information regarding proper handling of various substances, refer to the manufacturer's safety data sheet.

Coolant

- Coolant is also referred to as antifreeze.
- Protect eyes. In case of contact with eyes, flush with water for a minimum of 15 minutes. Receive medical attention immediately.
- Protect skin. In case of contact with skin, wash with soap and water. Remove contaminated clothing. If injection occurs, it is a medical emergency. Receive medical attention immediately.
- Do **not** ingest. If ingested, drink excess water for dilution and seek medical attention.
- Do **not** pour used antifreeze into containers that have been used to store other chemicals or products, such as oil or gasoline, unless they have been thoroughly cleaned.
- If material is spilled, avoid contact and dispersal with runoff, soil, waterways, drains, and sewers. Provide adequate ventilation to the area. Absorb with sand, clay, or commercial absorbent. Transfer to containers and neutralize the material. Flush spill area with soap and excess water.
- Report spills effecting water source contamination to local authorities immediately.
- Proper disposal is required. Dispose of in accordance with local and environmental regulations.

Liquid Nitrogen

- Work in a well-ventilated area.
- Protect eyes. In case of contact with eyes, flush with water for a minimum of 15 minutes. Receive medical attention immediately.
- Protect skin. In case of contact with skin, receive medical attention immediately.
- Wear protective clothing and gloves that insulate.
- Handle items with tongs or wire hooks.
- Avoid prolonged breathing of liquid nitrogen vapors. Utilize breathing assistance or oxygen if necessary.

Lubricating Oil

See Lubricating Oil in the "Hazardous Substances" step.

Refrigerant

- Protect eyes. In case of contact with eyes, flush with water for a minimum of 15 minutes. In case of frostbite, use lukewarm water, not hot. Seek medical attention if irritation continues.
- Protect skin. Wear leather or insulated gloves. In case of contact with skin, wash with soap and water. Seek medical attention if irritation continues.
- Proper disposal is required. Dispose of in accordance with local and environmental regulations.
- **Only** disconnect liquid refrigerant lines in a well-ventilated area. liquid refrigerant systems **must** be properly emptied and filled using equipment that prevents the release of refrigerant gas into the atmosphere. Federal law requires capturing and recycling refrigerant in the United States of America.

Solvents

- Follow the manufacturer's instructions for safe handling practices.
- Follow the manufacturer's recommendations for use.
- Some solvents are flammable and toxic..
- Protect eyes. In case of contact with eyes, follow manufacturer's recommendations.
- Protect skin. In case of contact with skin, follow manufacturer's recommendations.
- Dispose of in accordance with manufacturer's recommendations.

Starting Aids (Starting Fluid)

- Do **not** use starting fluid if the intake air heater option is used.
- Do **not** use volatile cold starting aids in underground mine or tunnel operations. The local United States Bureau of Mines inspector can provide more information and instructions.
- Avoid sparks, arcing switches and equipment, cigarettes, pilot lights, flames, and other sources of ignition.
- Work in a well-ventilated area.
- Avoid inhalation.

Hazardous Substances

Hazardous substances are known to some state and federal agencies to be carcinogenic and cause reproductive harm. Hazardous substances that may be encountered during service events are listed below.

Diesel Engine Exhaust

- Protect eyes. In case of contact with eyes, flush with water for a minimum of 15 minutes.
- Protect skin. In case of contact with skin, wash with soap and water.
- Avoid inhalation.

Lubricating Oil

- Protect eyes. In case of contact with eyes, flush with water for a minimum of 15 minutes.
- Protect skin. In case of contact with skin, wash with soap and water.
- Do **not** ingest. If ingested, contact a physician immediately..
- Proper disposal is required. Dispose of in accordance with local and environmental regulations.
- Do **not** allow water droplets to enter a container of hot oil. A violent reaction can result.

Mercury

- Protect eyes. In case of contact with eyes, flush with water for a minimum of 15 minutes.
- Protect skin. In case of contact with skin, wash with soap and water.
- Do **not** ingest. If ingested, contact a physician immediately.
- Proper disposal is required. Dispose of in accordance with local and environmental regulations.

Vanadium Pentoxide

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- Can be found in some selective catalytic reduction (SCR) catalysts.
- Protect eyes. In case of contact with eyes, flush with water for a minimum of 15 minutes.
- Protect skin. In case of contact with skin, wash with soap and water.
- Do **not** ingest. If ingested, contact a physician immediately.
- Avoid inhalation of vapors or airborne particles.
- Proper disposal is required. Dispose of in accordance with local and environmental regulations.

Electrical Components

Follow these recommended practices when interacting with electrical components.

Batteries

- Protect eyes. Wear safety glasses or goggles. In case of battery acid contact with eyes, flush with water for a minimum of 15 minutes. Receive medical attention immediately.
- Protect skin. Wear rubber gloves and a chemical apron. In case of battery acid contact with skin or clothing, rinse with water for several minutes. Avoid spreading the acid. Receive medical attention immediately.
- Do **not** open the battery caps with your face over or near the battery.
- Remove rings, watches, long jewelry, or metallic items when working with or near batteries.
- Ventilate the battery compartment before servicing the battery.
- Work in a well-ventilated area.
- Avoid sparks, arcing switches and equipment, cigarettes, pilot lights, flames, and other sources of ignition.
- Use insulated or non-conducting tools.
- Neutralize static buildup by contacting the nearest ground surface before working on a battery.
- Do **not** lift batteries by the posts.
- Do **not** touch both battery terminals with your bare hands at the same time.
- Disconnect the negative (-) battery cable first.
- Attach the negative (-) battery cable last.

Common Hazards

Follow these recommended practices when interacting with equipment as the following hazards may exist.

High Temperature Area

Be alert for high temperature areas which may cause severe burns. High temperature areas may be encountered in the following situations.

- On products that have just been turned off.
- On or around exhaust related components (turbocharger, aftertreatment systems, etc).
- In exhaust gas flow paths.
- Contacting hot fluid lines, tubes, or compartments.

Recommended Practices:

- Allow components to cool before servicing. Verify the temperature of the component. Utilize an infrared gun, temperature sensor, temperature gauge, or other reliable method to determine component temperature. Take appropriate precautions before starting work.
- Protect eyes.
- Protect skin. Wear insulated gloves.
- Ensure surrounding items do not come in contact with hot components or exhaust. Contact may ignite or melt those materials.

Heavy Objects

Be alert when working with heavy objects.

- Do **not** lift components that weigh 23 kg [50 lb] or more. Use mechanical help or seek assistance.
- Use mechanical help to move items whenever possible. Make sure the load is securely fastened to the equipment.
- Make sure lifting devices, like chains, hooks, slings, etc., are in good condition and are rated for the correct capacity before use.
- Make sure lifting devices are positioned correctly before use.
- Use a spreader bar when necessary.
- If the item can be lifted manually, squat to lift and lower the item. Do **not** bend at the waist.
- Maintain balance when lifting items by keeping feet apart or staggered if possible.
- If the item must be carried, make sure the path is clear when carrying the item to, and placing the item in, the desired location.

Pressurized Areas

Be alert for pressurized areas. Pressurized areas may be encountered in the following situations.

- Air, Oil, Fuel, and Cooling systems.
- When disconnecting or removing lines, fittings, or related items.
- When disconnecting a device from a pressurized system.
- When removing or loosening caps on tanks or pressurized systems.

Injuries that may result when interacting with pressurized areas are listed below.

- High pressure spray can penetrate the skin. Serious injury or death may result.
- Hot fluid spray can cause burns. See "High Temperature Area."

Recommended Practices:

- Protect skin. Wear impervious gloves. If skin penetration from high pressure spray occurs, it is a medical emergency. Receive medical attention immediately.
- Check for pressure leaks as instructed. **Never** check for pressure leaks with your hand.
- Allow product to cool before accessing pressurized areas.
- Relieve system pressure as instructed.
- Slowly loosen fill caps to relieve pressure before servicing.

Job Safety Assessment

Completing a Job Safety Assessment (JSA) prior to performing work helps identify job safety hazards and prevent incidents. Use the guidelines below to assess if a situation is safe or at risk prior to performing designated work. If deteremined to be at risk, take appropriate precautions to prepare for, or eliminate, the hazard. If the risks are uncontrollable, consult a knowledgeable resource to find a safe practice solution. A knowledgeable resource may include, but is not limited to, one of the following:

- Site supervisor
- Customer
- Work supervisor

Always check with the site where work is being performed to determine if safety assessment documentation is required.

Work Practices

Job Safety Analysis.

- Assess the job to identify safety hazards that may occur during the repair event.

Ascending or Descending

- Maintain 3 points of contact when using steps, ladders, or entering and exiting a unit.

Communication

- When working with others, make sure you understand what each other is doing to safely complete the task.

Eyes On Hands and Work.

- Confirm if you will be able to maintain an unobstructed view of your hands at all times while performing the task.

Eyes On Path

- Watch for hazards in your path to avoid trip or slip hazards. Examples are pits, platform edges, etc.

Line Of Fire

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- Position yourself so that you avoid striking against, or being struck by, anything that can swing, fall, or roll.

Pinch Point

- Prevent exposure of all parts of your body to a nip hazard or pinch point.

Rushing

- Take adequate time to safely perform the job. Do **not** rush or take short cuts.

Follow Procedures

- Utilize QuickServe® Online or other standard procedures when available.
- Make sure the procedures are correct and safe.

Ergonomics

Back-Bending and Twisting

- Avoid bending forward more than 45 at your waist.
- Avoid working with your back twisted with loads over 23 kg [50 lb].

Knee

- Avoid bending your knee more than 90.
- Avoid kneeling for more than 4 hours per day.

Lifting and Lowering

- Squat to pick up parts.
- Keep loads close to the body when lifting or carrying.
- Use a team lift or a lifting device if the object is more than 23 kg [50 lb].

Pulling or Pushing

- Pull with your arms.
- Push with your legs.
- Avoid exerting more force than necessary.
- Avoid moving heavy load(s) too quickly.

Tools and Equipment

Selection

- Select the correct tool or equipment to perform the task.

Condition

- Confirm the tool or equipment is free of defects before use.
- Confirm that safety devices are in place before use.

Use

- Use the tool or equipment as directed.
- Follow the manufacturer's instructions.

Personal Protective Equipment (PPE)

Eye, Face, and Head Protection

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- Confirm the eye, face, or head protection you plan to use are adequate for performing the task at hand.

Foot Protection

- Confirm the foot protection you plan to use is adequate for performing the task at hand in the current environment.

Fall Protection

- Fall protection should be used if you are working more than 1.2 m [4 ft] above the floor.
- Use fall protection if you have been properly trained to do so. If you are not trained to use fall protection, allow someone who has received proper training to perform the task.

Hand Protection

- Avoid exposing hands to cuts or burns while completing the task.
- Confirm the proper glove type is being used for the task at hand. Examples are cut-resistant, chemical-resistant, electric shock-resistant, electric arc flash, welding, etc.

Hearing Protection

- Hearing protection should be worn when required or recommended.

Body Protection

- Body parts should be protected from work hazards.
- Avoid contact with sharp edges, hot surfaces, etc.

Work Procedures

Training

- Confirm if you have received task and safety training for the job being performed.

Working Alone

- Avoid working alone.
- Avoid working where you are **not** able to be seen or heard by another person.
- If you **must** work alone, notify others of your location and schedule check-in times.

Lockout and Tagout

- Lock out or tag out energy sources before work. Examples are electrical, mechanical, hydraulic, and pneumatic.

Barricades and Warnings

- Mark overhead work areas with barricade tape or signs.
- Mark open floor hazards with barricade tape, signs, or cones.

Confined Space

- Confirm if a confined space entry permit is required.
- If required, confirm the permit is posted, signed, and dated correctly.

Hot Work

- Confirm a functional fire extinguisher is readily available.
- Maintain separation between ignition sources and fuel sources.

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Place Wheel Chocks

- Place wheel chocks at either the front or back tire of the unit prior to starting the task.

Spotter

- Use a spotter when moving a customer's unit.
- Confirm the driver can see and hear the spotter when moving.

Housekeeping (The 5 S's - Scrap or Segregate, Set to Order, Spotless, Standardize, and Sustain)

- Remove parts, extension cords, air hoses, and liquids from the work area that may cause trip, slip, or fall hazards.

Last Modified: 28-Nov-2017

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General Information

This system incorporates the latest technology at the time it was manufactured; yet, it is designed to be repaired using normal repair practices performed to quality standards.

⚠ WARNING ⚠

Cummins Inc. does not recommend or authorize any modifications or repairs to components except for those detailed in Cummins Service Information. In particular, unauthorized repair to safety-related components can cause personal injury or death. Below is a partial listing of components classified as safety-related:

1. Air Compressor
2. Air Controls
3. Air Shutoff Assemblies
4. Balance Weights
5. Cooling Fan
6. Fan Hub Assembly
7. Fan Mounting Bracket(s)
8. Fan Mounting Capscrews
9. Fan Hub Spindle
10. Flywheel
11. Flywheel Crankshaft Adapter
12. Flywheel Mounting Capscrews
13. Fuel Shutoff Assemblies
14. Fuel Supply Tubes
15. Lifting Brackets
16. Throttle Controls
17. Turbocharger Compressor Casing
18. Turbocharger Oil Drain Line(s)
19. Turbocharger Oil Supply Line(s)
20. Turbocharger Turbine Casing
21. Vibration Damper Mounting Capscrews
22. Manual Service Disconnect
23. High Voltage Interlock Loop
24. High Voltage Connectors/Connections and Harnesses
25. High Voltage Battery System
26. Power Inverter
27. Generator Motor
28. Clutch Pressure Plate

- Follow all safety instructions noted in the procedures

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- Follow the manufacturer's recommendations for cleaning solvents and other substances used during repairs. Some solvents have been identified by government agencies as toxic or carcinogenic. Avoid excessive breathing, ingestion and contact with such substances. **Always** use good safety practices with tools and equipment
- Provide a clean environment and follow the cleaning instructions specified in the procedures
- All components **must** be kept clean during any repair. Contamination of the components will cause premature wear.
- Perform the inspections specified in the procedures
- Replace all components or assemblies which are damaged or worn beyond the specifications
- Use genuine Cummins new or ReCon® service parts and assemblies
- The assembly instructions have been written to use again as many components and assemblies as possible. When it is necessary to replace a component or assembly, the procedure is based on the use of new Cummins or Cummins ReCon® components. All of the repair services described in this manual are available from all Cummins Distributors and most Dealer locations.
- Follow the specified disassembly and assembly procedures to reduce the possibility of damage to the components

Welding on a Vehicle with an Electronic Controlled Fuel System

⚠ CAUTION ⚠

Disconnect both the positive (+) and negative (-) battery cables from the battery before welding on the vehicle. Attach the welder ground cable no more than 0.61 meters [2 feet] from the part being welded. Do not connect the ground clamp of the welder to any of the sensors, wiring harness, electronic control units or the components. Direct welding of any electronic components must not be attempted. Sensors, wiring harness, and electronic control unit should be removed if nearby welding will expose these components to temperatures beyond normal operation. Additionally, all electronic control unit connectors must be disconnected

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Last Modified: 10-Jul-2012

Definition of Clean

Parts **must** be free of debris that can contaminate any engine system. This does **not** necessarily mean they have to appear as new.

Sanding gasket surfaces until the factory machining marks are disturbed adds no value and is often harmful to forming a seal. It is important to maintain surface finish and flatness tolerances to form a quality sealing surface. Gaskets are designed to fill small voids in the specified surface finish.

Sanding gasket surfaces where edge-molded gaskets are used is most often unnecessary. Edge-molded gaskets are those metal carriers with sealing material bonded to the edges of the gasket to seal while the metal portion forms a metal to metal joint for stability. Any of the small amounts of sealing material that can stick to the parts are better removed with a blunt-edged scraper on the spots rather than spending time polishing the whole surface with an air sander or disc.

For those gaskets that do **not** have the edge molding, nearly all have a material that contains release agents to prevent sticking. Certainly this is **not** to say that some gaskets are **not** difficult to remove because the gasket has been in place a long time, has been overheated or the purpose of the release agent has been defeated by the application of some sealant. The object however is just to remove the gasket without damaging the surfaces of the mating parts without contaminating the engine (don't let the little bits fall where they can not be removed).

Bead blasting piston crowns until the dark stain is removed is unnecessary. All that is required is to remove the carbon build-up above the top ring and in the ring grooves. There is more information on bead blasting and piston cleaning later in this document.

Cummins Inc. does **not** recommend sanding or grinding the carbon ring at the top of cylinder liners until clean metal is visible. The liner will be ruined and any signs of a problem at the top ring reversal point (like a dust-out) will be destroyed. It is necessary to remove the carbon ring to provide for easier removal of the piston assembly. A medium bristle, high quality, steel wire wheel that is rated above the rpm of the power tool being used will be just as quick and there will be less damage. Yes, one **must** look carefully for broken wires after the piston is removed but the wires are more visible and can be attracted by a magnet.

Oil on parts that have been removed from the engine will attract dirt in the air. The dirt will adhere to the oil. If possible, leave the old oil on the part until it is ready to be cleaned, inspected and installed, and then clean it off along with any attracted dirt. If the part is cleaned then left exposed it can have to be cleaned again before installation. Make sure parts are lubricated with clean oil before installation. They do **not** need to be oiled all over but do need oil between moving parts (or a good lube system priming process conducted before cranking the engine).

Bead blasting parts to remove exterior paint is also usually unnecessary. The part will most likely be painted again so all that needs happen is remove any loose paint.

Abrasive Pads and Abrasive Paper

The keyword here is "abrasive". There is no part of an engine designed to withstand abrasion. That is they are all supposed to lock together or slide across each other. Abrasives and dirt particles will degrade both functions.

⚠ WARNING ⚠

Abrasive material must be kept out of or removed from oil passages and parts wear points. Abrasive material in oil passages can cause bearing and bushing failures that can progress to major component damage beyond reuse. This is particularly true of main and rod bearings.

Cummins Inc. does **not** recommend the use of emery cloth or sand paper on any part of an **assembled** engine or component including but **not** limited to removing the carbon ridge from cylinder liners or to clean block decks or counterbores.

Great care **must** be taken when using abrasive products to clean engine parts, particularly on partially assembled engines. Abrasive cleaning products come in many forms and sizes. All of them contain aluminum oxide particles, silicon carbide, or sand or some other similar hard material. These particles are harder than most of the parts in the engine. Since they are harder, if they are pressed against softer material they will either damage the material or become embedded in it. These materials fall off the holding media as the product is used. If the products are used with power equipment the particles are thrown about the engine. If the particles fall between two moving parts, damage to the moving parts is likely.

If particles that are smaller than the clearance between the parts while they are at rest (engine stopped), but larger than the running clearance then damage will occur when the parts move relative to each other (engine started). While the engine is running and there is oil pressure, particles that are smaller than the bearing clearance are likely to pass between the parts without damage and be trapped in the oil filter. However, particles larger than the bearing clearance will remove material from one part and can become embedded in one of the parts. Once embedded in one part it will abrade the other part until contact is no longer being made between the two parts. If the damage sufficiently degrades the oil film, the two parts will come into contact resulting in early wear-out or failure from lack of effective lubrication.

Abrasive particles can fly about during cleaning it is **very** important to block these particles from entering the engine as much as possible. This is particularly true of lubricating oil ports and oil drilling holes, especially those located downstream of the lubricating oil filters. Plug the holes instead of trying to blow the abrasive particles and debris with compressed air because the debris is often simply blown further into the oil drilling.

All old gasket material **must** be removed from the parts gasket surfaces. However, it is **not** necessary to clean and polish the gasket surface until the machining marks are erased. Excessive sanding or buffing can damage the gasket surface. Many newer gaskets are of the edge molded type (a steel carrier with a sealing member bonded to the steel). What little

sealing material that can adhere is best removed with a blunt-edged scraper or putty knife. Cleaning gasket surfaces where an edge-molded gasket is used with abrasive pads or paper is usually a waste of time.

⚠ WARNING ⚠

Excessive sanding or grinding the carbon ring from the top of the cylinder liners can damage the liner beyond reuse. The surface finish will be damaged and abrasive particles can be forced into the liner material which can cause early cylinder wear-out or piston ring failures.

Tape off or plug all openings to any component interior before using abrasive pads or wire brushes. If really necessary because of time to use a power tool with abrasive pads, tape the oil drillings closed or use plug and clean as much of the surface as possible with the tool but clean around the oil hole/opening by hand so as to prevent contamination of the drilling. Then remove the tape or plug and clean the remaining area carefully and without the tool. DO NOT use compressed air to blow the debris out of oil drilling on an assembled engine! More likely than **not**, the debris can be blown further into the drilling. Using compressed air is fine if both ends of the drilling are open but that is rarely the case when dealing with an assembled engine.

Gasket Surfaces

The object of cleaning gasket surfaces is to remove any gasket material, not refinish the gasket surface of the part.

Cummins Inc. does **not** recommend any specific brand of liquid gasket remover. If a liquid gasket remover is used, check the directions to make sure the material being cleaned will **not** be harmed.

Air powered gasket scrapers can save time but care must be taken to **not** damage the surface. The angled part of the scraper must be against the gasket surface to prevent the blade from digging into the surface. Using air powered gasket scrapers on parts made of soft materials takes skill and care to prevent damage.

Do **not** scrape or brush across the gasket surface if at all possible.

Solvent and Acid Cleaning

Several solvent and acid-type cleaners can be used to clean the disassembled engine parts (other than pistons. See Below). Experience has shown that the best results can be obtained using a cleaner that can be heated to 90° to 95° Celsius (180° to 200° Fahrenheit). Kerosene

emulsion based cleaners have different temperature specifications, see below. A cleaning tank that provides a constant mixing and filtering of the cleaning solution will give the best results. Cummins Inc. does not recommend any specific cleaners. Always follow the cleaner manufacturer's instructions. Remove all the gasket material, o-rings, and the deposits of sludge, carbon, etc., with a wire brush or scraper before putting the parts in a cleaning tank. Be careful not to damage any gasket surfaces. When possible, steam clean the parts before putting them in the cleaning tank.

⚠ WARNING ⚠

When using solvents, acids, or alkaline materials for cleaning, follow the manufacturers recommendations for use. Wear goggles and protective clothing to reduce the possibility of personal injury.

Experience has shown that kerosene emulsion based cleaners perform the best to clean pistons. These cleaners should **not** be heated to temperature in excess of 77°C (170°F). The solution begins to break down at temperatures in excess of 82°C (180°F) and will be less effective.

Do **not** use solutions composed mainly of chlorinated hydrocarbons with cresols, phenols and/or cresylic components. They often do **not** do a good job of removing deposits from the ring groove and are costly to dispose of properly.

Solutions with a pH above approximately 9.5 will cause aluminum to turn black; therefore do **not** use high alkaline solutions.

Chemicals with a pH above 7.0 are considered alkaline and those below 7.0 are acidic. As you move further away from the neutral 7.0, the chemicals become highly alkaline or highly acidic.

Remove all the gasket material, o-rings, and the deposits of sludge, carbon, etc., with a wire brush or scraper before putting the parts in a cleaning tank. Be careful to **not** damage any gasket surfaces. When possible use hot high pressure water or steam clean the parts before putting them in the cleaning tank. Removing the heaviest dirt before placing in the tank will allow the cleaner to work more effectively and the cleaning agent will last longer.

Rinse all the parts in hot water after cleaning. Dry completely with compressed air. Blow the rinse water from all the capscrew holes and the oil drillings.

If the parts are **not** to be used immediately after cleaning, dip them in a suitable rust proofing compound. The rust proofing compound **must** be removed from the parts before assembly or installation on the engine.

Steam Cleaning

Steam cleaning can be used to remove all types of dirt that can contaminate the cleaning tank. It is a good method for cleaning the oil drillings and coolant passages

⚠ WARNING ⚠

When using a steam cleaner, wear safety glasses or a face shield, as well as protective clothing. Hot steam can cause serious personal injury.

Do **not** steam clean the following components:

- Electrical Components
- Wiring Harnesses
- Belts and Hoses
- Bearings (ball or taper roller)
- Electronic Control Module (ECM)
- ECM Connectors
- Capacitive Coil Driver Module (CCD)
- Ignition Coils and Leads
- NOx Sensor
- Fuel Control Valve
- Throttle Driver and Actuator.

Plastic Bead Cleaning

Cummins Inc. does **not** recommend the use of glass bead blast or walnut shell media on **any** engine part. Cummins Inc. recommends using **only** plastic bead media, Part Number 3822735 or equivalent on any engine part. **Never** use sand as a blast media to clean engine parts. Glass and walnut shell media when **not** used to the media manufacturer's recommendations can cause excess dust and can embed in engine parts that can result in premature failure of components through abrasive wear.

Plastic bead cleaning can be used on many engine components to remove carbon deposits. The cleaning process is controlled by the use of plastic beads, the operating pressure and cleaning time.

⚠ CAUTION ⚠

Do not use bead blasting cleaning methods on aluminum pistons skirts or the pin bores in any piston, piston skirt or piston crown. Small particles of the media will embed in the aluminum or other soft metal and result in premature wear of the cylinder liner, piston rings, pins and pin bores. Valves, turbocharger shafts, etc., can also be damaged. Follow the cleaning directions listed in the procedures.

⚠ CAUTION ⚠

Do not contaminate wash tanks and tank type solvent cleaners with the foreign material and plastic beads. Remove the foreign material and plastic beads with compressed air, hot high pressure water or steam before placing them in tanks or

cleaners. The foreign material and plastic beads can contaminate the tank and any other engine parts cleaned in the tank. Contaminated parts may cause failures from abrasive wear.

Plastic bead blasting media, Part Number 3822735, can be used to clean all piston ring grooves. Do **not** sure any bead blasting media on piston pin bores or aluminum skirts.

Follow the equipment manufacturer's cleaning instructions. Make sure to adjust the air pressure in the blasting machine to the bead manufacturer's recommendations. Turning up the pressure can move material on the part and cause the plastic bead media to wear out more quickly. The following guidelines can be used to adapt to manufacturer's instructions:

1. Bead size: U.S. size Number 16 — 20 for piston cleaning with plastic bead media, Part Number 3822735
2. Operating Pressure — 270 kPa (40 psi) for piston cleaning. Pressure should not cause beads to break.
3. Steam clean or wash the parts with solvent to remove all of the foreign material and plastic beads after cleaning. Rinse with hot water. Dry with compressed air.

⚠ CAUTION ⚠

The bead blasting operation must not disturb the metal surface. If the metal surface is disturbed the engine can be damaged due to increased parts clearance or inadequate surface finish on parts that move against other parts.

When cleaning pistons, it is **not** necessary to remove all the dark stain from the piston. All that is necessary is to remove the carbon on the rim and in the ring grooves. This is best done by directing the blast across the part as opposed to straight at the part. If the machining marks are disturbed by the blasting process, then the pressure is too high or the blast is being held on one spot too long. The blast operation **must not** disturb the metal surface.

Walnut shell bead blast material is sometimes used to clean ferrous metals (iron and steel). Walnut shell blasting produces a great amount of dust particularly when the pressure if the air pressure on the blasting machine is increased above media manufacturer's recommendation. Cummins Inc. recommends **not** using walnut shell media to clean engine parts due to the risk media embedment and subsequent contamination of the engine.

Cummins Inc. now recommends glass bead media **NOT** used to clean any engine parts. Glass media is too easily embedded into the material particularly in soft materials and when air pressures greater than media manufacturer's recommend are used. The glass is an abrasive so when it is in a moving part, that part is abrading all the parts in contact with it. When higher pressures are used the media is broken and forms a dust of a very small size that floats easily in the air. This dust is very hard to control in the shop, particularly if **only** compressed air (and not hot water) is used to blow the media after it is removed from the blasting cabinet (blowing the part off inside the cabinet may remove large accumulations but never removes all the media).

Bead blasting is best used on stubborn dirt/carbon build-up that has **not** been removed by first steam/higher pressure washing then washing in a heated wash tank. This is particularly true of pistons. Steam and soak the pistons first then use the plastic bead method to safely

remove the carbon remaining in the grooves (instead of running the risk of damaging the surface finish of the groove with a wire wheel or end of a broken piston ring. Make sure the parts are dry and oil free before bead blasting to prevent clogging the return on the blasting machine.

Always direct the bead blaster nozzle "across" rather than directly at the part. This allows the bead to get under the unwanted material. Keep the nozzle moving rather than hold on one place. Keeping the nozzle directed at one-place too long causes the metal to heat up and be moved around. Remember that the spray is **not** just hitting the dirt or carbon. If the machining marks on the piston groove or rim have been disturbed then there has **not** been enough movement of the nozzle and/or the air pressure is too high.

Never bead blast valve stems. Tape or use a sleeve to protect the stems during bead blasting. Direct the nozzle across the seat surface and radius rather than straight at them. The object is to remove any carbon build up and continuing to blast to remove the stain is a waste of time.

Fuel System

When servicing any fuel system components, which can be exposed to potential contaminants, prior to disassembly, clean the fittings, mounting hardware, and the area around the component to be removed. If the surrounding areas are **not** cleaned, dirt or contaminants can be introduced into the fuel system.

The internal drillings of some injectors are extremely small and susceptible to plugging from contamination. Some fuel injection systems can operate at very high pressures. High pressure fuel can convert simple particles of dirt and rust into a highly abrasive contaminant that can damage the high pressure pumping components and fuel injectors.

Electrical contact cleaner can be used if steam cleaning tools are **not** available. Use electrical contact cleaner rather than compressed air, to wash dirt and debris away from fuel system fittings. Diesel fuel on exposed fuel system parts attracts airborne contaminants.

Choose lint free towels for fuel system work.

Cap and plug fuel lines, fittings, and ports whenever the fuel system is opened. Rust, dirt, and paint can enter the fuel system whenever a fuel line or other component is loosened or removed from the engine. In many instances, a good practice is to loosen a line or fitting to break the rust and paint loose, and then clean off the loosened material.

When removing fuel lines or fittings from a new or newly-painted engine, make sure to remove loose paint flakes/chips that can be created when a wrench contacts painted line nuts or fittings, or when quick disconnect fittings are removed.

Fuel filters are rated in microns. The word micron is the abbreviation for a micrometer, or one millionth of a meter. The micron rating is the size of the smallest particles that will be captured by the filter media. As a reference, a human hair is 76 microns [0.003 in] in diameter. One micron measures 0.001 mm [0.00004 in.]. The contaminants being filtered out are smaller than can be seen with the human eye, a magnifying glass, or a low powered microscope.

The tools used for fuel system troubleshooting and repair are to be cleaned regularly to avoid contamination. Like fuel system parts, tools that are coated with oil or fuel attract airborne contaminants. Remember the following points regarding your fuel system tools:

- Fuel system tools are to be kept as clean as possible.
- Clean and dry the tools before returning them to the tool box.
- If possible, store fuel system tools in sealed containers.
- Make sure fuel system tools are clean before use.

Last Modified: 30-Apr-2013

ANADOLU ISUZU AFTER SALES

General Information

The following list contains some of the acronyms and abbreviations used in this manual.

ANSI	American National Standards Institute
API	American Petroleum Institute
ASTM	American Society of Testing and Materials
ATDC	After Top Dead Center
bhp	Brake Horsepower
BTU	British Thermal Unit
BTDC	Before Top Dead Center
°C	Celsius
CAN	Controller Area Network
CARB	California Air Resources Board
CCA	Cold Cranking Amperes
CCV	Closed Crankcase Ventilation
CES	Cummins Engineering Standard
CIB	Customer Interface Box
C.I.D.	Cubic Inch Displacement
CNG	Compressed Natural Gas
CO	Carbon Monoxide
CPL	Control Parts List
cSt	Centistokes
DEF	Diesel Exhaust Fluid
DOC	Diesel Oxidation Catalyst
DPF	Diesel Particulate Filter
ECM	Engine Control Module
EFC	Electronic Fuel Control
EGR	Exhaust Gas Recirculation
EPA	Environmental Protection Agency
ESN	Engine Serial Number
°F	Fahrenheit
ft-lb	Foot-Pound Force
FMI	Failure Mode Indentifier
GVW	Gross Vehicle Weight
Hg	Mercury
hp	Horsepower

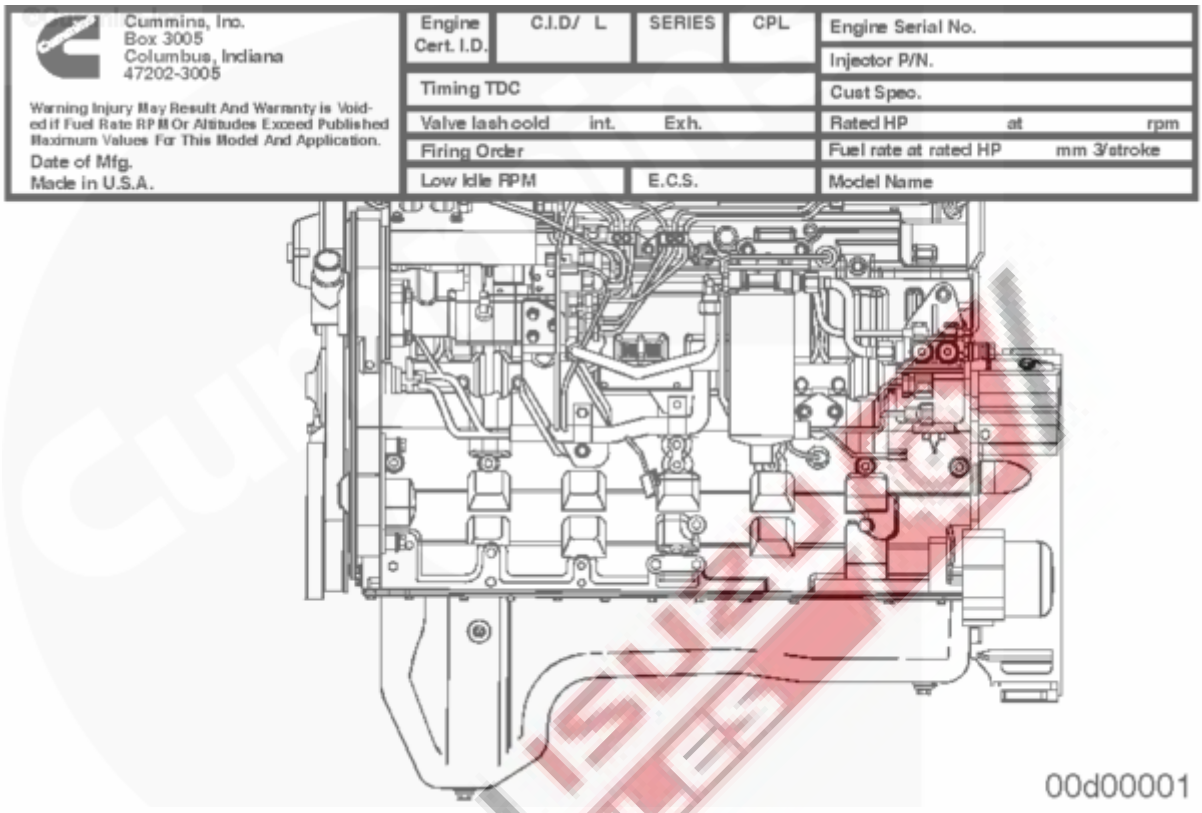
H_2O	Water
inHg	Inches of Mercury
in $H_2 0$	Inches of Water
ICM	Ignition Control Module
IEC	International Electrotechnical Commission
JSA	Job Safety Assessment
km/l	Kilometers per Liter
kPa	Kilopascal
LNG	Liquefied Natural Gas
LPG	Liquefied Petroleum Gas
LTA	Low Temperature Aftercooler
MCRS	Modular Common Rail System
MIL	Malfunction Indicator Lamp
MPa	Megapascal
mph	Miles Per Hour
mpq	Miles Per Quart
N•m	Newton-meter
NOx	Nitrogen Oxides
NG	Natural Gas
O2	Oxygen
OAT	Organic Acid Technology
OBD	On-Board Diagnostics
OEM	Original Equipment Manufacturer
OSHA	Occupational Safety and Health Administration
PCCNet	Power Command Control Network
PID	Parameter Identification Descriptions
PPE	Personal Protective Equipment
ppm	Parts Per Million
psi	Pounds Per Square Inch
PTO	Power Takeoff
QSOL	QuickServe® Online
REPTO	Rear Engine Power Takeoff
RGT	Rear Gear Train
rpm	Revolutions Per Minute
SAE	Society of Automotive Engineers
SCA	Supplemental Coolant Additive
SCR	Selective Catalytic Reduction

STC	Step Timing Control
SID	Subsystem Identification Descriptions
TDC	Top Dead Center
TSB	Technical Service Bulletin
ULSD	Ultra Low Sulfur Diesel
VDC	Volts of Direct Current
VGT	Variable Geometry Turbocharger
VS	Variable Speed
VSS	Vehicle Speed Sensor

Last Modified: 15-Apr-2020

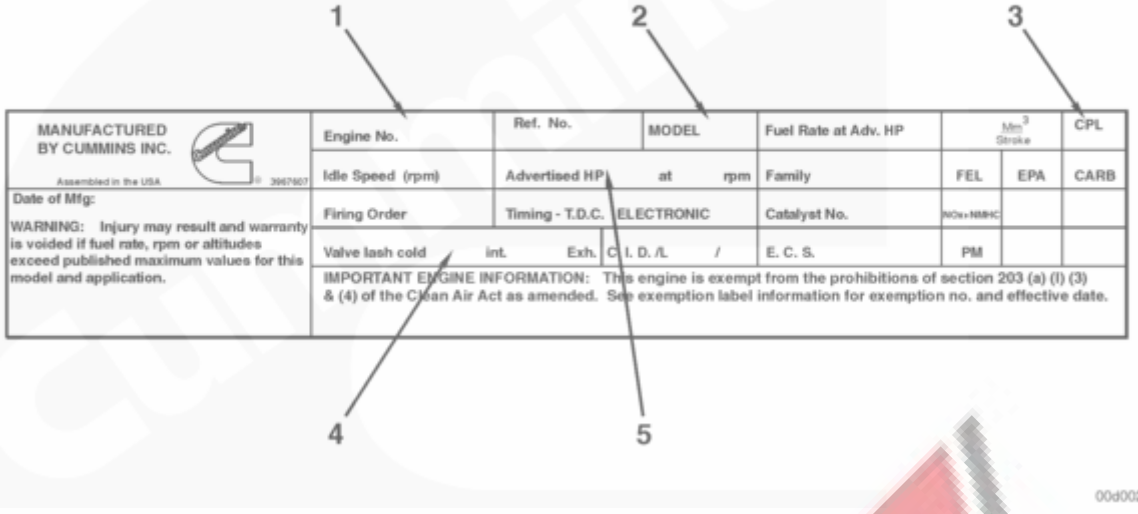
ANADOLU ISUZU AFTER SALES

Engine Dataplate



The engine dataplate provides important information about the engine. The engine serial number (ESN) and control part list (CPL) provide information for service and for ordering parts. The engine dataplate **must not** be changed unless approved by Cummins Inc.

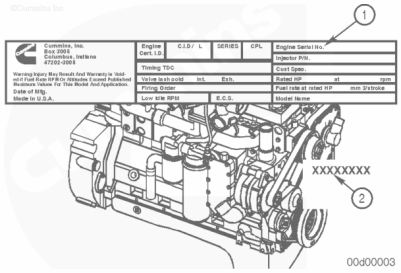
Have the following engine data available when communicating with a Cummins® Authorized Repair Location. The information on the dataplate is **mandatory** when sourcing service parts.



1. Engine serial number (ESN)
2. Engine model information
3. Control parts list (CPL)
4. Valve lash (overhead) setting
5. Horsepower and rpm rating.

Note : Depending on the manufacturing plant, calibration data can also be found on the engine dataplate.

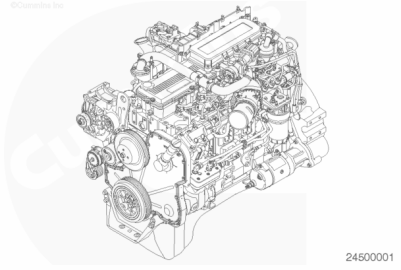
If the engine dataplate (1) is **not** legible, the ESN (2) can be found on the engine block, on top of the lubricating oil cooler housing. Additional engine information is on the engine control module (ECM) dataplate.



Cummins® Engine Nomenclature

The Cummins® Service Engine Model Identification procedure describes how to use the Cummins® Service Model Name to identify an engine. Refer to Procedure 100-008 in Section E. (/qs3/pubsys2/xml/en/procedures/99/99-100-008.html)

The Cummins® Product Technology procedure provides the Cummins® Service Model Name and describes the unique technology used by the engine covered by this manual.

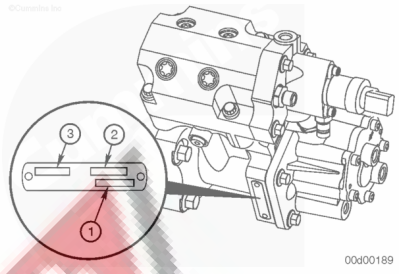


Refer to Procedure 100-006 in section E.
(/qs3/pubsys2/xml/en/procedures/425/425-100-006.html)

Fuel Pump Dataplate

The fuel pump dataplate is located on the side of the high-pressure pump. The dataplate contains the following information:

1. Cummins® part number
2. Pump serial number
3. Factory code.

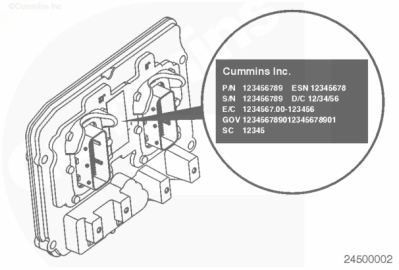


Engine Control Module Dataplate

The ECM dataplate is located on the front of the ECM.

The following information is found on the ECM dataplate:

- ECM part number (PN)
- ECM serial number (SN)
- ECM date code (DC)
- Engine serial number (ESN)
- ECM Code: identifies the software in the ECM).



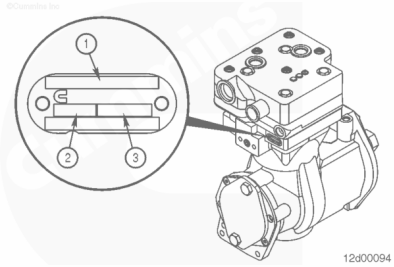
Note : The presence of an ECM dataplate depends on the manufacturing plant and the date the engine was manufactured. If an ECM dataplate was **not** installed by the manufacturing plant, calibration data can be found on the engine dataplate.

Note : Not all engines will have ECM dataplates.

Engines covered by this manual are equipped with a CM2350 ECM. A CM2350 engine control module has two 96 pin connectors.

Air Compressor

Note : Not all engines are equipped with an air compressor.

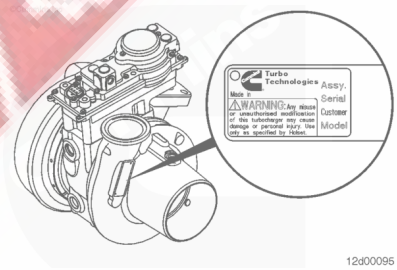


The Cummins® branded air compressor dataplate, identified by the Cummins Inc. logo on the dataplate, is typically located on the rear side of the air compressor. The dataplate contains the following information that assists in service or replacement.

1. Cummins® part number
2. Date code
3. Serial number.

Variable Geometry Turbocharger

The variable geometry turbocharger dataplate is located on the turbocharger inlet compressor housing. The dataplate contains the following information which will assist in service or replacement.

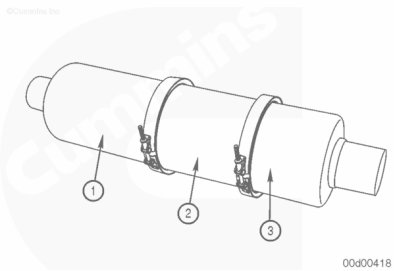


- Cummins® assembly part number
- Serial number
- Customer number
- Model number.

Note : The electronic actuator on the variable geometry turbocharger is a serviceable component and has a separate dataplate that assists in service or replacement.

Exhaust System

The diesel particulate aftertreatment assembly has important information for service and replacement stamped into the canister.



There are three important stamping locations on the aftertreatment assembly:

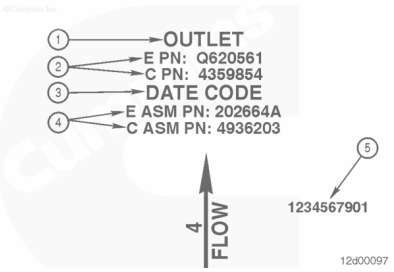
1. Aftertreatment diesel oxidation inlet/catalyst part number and serial number, located on the inlet/catalyst section
2. Aftertreatment diesel particulate filter part number and serial number, located on the filter section.

ANADOLU ISUZU AFTERSALES

3. Aftertreatment assembly outlet section part number, located on the outlet of the aftertreatment system.

A typical aftertreatment information stamping can provide the following:

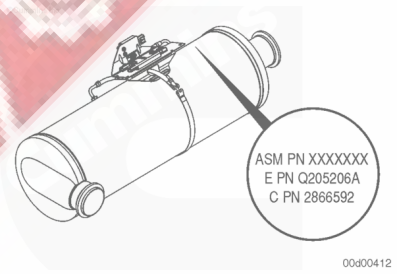
1. Section name
2. Part number
3. Date code
4. Assembly number (**only** located on the outlet section)
5. Serial number.



Note : Some aftertreatment components could possibly **only** have the Cummins Emission Solutions™ part number for cross referencing and part number identification. See QuickServe® Online.

The aftertreatment selective catalytic reduction catalyst identification is located on the side of the part and contains the following information to assist in service or replacement:

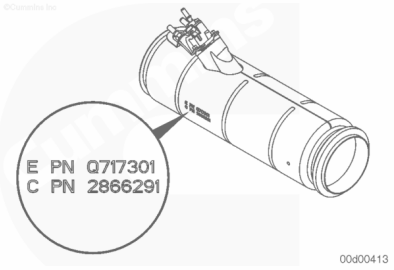
- Assembly part number
- Cummins Emission Solutions™ part number
- Cummins® part number.



Note : Some aftertreatment components could possibly **only** have the Cummins Emission Solutions™ part number for cross referencing and part number identification. See QuickServe® Online.

The aftertreatment decomposition tube identification is located on the side of the part and contains the following information to assist in service or replacement:

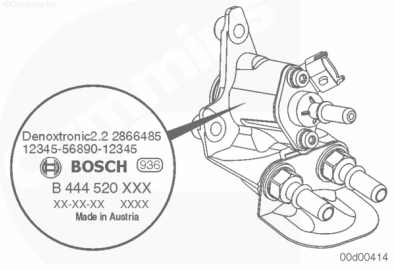
- Cummins Emission Solutions™ part number
- Cummins® part number.



Note : Some aftertreatment components may **only** have the Cummins Emission Solutions™ part number for cross referencing and part number identification. See QuickServe® Online.

The aftertreament diesel exhaust fluid dosing valve identification is located on the side of the valve and contains the following information to assist in service or replacement:

- Cummins® part number
- Cummins Emission Solutions™ part number
- Bosch™ part number
- Bosch™ production data (date code and serial number).

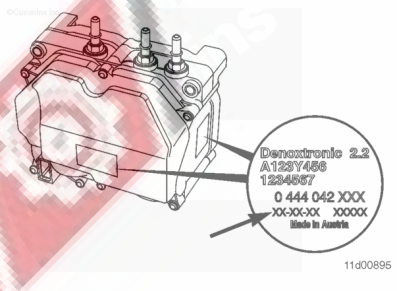


Example:

- 2866485 is the Cummins® part number
- 12345-67890-12345 is the Cummins Emission Solutions™ part number
- B 444 606 XXX is the Bosch™ part number
- XX-XX-XX is the date code
- XXXX is the serial number.

Note : Some aftertreatment components may **only** have the Cummins Emission Solutions™ part number for cross referencing and part number identification. See QuickServe® Online.

The aftertreament diesel exhaust fluid dosing unit identification is located on the side of the part and contains the following information to assist in servicing or replacement:



11d00895

- Cummins Emission Solutions™ part number
- Cummins® part number
- Bosch™ part number
- Bosch™ production data (date code and serial number).

Example:

- A123Y456 is the Cummins Emission Solutions™ part number
- 1234567 is the Cummins® part number
- 0 444 042 XXX is the Bosch™ part number
- XX-XX-XX is the date code
- XXXXX is the serial number.

Note : Some aftertreatment components may **only** have the Cummins Emission Solutions™ part number for cross referencing and part number identification. See QuickServe® Online.

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Last Modified: 10-Oct-2016

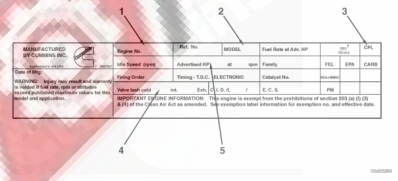
General Information

The Cummins® Service Engine Model Identification procedure describes:

- The purpose of the Cummins® Service Model Name.
- How to interpret a Cummins® Service Model Name to identify a Cummins® Engine.



The Cummins® Service Model Name differs from the Cummins® marketing model name. Service model names are more specific and help to match the correct Cummins® service information to the correct engine. Marketing engine model names are more generic and can capture multiple engine variations in the same model name.



Marketing Engine Model Name	Service Model Name
B6.7	B6.7 CM2350 B121B

Marketing engine model names (2) can be found on the engine dataplate, Cummins® brochures, and Cummins® promotional literature.

Examples of Cummins® service information and products that use service model names:

- QuickServe™ Online
- INSITE™ electronic service tool
- Owner's Manual
- Operation and Maintenance Manual
- Master Repair Manual
- Service Manual
- Wiring Diagram
- Fault Code Troubleshooting Manual
- Standard Repair Times
- Technical Service Bulletins
- Service Bulletins

The Cummins® Service Model Name begins with the marketing engine model name.

The first two letters of the marketing model may still contain an “IS” or “QS” if the engine is an electronic engine.

“IS” prefix designates an on-highway engine.

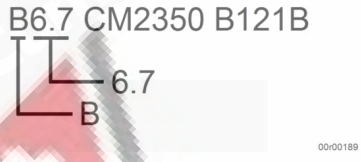
“QS” prefix designates an off-highway engine.



The first letter is the engine platform/series designation followed by the engine liter displacement. For the example shown in the graphic, the engine is a:

B Series engine.

6.7 Liters in Displacement.

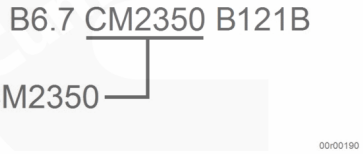


If no letter is located after the engine liter displacement information, the engine is fueled by diesel.

If the letter “N” is located after the engine liter displacement information, the engine is fueled by natural gas.



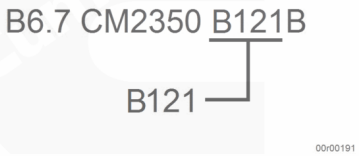
The engine control system is identified with the letters "CM" followed by the control system model number.



The identifier after the control system is a letter and number combination to identify variations between products.

The letter is the engine platform designation.

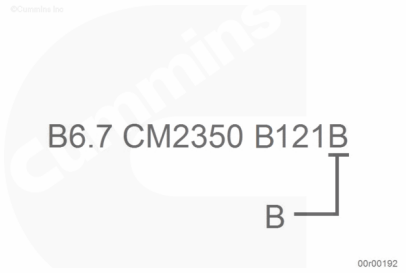
The number increments as new variations of the engine are released. The first number is 101.



The letter at the end of the suffix identifies the general application for which the product is intended to be used.

- B – Automotive
- C – Industrial

- G – Power Generation/Generator Drive
- M – Marine



Last Modified: 02-May-2017

ANADOLU ISUZU
AFTER SALES

General Information

The service model name for this product is L9 CM2350 L119B.

This engine is being released to meet the following emission regulations:

European Union

- Euro VI (Dyno Certification)
  - OBD-C

The Control Parts List(s) (CPL) associated with this product are:

- 4799
- 4800

Engine

- Number of Cylinders: 6
- Engine Configuration
  - Inline
- Engine Orientation
  - Vertical
- Cylinder Block Material
  - Cast Iron
- Cylinder Head Material
  - Cast Iron
- Valves Per Cylinder
  - Exhaust Quantity: 2
  - Intake Quantity: 2
- Camshaft Location
  - Cylinder Block
- Camshaft Followers/Tappets
  - Roller Followers/Tappets
- Primary Gear Train Location
  - Front of the Engine
- Engine Braking
  - Compression Brake Option
  - Variable Geometry Turbocharger Brake Option
- REPTO Option
- Accessory Drive Option
- Crankcase Ventilation System
  - Open

Fuel System

- Diesel

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- Common Rail Fuel System
  - Cummins® XPI Common Rail Fuel System
- Fuel Lift Pump
  - Electric
    - 12 VDC
    - 24 VDC

Air Handling

- Turbocharger (Single)
  - Variable Geometry
    - Sliding Nozzle Design
- Charge Air Cooler
- Intake Air Heater
- Engine Intake Throttle Actuator

Exhaust System

- Exhaust Gas Recirculation (EGR)
- Aftertreatment Fuel Injection
  - Internal
- Diesel Oxidation Catalyst (DOC)
- Diesel Particulate Filter (DPF)
  - Full Flow
- Selective Catalytic Reduction (SCR) Catalyst
- Bosch® Aftertreatment Diesel Exhaust Fluid (DEF) Dosing System
  - Airless Diesel Exhaust Fluid Dosing Unit

Electrical Equipment

- Starting System
  - Electric Starting Motor Option
    - 12 VDC
    - 24 VDC
- Charging System (Voltage Options)
  - 12 VDC
  - 24 VDC

Electronic Control System

- Engine Control Module (Single)
  - Control Module: CM2350
- ECM Supply Voltage
  - 12 VDC
  - 24 VDC
- Real-Time Clock Battery
- Engine Coolant Level Sensor
- Engine Coolant Temperature Sensor
- Engine Oil Pressure Sensor
- Crankcase Pressure Sensor
- Camshaft Position Sensor
- Crankshaft Position Sensor

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- Fuel Rail Pressure Sensor
- Fuel Pump Actuator
- Water in Fuel Sensor
- EGR Differential Pressure Sensor
- Exhaust Gas Pressure Sensor
- EGR Temperature Sensor
- Intake Manifold Pressure/Temperature Sensor
- Turbocharger Speed Sensor
- Turbocharger Compressor Intake Pressure/Temperature Sensor
- Ambient Air Temperature Sensor
- Aftertreatment Diesel Particulate Filter Differential Pressure Sensor
- Aftertreatment Exhaust Gas Temperature Sensor
- Aftertreatment Intake NOx Sensor
- Aftertreatment Outlet NOx Sensor

Market applications that will use this engine include, but are **not** limited to:

Automotive

- Truck
  - Conventional Truck
- Bus
  - Transit Bus

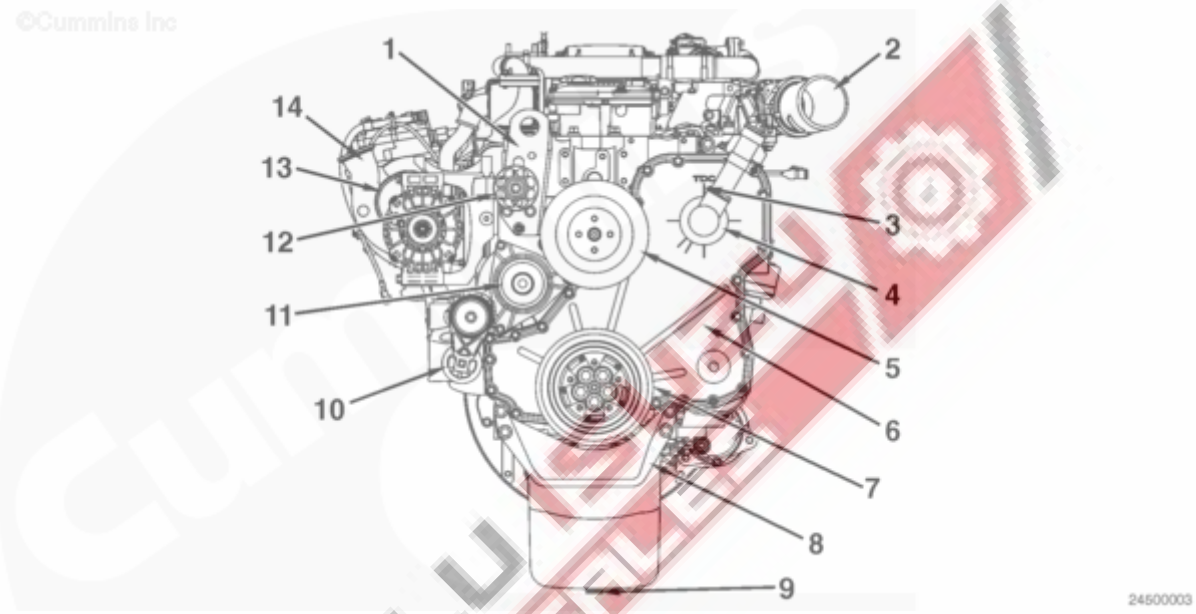
ANADOLU ISUZU AFTER SALES

Last Modified: 26-Jul-2016

Engine Views

The following illustrations provide the locations of the major external engine components, filters, and other service and maintenance points. Some external components will be at different locations for different engine models.

The illustrations are **only** a reference to show a typical engine.



Front View

1. Front engine lifting bracket
2. Air intake connection
3. Top dead center indicator
4. Fuel pump drive gear access cover
5. Fan pulley
6. Front gear cover
7. Vibration damper
8. Front engine mounting bracket
9. Engine lubricating oil pan drain plug
10. Belt tensioner
11. Water pump
12. Idler pulley
13. Turbocharger compressor air inlet
14. Turbocharger compressor air outlet.

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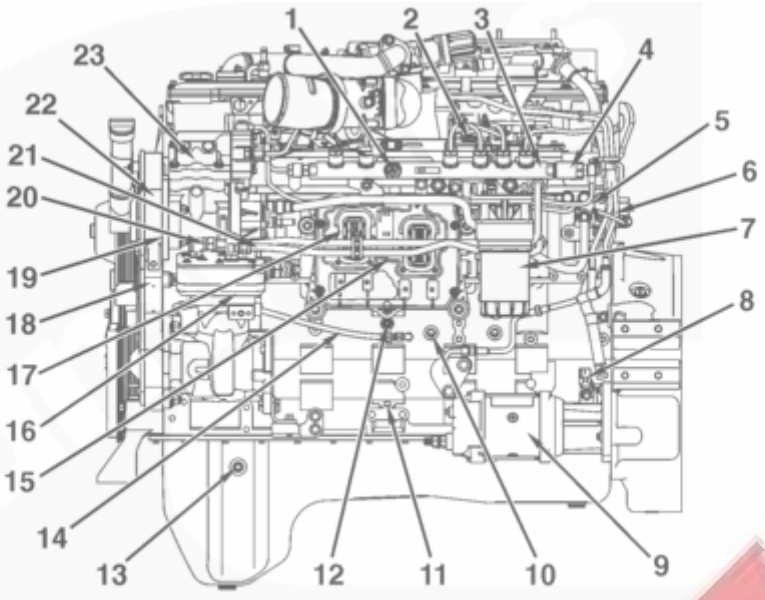

Left Side View

1. Fuel rail pressure sensor
2. Intake manifold temperature and pressure sensor
3. Fuel rail
4. Fuel rail high-pressure relief valve
5. Fuel drain manifold
6. Crankcase breather oil drain tubes
7. Fuel filter
8. Crankshaft speed sensor
9. Starter motor
10. Engine oil heater mounting boss
11. Engine lubricating oil fill location
12. Lubricating oil pressure sensor
13. Lubricating dipstick location
14. Air compressor oil supply line
15. Fuel lift pump (behind engine control module (ECM))
16. Air compressor
17. Engine control module
18. Gear housing
19. Camshaft speed sensor
20. Air compressor coolant supply line
21. Air compressor coolant drain line
22. Engine dataplate
23. Fuel pump.

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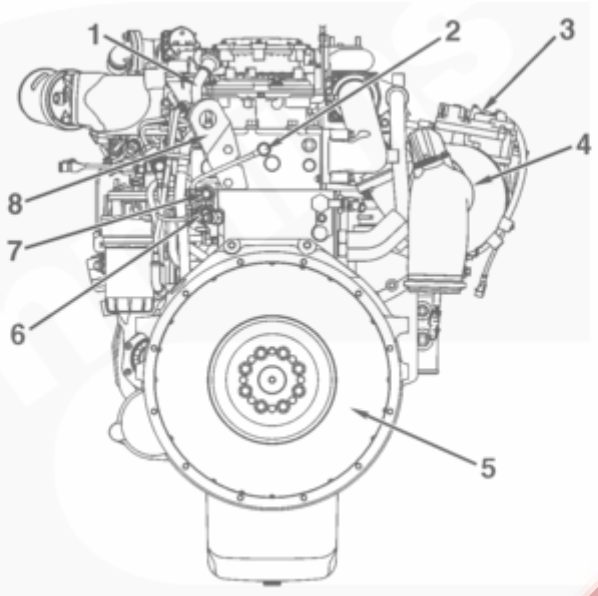
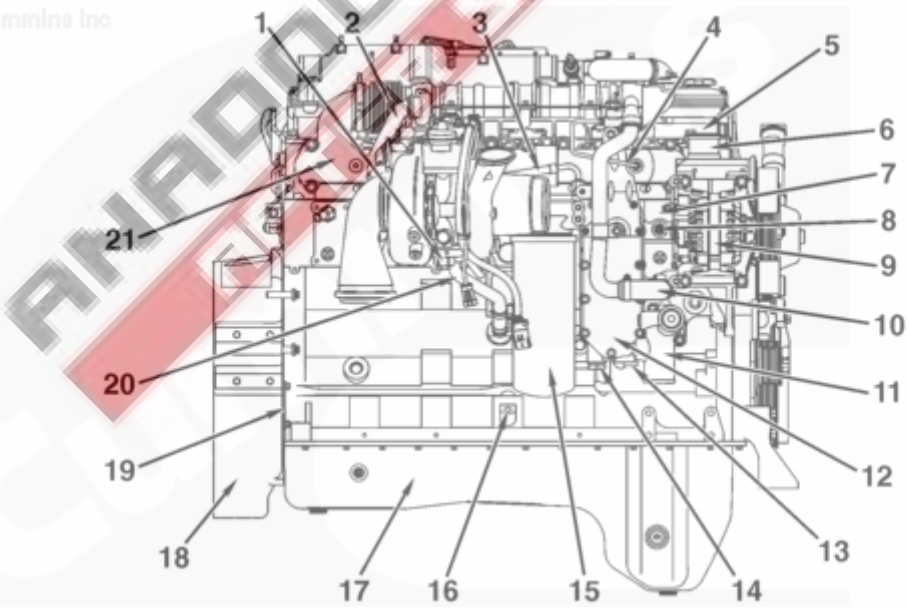


Rear View

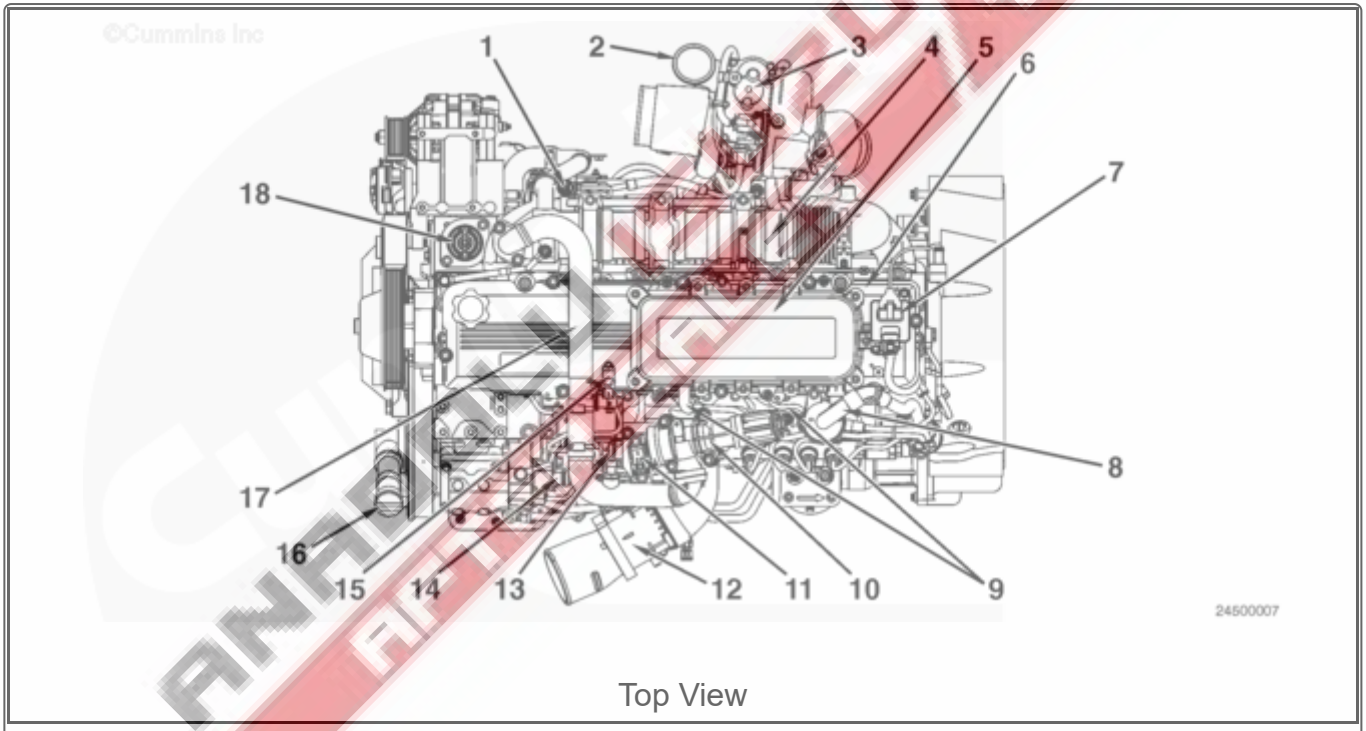
1. Crankcase breather draft tube
2. Injector drain line connection
3. Turbocharger actuator
4. Turbocharger exhaust outlet
5. Flywheel
6. Original equipment manufacturer (OEM) fuel supply line connection
7. OEM fuel drain line connection
8. Rear engine lifting bracket.



Right Side View

1. Turbocharger coolant drain
2. Exhaust gas recirculation (EGR) cooler coolant supply
3. Turbocharger oil supply line
4. Exhaust gas pressure sensor tube
5. Rocker lever housing

6. Coolant outlet connection
7. Lubricating oil thermostat
8. Coolant temperature sensor
9. Alternator
10. EGR cooler coolant
11. Coolant inlet connection
12. Lubricating oil cooler
13. Coolant drain petcock
14. Lubricating oil pressure regulator
15. Lubricating oil filter
16. Lubricating dipstick location
17. Lubricating oil pan
18. Flywheel housing
19. Engine barring port
20. Turbocharger oil drain lne
21. Exhaust manifold.



Top View

1. Exhaust gas pressure sensor
2. Turbocharger compressor air outlet
3. Turbocharger actuator
4. EGR cooler
5. Crankcase breather
6. Rocker lever cover
7. NOx sensor
8. Crankcase breather draft tube
9. Crankcase breather oil drain tubes
10. EGR valve
11. EGR pressure sensor
12. Engine intake throttle actuator
13. Exhaust gas temperature sensor

14. Fuel pump actuator
15. Crankcase pressure sensor
16. Engine lubricating oil fill location
17. EGR crossover tube
18. Thermostat.

Last Modified: 08-Nov-2016

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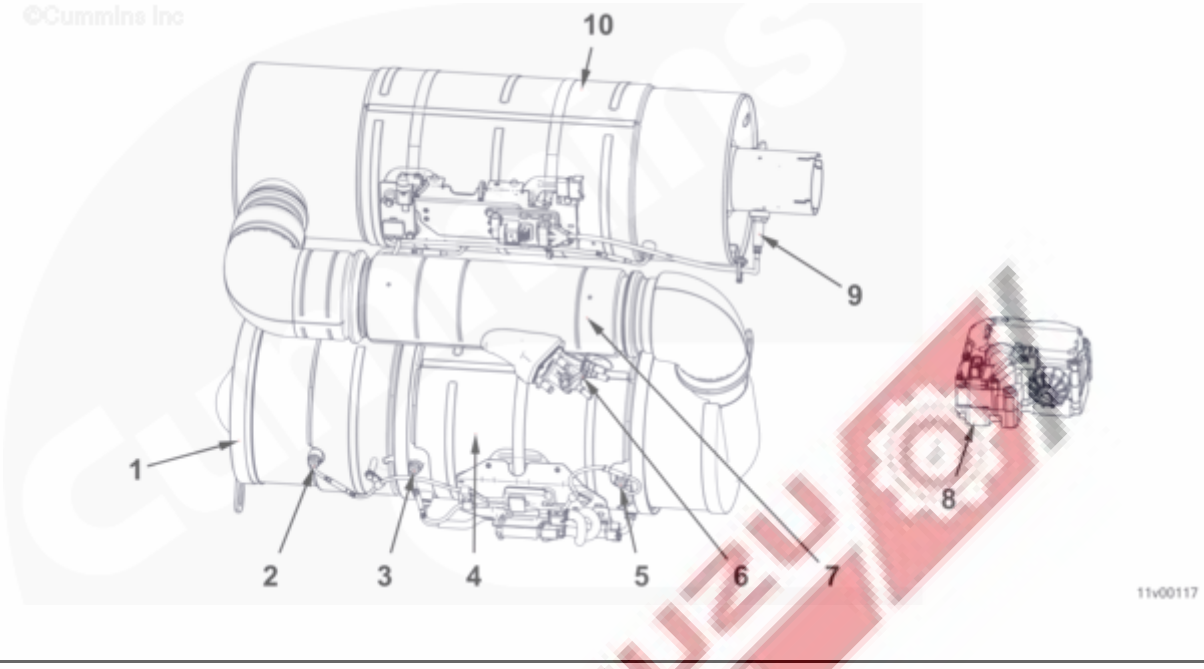
Aftertreatment System Views



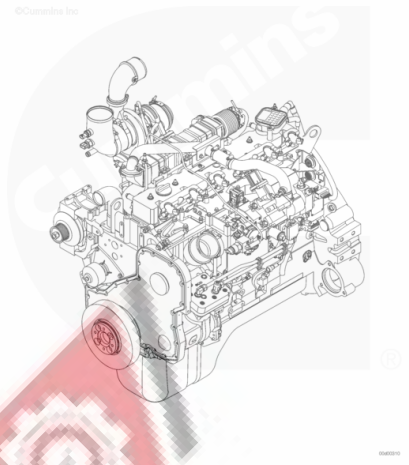
1. Aftertreatment diesel oxidation catalyst (DOC)
2. Aftertreatment DOC intake temperature sensor
3. Aftertreatment diesel particulate filter (DPF) temperature sensor
4. Aftertreatment DPF
5. Aftertreatment DPF temperature sensor
6. Aftertreatment diesel exhaust fluid (DEF) dosing valve
7. Decomposition reactor
8. DEF dosing pump
9. Aftertreatment outlet NOx sensor
10. Aftertreatment selective catalytic reduction (SCR) catalyst.

ANADOLU ISUZU
PARTS SALES

Last Modified: 07-Dec-2016

General Information

Note : All replacement steps will **not** apply to all types of equipment. Complete **only** the steps which apply to the equipment involved. Use equipment manufacturer recommendations and precautions for removal of chassis parts to gain access to the engine.



The procedures required to replace an engine will vary with different engine models, the type of equipment, optional equipment, and shop facilities. Use the following procedures as a guide.

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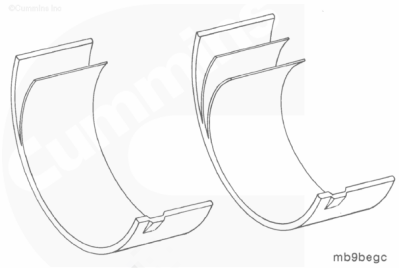
Last Modified: 25-Jul-2016

General Information

Bearing, Connecting Rod



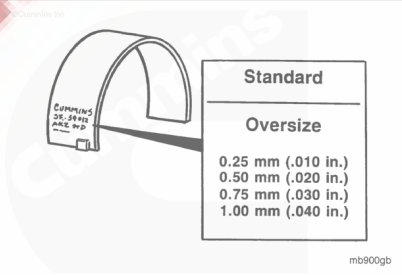
In general, various types of connecting rod bearings have been used in L series engines:

- Bi-metal overlays.
- Tri-metal overlays.

Note : Some engines may be built with a red polymer coating on the upper rod bearing, which gives the bearing a red texture finish.

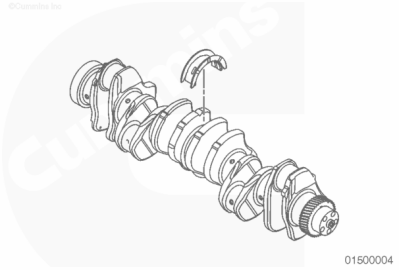
See the appropriate part information resources when replacing the connecting rod bearings, so the correct connecting rod bearings are installed.

Oversize connecting rod bearing shells are available for crankshafts that require being ground undersize.



The connecting rod bearing shells are identified by steel-stamped characters on the back of the bearings. The characters indicate either standard (STD) or the amount of oversize (OS).

Bearing, Main



The crankshaft and cylinder block utilize main bearing journals. The main bearings for each journal are the same except for the number four main bearing journal, counted from the front of the engine. The number four main bearing journal is fitted with a flanged upper main bearing, referred to as a thrust bearing. The flanges on the main bearing control the end thrust of the crankshaft when axial loads are applied to the end of the crankshaft.

Note : During bearing inspection, while the engine is in chassis, try to avoid removing the thrust bearing. If the thrust bearing is removed for inspection, it **must** be replaced with a new thrust bearing. The 180 degree thrust washers are designed to separate from the main bearing shell in operation. Use the following procedure for more information on main bearings. Refer to Procedure 001-006 in section 1. (/qs3/pubsys2/xml/en/procedures/425/425-001-006.html)

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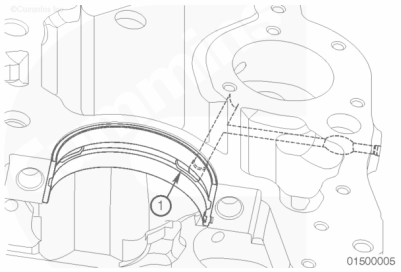
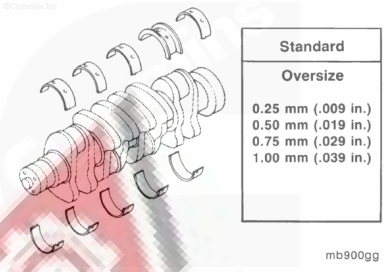
The upper bearings have two slots in them. The slot (1) on the intake side of the engine receives lubricating oil from the main oil rifle.

There is a drilling from the main bearing saddle to the camshaft bore. This drilling is bisected by the intake side oil rifle and provides oil to the main bearings.



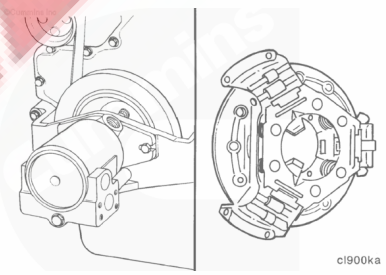
Oversize main bearing shells are available for crankshafts that require being ground undersize.

The main bearing shells are identified by steel-stamped characters on the back of the bearings. The characters indicate either standard (STD) or the amount of oversize (OS).

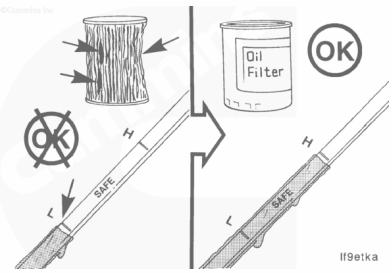


A common cause for increased crankshaft end clearance and thrust bearing damage is increased end-loading of the engine. The increased end-loading can be the result of driven units at the front or rear of the engine being:

- Incorrectly installed.
- Incorrectly adjusted.
- Incorrectly matched to the engine and exceeding the thrust load limits.



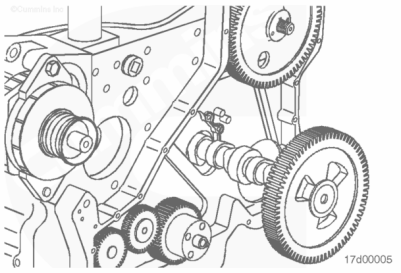
Improper maintenance of the lubricating system is the primary cause of reduced bearing life. Refer to Procedure 007-083 in Section 7. (/qs3/pubsys2/xml/en/procedures/425/425-007-083.html)



Camshaft and Gear

The camshaft is of a cast iron material and is gear-driven directly off of the crankshaft gear.

The camshaft gear is located at the front of the engine, and is pressed onto the camshaft.



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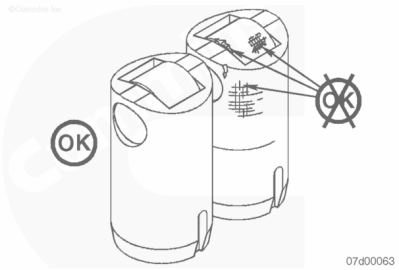
The camshaft has lobes to operate the intake and exhaust valves. The valve lobes contact roller valve tappets that operate the push rods.

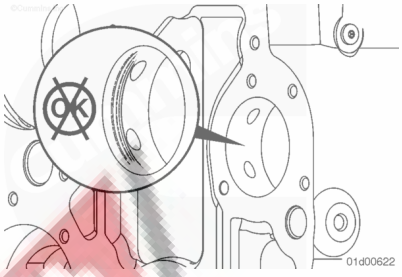


Camshaft Bushings

The engines covered by this manual have seven camshaft bushings, starting with camshaft bushing 1 at the front of the engine.

Camshaft bushings 1 through 6 can be replaced through the front of the engine by driving them towards the rear of the engine.

Replacing camshaft bushing 7 requires the flywheel housing and the cup plug at the rear of the camshaft to be removed, to drive camshaft bushing 7 forward for replacement.

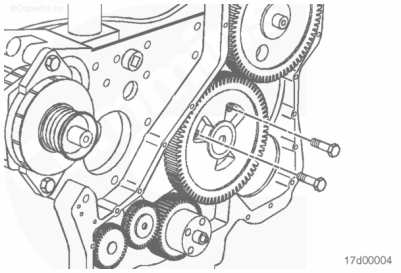


Camshaft Thrust Plate

The camshaft thrust plate is used to control the camshaft end clearance.

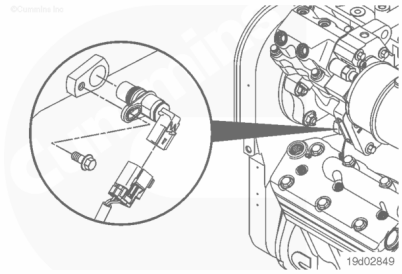
The camshaft thrust plate is located between the camshaft gear mounting flange and camshaft journal.

Note : Because the thrust plate extends more than 180 degrees around the camshaft, the thrust plate can **only** be removed from the camshaft after removing the camshaft gear from the camshaft.



Camshaft Speed Indicator Ring

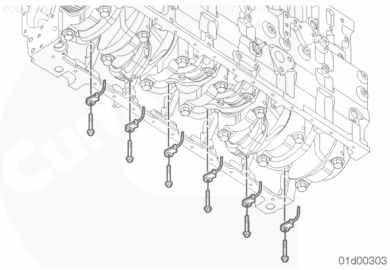
The camshaft speed indicator ring is located on the back side of the camshaft gear.



Piston Cooling Nozzles

The engines covered by this manual use J-jet piston cooling nozzles located in between the main bearing saddles on the exhaust side of the engine. Lubricating oil is supplied from

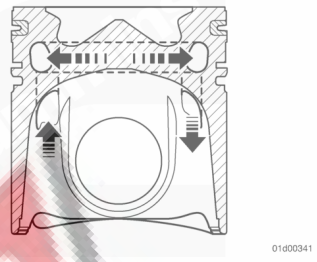
an oil gallery in the cylinder block on the exhaust side of the engine.



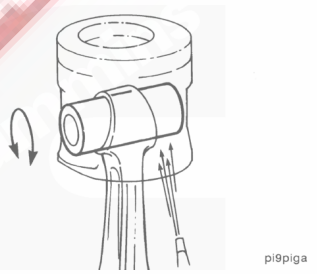
Piston and Connecting Rod Assembly

The piston cooling nozzles supply lubricating oil to the underside of the pistons.

An open chamber oil gallery is located on the underside of the crown of the piston to provide more oil contact with the piston and provide better piston cooling.

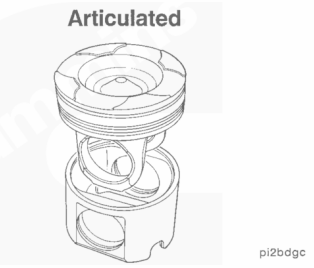


A free-floating, hollow piston pin is used to attach the piston to the connecting rod. Lubrication for the piston pin and journal is supplied by residual spray from the piston cooling nozzles.



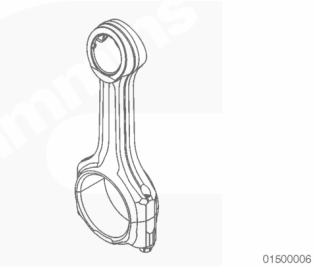
Pistons

Depending on horsepower rating, the engine has aluminum mono block pistons or articulated pistons. The articulated piston is a two piece piston consisting of a forged steel crown and an aluminum skirt.



Connection Rods

The engine has straight fracture split connecting rods with the fractured surface at the crankshaft end. These connecting rods can **not** be mixed in with previous product ISC/ISL engines.



When assembling and installing the piston and connecting rod assembly, it is critical the orientation of the components is correct.

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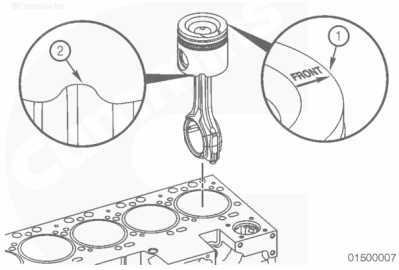
For all piston types make sure the "FRONT" marking on the piston crown is pointed toward the front of the engine block.

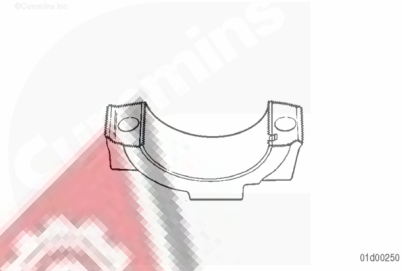
The notch in the piston skirt provides clearance for the J-jet piston cooling nozzle when the piston is at bottom dead center.

Piston grading is **not** required for the engines covered by this manual.



The contact surface between the connecting rod and connecting rod cap is **not** a machined surface. The surface is the result of the connecting rod being fractured during the manufacture process to separate the connecting rod cap from the connecting rod.

This surface can **not** be considered damaged unless there are deep nicks or cracks across the surface.

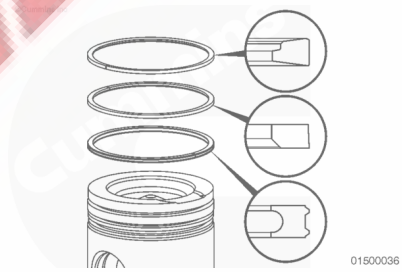


Piston Rings

The piston ring type and location can be identified by the piston ring profile.

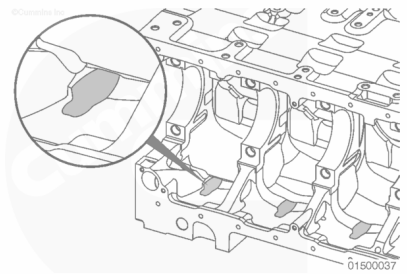
- Top piston ring (top)
- Intermediate piston ring (middle)
- Oil control ring (bottom).

Make certain to reference the appropriate part information resources when replacing the piston rings, so the correct components are installed.



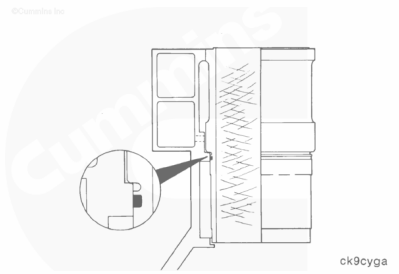
Cylinder Block

The CM2350 cylinder block design incorporates clearance scallops on the hot side skirt to accommodate the new larger rod design.



The cylinder block has a replaceable cylinder liner. A mid-stop design is used to locate the liner in the block. A press fit between the liner and block provides coolant sealing at the top of the liner. A rectangular ring seal (liner seal) is used for sealing at the mid-stop portion of the liner.

Note : If a liner bore is **not** acceptable for reuse, it **must** be replaced. Damaged liners can **not** be honed



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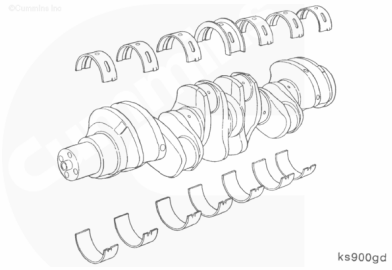
or deglazed. This would destroy the cross-hatch pattern needed for oil control.

Crankshaft and Crankshaft Speed Indicator



The crankshaft uses forged counterweights. Cummins Inc. recommends regrinding all of the main or the connecting rod journals when one requires regrinding.

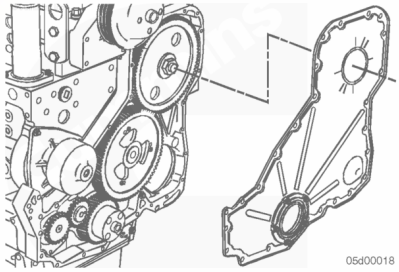
The crankshaft speed indicator feature is located on the rear end of the crankshaft. The crankshaft speed sensor is mounted on the cold side of the engine block, near the flywheel housing.

Vibration Damper



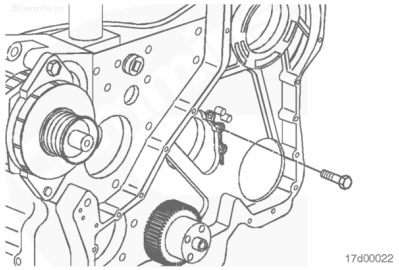
The engine uses a 5 bolt rubber or viscous damper.

Gear Cover, Front



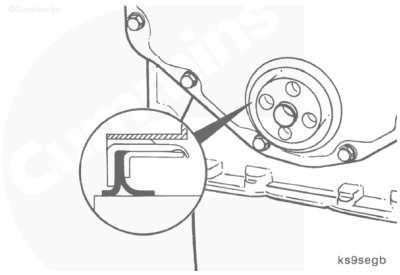
The front gear cover houses the lubricating oil pump, front crankshaft seal, and camshaft speed indicator ring.

Gear Housing, Front



The front gear housing is used to mount the fuel pump and a gear driven accessory drive.

Crankshaft Seal, Front

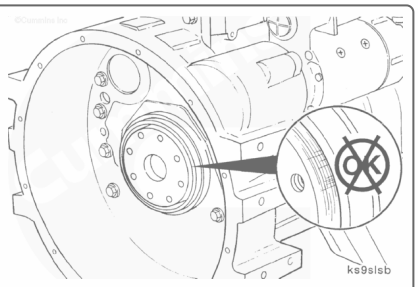


The engine uses a lip style front crankshaft seal (shown) in which the rotating portion of the sealing occurs at the contact surface between the lip of the seal and crankshaft.

Always replace the front crankshaft seal with the same style seal as was previously installed.

ANADOLU ISUZU AFTER SALES

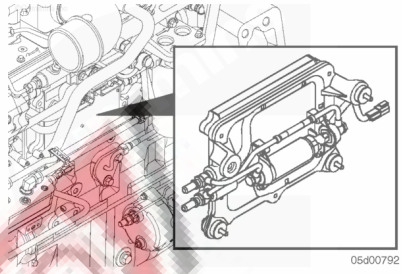
Crankshaft Seal, Rear



The engine uses a lip style rear crankshaft seal in which the rotating portion of sealing occurs at the contact surface between the lip of the seal and crankshaft.

The rear crankshaft seal is installed in the crankshaft seal carrier.

Engine Control Module (ECM) Mounting Plate



A composite mounting plate and rubber vibration isolators are used to mount the ECM to the cylinder block.

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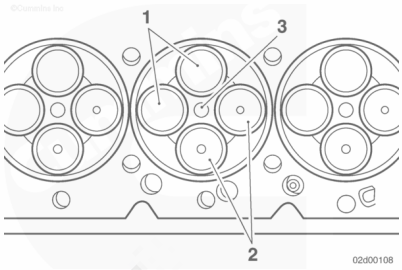
General Information

Cylinder Head Assembly

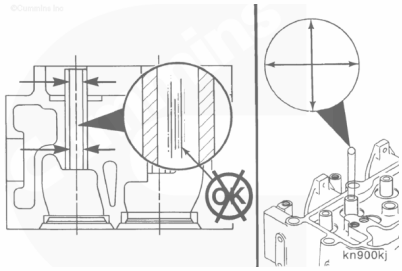


The cylinder head is a one-piece, cross flow design with four valves per cylinder. The cylinder head has an integral intake manifold and thermostat housing. The four valve per cylinder design allows for a centered injector in the cylinder head (3).

The intake and exhaust valves (1 and 2) are made of heat resistant steel, and have chrome plated stems to prevent scuffing. The intake and exhaust valves are both similar in head diameter and overall length, but have unique face angles, which makes them non-interchangeable. The exhaust valves are distinguished by unique dimples on the valve head (2).

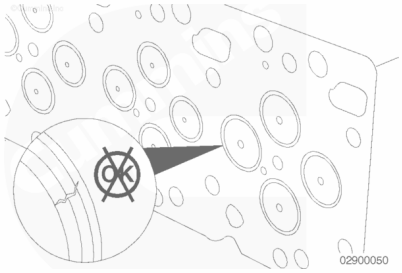
The exhaust valve springs are made from high strength, chrome silicon steel. The exhaust valve spring ratings allow for a exhaust back pressure device for enhanced engine braking.

Valve Guides



The cylinder head has pressed in valve guides that are **not** serviceable. If the valve guide inside diameter is damaged or worn larger than the maximum specified, the cylinder head must be replaced.

Valve Seat Inserts

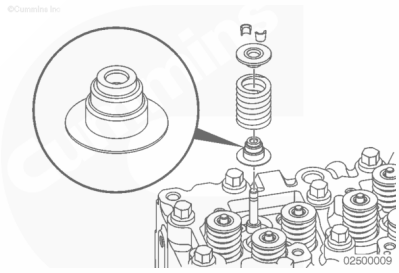


If the valve seat has dropped out and caused damage to the cylinder head combustion face, the cylinder head must be replaced. Use the following procedure for cylinder head inspection criteria. Refer to Procedure 002-004 in Section 2. (/qs3/pubsys2/xml/en/procedures/425/425-002-004.html)

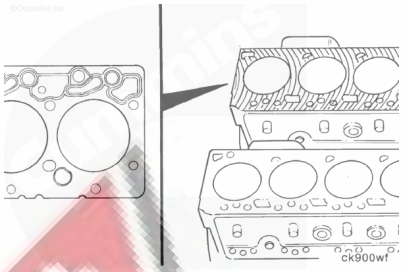
Valve Stem Seals

The valve stem seal utilizes the valve spring to secure the valve stem seal in place.

ANADOLU ISUZU PARTS SALES



Cylinder Head Gasket

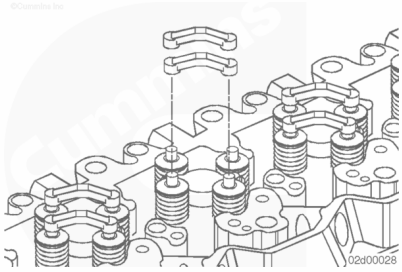


The cylinder head gasket is a graphite design with a printed silicone sealing path on both sides around the water holes. An embossment in the gasket seals the cylinder bores. The gasket also provides orifices to control coolant flow from the cylinder block to the cylinder head.

The head gasket grading is **not** required for the engines covered by this manual.

No specific head gasket with an increased thickness is available for cylinder head or block combustion deck resurfacing. If the combustion deck can **not** be resurfaced such that piston protrusion, valve depth, and injector protrusion specifications be maintained, the cylinder head and/or cylinder block **must** be replaced.

Crossheads



With the four valve per cylinder design, the rocker lever sockets do **not** directly contact the valve stem. With one rocker lever being required to operate two valves, a bridge, or crosshead, is needed to connect both intake and exhaust valves.

The socket on the rocker lever contacts the crosshead, which in turn contacts both corresponding valve stems.

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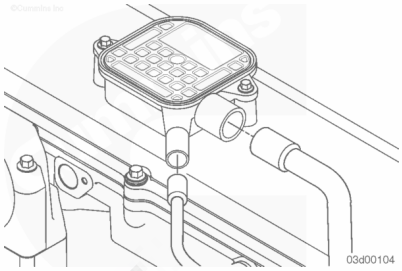
General Information

The crankcase breather system utilizes a baffle system that is mounted on the valve cover. The breather contains two tubes. The larger tube is the crankcase gas draft tube. The smaller tube is for draining oil that is accumulated in the valve cover baffle. The oil is drained back to the oil pan through a port on the lower intake-side of the cylinder block.

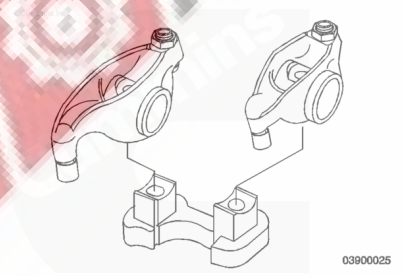


There is no maintenance required for any breather system components.

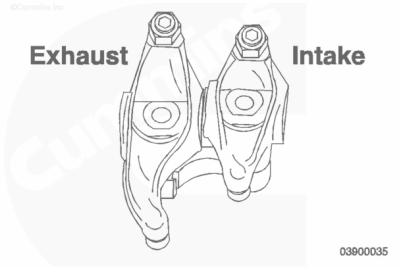
Rocker Levers

The exhaust and intake rocker levers are mounted on a common pedestal, but rotate on separate shafts.

Oil is supplied through a drilling in the cylinder head through the pedestals to supply oil to the rocker shafts, socket, and adjusting screw.

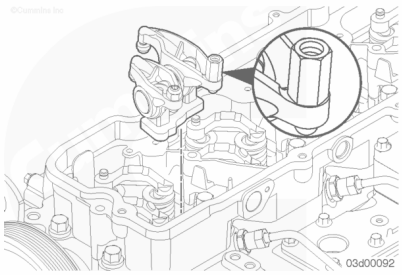


The exhaust and intake rocker levers are **not** interchangeable and **must** be located as shown.



If the engine is equipped with compression brakes, the exhaust rocker levers will have a longer adjusting screw locknut.

Special capscrews are also used to hold down the exhaust rocker levers on engines equipped with compression brakes.



Rocker Lever Cover

Several different kinds of rocker lever covers are available:

A tall rocker lever cover for engines with compression brakes (2).

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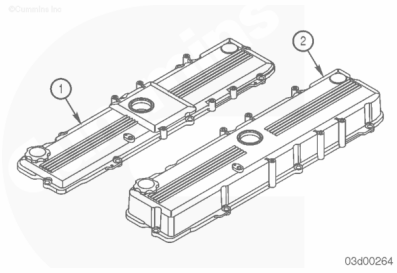
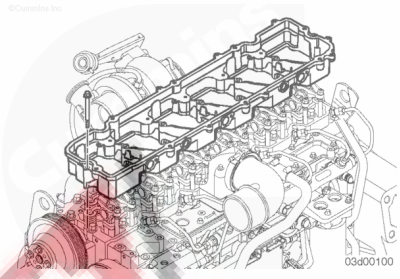
A short rocker lever cover for engines without compression brakes (1).

Additionally, various oil fill options are available (front oil fill, rear oil fill, or no oil fill).



Rocker Lever Housing

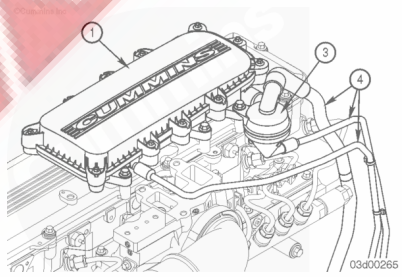
A rocker housing spacer is required on the engines covered by this manual to accommodate a pass-through location for the injector wiring harness. The rocker housing utilizes a press-in-place gasket to form a seal with the cylinder head. The valve cover is mounted to the rocker housing by capscrews, isolators, and a press-in-place gasket.



Crankcase Breather

The crankcase breather is located on top of the rocker lever cover towards the rear of the engine and consists of four main parts:

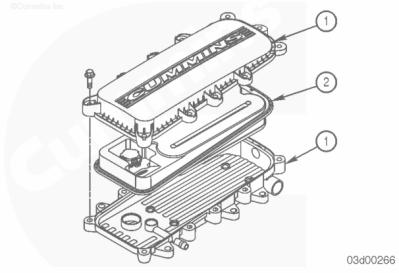
1. Crankcase breather housing
2. Crankcase breather element (**not** shown)
3. Oil separator
4. Oil drain and draft tubes.



The crankcase breather housing (1) is attached to the valve cover and contains the crankcase breather element.

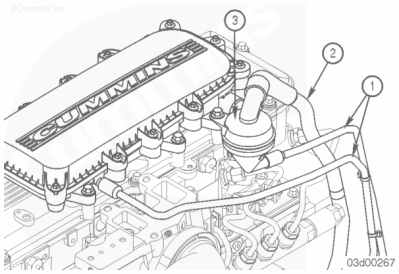
The crankcase breather element (2) filters engine oil from the blowby gas and returns it to the crankcase via an oil drain tube.

The crankcase breather element requires periodic replacement. Reference the appropriate Operation and Maintenance and/or Owner's Manual for the correct maintenance specification.



The drain lines (1) return excess lubricating oil from the crankcase breather housing and oil separator to the lubricating oil pan.

The crankcase breather draft tube (2) attaches to the oil separator and vents the filtered blowby gas to the atmosphere.



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The oil separator (3) is attached to the outlet of the crankcase breather housing and removes any remaining lubricating oil from the blowby gas before the blowby gas is vented to the atmosphere.

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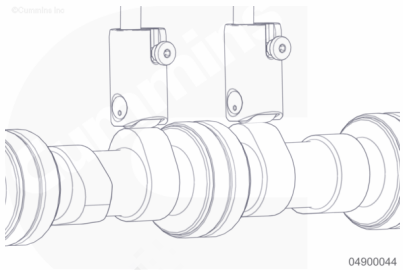
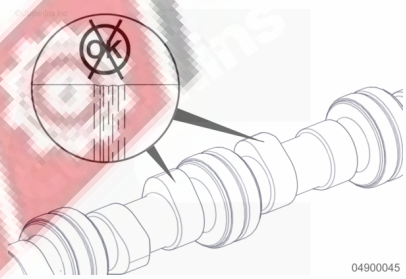
General Information

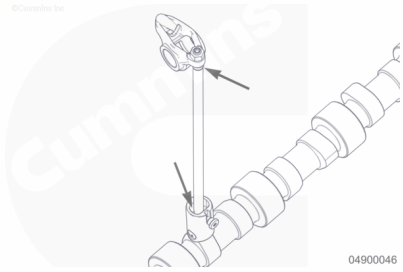
The engine covered by this manual utilizes roller tappet assemblies.



Loose rocker lever lash and the need to reset the valve clearance frequently can indicate camshaft valve lobe or tappet wear. If an inspection of the rocker levers, valve stems, crossheads, and push rods does **not** show wear, the tappet and/or camshaft valve lobe wear **must** be checked.



The push rod is a solid link between the tappet and rocker lever. At the bottom, the ball end of the push rod fits into a ball socket in the tappet. At the top, the push rod is fitted with a socket into which the ball end of the rocker lever adjusting screw is seated.



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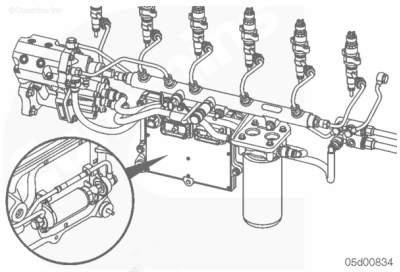
AFTER SALES

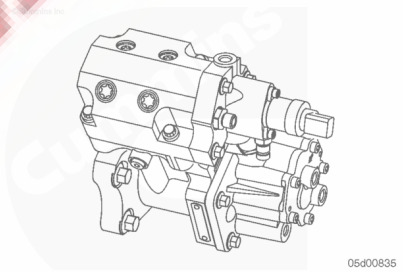
Last Modified: 05-Oct-2016

General Information

The fuel system is a high-pressure common rail injection system. A fuel rail is used to store pressurized fuel for fuel injection. There are four components that provide or receive input to the engine control module (ECM). The ECM powers the electric fuel lift pump (located behind the ECM) for approximately 30 seconds at keyswitch ON to prime the fuel system. The normally open fuel pump actuator receives a pulse width modulated (PWM) signal from the ECM to open or close in response to the signal from the fuel rail pressure sensor. The injectors have individual solenoids. The ECM powers each injector individually to provide fueling to each cylinder.

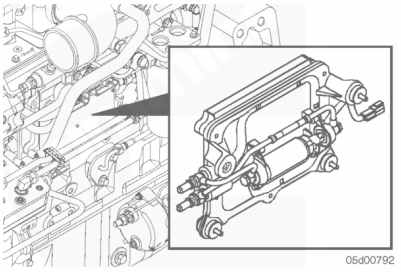


The high-pressure fuel pump can be divided into four distinct assemblies. They are the fuel gear pump, fuel pump actuator housing, cam housing, and high-pressure fuel pump head. Fuel flows through the gear pump to a pressure-side filter. After the pressure-side filter, fuel enters the fuel pump actuator housing. The fuel pump actuator housing includes an air-bleed fitting and fuel pump actuator. Some fuel continuously returns to drain through the air-bleed orifice fitting. Fuel metered through the fuel pump actuator enters the high-pressure fuel pump head where it is pumped to fuel rail pressure and exits at the high-pressure outlet fitting.



A lift pump is used for priming the gear pump at start-up. The lift pump runs for approximately 30 seconds after keyswitch ON. Once the engine is started, the gear pump is able to maintain prime without any assistance from the lift pump.

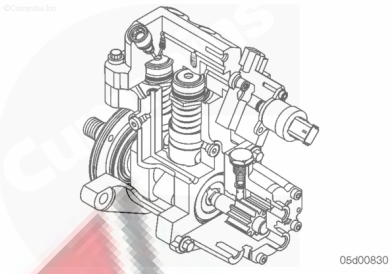
A bypass check valve in the ECM mounting plate makes sure the system is primed by the lift pump. This check valve opens under vacuum created by the gear pump, once the engine is started. High vacuum measured between the electric lift pump and gear pump can indicate this check valve has become plugged. The ECM mounting plate check valve is integral with the lower (outlet) fitting of the ECM mounting plate.



The ECM and ECM mounting plate **must** be removed to access the lift pump and lift pump fuel lines. This is accomplished by disconnecting the engine harnesses and fuel lines first. Removal of the ECM mounting plate capscrews allows the ECM, mounting plate, lift pump, and lift pump plumbing to be removed as one assembly.

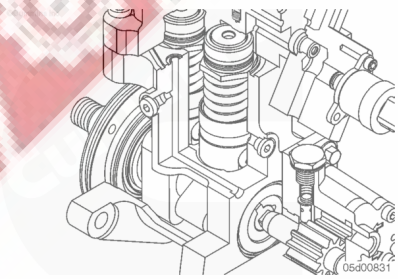
The gear pump output is routed to a fuel filter. The filtered fuel returns to the fuel pump actuator housing.

The high-pressure pump is driven by the engine camshaft. The gear pump is driven by the pump camshaft through an internal coupling.



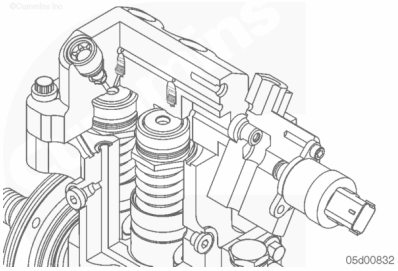
Each of the two pumping plungers is driven by a three lobed camshaft. The camshaft is located in the cam housing module by tapered roller bearings. The bearings that support the camshaft, as well as the tappets, rollers, and camshaft itself are lubricated with engine oil. These are the only components in the pump lubricated with engine oil.

Engine oil to the high-pressure pump is supplied through a drilling in the engine gear housing. The oil passes from the engine gear housing to the high-pressure pump cam housing. A small o-ring in a recess on the back of the engine gear housing seals this passage.

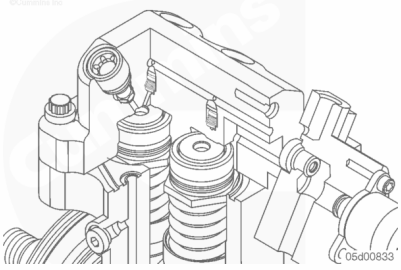


Pressurized fuel from the gear pump is supplied to the fuel pump actuator. The fuel pump actuator is opened or closed by the ECM to maintain the appropriate fuel rail pressure.

An air-bleed orifice fitting in the fuel pump actuator housing aids in purging air from the fuel supply. Because of the air-bleed orifice fitting, some fuel supplied by the gear pump will return to drain at all times.



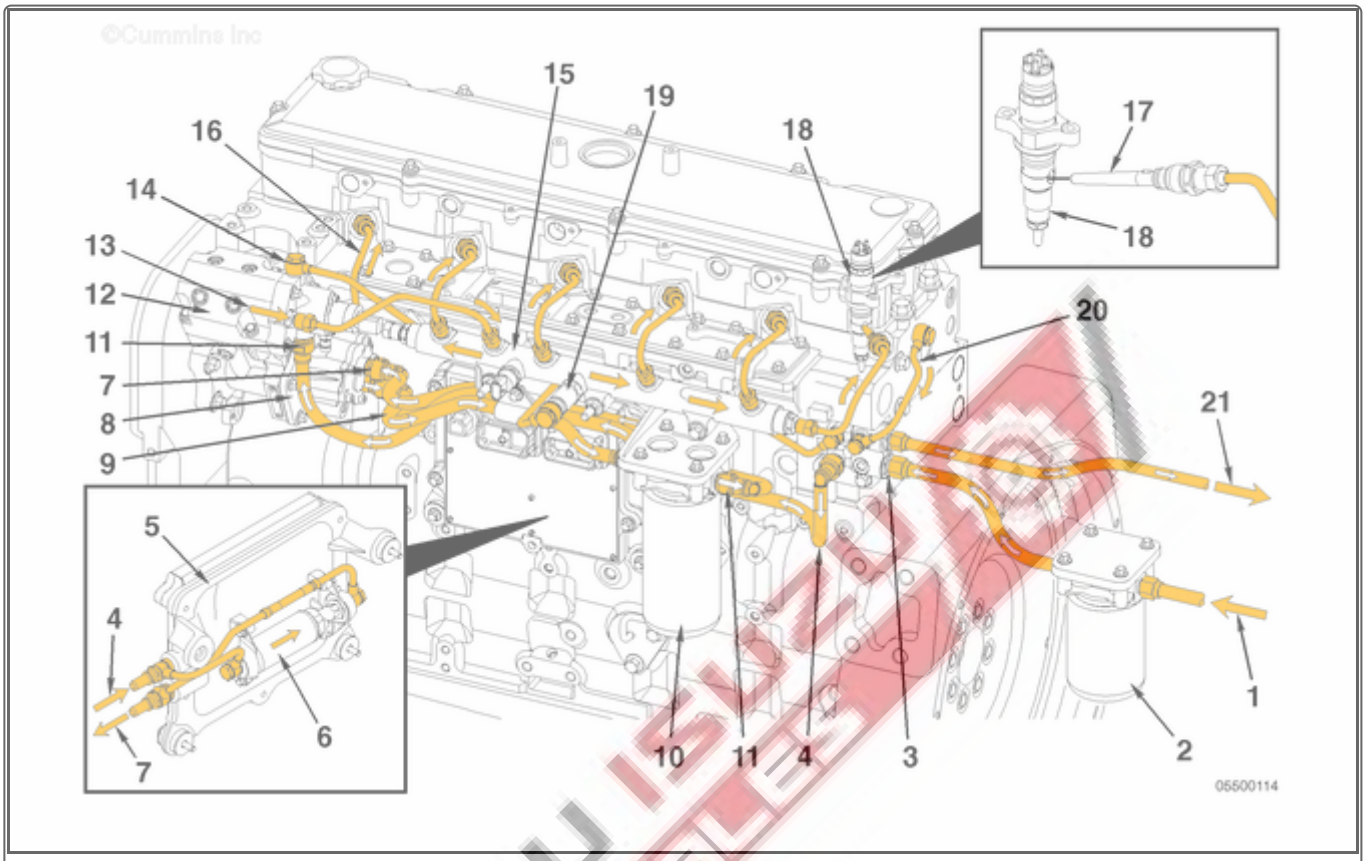
Fuel metered past the fuel pump actuator enters the high-pressure fuel pump inlet drilling, past the inlet check valve, and fills the pumping chamber by pressing the pumping plunger downward. When the camshaft pushes the pumping plunger upward, fuel reaches rail pressure and causes the outlet check valve to lift. Fuel then enters the outlet drilling of the fuel pump and exits the high pressure fuel line to the fuel rail.



Last Modified: 27-Jul-2016



Flow Diagram



1. Fuel from supply tank
2. Fuel filter and water separator
3. Original equipment manufacturer (OEM) fuel supply connection
4. Fuel supply to engine control module (ECM) mounted fuel lift pump
5. ECM mounting plate
6. ECM mounted fuel lift pump
7. Fuel outlet from ECM mounted fuel lift pump
8. Fuel gear pump
9. Fuel from gear pump to fuel filter
10. Pressure side fuel filter
11. Fuel inlet to fuel pump actuator
12. High-pressure fuel pump
13. Fuel outlet from high-pressure pump
14. High-pressure pump drain flow connection
15. Fuel rail
16. High-pressure injector supply lines
17. High-pressure fuel connector
18. Fuel injector
19. Fuel pressure relief valve
20. Fuel injector drain flow line
21. Fuel return to supply tanks.

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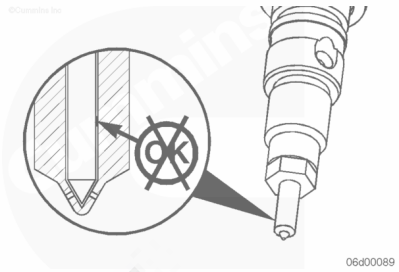
Last Modified: 25-Jul-2016



General Information

⚠ WARNING ⚠

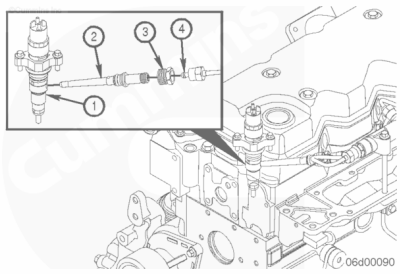
Fuel is flammable. Keep all cigarettes, flames, pilot lights, arcing equipment, and switches out of the work area and areas sharing ventilation to reduce the possibility of severe personal injury or death when working on the fuel system.



High-pressure common rail fuel systems use solenoid-actuated injectors. High-pressure fuel flows into the side of the injector. When the solenoid is activated, an internal needle lifts and fuel is injected. The clearances in the nozzle bore are extremely small and any dirt or contaminants can cause the injector to stick. This is why it is important to clean around all fuel connections before servicing the fuel system. Also, cap or cover any open fuel connections before a fuel system repair is performed.

⚠ CAUTION ⚠

To reduce the possibility of engine damage, always use the proper torque value and proper torque sequence on the high-pressure line nuts.



High-pressure fuel is supplied to the injector from the fuel rail by an injector supply line and a fuel connector. The fuel connector pushes against the injector body when the fuel connector nut is tightened. The injector supply line is then connected to the fuel connector.

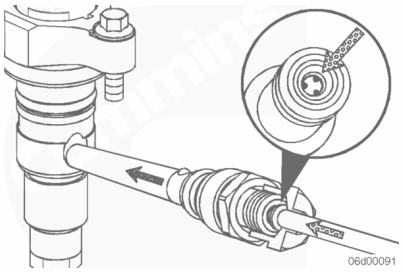
The torque and sequence for this joint is critical. If the nut or line is undertightened, the surfaces may **not** seal and a high-pressure fuel leak will result. If the nut is overtightened, the connector and injector will deform and can cause a high-pressure fuel leak. This leak will be inside the head and will **not** be visible. The result will be a fault code, low power, or no-start.

If the injector is **not** fully seated prior to the installation of the high-pressure connector, the joint will **not** seal.

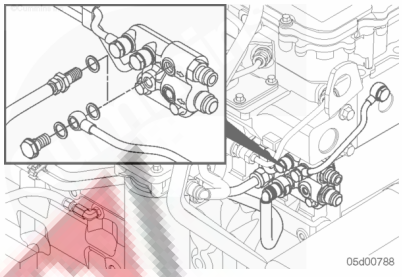
The fuel connector contains an edge filter that breaks up small contaminants that enter the fuel system.

The edge filters are **not** a substitute for cleaning and covering all fuel system connections during repair.

Make sure to cap or cover all fuel fittings and ports.



All injectors feed into a common return drilling contained within the cylinder head. Any excess fuel is returned to the tank via this drilling and return line attached to the rear of the cylinder head. A back-pressure valve is located on the back of the cylinder head where the drain line attaches.



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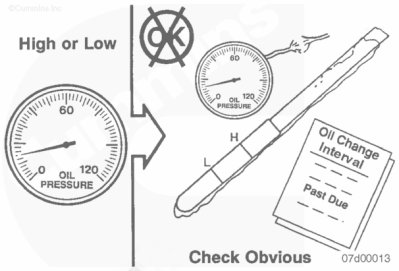
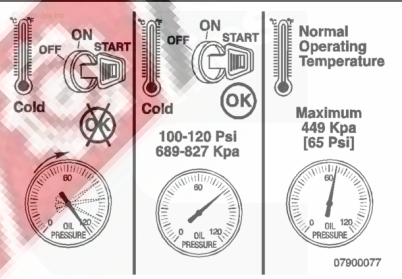
General Information

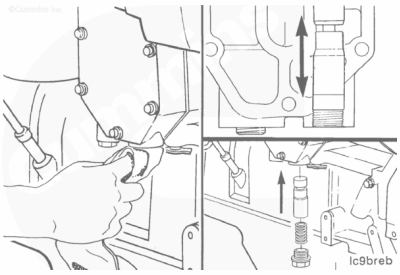
When diagnosing lubrication system malfunctions, check all obvious items related to oil pressure, such as gauges, high and low oil level, excessive oil contamination, and oil viscosity.



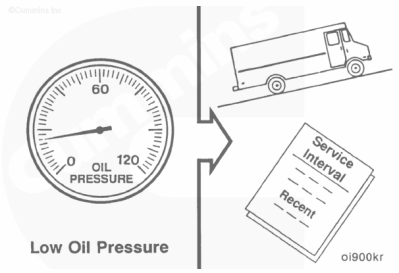
High oil pressure usually occurs after the engine is first started in cold weather. Cold start oil pressure typically will be approximately 827 to 1034 kPa [120 to 150 psi]. If the pressure regulator plunger is operating properly, the oil pressure should drop back to approximately 449 kPa [65 psi] when normal operating temperature is reached.



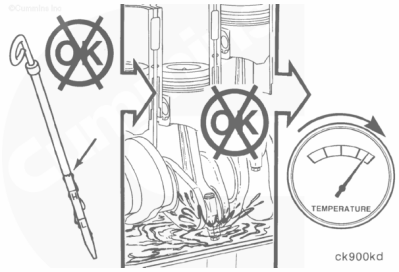
The engine will have high oil pressure at the normal operating temperature if the regulator sticks in the closed position. Check the regulator for freedom of movement. Refer to Procedure 007-029 in Section 7. (/qs3/pubsys2/xml/en/procedures/425/425-007-029.html)



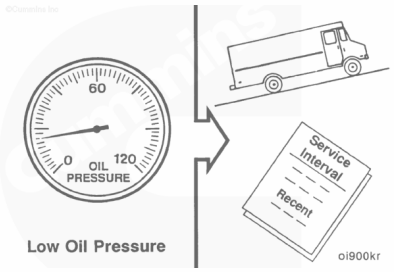
Low lubricating oil pressure (or no oil pressure) can be caused by several lubrication system-related malfunctions. To begin the investigation, determine the engine operating conditions when the low pressure was first observed; for example, following a service interval, at idle **only**, or while operating on a steep grade.



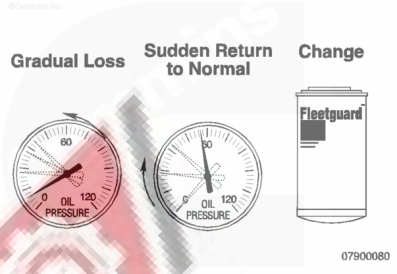
High oil level can cause low oil pressure. If the oil level is high enough for the connecting rods to dip into during operation, the oil can become aerated. This will result in low oil pressure and high engine temperature.



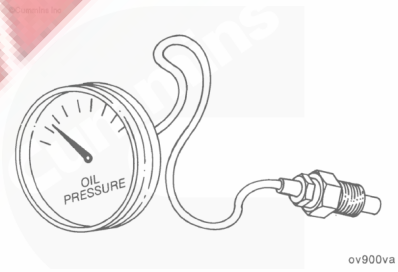
Low lubricating oil level will **not** normally appear as low oil pressure. Typically, it will appear as an intermittent loss of oil pressure when rounding a corner or operating on a steep grade. This condition exists when the oil level is extremely low and the suction tube can **not** pick up oil during all modes of operation.



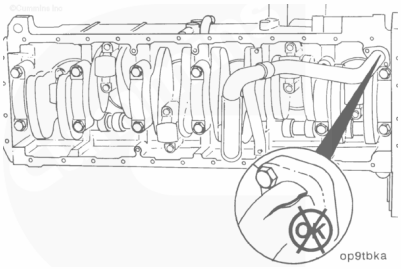
A plugged filter will cause a gradual loss of oil pressure by approximately 69 kPa [10 psi]. The pressure will return to normal when the filter bypass valve opens. If **not** corrected, this will result in severe engine wear, as the engine is running on unfiltered oil when the bypass valve is open.



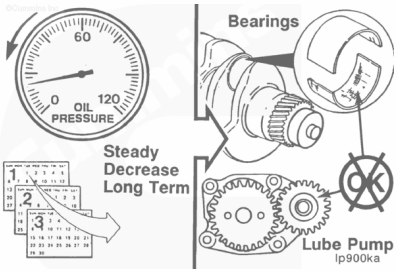
Check the lubricating oil gauge and sending unit to make sure they are operating correctly, by verifying the pressure with a manual gauge.



A loose suction tube, damaged gasket, or crack in the suction tube can cause a temporary loss of prime for the oil pump. The engine will have low pressure or no oil pressure at starting, followed by normal oil pressure.



A steady decrease in oil pressure over a long period can be an indication of worn bearings or excessive oil pump wear.



Check the condition of the lubricating oil.

- Thin, black lubricating oil is an indication of fuel in the lubricating oil.

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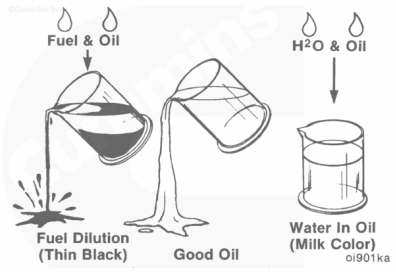
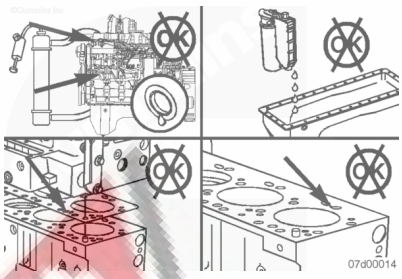
- Milky discoloration is an indication of coolant in the lubricating oil.

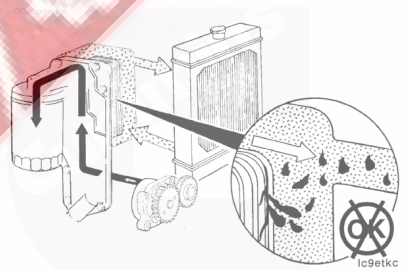


Coolant in the oil can be caused by:

- Expansion plugs leaking
- Lubricating oil cooler element leaking
- Damaged cylinder head or gasket
- Cracked engine block
- Casting porosity.

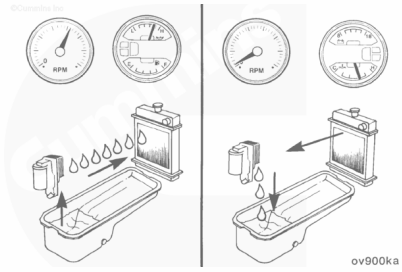


Since the lubricating oil cooler design does **not** require gaskets or seals to maintain the separation of oil and coolant, the element itself **must** leak to allow mixing of the fluids. Refer to Procedure 007-003 in Section 7. (/qs3/pubsys2/xml/en/procedures/425/425-007-003.html)



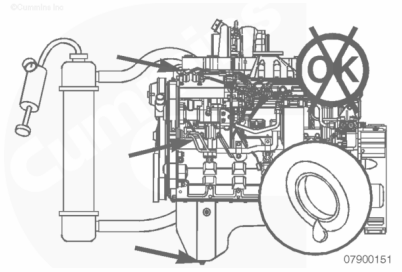
During operation, the lubricating oil pressure will be higher than coolant pressure. A leak in the lubricating oil cooler will appear as lubricating oil in the coolant.

However, following an engine shutdown, the residual pressure in the coolant system can cause coolant to seep through the leak path into the lubricating oil.



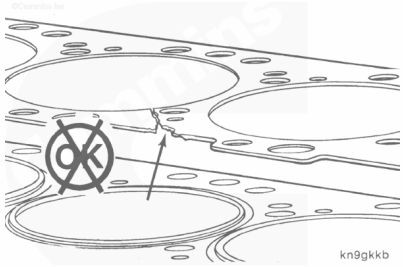
To check for leaks, pressurize the cooling system to 140 kPa [20 psi]. With the system pressurized, remove the following components, and inspect for leaks:

- Valve covers (leaks indicate cracked head)
- Lubricating oil drain plug (leaks indicate malfunctioning lubricating oil cooler, head gasket, cracked head, or block).



Coolant in the lubricating oil can be caused by a damaged cylinder head gasket or cracked cylinder head or block.

Remove the cylinder head and gasket, and inspect for cracks or other damage. Refer to Procedure 002-004 in Section 2. (/qs3/pubsys2/xml/en/procedures/425/425-002-004.html)



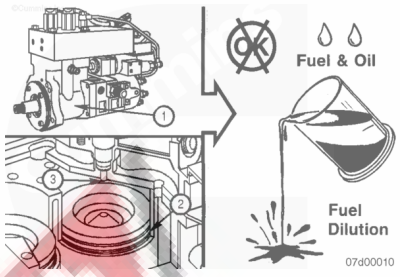
Fuel-Diluted Lubricating Oil

Use the following logic to determine the source of the oil dilution with fuel.

Fuel dilution is limited to three sources:

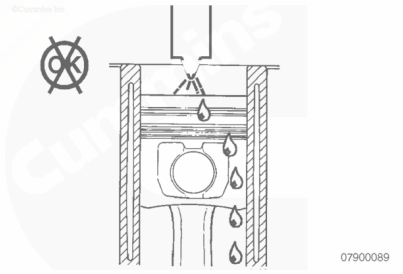
- Injection pump camshaft housing
- Fuel leaking by the rings
- Injector leakage.

A cracked camshaft housing can cause fuel to leak into the gear housing and then into the lubrication oil pan.



Incomplete combustion in the cylinders can result in unburned fuel draining into the oil pan.

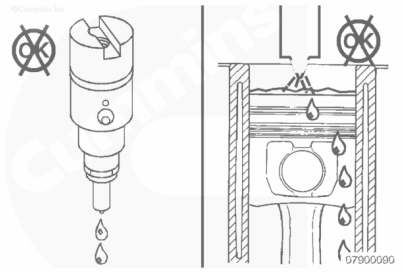
This condition can be caused by a leaking injector or reduced compression caused by inadequate piston ring sealing.



An increase in white exhaust smoke during the first start of the day is a symptom an injector is leaking.

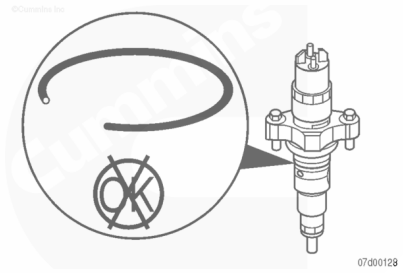
An injector leak will also cause the engine to run rough and have low power.

Use the following procedure for remove, repair, replace leaking injector, test, and repair instructions. Refer to Procedure 006-026 in Section 6. (/qs3/pubsys2/xml/en/procedures/425/425-006-026.html)



The o-rings in the injectors should be inspected for cracks or wear. A missing or damaged o-ring in an injector can result in improper injection of fuel into the cylinder.

Also, a poor seal between the injector and high-pressure transfer tube can also cause the injector o-rings to malfunction or leak into the top of the cylinder head.



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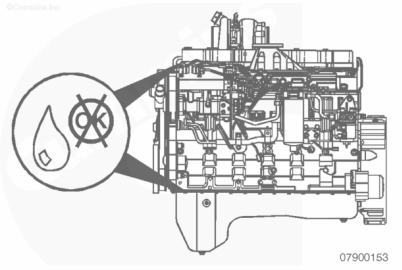
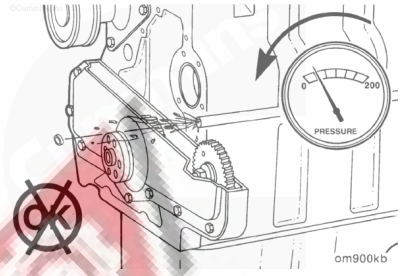
Various gaskets, seals, and plugs are used to contain the lubricating oil. Most leaks can be identified during routine inspection of the engine and vehicle.



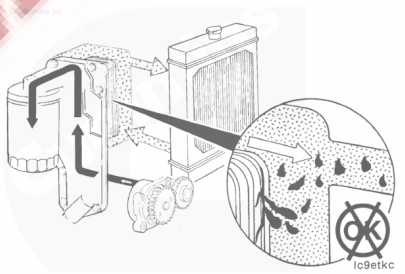
A blown expansion plug can allow a relatively large quantity of lubricating oil to escape, resulting in a sudden drop in the lubricating oil pressure.

When checking for such a leak, make sure to check all expansion plugs obscured by chassis parts.

Lubricating oil blowing out of the breather is a sign of a blown expansion plug.

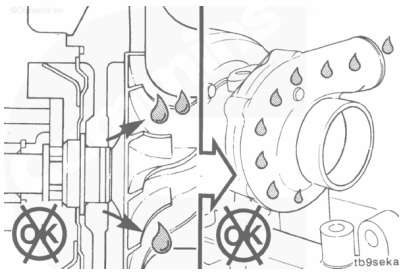


If the lubricating oil cooler element ruptures, the lubricating oil pressure can force lubricating oil into the cooling system. Lubricating oil in the coolant should be visible when the radiator cap is removed. Refer to Procedure 007-003 in Section 7. (/qs3/pubsys2/xml/en/procedures/425/425-007-003.html)

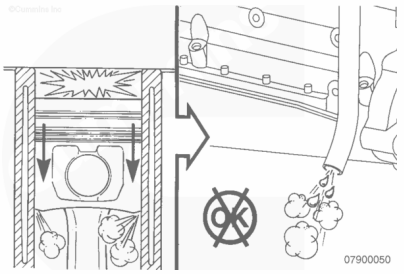


Worn or damaged seals in the turbocharger can also allow lubricating oil to leak into the air crossover pipe and be burned in the engine.

The condition can be verified by removing the air crossover tube or charge air cooler tubing and looking for oil.



Inadequate sealing of the piston rings will result in lubricating oil being blown out the breather tube and/or consumed by the engine. Refer to Procedure 014-002 in Section 14. (/qs3/pubsys2/xml/en/procedures/425/425-014-002.html)



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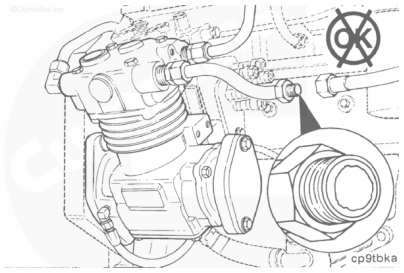
Lubricating oil can also be lost through a worn or malfunctioning air compressor. Check for carbon buildup in the air line from the compressor to the air tank. Also, a malfunctioning air compressor head or head gasket can allow oil to leak into the coolant, or coolant to leak into the oil, during hot shutdown.



The lubricating oil cooler contains two ports for measuring oil pressure or recording oil pressure drop across the lubricating oil filter. The top port is after the lubricating oil filter, filtered oil pressure port (A). The bottom port is before the lubricating oil filter, unfiltered oil pressure port (B).

Lubricating Oil Filters

The LF9009 oil filter is used on all engines. This filter is a spin-on element and contains an internal venturi that provides filter bypass oil flow through a stacked disk section of the filter. Lubricating oil filters **must** be of the venturi style. The use of a lubricating oil filter without a venturi will result in premature engine wear.

Lubricating Oil

⚠ WARNING ⚠

Some state and federal agencies have determined that used engine oil can be carcinogenic and can cause reproductive toxicity. Avoid inhalation of vapors, ingestion, and prolonged contact with used engine oil. If not reused, dispose of in accordance with local environmental regulations.

⚠ WARNING ⚠

To reduce the possibility of personal injury, avoid direct contact of hot oil with your skin.

Note : Use the following procedure for lubricating oil requirements and maintenance intervals in the Operation and Maintenance Manual, L9 CM2350 L119B, Bulletin 5411268. Refer to Procedure 358-001 in Section 2. (/qs3/pubsys2/xml/en/procedures/425/425-358-001-om.html)

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Use the following procedure when searching for bulletin numbers. Refer to Procedure 205-001 in Section L. (/qs3/pubsys2/xml/en/procedures/425/425-205-001.html)

Cummins Inc. recommends the use of a high quality, Society of Automotive Engineers (SAE), heavy-duty engine oil, such as Premium Blue™, which meets the American Petroleum Institute (API) performance classification.

Arctic Operation Engine Oil

⚠ CAUTION ⚠

Limited use of low-viscosity lubricating oils, such as 10W-30, can aid in starting the engine and providing sufficient lubricating oil flow at ambient temperatures below -5°C [23°F] as shown in the illustration. However, the continuous use of low-viscosity lubricating oils can decrease engine life.

When diagnosing lubricating system malfunctions, check all obvious items related to oil pressure, such as gauges, high and low oil level, excessive oil contamination, and oil viscosity. Refer to Procedure 007-048 in Section 7. (/qs3/pubsys2/xml/en/procedures/425/425-007-048.html)

Lubricating Oil Pump

A gerotor type lubricating oil pump is used. It is similar in design to other same series engines. The lubricating oil pump is located at the front of the engine and is driven by the front crankshaft gear. Due to the lubricating oil pump similarity in design to other same series engine lubricating oil pumps, always verify the correct replacement lubricating pump is used before installing a new lubricating oil pump. See the appropriate part information resources when replacing the lubricating oil pump to make sure the correct lubricating oil pump is installed.

Lubricating Oil Cooler

A full-flow, plate-type lubricating oil cooler is used. It is similar in design to other same series engines. The lubricating oil cooler is located in a cylinder block cavity on the exhaust side of the engine, mounted between the

lubricating oil cooler cover and the cylinder block. Lubricating oil flows through the plates of the oil cooler, where it is cooled by engine coolant flowing past the plates.

Due to the similarity in design to other same series engine lubricating oil coolers, always verify the correct replacement lubricating oil cooler is used before installing the new replacement. The main difference between the various lubricating oil coolers is the number of plates. Depending on engine configuration, the engine can require more (B) or less (A) plates to adequately cool engine lubricating oil.

The use of incorrect components can cause high or low oil temperature, varnish, and sludge buildup in the lubricating oil system.

⚠ CAUTION ⚠

Be careful at debris is not poured into the filter. If using an oil supply with a metallic or plastic seal under the cap, be careful to peel the seal back. Puncturing the seal with a knife or sharp object can put debris in the oil container. Engine damage can occur.

Lubricating Oil Filter

A full-flow oil filter is used for engine oil filtration. The oil filter is located on the exhaust side of the engine, toward the front. Some applications utilize a remote lubricating oil filter option, mounting the lubricating oil filter on the vehicle instead of the engine.

Cummins Inc. recommends the oil filter be pre-filled when changed to prevent lubrication oil pressure delay at start-up.

Lubricating Oil Pressure Regulator

The lubricating oil pressure regulator is used to prevent high lubricating oil pressure. The oil pressure regulator is located in the lubricating oil cooler cover on the exhaust side of the engine. The lubricating oil pressure regulator consists of a cap, spring, and plunger.

The oil pressure regulator is similar in design to other same series engines. Always verify the correct replacement lubricating oil pressure regulator components are used before installation.

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Lubricating Oil Thermostat

The lubricating oil thermostat mounted in the lubricating oil cooler regulates the temperature of the lubricating oil to 116°C [240°F] by bypassing the lubricating oil cooler at lower lubricating oil temperatures.

Lubricating Oil Pan

A front sump (1), rear sump (2), or center sump (3) lubricating oil pan option can be used, depending on the application. The mounting of the lubricating oil suction tube will vary with the type of lubricating oil pan used.

Engine Oil Heater

Some engine oil pans allow for an optional lubricating oil heater to be installed, to aid engines operating in cold climates.

Standard Oil Pan

Note : Applying RTV sealant to the gasket will help to hold the gasket in place during assembly.

A standard oil pan uses a non-reusable gasket between the lubricating oil pan and cylinder block.

Lubricating Oil Suction Tube

The lubricating oil suction tube is a formed steel tube with a cast iron mount at the cylinder block. The submersed portion of the tube in lubricating oil is perforated to prevent any large debris particles from entering the lubricating oil system.

The mounting of the lubricating oil suction tube will vary with the type of lubricating oil pan used.

Lubricating Oil Dipstick

Note : Some engine/applications also have an optional oil level sensor to notify the operator when the lubricating oil level is low.

The lubricating oil dipstick location for checking engine oil level varies by engine application.

If the dipstick is a locking type, twist the handle **counterclockwise** to unlock and **clockwise** to lock.

Lubricating Oil Pressure Sensor

To monitor oil pressure, an oil pressure sensor is used. If the oil pressure drops below a preset value, a fault will be recorded in the engine control module (ECM) and a dash light will illuminate to notify the operator there is a problem with the engine.

The oil pressure sensor is located along the main oil rifle.

Piston Cooling Nozzles

The engines covered by this manual use J-jet piston coolant nozzles located in between the main bearing saddles on the exhaust side of the engine. Lubricating oil is supplied from an oil gallery in the cylinder block on the exhaust side of the engine.

Lubricating Oil Flow Description

Lubricating Oil Pump

The engine uses a gerotor-type lubricating oil pump (1). Lubricating oil flow through the engine enters the suction tube and travels into the gerotor-type lubrication pump. The oil is then pressurized and fed into the oil cooler cover to the pressure regulating valve.

Pressure Regulating Valve

The pressure regulating valve is designed to keep the lubricating oil pressure from exceeding 449 kPa [65 psi]. When the lubricating oil pressure from the pump is greater than 449 kPa [65 psi], the valve opens, uncovering the dump port so part of the lubricating oil is routed back to the oil pan. Because of manufacturing tolerances of the components and oil passages, the lubricating oil pressure can differ as much as 69 kPa [10 psi] between engines.

Lubricating Oil Thermostat

The lubricating oil thermostat regulates the lubricating oil temperature at the oil filter inlet to 116°C [240°F] by allowing the oil to bypass the lubricating oil cooler as long as the lubricating oil temperature at the oil filter inlet is below 116°C [240°F].

Bypass Valve

Lubricating oil continues through the lubricating oil cooler to the lubricating oil bypass valve. The lubricating oil filter bypass valve will open if pressure across the lubricating oil filter exceeds 345 kPa [50 psi].

Oil Filter

Lubricating oil from the oil cooler flows through the full-flow lubricating oil filter. Oil exiting the full-flow oil filter is directed to the main oil gallery(s) of the cylinder block.

Lubrication for the Turbocharger

The turbocharger is the first component to receive filtered, cooled, and pressurized lubricating oil through a supply tube from the lubricating oil filter head. A drain tube connected to the bottom of the turbocharger housing returns the lubricating oil to the lubricating oil pan through a port in the cylinder block.

Lubrication for the Power Components

J-Jet Piston-Cooling Nozzle Oil Rifle

Lubricating oil leaving the full-flow oil filter supplies oil to the J-jet piston-cooling nozzle oil rifle, which supplies oil to the J-jet piston-cooling nozzles. Spray from the nozzles is directed at the underside of the pistons to an internal passage in the piston for cooling.

Main Oil Rifle

Lubricating oil from the oil filter also supplies oil to the main oil rifle through a drilling between cylinders 2 and 3. The main bearings, overhead components, and accessory drive are lubricated by pressurized oil directly from the main oil rifle. The other power components, connecting rods, pistons, and camshaft receive pressurized oil directly from the main oil rifle.

The drillings in the crankshaft supply oil to the connecting rod bearings. The oil is supplied to the camshaft journals through drillings in the main bearing saddle.

Lubrication for the overhead components is supplied through separate drillings in the block. The oil flows through the drillings and across the slot in the cylinder head gasket.

Lubrication for the Overhead Components

From the cylinder block, the drilling continues in the cylinder head to a drilling in the rocker lever pedestal. Internal drillings in the pedestal supply lubricating oil to the rocker shaft, push rod socket, and crosshead pad. Residual oil from the overhead lubricates the camshaft and tappets.

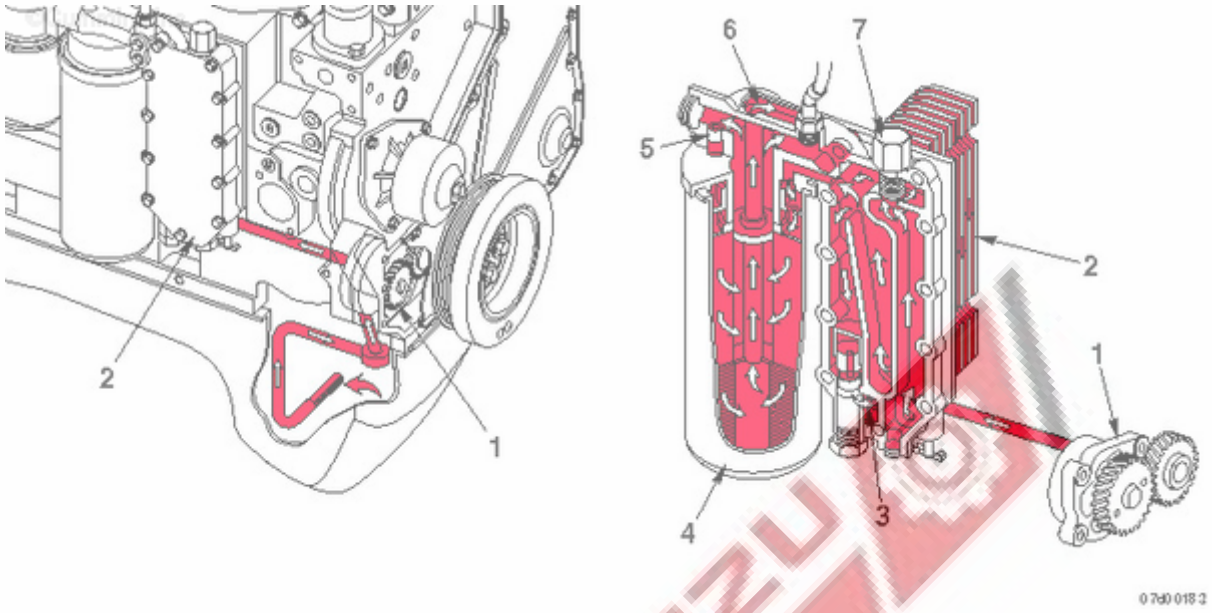
Lubrication for the Accessory Drive

From the main oil rifle, oil is supplied to a drilling in the rear gear housing that feeds the accessory drive. Return oil from the accessory drive is returned to the oil pan through the rear gear housing.

Last Modified: 14-Sep-2016



Flow Diagram



Lubricating Oil Cooler Flow

1. Gerotor lubricating oil pump
2. Lubricating oil cooler
3. Bypass oil to lubricating oil pan
4. Full flow lubricating oil filter
5. Filter bypass valve
6. From lubricating oil filter to main oil rifle
7. Oil thermostat.

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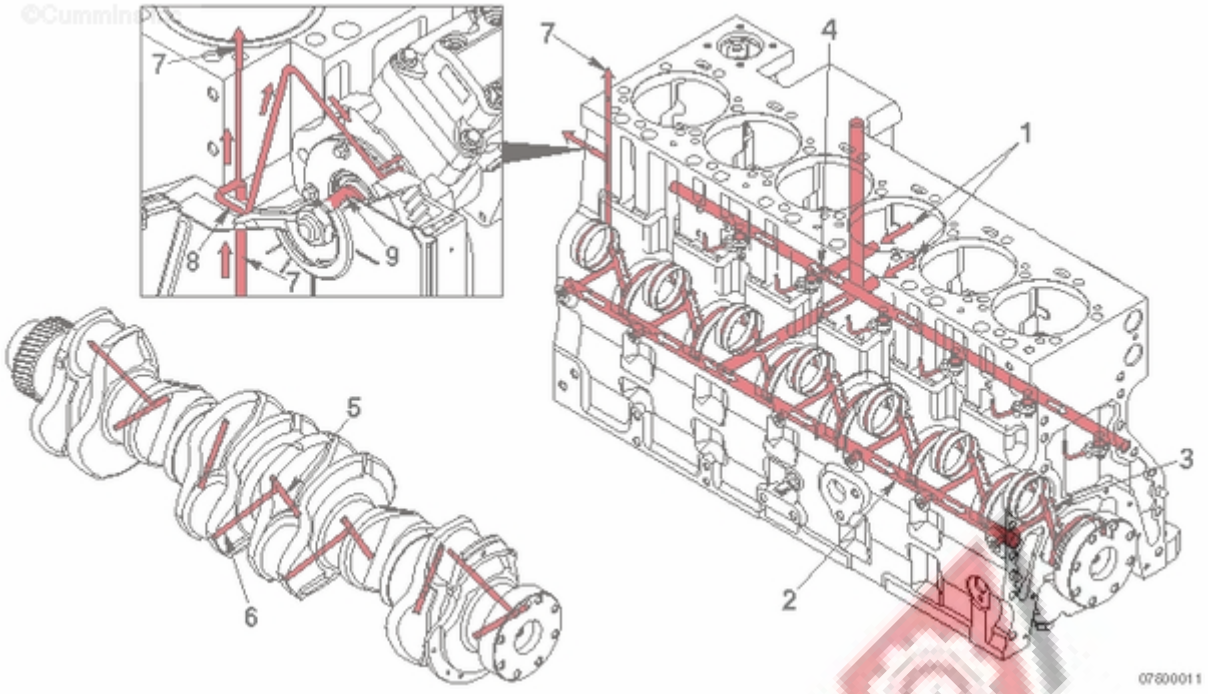
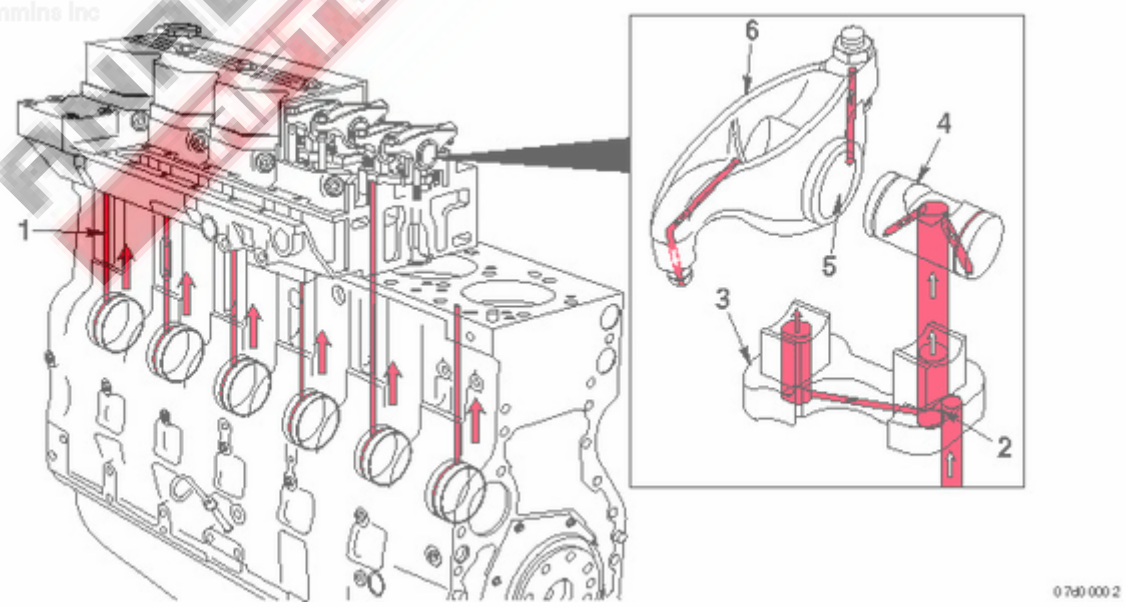


Lubrication for Power Components

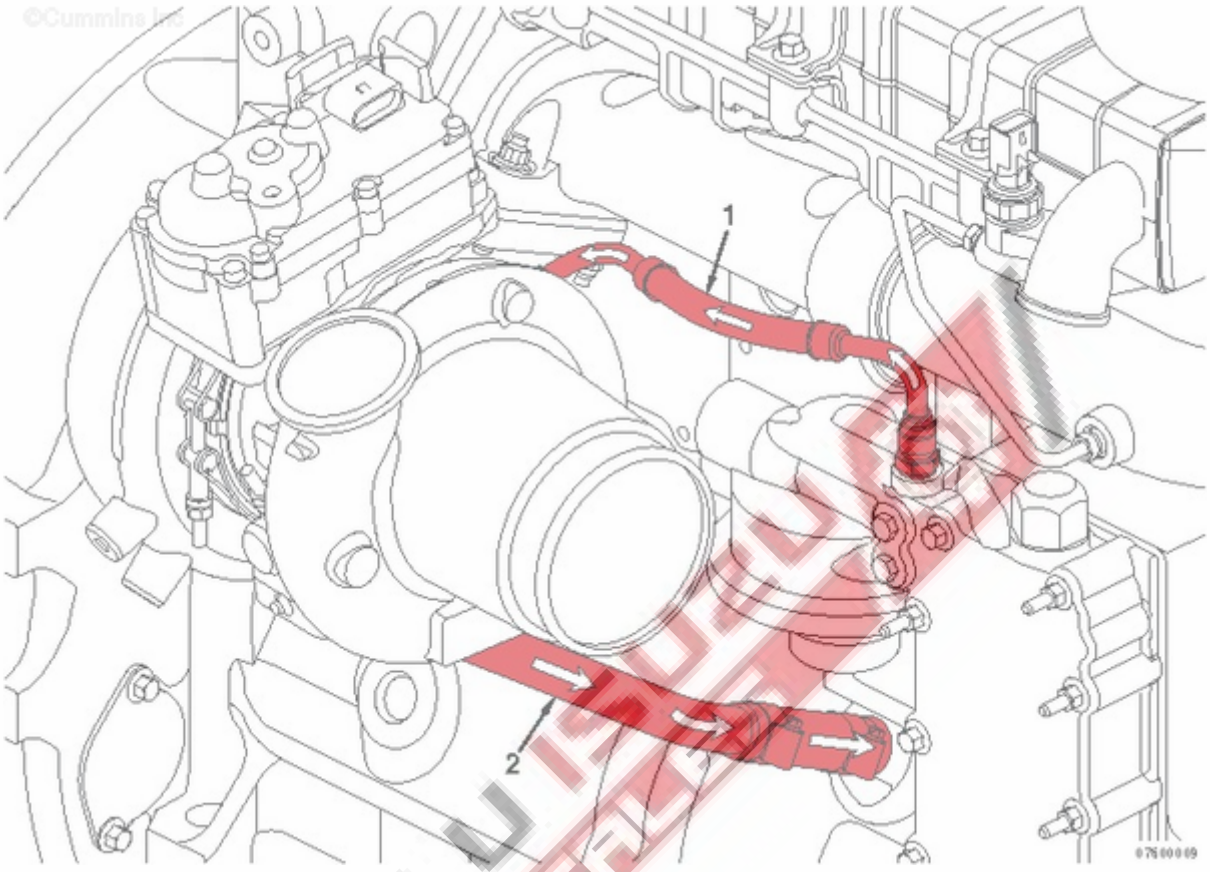
1. Oil flow from lubricating oil filter
2. Main lubricating oil rifle
3. Oil flow to camshaft
4. Oil flow to piston cooling nozzle
5. Oil flow from main lubricating oil rifle
6. Oil flow to connector rod bearing.
7. Oil flow to cylinder head from camshaft bushing
8. Oil flow through front gear housing to fuel pump
9. Oil return from fuel pump to gear housing cavity.



Lubrication for the Overhead

1. From camshaft bushings
2. Transfer slot

3. Rocker lever support
4. Rocker lever shaft
5. Rocker lever bore
6. Rocker lever.



Turbocharger Oil Flow

1. Turbocharger oil supply from oil filter head
2. Turbocharger oil drain to cylinder block.

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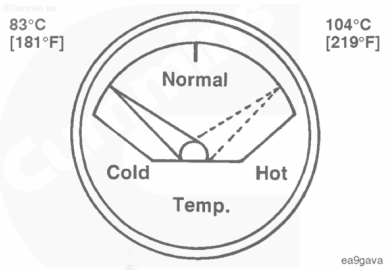
Last Modified: 25-Jul-2016

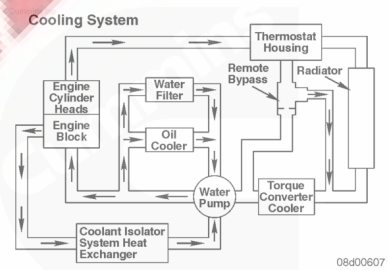
General Information

The function of the cooling system is to maintain a specified operating temperature for the engine. Some of the heat generated by the engine is absorbed by the engine coolant flowing through the passages in the cylinder block and cylinder head. Heat is removed from the coolant as it flows through the radiator.



On engines equipped with exhaust gas recirculation (EGR) and a variable geometry turbocharger (VGT), there are additional components that depend on the cooling system for heat dissipation. Refer to Procedure 010-999 in Section F. (/qs3/pubsys2/xml/en/procedures/425/425-010-999.html)

Conventionally cooled engines with automatic transmissions typically use oil-to-water transmission torque converter coolers plumbed between the radiator and the engine water pump.

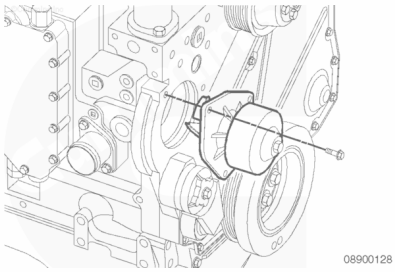


A torque converter cooling system with a remote bypass allows the torque converter to receive coolant flow when the thermostat is closed (engine cold).

Transit bus applications use a water-to-water heat exchanger to isolate the engine cooling system from the bus heat system.

Water Pump

The water pump is a belt-driven, centrifugal-type pump with the inlet and bypass as integral parts of the cylinder block. The water pump is located at the front of the engine and can **only** be replaced as an assembly.



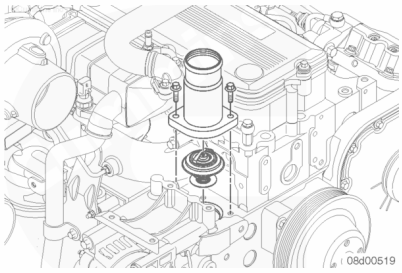
Due to water pump design similarities, especially in same-series engines, **always** verify the correct replacement water pump is used before installing a new water pump.

The main difference in the various available water pumps is the drive pulley size. The use of the incorrect water pump can cause decreased coolant flow and damage due to overheating conditions.

Thermostat

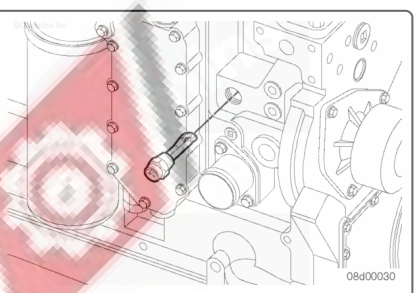
The thermostat controls the engine coolant temperature. The thermostat is located at the front of the engine in the cylinder head. The opening and closing of the thermostat is controlled by a wax motor.

When the coolant temperature is below the operating range of the thermostat, engine coolant is bypassed back to the inlet of the water pump. When the engine coolant temperature reaches the operating range, the thermostat opens, sealing off the bypass, forcing engine coolant to flow to the radiator.



Coolant Heater

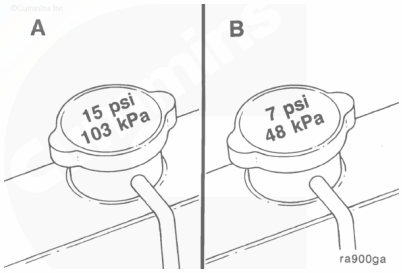
An optional coolant heater is available for engines operating in cold climates. A dedicated port in the cylinder block located adjacent to the lubricating oil cooler is available for the coolant heater.



Radiator Pressure Cap

The cooling system is designed to use a pressure cap to prevent boiling of the coolant. See the original equipment manufacturer's (OEM's) cooling system specifications for the correct radiator pressure cap for the application being serviced.

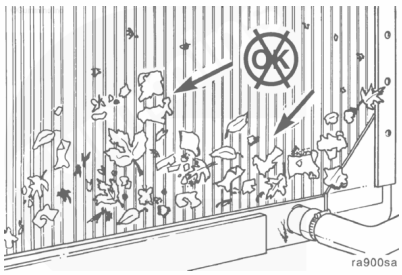
An incorrect or malfunctioning cap can result in the loss of coolant and an engine overheat condition.



Radiator

Air forced through the fins of the radiator by a fan cools the coolant flowing through the radiator. Environmental debris (such as paper, straw, lint, and dust) can obstruct the fins and reduce the flow of air, which will reduce the cooling effect of the radiator.

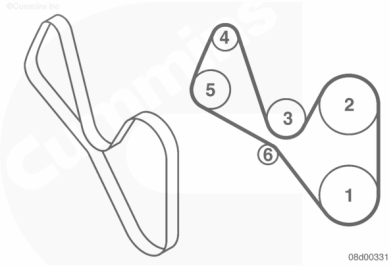
For maintenance, removal and/or installation of the radiator, see equipment manufacturer service information.



Drive Belt (Cooling Fan, Water Pump, Alternator)

The drive belt is an 8 rib design commonly referred to as a “serpentine” belt and is used to drive the various front engine mounted accessories. A number of different drive belt arrangements are available to cover various applications. To

make sure the drive belt is routed correctly upon installation, make a diagram of the cooling fan belt routing prior to removing the belt, as shown in the illustration. The cooling fan belt routing typically consists of the following components, but could possibly **not** include all of them:

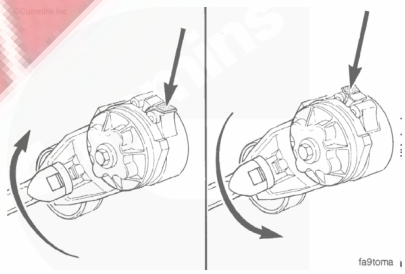


1. Crankshaft pulley/vibration damper
2. Fan pulley
3. Water pump pulley
4. Alternator pulley
5. Refrigerant compressor pulley
6. Belt tensioner pulley
7. Idler pulley(s) (not shown).

Note : Some engine driven belts are installed/supplied by the vehicle's OEM. See equipment manufacturer service information for removal and installation procedures.

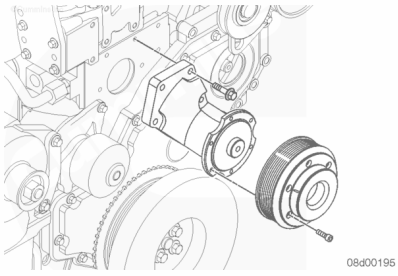
Fan Belt Tensioner

An automatic belt tensioner is used to maintain proper drive belt tension. The tensioner maintains proper drive tension through an internal spring. The belt tensioner mounting location varies depending on the front accessory drive configuration. The belt tensioner winds in the direction that the spring tang is bent over the tensioner body. To loosen the tension on the belt, rotate the tensioner to wind the spring tighter.



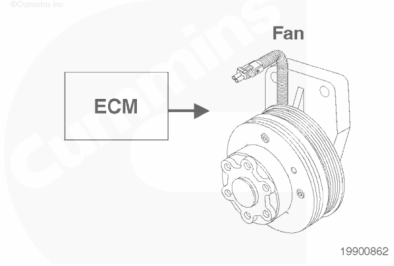
Fan Hub

The fan hub is mounted at the front of the engine to support the cooling fan and drive belt configuration. The fan hub is typically a cast iron mount that houses a pulley/bearing assembly. The type and location of the fan hub is dependent on the front accessory drive configuration.



Cooling Fan Clutch

Some applications utilize a cooling fan clutch to control cooling fan operation. All fan clutches can be controlled by the engine electronic control module (ECM). The ECM monitors coolant temperature and intake manifold temperature to determine when to engage the cooling fan. Some applications have additional sensors monitored by the

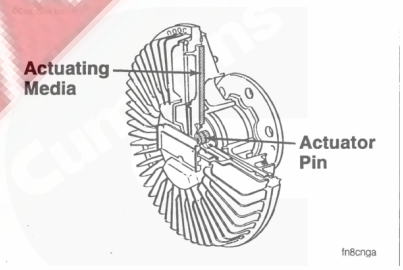


ECM for fan control (for example, air conditioner pressure and transmission temperature). There are various fan clutch types, such as:

- Air engaged
- Air disengaged
- Electric
- Viscous
- ON-OFF.

See the manufacturer's service manual to determine fan clutch type. The ECM is capable of using either a zero (“0”) VDC or +12/24 VDC signal to engage the fan clutch. The exact enable logic can be selected in the Features and Parameters section of INSITE™ electronic service tool. See equipment manufacturer service information for fan clutch troubleshooting and repair information.

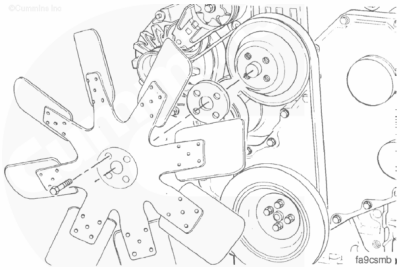
Some applications use viscous fan drives that are activated by built-in sensor that monitors air temperature.When the air temperature reaches a specific level, depending on the temperature setting of the sensor used, the temperature-sensing control moves an actuator that allows viscous fluid to engage the fan drive and increase the fan speed.



Cooling Fan

The cooling fan is typically mounted at the front of the engine and is driven by the drive belt. Some cooling fans, depending on the application, can be mounted off the engine, as in the case for side mount radiators.

The cooling fan is supplied by the OEM. See equipment manufacturer service information for fan troubleshooting and repair information.



⚠ CAUTION ⚠

Never operate the engine without a thermostat. Without a thermostat, the coolant will not flow to the radiator and the engine will overheat.

Cooling System Flow

Cylinder Block and Water Pump

Through the water/coolant inlet connection, engine coolant is drawn into an integral water pump cavity machined into the block. The cylinder block mounted water pump is belt driven and pressurizes the coolant before flowing into the cylinder block water jacket. The coolant first flows around the lubricating oil cooler plates and enters the lower water manifold before passing through the water jacket cavity around the cylinder liners. Coolant flows around the cylinders and between the inner cylinder bores. From the cylinder block water jacket, the coolant flow continues through holes around and between each cylinder in the cylinder block combustion deck to the cylinder head.

Cylinder Head and Gasket

From the cylinder block, the coolant flows into the cylinder head through orifices in the cylinder head gasket. The orifices in the cylinder head gasket control the coolant flow from the cylinder block to the cylinder head. Coolant flow continues around the valve guide and injector areas before continuing to the exhaust side of the cylinder head, then into the upper water manifold and back to the integral thermostat housing.

Thermostat Bypass

Before the engine reaches thermostat opening temperature, a bypass port is open to allow engine coolant to flow back to the inlet of the water pump. Until the thermostat opens, engine coolant is continuously recirculated through the engine **only**. Once the engine reaches the thermostat opening temperature, the thermostat opens, allowing the coolant to flow to the radiator. This action also closes the bypass passage to the water pump.

Variable Geometry Turbocharger

From a port in the cylinder block adjacent to the lubricating oil cooler, coolant is supplied from the cylinder block to the bearing housing of the variable geometry turbocharger through an external coolant hose. Coolant flow internally circulates through the variable geometry turbocharger bearing housing and actuator. Coolant flow exiting the variable geometry turbocharger is directed to the cylinder block through an external coolant hose.

EGR Cooler

From a port in the cylinder block, coolant is supplied to the EGR cooler through an external coolant tube. Coolant flows through the EGR cooler parallel to the EGR gas flow toward the front of the engine. Coolant flow exiting the EGR cooler is directed to the water/coolant inlet connection through an external coolant tube.

The EGR cooler and turbocharger are equipped with a de-aeration port that is connected to the OEM coolant top tank. This port constantly flows coolant to the top tank to make sure air is **not** trapped in the cooling system and plumbing during coolant fill and operation.

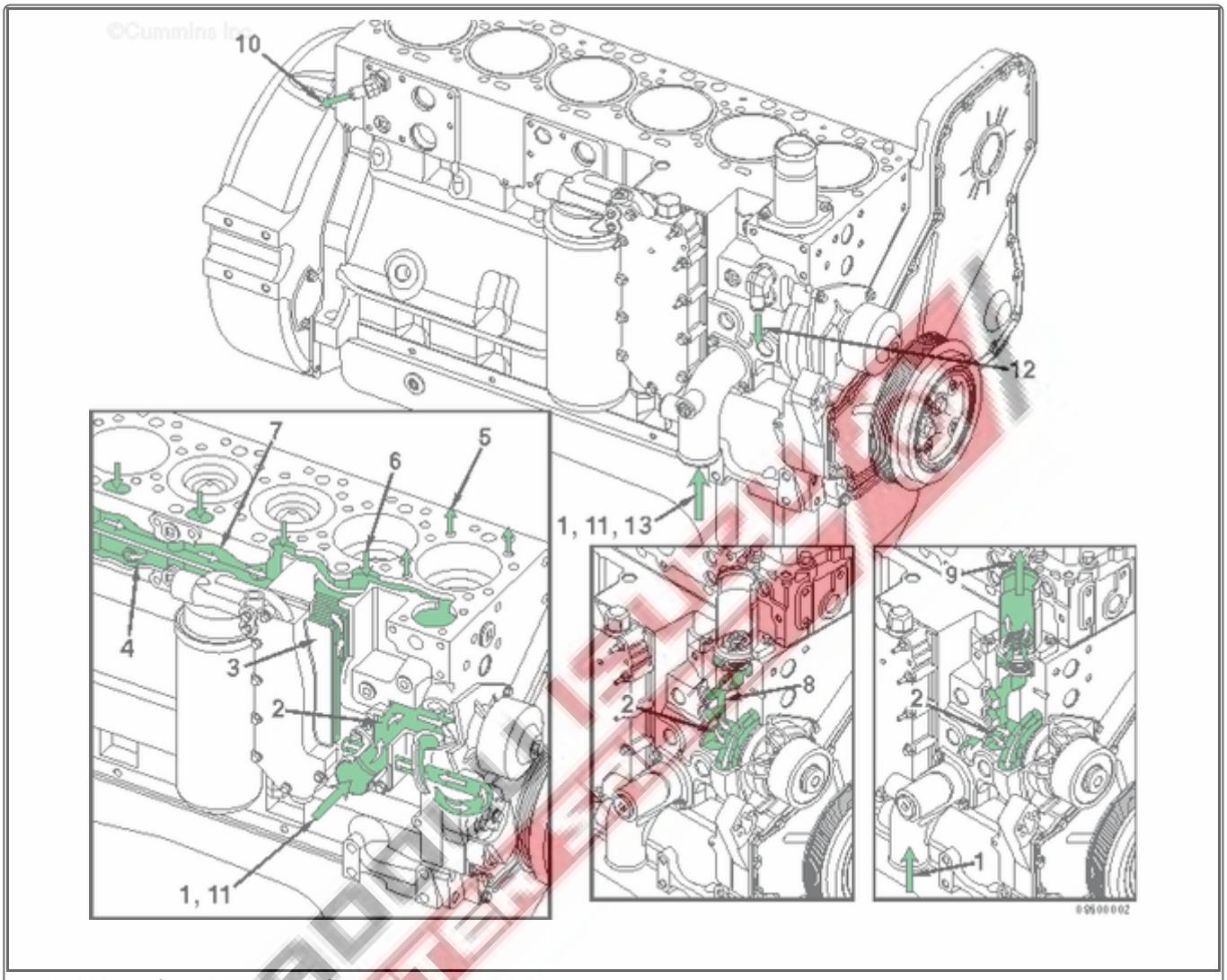
Selective Catalytic Reduction System

The aftertreatment diesel exhaust fluid dosing valve and tank are cooled and heated respectively by the engine coolant. Use the following procedure for further information on the aftertreatment dosing valve or see equipment manufacturer service information. Refer to Procedure 011-058 in Section 11. (/qs3/pubsys2/xml/en/procedures/425/425-011-058.html)

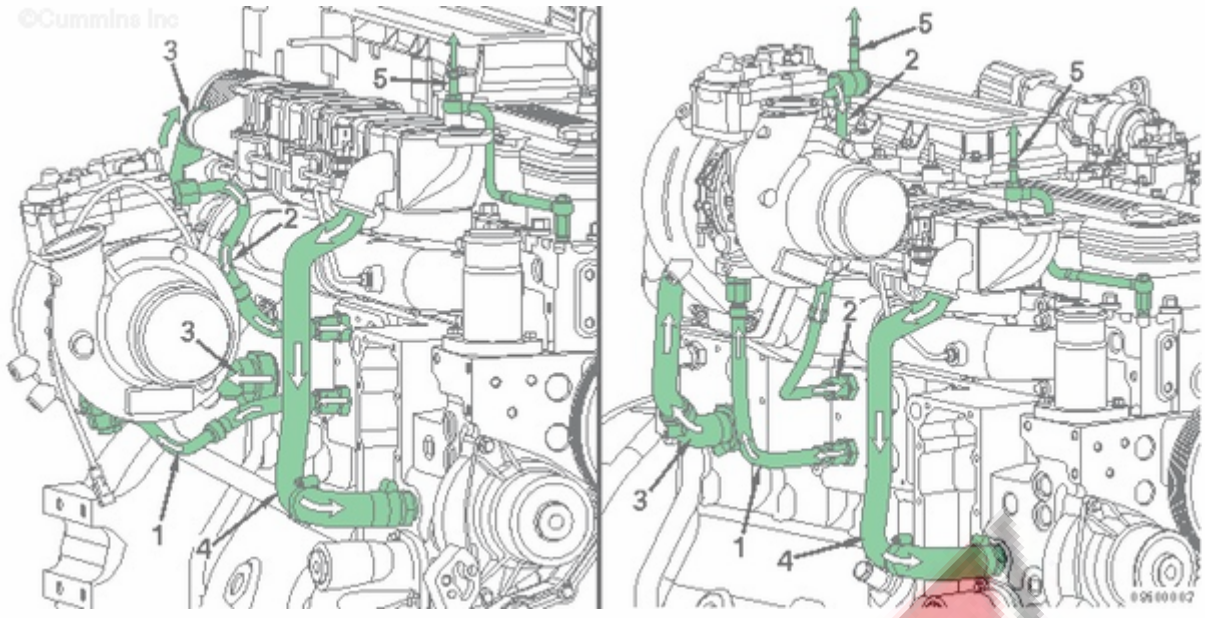
Last Modified: 04-Nov-2016



Flow Diagram



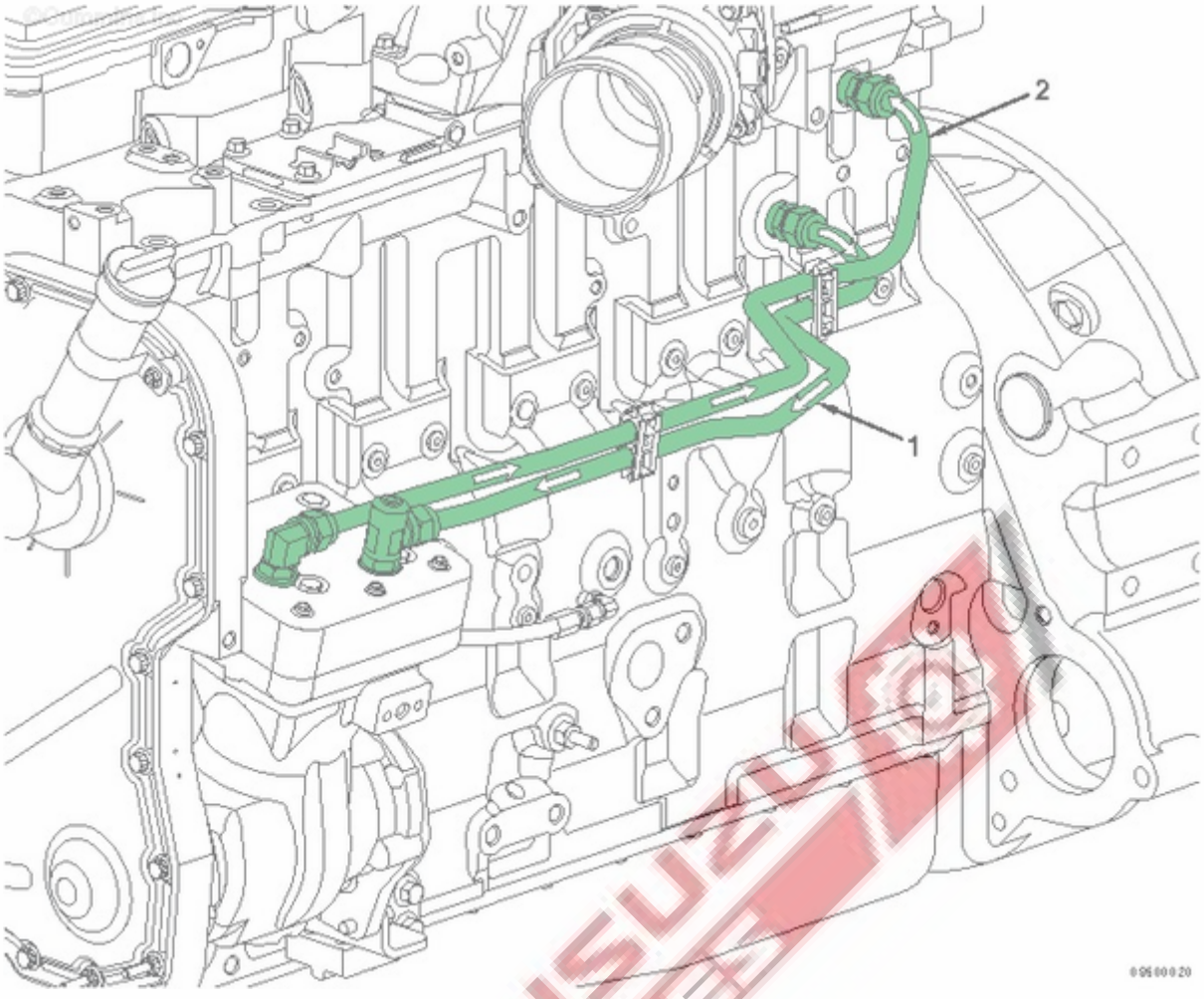
1. Water/coolant inlet from radiator
2. Water pump suction
3. Coolant flow through lubricating oil cooler
4. Block lower water manifold (to cylinders)
5. Coolant supply to cylinder head
6. Coolant return from cylinder head
7. Block upper water manifold
8. Thermostat bypass
9. Coolant return to radiator
10. Coolant supply to aftertreatment diesel exhaust fluid dosing valve and tank from cylinder block
11. Aftertreatment diesel exhaust fliuid valve and tank coolant return line to water/coolant inlet connection. Optional aftertreatment diesel exhaust fluid dosing valve and tank coolant return is (1)
12. Optional torque converter coolant supply from cylinder block with thermostat closed
13. Optional torque converter coolant return to water/coolant inlet connection.



Low Mount (left side) and High Mount (right side) Turbochargers

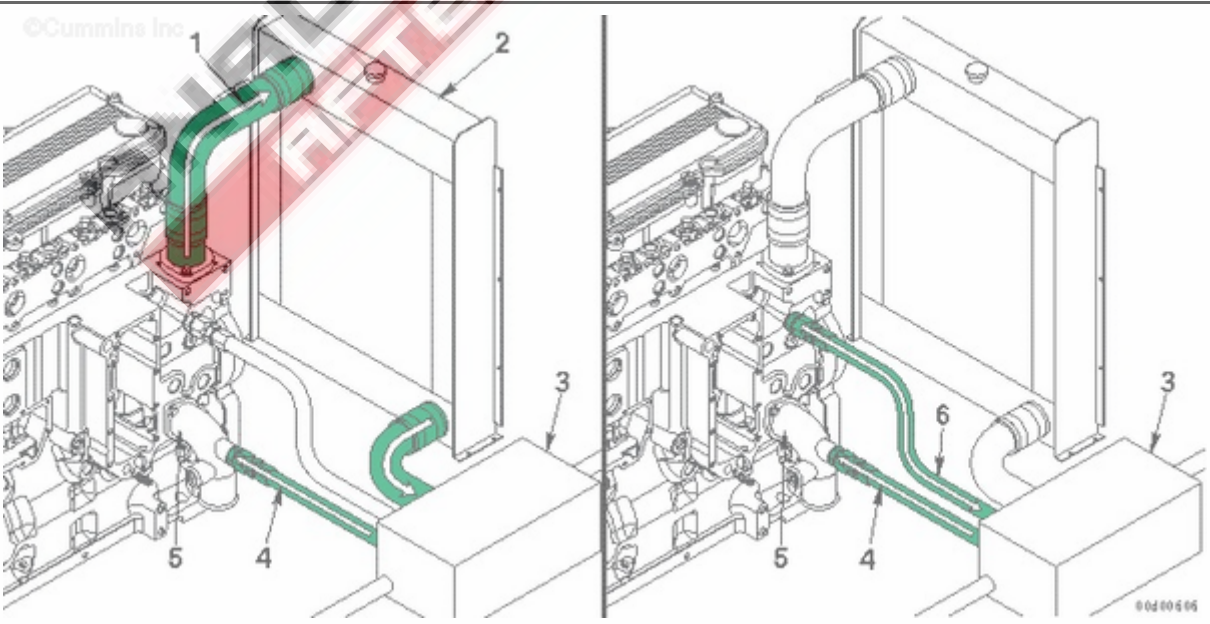
1. Coolant supply to variable geometry turbocharger (VGT) from cylinder block
2. VGT coolant return to the cylinder block
3. Coolant supply to the exhaust gas recirculation (EGR) cooler from the cylinder block
4. EGR cooler coolant return to the water inlet connection
5. De-aeration port to original equipment manufacturer (OEM) coolant top tank.

ANADOLU ISUZU AFTER SALES



Cold Side of Engine

1. Air compressor coolant supply from cylinder block
2. Air compressor coolant return to cylinder head.



Note : For engines equipped with optional torque converter cooler option.

Note : Conventionally cooled engines with automatic transmissions typically use oil-to-water transmission torque converter coolers plumbed between the radiator

and engine water pump.

Note : A torque converter cooling system with a remote bypass allows the torque converter to receive coolant flow when the thermostat is closed (engine cold, no flow through radiator).

Note : For OEM components, see equipment manufacturer service information and literature.

1. Flow to radiator and torque converter when thermostat is open
2. Radiator
3. Torque converter cooler
4. Coolant return to engine inlet connection from torque converter cooler
5. Engine inlet connection
6. Flow to torque converter **only** when the thermostat is closed.

ANADOLU ISUZU AFTER SALES

Last Modified: 25-Jul-2016

General Information

The Drive Units section consists of the removal, inspection, and installation of the accessory drive, engine barring device, and compressor mounting and belt options.

The accessory drive is located on the rear gear housing. Typically the driven accessory is a hydraulic pump. When **not** in use the accessory drive is covered by an accessory drive gasket and cover.

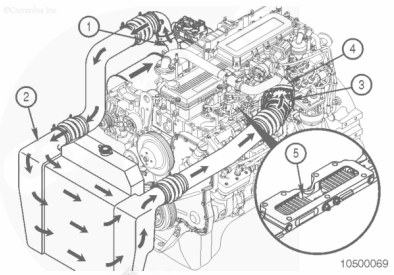
The engine barring device is located on the flywheel housing.

Last Modified: 05-Oct-2016

ANADOLU ISUZU AFTER SALES

General Information

On an engine with exhaust gas recirculation (EGR), the air intake system and exhaust system components work together to provide the correct amount of intake charge flow into the engine. This overview will cover the major components of the intake system.

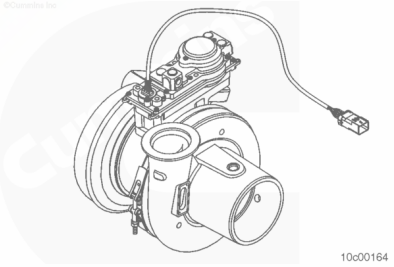


1. Turbocharger
2. Chargeair cooler
3. Engine intake throttle actuator
4. Air intake connection
5. Air intake manifold/cold starting aid.

The exhaust system components are covered in Exhaust System - Overview. Refer to Procedure 011-999 in Section F. (/qs3/pubsys2/xml/en/procedures/425/425-011-999.html)

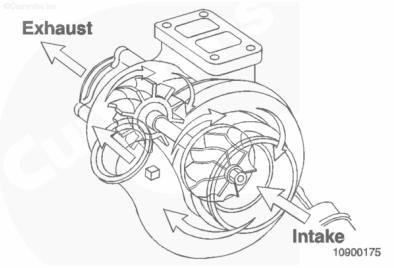
Turbocharger

The turbocharger is a variable geometry turbocharger (VGT) with:



- Serviceable actuator mounted to the bearing housing of the turbocharger
- Speed sensor in the bearing housing to monitor turbocharger operation
- Water-cooled bearing housings (in addition to oil lubrication).

The turbocharger uses exhaust gas energy from the engine to turn the turbine wheel.



The turbine wheel drives the compressor wheel through a common shaft.

The impellers on the compressor wheel draw intake air through the original equipment manufacturer (OEM) air filter and inlet plumbing into the compressor housing of the turbocharger.

The air is then pressurized by the compressor wheel before being delivered to the charge air cooler.

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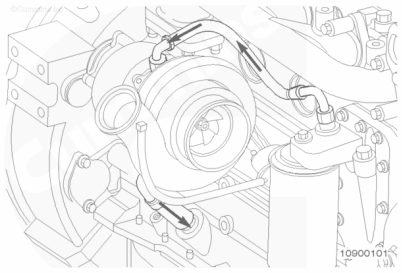
Engine lubricating oil is used to lubricate the bearings and provide some cooling for the turbocharger.

The lubricating oil supplied to the turbocharger through the supply line is at the engine oil operating pressure.

A return line connected to the bottom of the turbocharger routes the lubricating oil back to the engine lubricating oil pan.



The turbine, compressor wheel, and shaft are supported by two rotating bearings in the bearing housing.

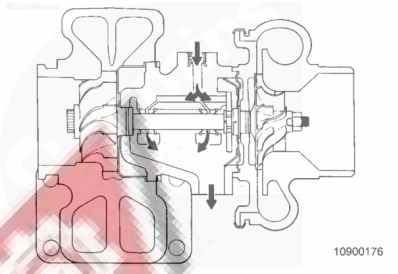
Passages in the bearing housing direct filtered, pressurized engine oil to the shaft bearings and thrust bearings.

The oil is used to lubricate and cool the rotating components.

Oil then drains from the bearing housing to the engine sump, through the oil drain line.

An adequate supply of good, filtered oil is very important to the life of the turbocharger.

Make sure a high quality oil is used and the oil and oil filter are changed according to maintenance recommendations.



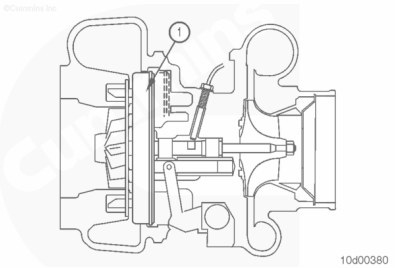
The actuator mounted on the turbocharger is used to control a sliding nozzle ring (1) internal to the turbine housing of the turbocharger.

The position of the sliding nozzle ring is controlled by the engine control module (ECM) through a data link connection.

The position of the sliding nozzle ring, internal to the VGT, allows for control of turbine wheel speed and exhaust flow through the turbocharger.

This allows for control of:

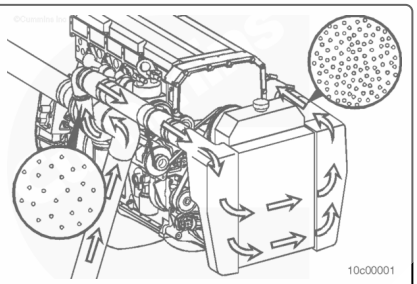
- Exhaust pressure
- Turbocharger compressor wheel speed
- Exhaust outlet temperatures.



Charge Air Cooler

Automotive engines use a chassis-mounted charge air cooler to improve engine performance.

This system also uses large diameter piping to transfer the air from the engine turbocharger to the charge air cooler, then returns the air from the charge air cooler to the engine



intake manifold.

As the intake air is compressed by the turbocharger, the air temperature increases.

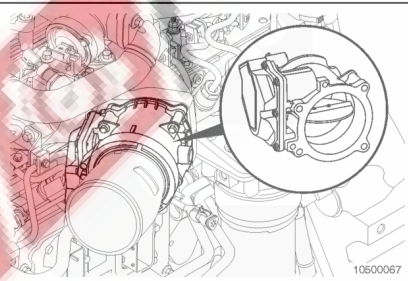
This heated air is then passed through the charge air cooler, which cools the air.

Cool air is more dense, which allows more air to be compressed into the cylinder, yielding higher combustion efficiency.

Note : The long-term integrity of the charge air cooling system is the responsibility of the vehicle and component manufacturers.

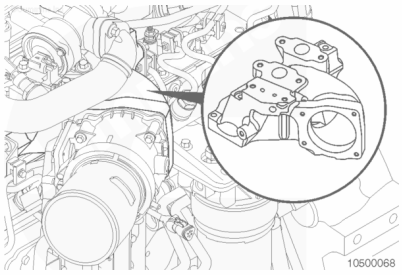
Engine Intake Throttle Actuator

The engine intake throttle actuator attaches to the air intake connection. It is used in combination with the EGR valve to control the flow of compressed and cooled air and cooled exhaust gases into the air intake connection.



Air Intake Connection

The air intake connection attaches to the top of the air intake manifold. It mixes compressed and cooled air from the charge-air plumbing with the cooled exhaust gases from the EGR cooler, then directs the mixture into the air intake manifold.



Air Intake Manifold/Cold Starting Aid

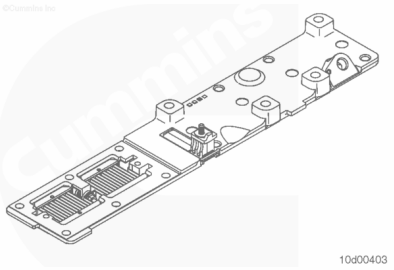
An air intake manifold with an integral cold starting aid is used to cover the intake portion of the cylinder head.

The integral cold starting aid is a single element intake air heater used to pre-heat the intake air under cold ambient conditions.

The ON/OFF operation of the intake air heater is controlled by the engine ECM.

The ECM controls a single OEM supplied relay which provides power for the intake air heater when commanded.

Note : The cold starting aid is **not** a serviceable part. If the cold starting aid has cracked, broken, or melted elements, the engine air intake manifold **must** be replaced. Refer to Procedure 010-023 in Section 10.



(/qs3/pubsys2/xml/en/procedures/425/425-010-023.html)

Intake Air Flow Description

Air Cleaner

Air first flows through the OEM supplied air cleaner, where foreign material and debris are removed from the air.

Air flows first through the Cummins Inc. supplied air cleaner element (direct flow) where foreign material and debris are removed from the air. Refer to Procedure 010-031 in Section 10. (/qs3/pubsys2/xml/en/procedures/425/425-010-031.html)

Air Inlet Piping and Turbocharger

Air then flows through the OEM supplied air inlet piping to the turbocharger compressor inlet. Once air reaches the compressor wheel, it is compressed to a level determined by the ECM. The ECM regulates the level of pressure (boost) by using the electronically controlled variable geometry turbocharger. The electronic controls on the turbocharger adjust the compressor wheel speed, and thus boost, to meet the commands of the ECM.

Charge Air Cooler

After the air flows through the turbocharger compressor outlet, it gets passed through an OEM supplied charge air cooler to remove some of the heat generated by compressing the air. By lowering the temperature of the air, its density is increased. The increased density of the air allows the engine to maintain a higher level of performance.

Air Intake Connection Adapter, Engine Intake Throttle Actuator, Air Intake Connection, and Air Intake Manifold

From the outlet of the charge air cooler compressed and cooled air flows into the air intake connection adapter. The air intake connection adapter allows different OEM arrangements to plumb to the engine. Compressed and cooled air then flows through the engine intake throttle actuator and into the air intake connection. The air intake connection mixes the compressed and cooled air with the cooled exhaust gases then directs the mixture into the air intake manifold where the air is distributed to the cylinders for combustion.

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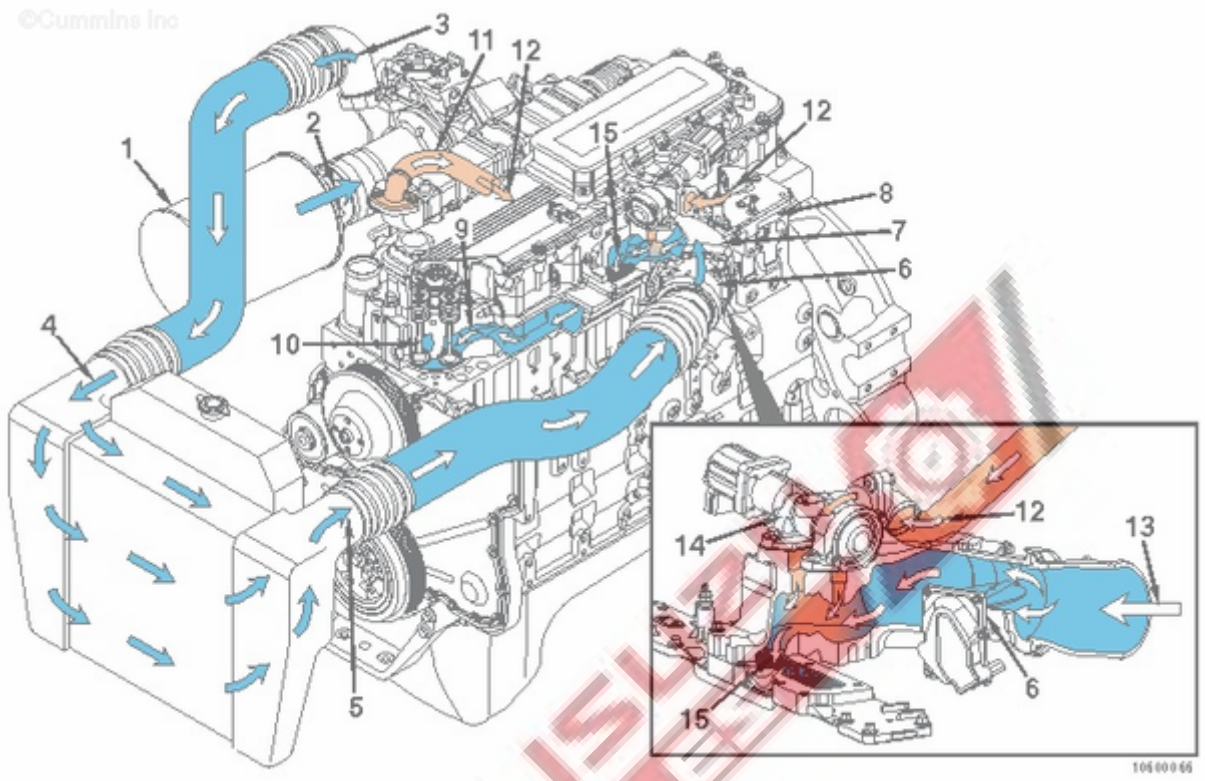
Last Modified: 10-Oct-2016

Flow Diagram



Air Intake Flow

1. Air cleaner
2. Turbocharger compressor inlet
3. Turbocharger compressor outlet
4. Charge air cooler inlet
5. Charge air cooler outlet
6. Engine intake throttle actuator
7. Air intake connection
8. Intake manifold
9. Intake port
10. Intake valve
11. Exhaust gas recirculation (EGR) connection tube
12. EGR cooled exhaust gases
13. Charge air cooler intake air
14. EGR valve
15. Air mixture to combustion cylinder.

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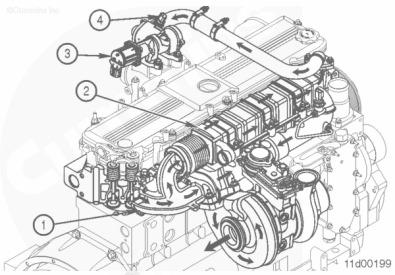
AFTER SALES

General Information

On an engine with exhaust gas recirculation (EGR), the air intake system and exhaust system components work together to provide the correct amount of intake charge flow into the engine. This overview covers the major components of the exhaust system.

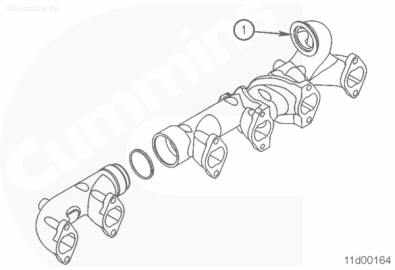


1. Exhaust manifold and seal
2. EGR cooler
3. EGR valve
4. Exhaust pressure sensor and mounting.

Note : Use the following procedure for intake air components. Refer to Procedure 010-999 in Section F. (/qs3/pubsys2/xml/en/procedures/425/425-010-999.html)

This overview also covers the aftertreatment system components located off the engine in the exhaust system.

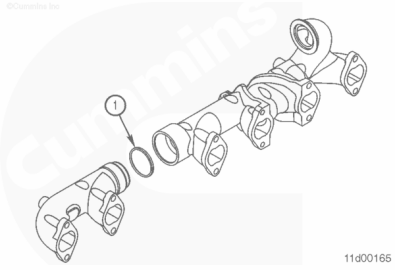
The exhaust manifold is a two-piece design with a sealed slip-joint to allow for thermal expansion.



Depending on the application, the exhaust manifold used can vary in order to locate the turbocharger in various positions, as required by the application.

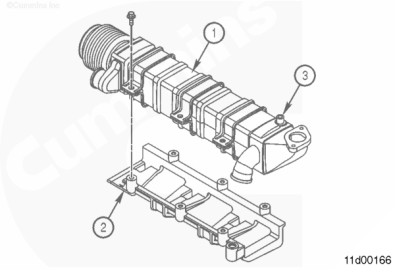
The exhaust manifold has an additional port that connects to the EGR cooler inlet (1).

The exhaust manifold sections are sealed by a metallic exhaust seal (1), which is replaceable in the event the seal malfunctions and leaks exhaust gas.



The seal requires a special installation tool to be properly installed to the exhaust manifold.

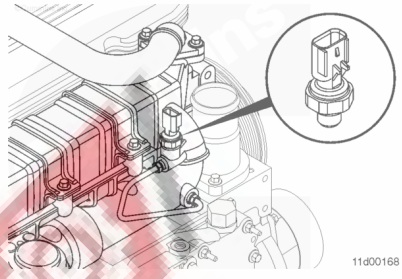
The EGR cooler (1) cools the exhaust gases flowing to the EGR valve. The EGR cooler is mounted above the exhaust manifold and is supported by the EGR cooler mounting bracket (2) attached to the cylinder head.



Because the EGR valve is mounted after the EGR cooler, the EGR cooler is under the same exhaust temperatures and pressures as the exhaust manifold.

The EGR cooler has a coolant vent (3) near the exhaust outlet of the EGR cooler. This vent prevents air from being trapped in the cooler during coolant filling and engine operation by continuously flowing coolant to the top tank of the vehicle cooling system.

Exhaust pressure in the exhaust manifold (which determines the position of the variable geometry turbocharger and the EGR valve) is measured by an exhaust pressure sensor. To maximize the longevity of the exhaust pressure sensor, the sensor does **not** mount directly in the exhaust manifold. The exhaust pressure sensor is connected by a tube to the exhaust manifold and is located on the EGR cooler coolant outlet connection, for additional cooling of the sensor.

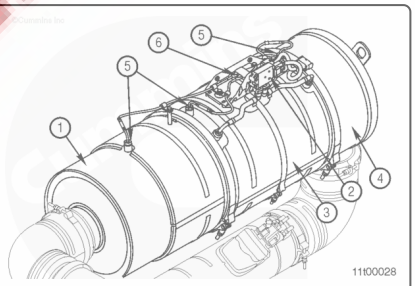


The aftertreatment diesel particulate filter system is used to reduce particulate emissions and is composed of six main components:

1. Aftertreatment inlet and aftertreatment diesel oxidation catalyst
2. Aftertreatment diesel particulate filter differential pressure sensor
3. Aftertreatment diesel particulate filter
4. Aftertreatment outlet
5. Aftertreatment exhaust gas temperature sensor probes
6. Aftertreatment diesel particulate filter temperature sensor interface module.

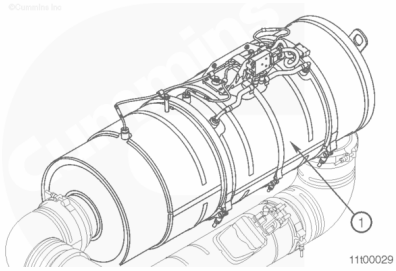
Note : In some applications, the aftertreatment diesel oxidation catalyst can be contained within the inlet section of the aftertreatment system.

Note : The temperature sensor module and temperature sensor probes are **not** serviceable separately and must be replaced as an assembly.



Passive regeneration occurs when the exhaust temperatures are naturally high enough to oxidize the soot collected in the aftertreatment diesel particulate filter (1) faster than the soot is collected.

Passive regeneration typically occurs when the temperature of the aftertreatment diesel particulate filter is above 316°C [600°F]. This occurs during highway driving or driving with



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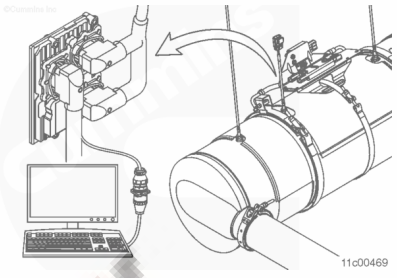
heavy loads.

Since passive regeneration occurs naturally, it is considered to be normal engine operation. No fuel is added to the exhaust stream during passive regeneration.

Active regeneration occurs when passive regeneration is unable to oxidize the soot faster than it is collected in the diesel particulate filter.



Active regeneration occurs when the exhaust temperatures are **not** naturally high enough to oxidize the soot collected in the aftertreatment diesel particulate filter faster than it is collected.

Active regeneration requires assistance from the engine in order to increase the exhaust temperature. This is typically done by injecting a small amount of diesel fuel into the exhaust stream (called aftertreatment injection) which is then oxidized by the aftertreatment diesel oxidation catalyst. The oxidation of this additional fuel creates the heat needed to regenerate the aftertreatment diesel particulate filter.

For active regeneration to occur, the engine control module (ECM) **must** detect that the aftertreatment diesel particulate filter restriction has reached a specified limit. Once this limit is reached, the engine will alter its operation in order to create exhaust temperatures high enough to actively regenerate the aftertreatment diesel particulate filter.

Aftertreatment injection requires that temperatures in the aftertreatment system reach approximately 288°C [550°F]. At this temperature and above, the small quantities of fuel injected into the exhaust will properly oxidize across the aftertreatment diesel oxidation catalyst creating the additional heat required to actively regenerate the aftertreatment diesel particulate filter.

During active regeneration, the engine ECM monitors the exhaust temperatures before and after the aftertreatment diesel particulate filter and maintains the temperatures in a range of approximately 482 to 649°C [900 to 1200°F]. The quantity of fuel used for aftertreatment injection will vary as the temperature is controlled within these limits.

The temperatures achieved during active regeneration are typically higher than those achieved during passive regeneration. The conversion of soot to carbon dioxide occurs much faster as temperatures increase.

A typical active regeneration event will take approximately 20 to 40 minutes to complete while the vehicle is operating. The vehicle operator can notice additional turbocharger noise during this time, along with an illuminated high exhaust temperature lamp.

The frequency at which an engine will require an active regeneration varies greatly from application to application. In general, vehicles with a low vehicle speed, such as urban vehicles, or a low-load duty cycle, will require more active regeneration events than a heavily loaded vehicle or a vehicle with a highway speed duty cycle.

The engine ECM also contains a time-based feature for active regenerations which is used to verify correct aftertreatment operation when the vehicle duty cycle is typically high enough that active regeneration events are **not** necessary.

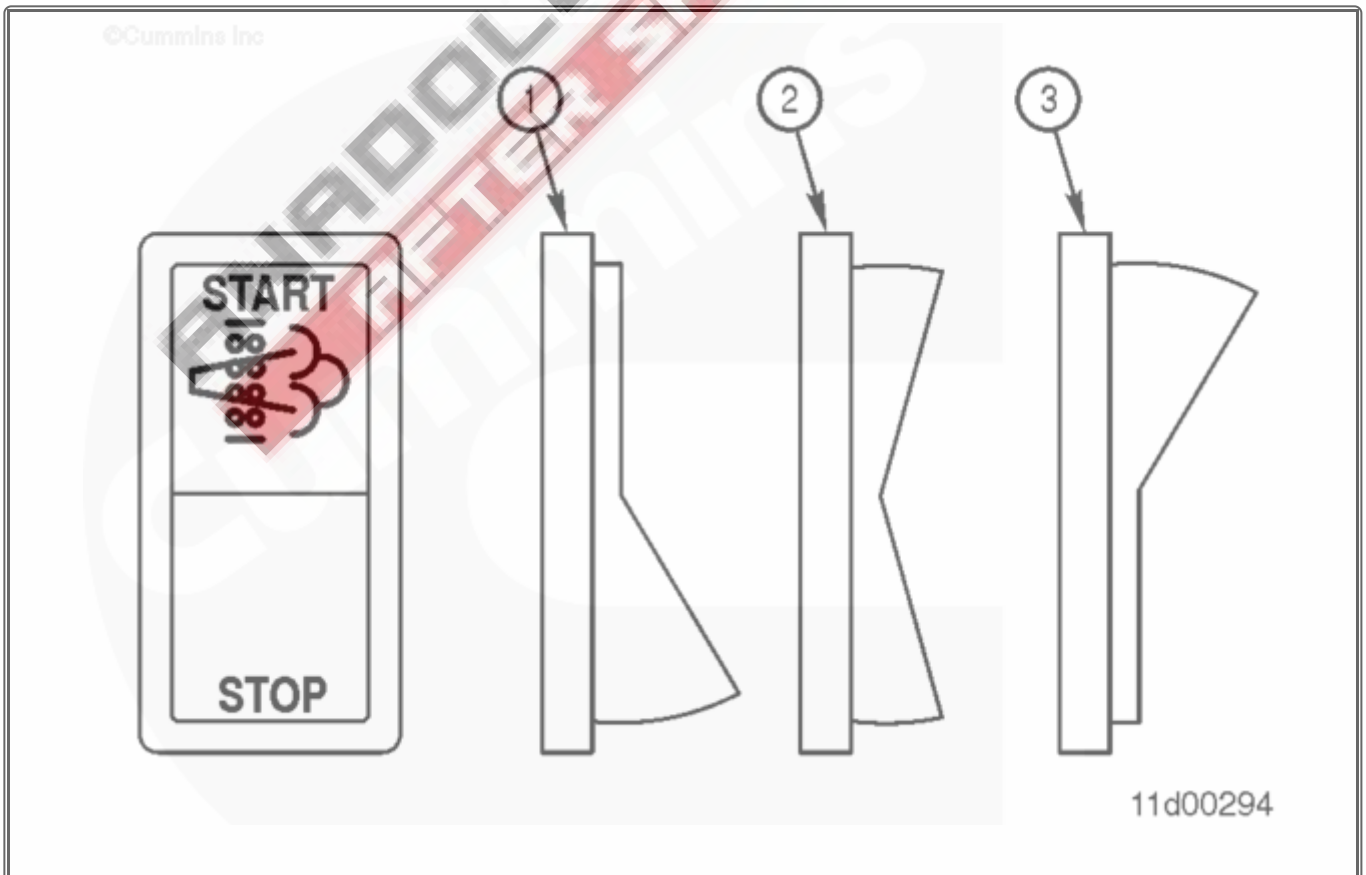
If the engine has **not** completed an active regeneration within the last 24 hours of operation, the engine ECM will call for a time-based active regeneration event.

The 24 hour timer resets each time the ECM detects an active regeneration event has completed.

Under some operating conditions, such as low speed, low load, or stop-and-go duty cycles, the engine may **not** have enough opportunity to regenerate the aftertreatment diesel particulate filter during normal vehicle operation. When this occurs, the engine illuminates the aftertreatment diesel particulate filter lamp to inform the vehicle operator assistance is required, typically in the form of a stationary (parked) regeneration.

Stationary (parked) regeneration is a form of active regeneration initiated by the vehicle operator when the vehicle is **not** moving.

Use the following procedure for more information on stationary (parked) regeneration. Refer to Procedure 014-016 in Section 14. (/qs3/pubsys2/xml/en/procedures/425/425-014-016.html)



The equipment manufacturer installed two switches that control aftertreatment functions: the start switch and the permit switch.

The start switch (known as the Diesel Particulate Filter Regeneration Start Switch in INSITE™ electronic service tool) is used to start a manual (non-mission) regeneration. The equipment manufacturer can also reference this switch as a manual (non-mission) regeneration switch, start switch, or parked regeneration switch.

The permit switch (known as the Diesel Particulate Filter Permit Switch in INSITE™ electronic service tool) is used to allow the equipment operator to disable active regeneration, if necessary. The equipment manufacturer can also reference this switch as an inhibit switch, stop switch, or disable switch.

Use the following procedure for switch operation and troubleshooting. Refer to Procedure 011-056 in Section 11. (/qs3/pubsys2/xml/en/procedures/425/425-011-056.html)

The Minimum Vehicle Speed for Automotive Mobile Regeneration parameter in INSITE™ electronic service tool allows the vehicle manufacturer to program a minimum vehicle speed at which active regeneration is allowed.

This parameter is controlled by the vehicle manufacturer and can be protected by an original equipment manufacturer (OEM) password. Do **not** change the value of this parameter without written consent of the vehicle manufacturer.

This parameter can be set between 0 to 40 kph [0 and 25 mph].

When this parameter is set to zero mph, the engine is allowed to activate an active regeneration event at any vehicle speed.

If the engine needs to initiate an active regeneration event, but the vehicle speed is zero and the engine is at low idle speed, the engine will **not** immediately enter an active regeneration event. The ECM will wait until the engine speed increases to begin the active regeneration event. Once the active regeneration begins, and the exhaust temperatures have increased, the engine will maintain the active regeneration event, even if the vehicle speed returns to zero and the engine speed returns to idle.

When the vehicle speed is greater than zero and the engine speed is above idle speed, an active regeneration event can occur at any time.

When this parameter is set to any speed other than zero mph, the triggers for active regeneration change.

In order for an active regeneration event to start, the vehicle speed **must** exceed 64 kph [40 mph], regardless of minimum vehicle speed parameter setting. Once the vehicle speed exceeds 40 mph, an active regeneration event can begin.

Once the vehicle speed has exceeded 64 kph [40 mph] and the active regeneration event has started, the active regeneration event will continue until the vehicle speed drops below the minimum speed parameter. Once the vehicle speed drops below the minimum speed parameter, the active regeneration stops.

The vehicle **must** once again exceed 64 kph [40 mph] to begin the active regeneration event again.

If a vehicle has a non-zero minimum vehicle speed for mobile active regeneration, and has a low vehicle speed or stop-and-go duty cycle (such as a transit bus, delivery vehicle, school bus), the engine may **not** have enough opportunity to perform or complete an active regeneration event. An engine in this situation can illuminate the diesel particulate filter lamp on a frequent basis, signaling the need for a stationary regeneration.

The Active Regeneration in power takeoff (PTO) and Remote Modes parameter in INSITE™ electronic service tool allows the vehicle manufacturer to allow/disallow regeneration when a vehicle is in a PTO or remote operating mode.

This parameter is controlled by the vehicle manufacturer and can be protected by an OEM password. This parameter can be set to enable or disable. Do **not** change the value of this parameter without written consent of the vehicle manufacturer.

When this parameter is set to Disable, an active regeneration event can **not** occur when the vehicle is in a PTO or remote operating mode. Certain applications (such as a fire truck, delivery vehicle, and transit bus) can assume a PTO or remote operating state many times during normal operation and may **not** have enough opportunity to perform or complete an active regeneration event. An engine in this situation can illuminate the diesel particulate filter lamp on a frequent basis, signaling the need for a stationary regeneration. Consult the vehicle manufacturer for information regarding specific engine operating states.

The aftertreatment warm-up feature activates during periods of extended idle time.

The purpose of this feature is to increase the temperature of the aftertreatment system to remove any water condensation built up during the idle time.

After the ECM detects the exhaust temperature entering the aftertreatment system has been below 150°C [302°F] for 4 hours, the ECM automatically increases the engine speed to between 1000 and 1100 rpm for approximately 10 minutes.

For the aftertreatment warm-up feature to activate, the following conditions **must** be met:

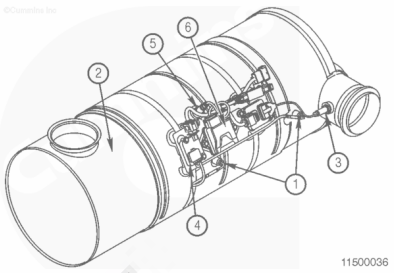
- The clutch pedal is released.
- The brake pedal is released.
- The transmission is in neutral or park.
- PTO or remote PTO is off.
- The vehicle speed is zero mph.
- The accelerator pedal is released.

The aftertreatment warm-up feature is similar to stationary regeneration because it uses the same engine speeds and inputs. However, the aftertreatment warm-up feature does **not** require aftertreatment injection, as it does **not** require the higher temperatures needed during stationary (parked) regeneration.

The aftertreatment warm-up feature is similar to manual (non-mission) regeneration because it uses the same engine speeds and inputs. However, the aftertreatment warm-up feature does **not** require aftertreatment injection, as it does **not** require the higher temperatures needed during manual (non-mission) regeneration.

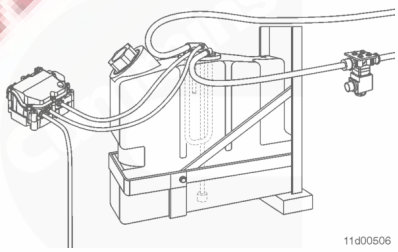
Increasing the exhaust temperature entering the aftertreatment system to above 150°C [302°F] for approximately 10 minutes allows the aftertreatment warm-up to deactivate. This can be done by allowing the engine to operate in this condition for approximately 10 minutes or by driving the vehicle.

Aftertreatment selective catalyst reduction (SCR) system is designed to reduce the nitrogen oxide (NOx) emissions from the engine exhaust into nitrogen and water. This is accomplished by two main entities: the aftertreatment SCR dosing system and the aftertreatment SCR exhaust system.

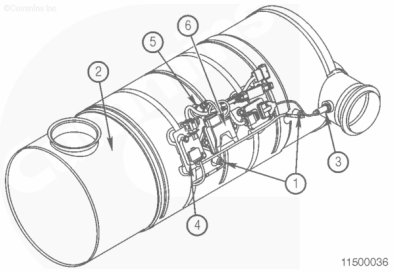


1. The aftertreatment SCR exhaust system mixes and converts the diesel exhaust fluid (DEF) to eliminate unwanted gases from being released in the atmosphere. This system includes the aftertreatment SCR catalyst, aftertreatment decomposition tube, and any ancillary tubing (elbows, etc) involved.

2. The aftertreatment SCR dosing system monitors and injects DEF into the exhaust stream. The SCR dosing system is comprised of the aftertreatment DEF dosing valve, aftertreatment DEF dosing unit, aftertreatment DEF tank, and aftertreatment DEF lines.



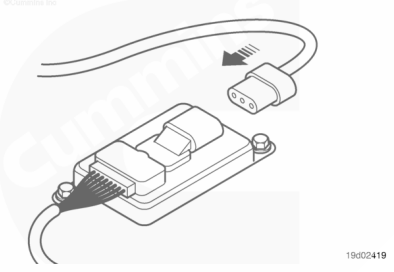
The aftertreatment SCR is designed to reduce NOx emissions from the engine using these main components:



1. Aftertreatment SCR intake/outlet temperature sensor probes
2. Aftertreatment SCR catalyst
3. Aftertreatment outlet NOx sensor
4. Aftertreatment SCR catalyst temperature sensor interface module.

Note : The temperature sensor module and temperature sensor probes are **not** serviceable separately and **must** be replaced as an assembly.

During initial cold start up the engine will go into SCR warm up condition. This condition will sound and act like an active diesel particulate filter regeneration. The SCR catalyst will need to have a temperature of over 150°C [302°F] degrees in order to properly convert NOx in the exhaust stream.



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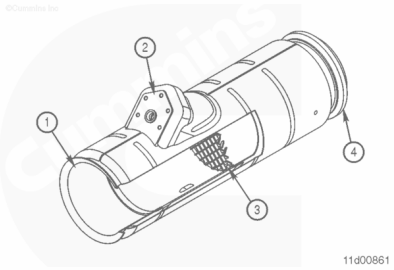
The NOx sensors at the outlet of the turbo and SCR catalyst will monitor the NOx output of the exhaust system and relay the information back to the ECM.

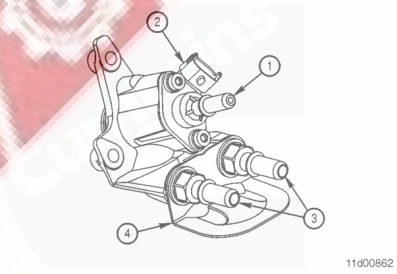
Aftertreatment Decomposition Tube:



The DEF dosing valve is mounted to the decomposition tube. The decomposition tube contains a mixer to help DEF mists distribute evenly in the exhaust stream to convert DEF into ammonia.

1. Aftertreatment decomposition tube inlet
2. Aftertreatment DEF dosing valve mounting
3. Aftertreatment decomposition tube mixer
4. Aftertreatment decomposition tube outlet.

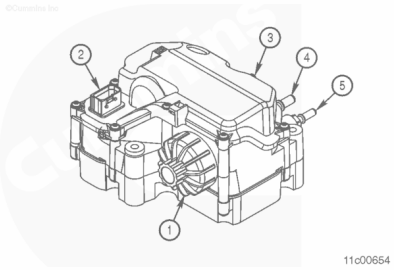
Aftertreatment Diesel Exhaust Fluid Dosing Valve:



The aftertreatment DEF dosing valve is controlled by the ECM and sprays the correct amount of DEF into the exhaust stream. Engine coolant is supplied to the DEF dosing valve to keep the valve cool and operable.

1. DEF intake port
2. Electrical connection to the OEM harness
3. Coolant ports
4. Heat shield.

Aftertreatment Diesel Exhaust Fluid Dosing Unit:



The aftertreatment DEF dosing unit is the pumping mechanism of the dosing system. The aftertreatment DEF dosing unit draws DEF through its suction port and pressurizes it. The aftertreatment DEF dosing unit then filters the DEF which is eventually sprayed into the exhaust stream via the pressure port. Any unused DEF is returned to the DEF tank through the return port.

The main components of the aftertreatment DEF dosing unit:

1. Aftertreatment DEF dosing unit filter (internal) and cap
2. Electrical connector
3. Inlet port
4. Backflow port
5. Outlet port.

Aftertreatment Diesel Exhaust Fluid Tank:

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The DEF tank is designed to store DEF and report DEF tank level and DEF tank temperature to the ECM.

If the tank level becomes too low, it will set fault codes followed by a power derate. See equipment manufacturer service information.

If the tank is filled with the incorrect fluid, (anything other then DEF), the aftertreatment system will fail to operate correctly. A fault will become active and power derates will follow.

See the appropriate Owner's Manual and/or Operation and Maintenance Manual in Section V for DEF specifications.

See Service Bulletin, Diesel Exhaust Fluid Specifications for Cummins® Selective Catalytic Reduction Systems, Bulletin 4021566 (/qs3/pubsys2/xml/en/bulletin/4021566.html).

DEF tanks will vary in size and shape. For further details, see equipment manufacturer service information.

Aftertreatment Diesel Exhaust Fluid Lines:

The aftertreatment DEF lines carry the DEF to and from the DEF tank, aftertreatment DEF dosing unit, and aftertreatment DEF dosing valve.

DEF will fill the lines during a prime or operating state and then be removed in a purge state to prevent freezing of the lines.

DEF line connectors, length, and design will vary by vehicle manufacturer. The DEF lines incorporate electrically heated elements. See the vehicle manufacturer owner's manual for further details.

The SCR system is comprised of many components, but requires a minimal amount of servicing or driver intervention. The SCR system is comprised of four main states: priming, dosing, purging, and heating.

Priming State

- Once the SCR reaches a temperature of 150°C [302°F] the ECM will command the aftertreatment DEF dosing unit to start its priming process. The aftertreatment DEF dosing unit will draw DEF from the DEF tank, pressurize the DEF, and then filter the DEF to the aftertreatment DEF dosing valve. The aftertreatment DEF dosing valve will open and close to rid any air from the system. Once the system is able to build up pressure and has removed most of the air bubbles from the DEF lines, the aftertreatment DEF dosing system is capable of dosing.

Dosing State

- The aftertreatment DEF dosing valve will open and spray DEF in the exhaust stream when the engine ECM aftertreatment calibration limits are met. The DEF will then be chemically altered by the aftertreatment SCR catalyst to clean the exhaust gases. As long as the dosing system is in the dosing state, the aftertreatment DEF dosing unit will continue to run regardless if the aftertreatment DEF dosing valve is or is **not** spraying DEF. DEF dosing rates are dependent on vehicle duty cycle. The dosing rates are **not** necessarily constant under most duty cycles. The aftertreatment DEF dosing valve will pulse the demanded amount of DEF into the exhaust stream. Any DEF **not** used by the aftertreatment DEF dosing valve is returned to the DEF tank.

Purging State

- When a driver keys OFF, the dosing system will shut itself down with a purge cycle to prevent DEF from being left in the system, and in cold climates, potentially freezing. An audible click and pumping sound will be heard from the DEF dosing unit when it is in a purge cycle. The DEF dosing unit will slide its internal reverting valve and cause a change in the flow direction of the DEF. The DEF dosing unit will pull all the DEF out of the aftertreatment DEF dosing valve and pressure line, then return the unused DEF to the DEF tank. In this process the aftertreatment DEF dosing valve will open, eliminating the vacuum created in the lines for a more complete purge process. After a complete purge the majority of the system will be free of any remaining DEF. If the main power to the ECM is removed, via battery cut off or other means before the purging state is competed, an internal fault will be logged in the ECM. The incomplete purge counter can be viewed in INSITE™ electronic service tool.

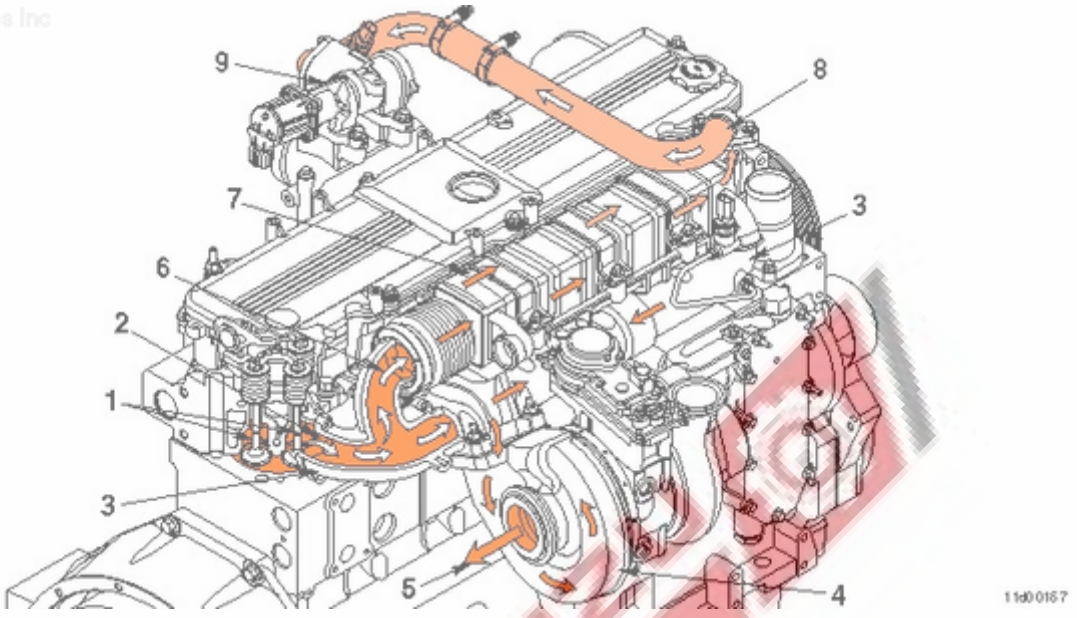
Heating State

- DEF freezes at -11°C [12°F]. If a driver starts the engine in a cold climate, the dosing heating state will be activated. If the ambient air temperature sensor reads ambient conditions are below -4°C [25°F] the ECM will command the dosing system to go into the defrost state. The aftertreatment dosing unit will turn on its internal heater to defrost any remaining DEF inside it. The heated DEF lines will also be commanded on. If the DEF tank temperature drops below -5°C [23°F], the DEF tank coolant valve will be commanded open by the ECM. Engine coolant will flow though the tank to defrost the frozen DEF. The DEF dosing system will **not** prime until every component is completely defrosted. If ambient conditions continue to be cold after the system has primed, the ECM will command a maintenance heating feature to prevent the DEF dosing system from refreezing. This feature will cycle the heating on and off to the DEF lines, DEF tank, and aftertreatment DEF dosing unit.

PYROLU ISUZU DIESELS

Last Modified: 01-Nov-2016

Flow Diagram



Engine Exhaust Flow

1. Exhaust valves
2. Exhaust port
3. Exhaust manifold
4. Turbocharger turbine housing
5. Turbocharger exhaust outlet
6. Exhaust gas recirculation (EGR) cooler gas inlet
7. EGR cooler
8. EGR cooler gas outlet
9. EGR valve.

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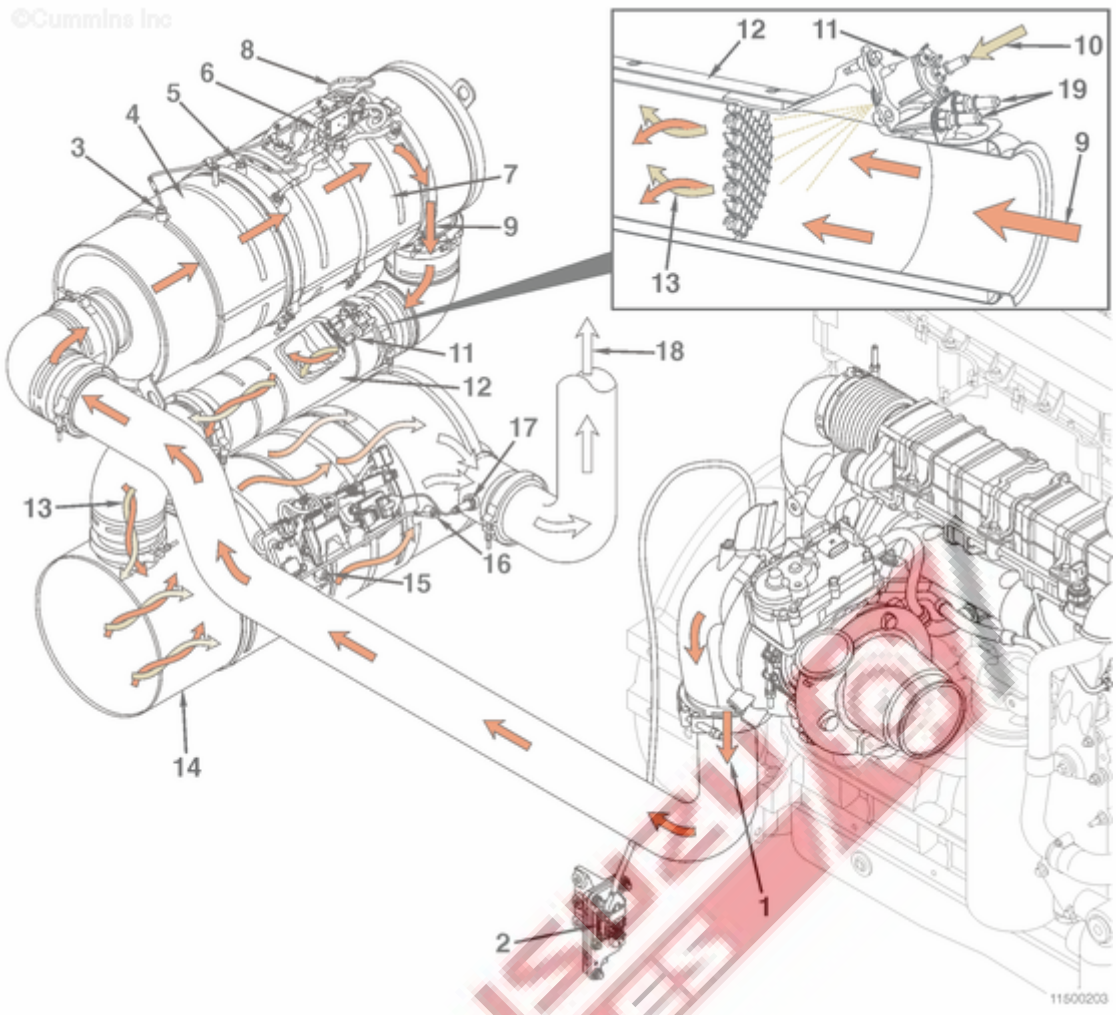

Aftertreatment Exhaust Flow

1. Exhaust from turbocharger
2. Aftertreatment intake nitrogen oxides (NOx) sensor
3. Aftertreatment diesel oxidation catalyst (DOC) intake temperature sensor
4. Aftertreatment DOC
5. Aftertreatment diesel particulate filter (DPF) intake temperature sensor
6. Aftertreatment DPF combination pressure sensor
7. Aftertreatment DPF
8. Aftertreatment DPF outlet temperature sensor
9. Exhaust gas flow from the DPF
10. Diesel exhaust fluid (DEF) supply to aftertreatment DEF dosing valve
11. Aftertreatment DEF dosing valve
12. Decomposition reactor
13. Exhaust and DEF mixture
14. Aftertreatment selective catalytic reduction (SCR) catalyst
15. Aftertreatment SCR intake temperature sensor
16. Aftertreatment SCR outlet temperature sensor
17. Aftertreatment SCR outlet NOx sensor
18. Exhaust flow exiting aftertreatment system
19. Aftertreatment DEF dosing valve coolant fittings.

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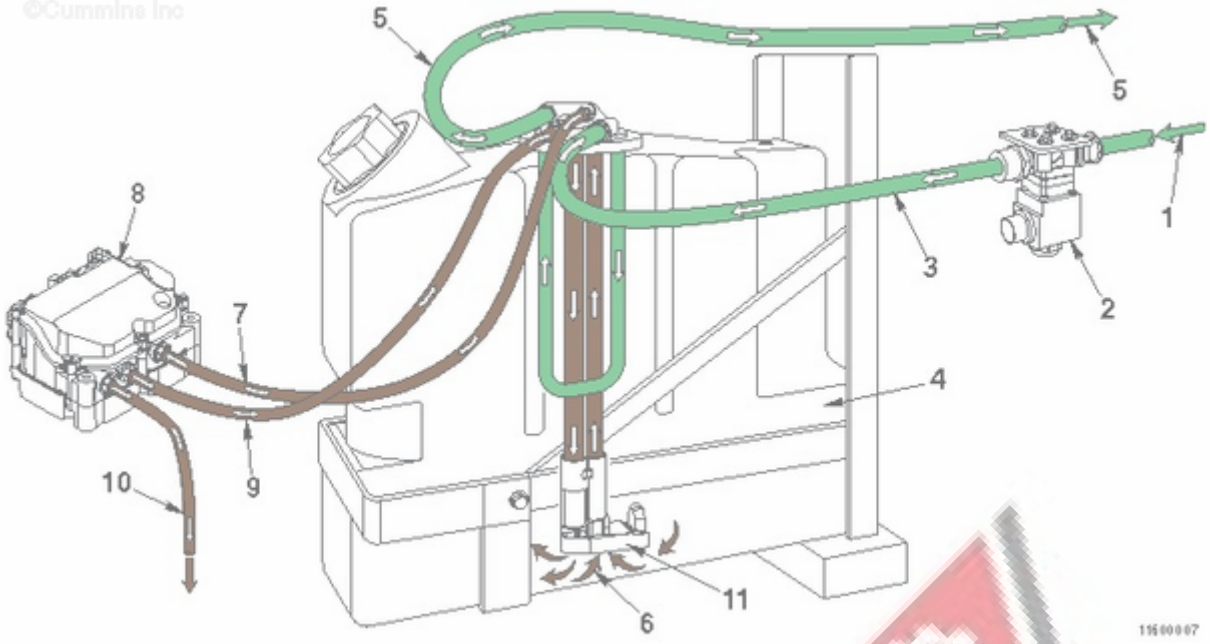

Diesel Exhaust Fluid and Tank Heater Coolant Flow

1. Coolant flow from engine to aftertreatment DEF
2. Aftertreatment DEF tank coolant valve
3. Coolant flow to aftertreatment DEF tank (**Only** when aftertreatment DEF tank coolant valve is open)
4. Aftertreatment DEF tank
5. Coolant return to engine
6. Aftertreatment DEF supply from aftertreatment DEF tank
7. Aftertreatment DEF flow to aftertreatment DEF dosing unit
8. Aftertreatment DEF dosing control valve
9. Aftertreatment DEF return to aftertreatment DEF tank
10. Aftertreatment DEF flow to the aftertreatment DEF dosing valve
11. DEF tank filter.

Note : For additional information regarding the DEF tank or coolant valve, see equipment manufacturer service information.

ANADOLU ISUZU Aftersales

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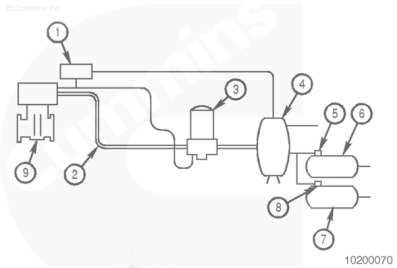
General Information

The compressed air system normally consists of an on-engine/gear-driven air compressor, air governor, air tanks, and all necessary plumbing.



10200070

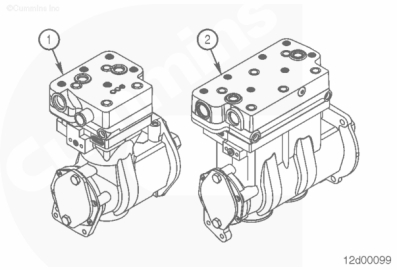
The components listed below are commonly used in a compressed air system:

1. Air governor
2. Discharge line
3. Air dryer
4. Supply tank
5. Check valve
6. Primary tank
7. Secondary tank
8. Check valve
9. Air compressor.

The engine is supplied with the air compressor and related coolant plumbing **only**. The remainder of the compressed air system is the responsibility of the vehicle manufacturer.

Air Compressor

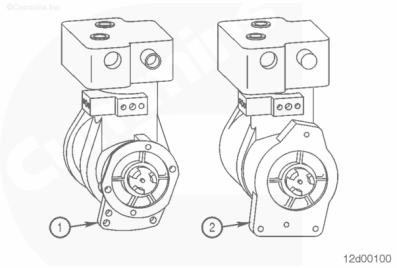
Several different air compressors are available for the engine covered in this manual. Both single cylinder (1) and two cylinder (2) modules are available.



12d00099

The air supplied to the air compressor is pressurized by the turborcharger on all models.

The air compressor can also be a low throughput torque or high throughput torque model, depending on the application.



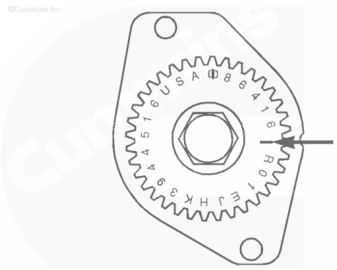
12d00100

Low throughput torque models have a Society of Automotive Engineers (SAE) A rear flange (1).

High throughput torque models have an SAE B rear flange (2).

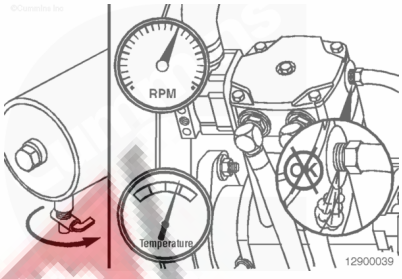
To make sure the air compressor does **not** contribute to engine vibrations, when installed, the air compressor **must** be properly timed on the engine.

ANADOLU ISUZU
WEB SALES



12800057

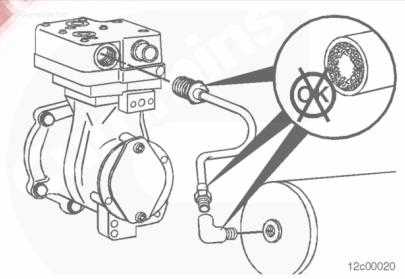
The key factor which determines the reliability and durability of an air compressor in an application is the amount of time the air compressor is supplying air during the vehicle/machine operation, known as the duty cycle of the air compressor.



12900039

Air compressors are **not** designed to pump continuously and will generate a lot of heat when pumping, which is dissipated during the time the compressor is **not** pumping (called the unloaded operation).

Compressed air system maintenance/servicing can help minimize air compressor duty cycle and ensure reliability and durability of the air compressor. These item include but are **not** limited to:



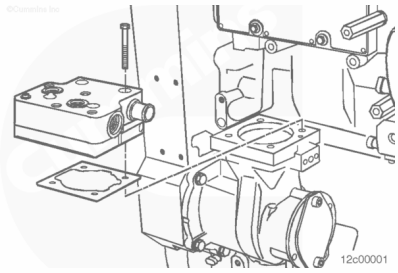
12c00020

1. Find and stop all leaks in the system. Air leaks can double or triple operating duty cycles. Close attention to correcting air system leaks is critical.
2. Checking the air compressor exhaust port, discharge line, and fittings for carbon build up. If the carbon buildup is greater than 1.6 mm [0.06 in], clean or replace as necessary.
3. Check the air lines and fittings between the outlet port of the air dryer and the first tank after the air dryer for any water or oil. The tank should be dry. If oil is present, replace the dryer desiccant and clean the downstream system and components as required.

See equipment manufacturer service information for the vehicle for maintenance and service information for the compressed air system. For air compressor specific maintenance, see the Operation and Maintenance and/or Owner's manual for the engine being serviced.

Air Compressor Cylinder Head

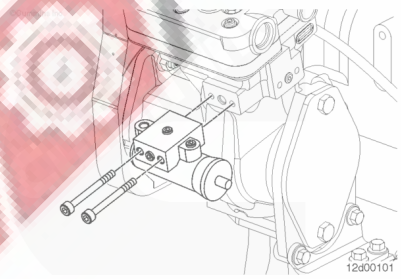
The air compressor cylinder head is cooled by engine coolant. The cylinder contains intake and exhaust valves to regulate air flow into and out of the cylinder head.



Most air compressor cylinder heads can be serviced without removing the compressor from the engine. This manual covers servicing of the cylinder head with the compressor installed on the engine. If there is internal damage to the air compressor, the air compressor **must** be replaced.

Prior to removing the air compressor cylinder, make sure to check if replacement parts are available. Some air compressor cylinder heads may **not** be able to be serviced separately from the air compressor.

The compressor operates continuously, but has a ”loaded" and ”unloaded" operating mode. The operating mode is controlled by a pressure activated air governor and the air compressor unloader assembly. The air governor can be located on the air compressor or remotely on the vehicle.



When the air system reaches a predetermined pressure, the governor applies an air signal to the unloader assembly, causing the unloader to either hold open or shut off the compressor intake valve. This causes compressed air to stop flowing into the compressed air system.

As the system is used, the pressure drops. At a predetermined pressure, the governor directs an air signal to the compressor unloader assembly, allowing the compressor to again pump compressed air into the system.

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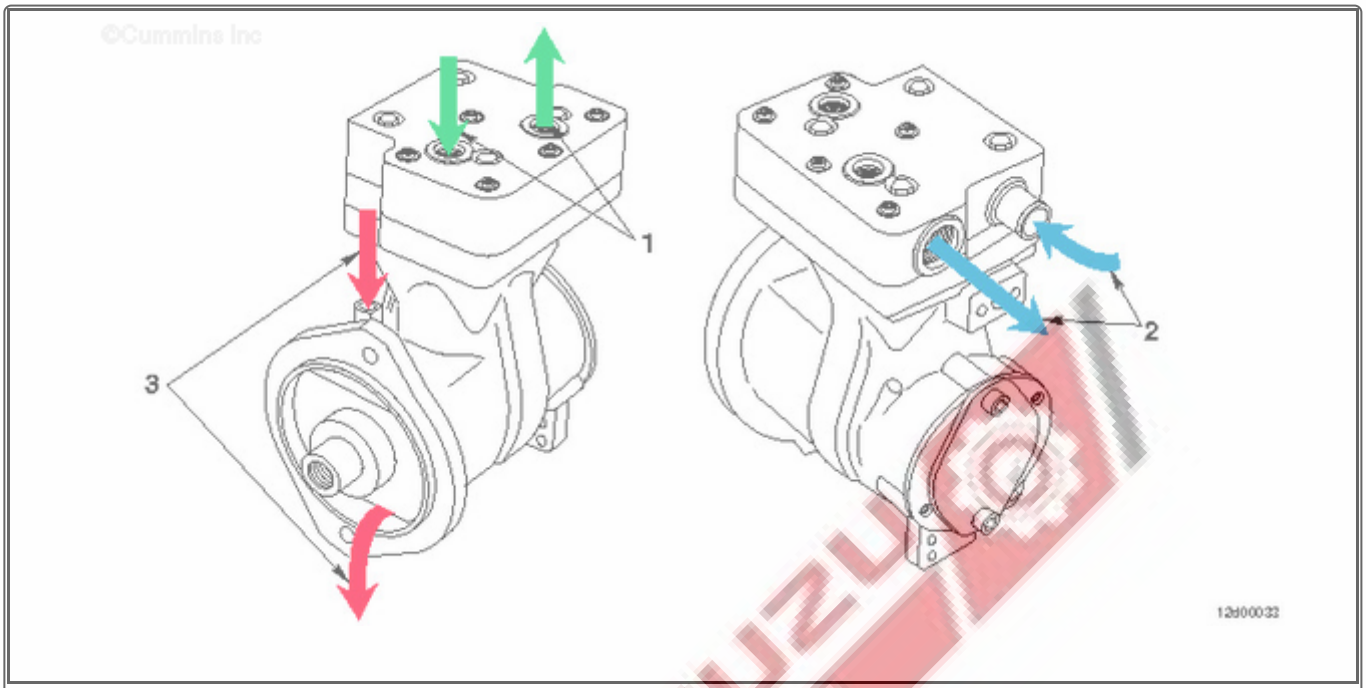
Last Modified: 25-Jul-2016

General Information



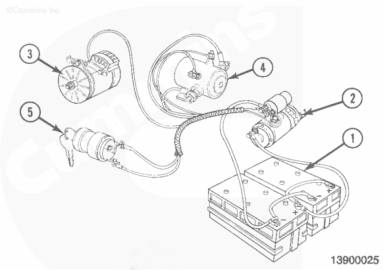
1. Coolant
2. Air
3. Lubricant.

ANADOLU ISUZU AFTER SALES

Last Modified: 25-Jul-2016

General Information

The basic heavy-duty electrical system consists of:



- Batteries (1)
- Starting motor (2)
- Alternator (generator) (3)
- Magnetic switch (4)
- Push-button switch or keyswitch (5)
- Control (or relay) circuit wiring
- Battery cables or cranking circuit.

ANADOLU ISUZU AFTER SALES

Last Modified: 25-Jul-2016

General Information

The engine test is a combination of an engine run-in and performance check. The engine run-in procedure provides an operating period that allows the engine parts to achieve a final finish and fit. The performance check provides an opportunity to perform final adjustments needed to optimize engine performance.

An engine test can be performed using **either** an engine dynamometer **or** a chassis dynamometer. If a dynamometer is **not** available, an engine test **must** be performed in a manner that simulates a dynamometer test.

Check the dynamometer before beginning the test. The dynamometer **must** have the capability to test the performance of the engine when the engine is operating at the maximum rpm and horsepower range (full power).

The engine crankcase pressure, often referred to as engine blowby, is an important factor that indicates when the piston rings have achieved the correct finish and fit. Rapid changes of blowby or values that exceed specification by more than 50 percent indicate something is wrong. The engine test **must** be discontinued until the cause has been determined and corrected.

ANADOLU ISUZU AFTER SALES

Last Modified: 25-Jul-2016

General Information

The mounting adaptations group consists of the flywheel housing, flywheel, flywheel ring gear, and engine lifting brackets.

There are two dowel pins in the cylinder block. The pins protrude into holes in the flywheel housing. The pins are used to align the housing properly to the cylinder block when it is installed.

Last Modified: 05-Oct-2016

ANADOLU ISUZU AFTER SALES

General Information

The Miscellaneous section consists of the removal, inspection, and installation of cup plugs, pipe plugs, straight thread plugs, and expansion plugs.

Last Modified: 05-Oct-2016

ANADOLU ISUZU
AFTER SALES

General Information

Engine Wiring Harness

- The engine wiring harness that supports the engine control module (ECM) and connects the ECM to the engine sensors and actuators has been developed so it does **not** allow service repairs. When a malfunction is detected on a section of the engine harness, that part of the engine harness **must** be replaced.

INSITE™ Electronic Service Tool

- INSITE™ electronic service tool is required to communicate with the engine. In order to communicate with the engine, it is necessary to use INSITE™ electronic service tool 8.1.0 and later versions.

INLINE™ 6 or Later

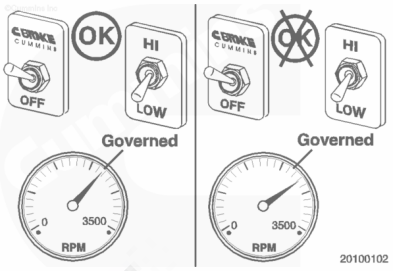
- This data link adapter tool is recommended to connect INSITE™ electronic service tool with the ECM. This tool can connect to a personal computer via a universal serial bus tool.

ANADOLU ISUZU AFTER SALES

Last Modified: 04-Nov-2016

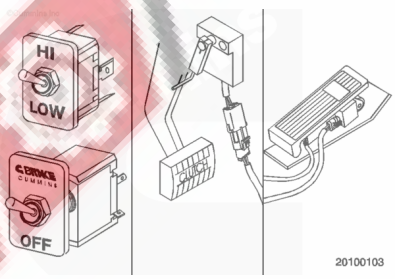
General Information

Note : The engine brake is comprised of two assemblies. The following instructions apply to both of the engine brake assemblies.

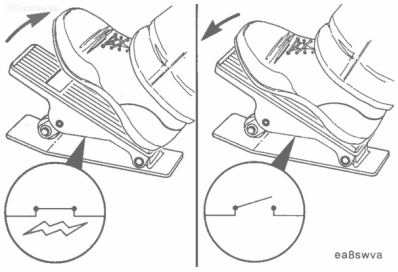


Engine brake controls consist of the following:

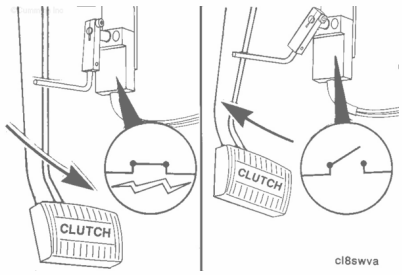
- ON/OFF switch
- Clutch switch
- Throttle sensor
- Two-position selector switch (optional).



The throttle sensor is part of the accelerator pedal assembly located in the cab, and will deactivate the engine brakes when depressed.

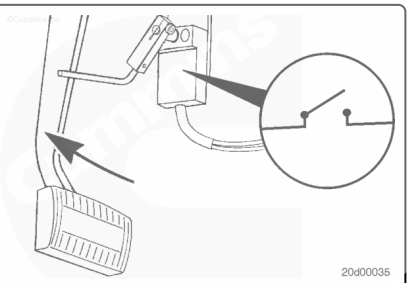


The clutch switch uses the motion of the clutch linkage to deactivate the engine brakes when the clutch pedal is depressed. Depressing the clutch while in cruise control will disengage the cruise control.



The service brake switch is attached to the service brake.

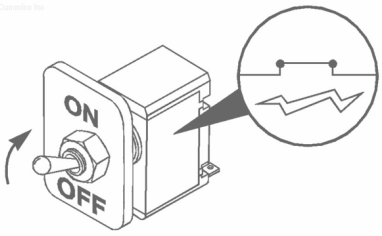
Applying the service brakes while in cruise control will disengage the cruise control and enable the engine brakes.



ANADOLU ISUZU
DEALER SALES

Note : Reference the appropriate pages in this section for specific information about engine brake operation under certain road conditions.

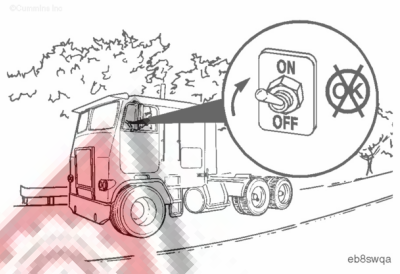
To activate the engine brakes, switch the ON/OFF switch to the ON position. Once activated, the operation of the engine brakes is fully automatic.



eb8swvc

⚠ WARNING ⚠

Do not use the engine brakes while bobtailing or pulling an empty trailer. With the engine brakes in operation, wheel lockup can occur more quickly when the service brakes are applied, especially on vehicles with single-drive axles.

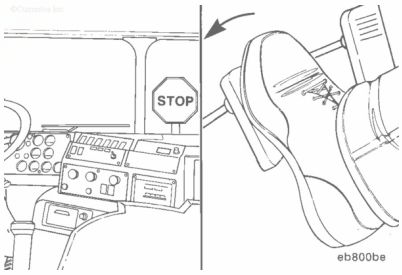


eb8swqa

Make sure the engine brakes are switched to the OFF position when bobtailing or pulling an empty trailer.

⚠ CAUTION ⚠

The engine harness is designed to assist vehicle service brakes in slowing the vehicle to a stop.

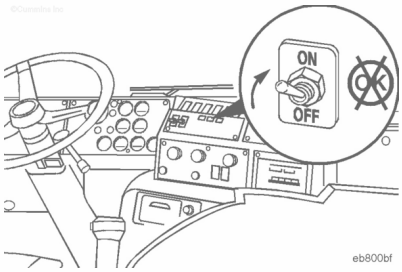


eb800be

Service brakes will be required to bring the vehicle to a stop.

⚠ CAUTION ⚠

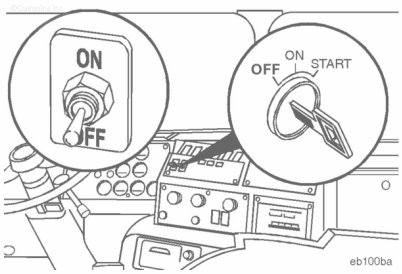
Do not use the engine brakes to aid clutchless gearshifting. This can cause the engine to stall or lead to engine damage.



eb800bf

⚠ CAUTION ⚠

Do not operate the engine if the engine brakes will not deactivate.



eb100ba

If the engine brakes will **not** shut off, shut off the engine immediately.

ANADOLU ISUZU

Last Modified: 25-Jul-2016



General Information

Cummins Inc. produces many engines that are electronically controlled. These engines have special diagnostic requirements for the engine control module (ECM) in the system. To interface with the ECMs, electronic service tools have been developed.

The recommended Cummins® electronic service tool or equivalent interfaces with the electronic engines via a data link. A data link provides a means of transmitting and sorting electric signals, and consists of special electronic circuitry and electrical harnesses. Connection points from electronic service tools are also part of the data link. An original equipment manufacturer (OEM) data link, if available, is provided by the OEM and consists of circuitry located in the OEM harness. An engine data link consists of circuitry located in the engine harness. Both engine and OEM data links alike are defined by standards written by the Society of Automotive Engineers (SAE). Cummins Inc. uses two such standards for electronic service tools. One is a combination of SAE J1587 and SAE J1708 and the other is SAE J1939. The J1939 data link is described in more detail in Procedure 019-165 in the appropriate engine service manual. The J1587/J1708 data link is described in more detail in Procedure 019-166 in the appropriate service manual, and is hereafter referred to as J1708 in this document. Engine data links (both J1939 and J1708) are discussed in more detail in Procedure 019-428 in the appropriate engine service manual.

Electronic Service Tool Description

The recommended Cummins® electronic service tool, or equivalent, is a Windows® based software application that works with Cummins® ECMs to diagnose and troubleshoot engine problems, store and analyze historical information about an engine, and to modify an engine's operating values. The electronic service tool Professional also enables you to transfer calibrations to an ECM.

The electronic service tool is used on a personal computer (PC) that is attached to an ECM through an INLINE™ data link adapter kit.

Note : 1. The INLINE™, INLINE™ I, INLINE™ 2, INLINE™ 4, and INLINE™ 5 adapters have become obsolete. They can be used with the electronic service tool, but technical support for these adapters is not available.

After registering a copy of the electronic service tool and connecting to an ECM data source, the electronic service tool enables you to retrieve present or recorded data about an engine, alter ECM settings, store data for viewing at a later time, analyze data to monitor and assess the operation of an engine, and view active or inactive engine fault codes.

The electronic service tool is installed in the INTELECT™ folder on the hard drive of a personal computer. User manuals are available in the INTELECT™ and Manuals folder for specific Cummins® electronic engines. Additional information for service and support from a Cummins® distributor for the electronic service tool questions is included in the front of the user manuals.

Different versions of the electronic service tool may be available for use at one time, although some electronic service tool versions may **not** be compatible with some ECMs. ECM and electronic service tool compatibility information is available at the Product website. Electronic service tool improvements are sometimes released as Feature Packs. The latest Feature Pack information for specific electronic service tool versions is also available at the electronic service tool product website. It is important to maintain the electronic service tool with the latest versions and Feature Packs that become available.

The electronic service tool can utilize either a communication port (COM port), universal serial bus (USB), WIFI, or Bluetooth connection on the PC when communicating with an ECM. A COM port **must** be configured properly for the electronic service tool to function correctly. It is possible for other software programs on the PC to take control of a COM port and prevent the electronic service tool from accessing the COM port. Troubleshooting information for the electronic service tool communication issues is available in the base user manual and also in the ECM No Communication Troubleshooting Tree on QuickServe™ Online or Intercept.

Initial Check

Electronic service tool

- In the main electronic service tool window, verify that the data link selected in the ECM Data Source Connection drop-down matches the data link hardware being used
- Verify the correct version is installed. The version can be determined from the main window by selecting Help, About.
- Verify the infrared port is disabled so the serial port is **only** being used for ECM communications.
- If you have the Palm Pilot Hot Sync Manager on a PC that **only** has one serial port, you **must** disable the Hot Sync Manager before connecting to an ECM.

Data Link Adapters

- Check the firmware version of the INLINE™ data link adapter to make sure it is the latest firmware version available
- Verify that the data link adapter being used is compatible with the data link wiring available on the engine or vehicle.

- A data link adapter is a device that converts the J1708, or J1939 data link messages from the ECM into a message that a PC can process. Because the electronic service tool is a

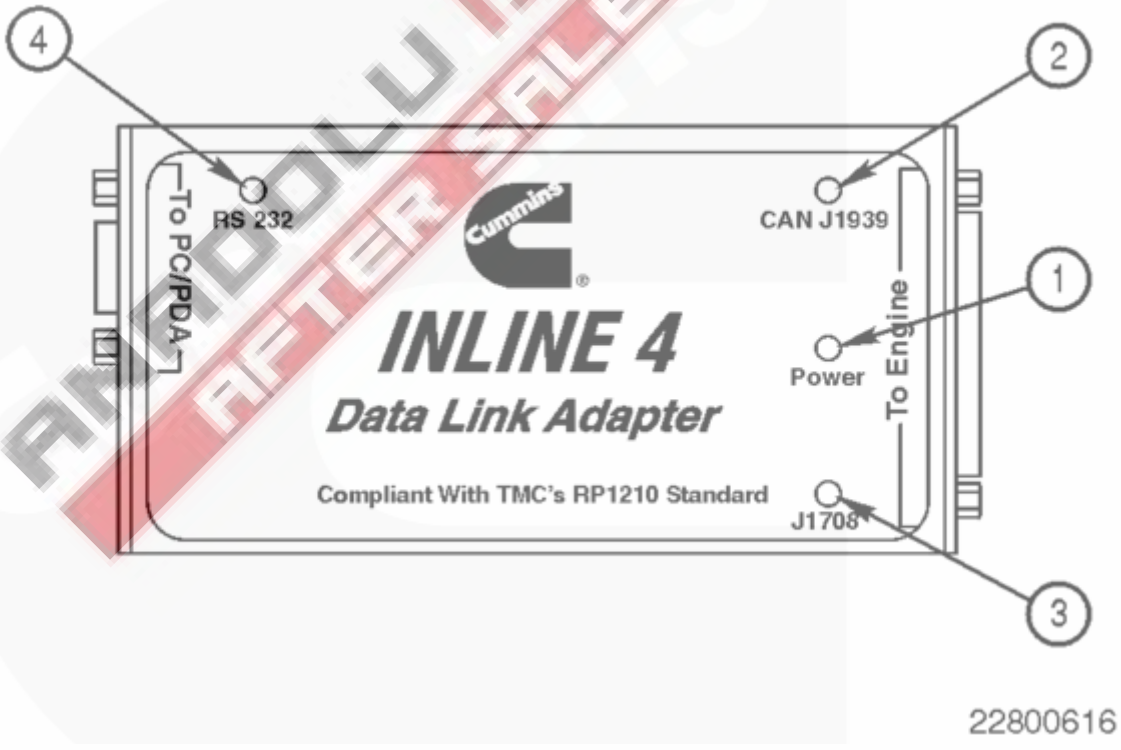
PC based tool, a data link adapter is required to troubleshoot engines.

- Cummins® Service Products offer the following data link adapter kits:
  - INLINE™ 4 adapter kit, Part Number 4918190
  - INLINE™ 5 adapter kit, Part Number 4918416
  - INLINE™ 6 adapter kit, Part Number 2892092
  - INLINE™ 7 adapter kit, Part Number 5299899.

- The following illustration shows INLINE™ data link adapters.

Power for the INLINE™ data link adapters depends upon the communication setup in use. The 12 VDC power is supplied by the vehicle power system for the vehicle and engine communication setups. The 12 VDC power is supplied by an auxiliary power supply for the bench communication setup.

The INLINE™ data link adapter will support either J1708 or J1939 protocol. When connecting with the electronic service tool using an INLINE™ data link adapter, the electronic service tool will attempt to establish communication with an ECM on J1939 first. If no communication is established on J1939, the electronic service tool will then attempt to establish communication on J1708.



Data Link Adapter Identification Diagram - INLINE™ 4.

1. Power light
2. J1939 communication light
3. J1708 communication light
4. RS-232 to PC light.

The INLINE™ 4 is an RP1210A compliant data link adapter that will support both J1708, and J1939 protocol. RP1210A is an industry wide standard that defines data link message format for service tools. The INLINE™ 4 **must** be configured correctly within the electronic service tool to define the COM port being used on the PC and the type of data link protocol that is available, J1708, J1939, or autodetect.



Data Link Adapter Identification Diagram - INLINE™ 5.

1. Power light
2. J1939 communication light
3. J1708 communication light
4. RS-232 to PC light
5. USB to PC light.

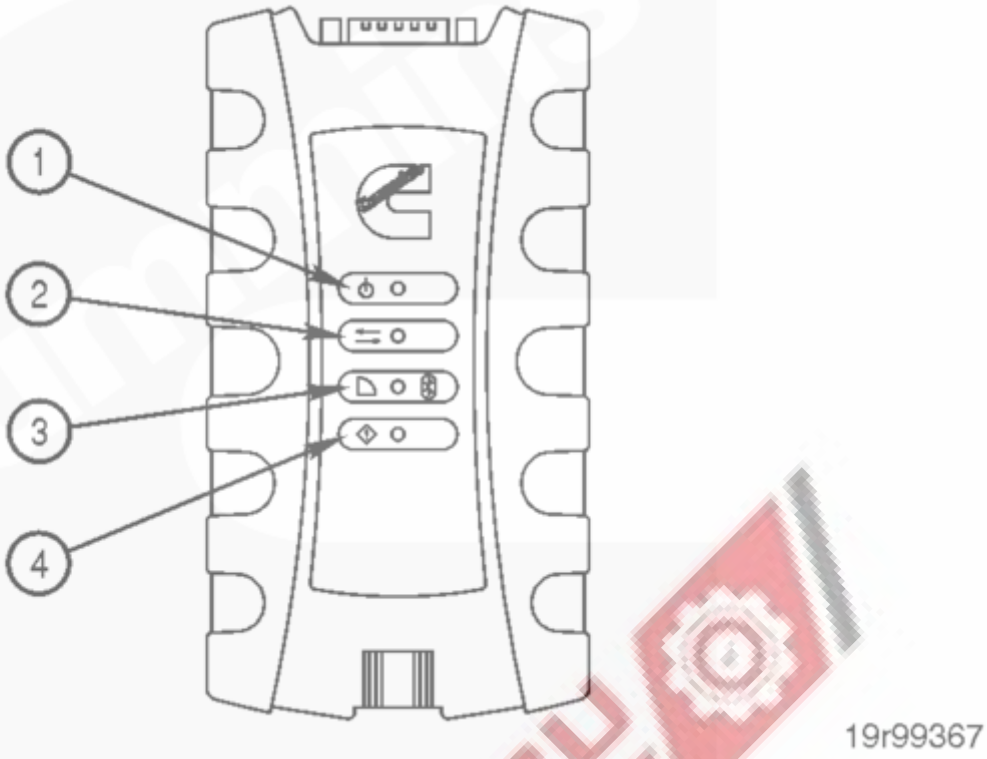
The INLINE™ 5 is an RP1210A compliant data link adapter that will support both J1708, and J1939 protocol. It can be used with either a COM port or USB port. The INLINE™ 5 **must** be configured correctly within the electronic service tool to define the COM or USB port being used on the PC and the type of data link protocol that is available, J1708, or J193, or autodetect.



Data Link Adapter Identification Diagram - INLINE™ 6

1. Power light
2. CAN 1 communication light (J1939)
3. CAN 2 communication light (J1939)
4. J1708 communication
5. RS-232 to PC light
6. USB to PC light.

The INLINE™ 6 is an RP1210A compliant data link adapter that will support both J1708 and J1939 protocols. It can be used with either a COM port or USB port. The INLINE™ 6 **must** be configured correctly within the electronic service tool to define the COM or USB port being used on the PC and the type of data link protocol that is available, J1708, J1939, or autodetect.



Data Link Adapter Identification Diagram - INLINE™ 7

1. Power light
2. Communication light
3. Communication-type light/indicator
4. Fault light.

The INLINE™ 7 is an RP1210A, RP1210B, and RP1210C compliant data link adapter that will support J1587/J1708 as well as J1939 (250K, 500K, or 1MB Baud Rate). It can **only** be connected to the PC via USB, WIFI, or Bluetooth connection. The tool **must** be configured correctly within the electronic service tool to define the connection type on the PC and the type of data link protocol that is available, either J1587/J1708 or J1939.

The INLINE™ data link adapters require firmware software in order to operate correctly. Firmware versions are updated periodically and **must** be uploaded into data link adapters when updates are released. The latest firmware version is always available on the most recent INCAL™ DVD-ROM as well as from the website http://cumminsengines.com/inline. The firmware version for a data link adapter can be found within the recommended Cummins electronic service tool or equivalent. When using the electronic service tool, the firmware version is displayed at the lower right corner of the main window when connected to an ECM. The electronic service tool **must** be connected to an ECM in order for the firmware version to be displayed.

Setup

General Information

Communication with the ECM can be established at three basic locations:

- Bench communication setup
- Vehicle communication setup
- Engine communication setup.

The communication setups are described in more detail in the remainder of this procedure. Each location utilizes different data link adapter cables. All three locations require either a serial cable, USB cable, WIFI, or Bluetooth connection to interface from the data link adapter to the PC. Reference the table below.

The ECM on newer engines can support data link communication on the OEM data link through the OEM connector at the ECM. It can also support data link communication on the engine data link through the engine connector at the ECM. The wiring diagram for a specific engine and ECM **must** be consulted to determine if an ECM supports both OEM data link and engine data link communication.

For Midrange and Heavy Duty engines, the recommended communication setup, if available, is the Cummins Inc. bench communication setup which establishes communication directly to the ECM. The bench communication setup can support both J1708 and J1939 data link protocols, when used with ECMs that support both protocols.

For High Horsepower engines with multiple ECMs, the recommended communication setup is the engine communication setup through the 9 pin connector provided in the engine harness.

J1939 data link communication, if available, is preferred for transferring calibrations because of less interference from other data link devices such as traction control systems and electronic dashes. J1708 communication can require extra time to disable the OEM ECMs that are also communicating on the J1708 data link in order to avoid interference from those devices. Also, the J1939 information transfer rate is faster than J1708 and a calibration download will take less time to complete using J1939 communication compared to J1708 communication.

The functionality of a communication setup can be verified by testing the communication setup on a second ECM or vehicle, if available, or by completing the resistance checks defined for each setup type.

The following table summarizes the ECM communication setups.

Communication Setup	Data Link Connection Location	Engine ECM data link Source	Data Link Protocols Supported
Bench	ECM connector	OEM	J1708, J1939
Vehicle 6 pin	Dash 6 pin connector	OEM	J1708
Vehicle 9 pin	Dash 9 pin connector	OEM	J1708, J1939[1]

Communication Setup	Data Link Connection Location	Engine ECM data link Source	Data Link Protocols Supported
Engine	Engine harness 3 pin connector	Engine	J1939
Engine	Engine harness 6 pin connector	Engine	J1708[2]
Engine	Engine harness 9 pin connector	Engine	J1939[3]

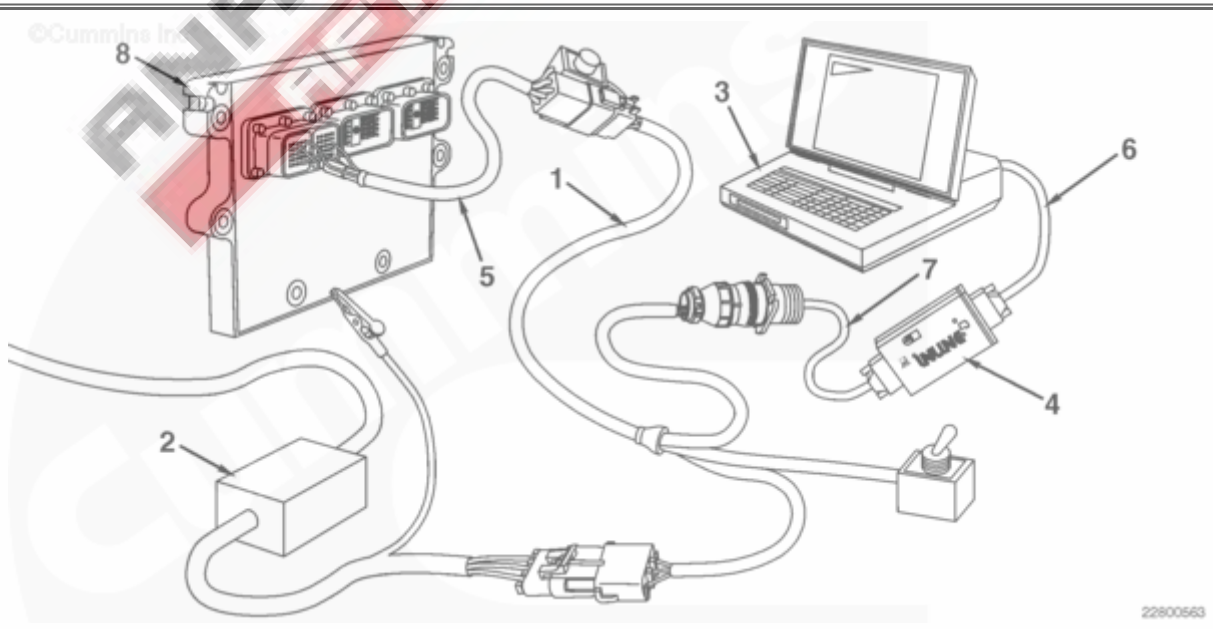
Notes:

1. The 9 pin connector **must** be fully wired to support J1939 protocol.
2. Available **only** on selected older engines.
3. Available **only** on selected High Horsepower engines.

Bench Communication Setup

The bench communication setup establishes communication directly with the ECM through the connector port on the ECM. An example of a bench communication setup is shown below.

The bench calibration harness (1) is common for most bench setups and can be used with the appropriate bench calibration cable (5) to communicate with various ECMs. A list of available bench calibration cables (5) for various ECMs is included in Service Tool Instruction, Bulletin 3377791, which is accessible on QuickServe™ Online. Proper function of the bench calibration harness (1) and bench calibration cable (5) can be verified by using the wiring diagrams provided to complete resistance checks.



Bench Communication Setup

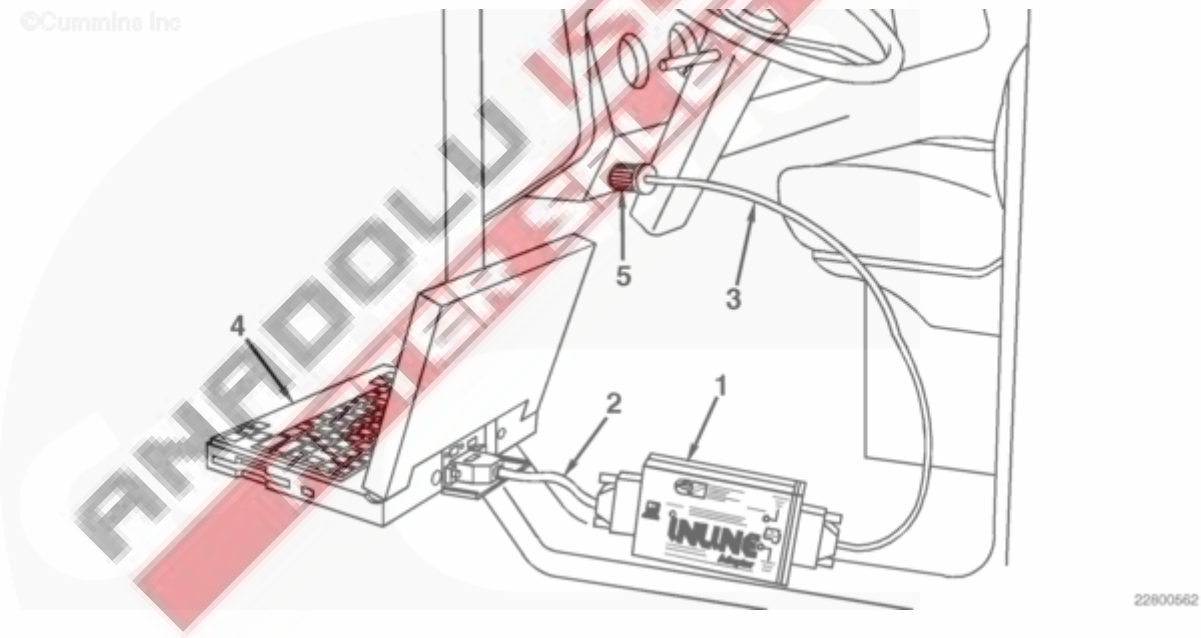
1. Bench calibration harness, Part Number 3163151

2. Power supply$_1$
3. Electronic service tool
4. Data link adapter
5. ECM$_1$ bench calibration cable
6. USB cable, Part Number 4918591, or serial cable, Part Number 4918418 (reference table above for cable type)
7. Data link adapter cable, Part Number 3165159 (INLINE™ 4, 5, and 6
8. CM570 ECM (example).

Note : 1. See Service Tool Instruction, ECM Bench Calibration Base Harness, Bulletin 3377791, for part number.

Vehicle Communication Setup

An additional communication setup is a 9 pin or 6 pin Deutsch™ connection that is commonly located in the cab of a vehicle. The vehicle communication setup utilizes the OEM harness and connects to the ECM at the OEM connector port. A 9 pin connector in the cab, if fully wired, is capable of supporting both J1939 and J1708 protocol. Some OEMs place a 9 pin connector in the cab but do **not** provide wiring to support J1939 protocol. A 6 pin connector will **only** support J1708 protocol.



On Vehicle Communication Setup

1. Data link adapter
2. USB cable, Part Number 4918591, or serial cable, Part Number 4918418 (reference table above for cable type)
3. Data link adapter cable$_1$
4. Electronic service tool
5. Vehicle data link adapter connector$_1$.

Note : 1. See Service Tool Instruction, ECM Bench Calibration Base Harness, Bulletin 3377791, for part number.

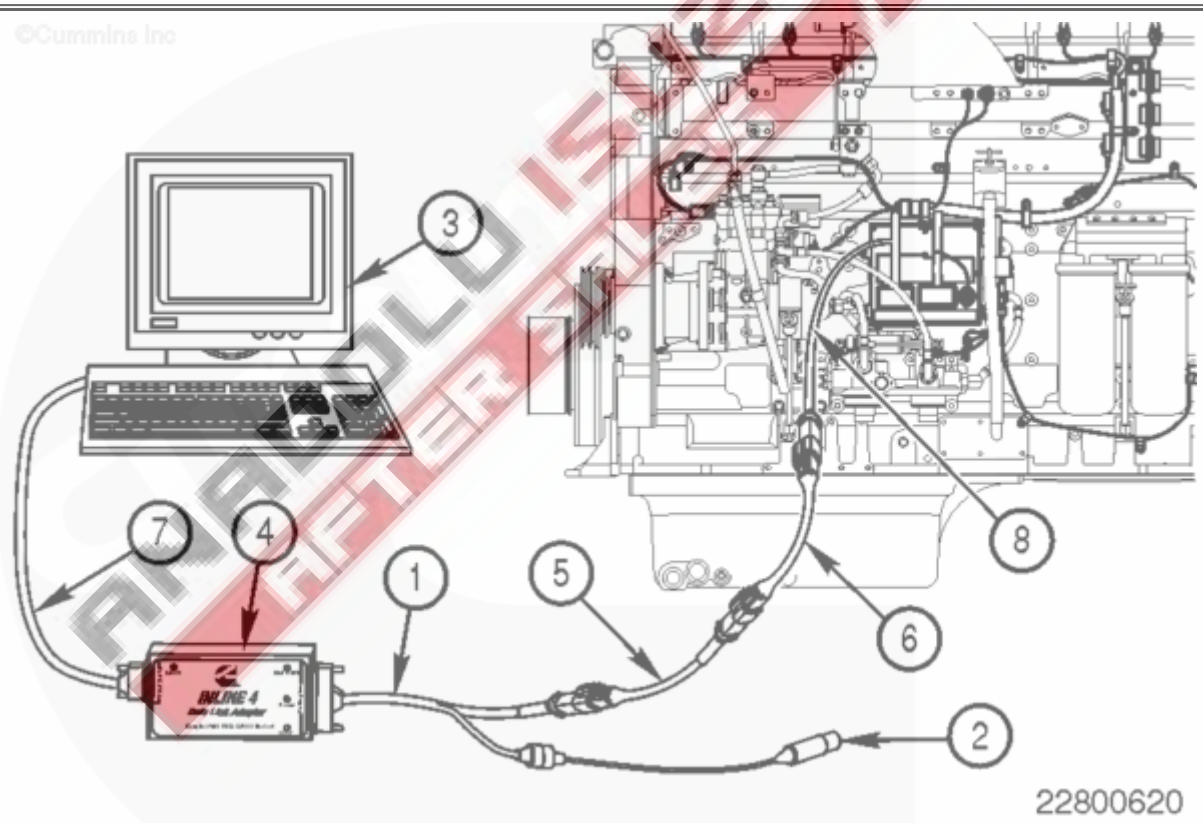
Note : INLINE™ 6 data link networks equipped to support 500K baud data link speeds require an adapter tool, Part Number 5299126, to connect to the 9 pin connector.

Note : Only the INLINE™ 6 and INLINE™ 7 are capable of supporting data link speeds of 500K baud. The INLINE™ 4 and INLINE™ 5 do **not** support 500K baud data link speeds.

Engine Communication Setup

The engine communication setup utilizes the engine data link provided on the engine wiring harness. Depending upon the engine, the engine communication setup available on the engine harness can be a 3 pin Deutsch™ connector, a 6 pin Deutsch™ connector, or a 9 pin Deutsch™ connector.

A 3 pin Deutsch™ connector on the engine harness is available on newer engines and provides a connection point to the J1939 data link. A mini-backbone cable, which includes a 60 ohm resistor and a gender changer cable, may be required in order to connect to the ECM on the J1939 protocol. An auxiliary power supply is required for the data link adapter.



3 Pin Deutsch™ Connector

1. Data link cable$_1$
2. Power supply cable$_1$
3. Electronic service tool
4. Data link adapter
5. Gender changer cable, Part Number 3163597
6. Mini-backbone cable, Part Number 3163096

7. USB cable, Part Number 4918591, or serial cable, Part Number 4918418 (reference table above for cable type)
8. Engine harness 3 pin connector, Part Number 3165141.

Note : 1. See Service Tool Instruction, ECM Bench Calibration Base Harness, Bulletin 3377791, for part number.

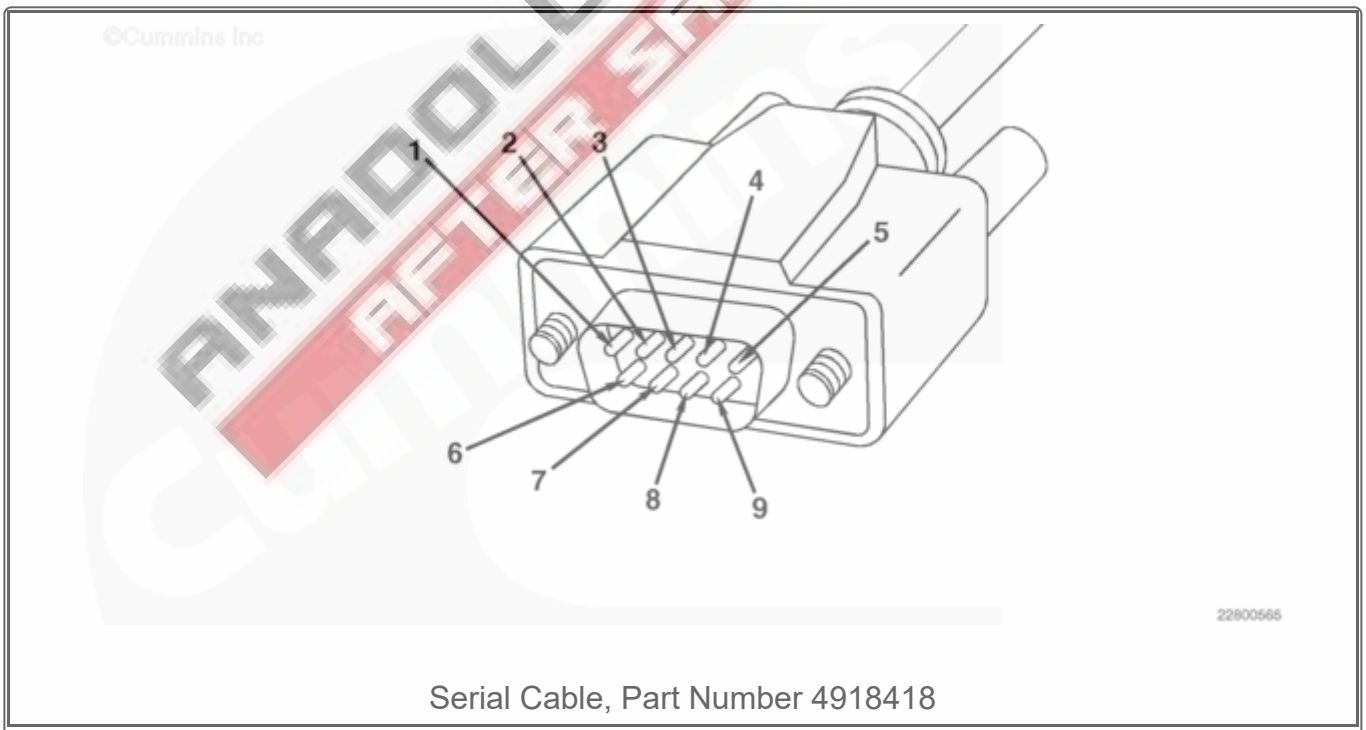
A 6 pin Deutsch™ connector is available on the engine harness for some older engines and provides a connection point to the engine J1939 data link. The 6 pin connector includes a power supply for the data link adapter.

Resistance Check

A serial cable is required to interface from the data link adapter to the PC, or a USB cable can be used with an INLINE™ 5/6/7 data link adapter.

⚠ CAUTION ⚠

Use test lead, Part Number 3822758, and test lead, Part Number 3822917, to avoid the possibility of damage to the serial cable pins.



Serial Cable, Part Number 4918418

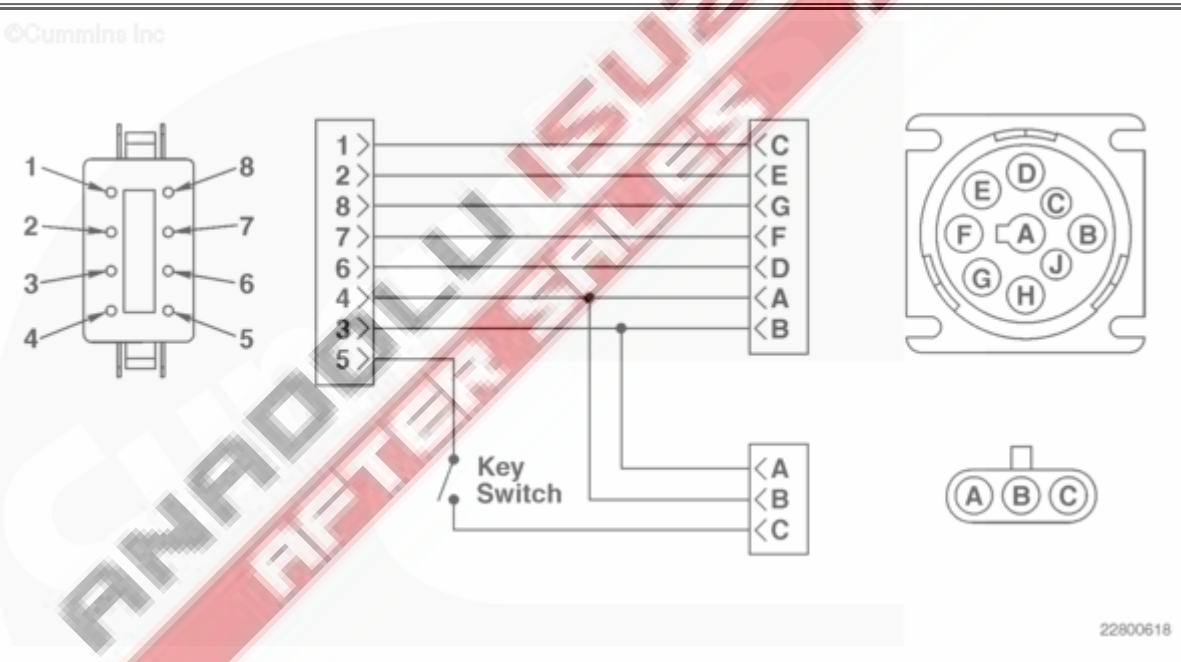
1. Open
2. Transmit data
3. Receive data
4. Data terminal ready (+5 VDC)
5. Signal ground
6. Open

7. Request to send (+5 VDC)
8. Clear to send
9. Open.

- Insert a test lead into pin 1 of the female end of the serial cable, and connect it to the multimeter probe. Attach the other test lead to pin 1 of the male end of the serial cable, and connect it to the multimeter probe.
- Measure the resistance. The multimeter **must** show a closed circuit (10 ohms or less). Repeat the resistance measurement for pins 2 through 9. The multimeter **must** show a closed circuit (10 ohms or less) for each pin. If the circuit is **not** closed, replace the serial cable.

⚠ CAUTION ⚠

To avoid the possibility of damage to connector pins, use test lead, Part Number 3823993, on the 8 pin connector. Use test lead, Part Number 3823994, on the round 9 pin connector. Use test lead, Part Number 3824812, on the 3 pin connector.



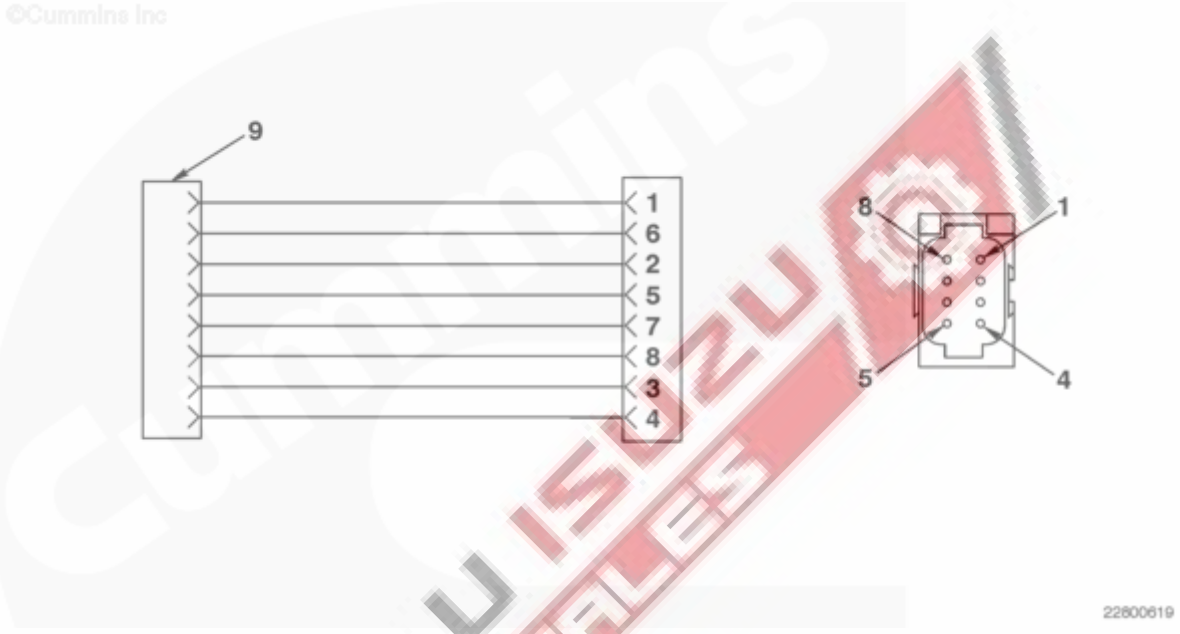
Bench Calibration Harness, Part Number 3163151

1. J1939 data link (+)
2. J1939 data link shield
3. Battery (+)
4. Battery (-)
5. Keyswitch
6. J1939 data link (-)
7. J1708 data link (+)
8. J1708 data link (-)

- Measure the resistance from each pin in the 8 pin connector to the corresponding location in the 9 pin and/or 3 pin connector. The multimeter **must** show a closed circuit (10 ohms or less). If a circuit is **not** closed, replace the bench calibration harness.

⚠ CAUTION ⚠

To avoid the possibility of damage to connector pins, use test lead, Part Number 382994, on the 8 pin connector. Determine the appropriate test lead needed for the ECM connector on the bench calibration cable.



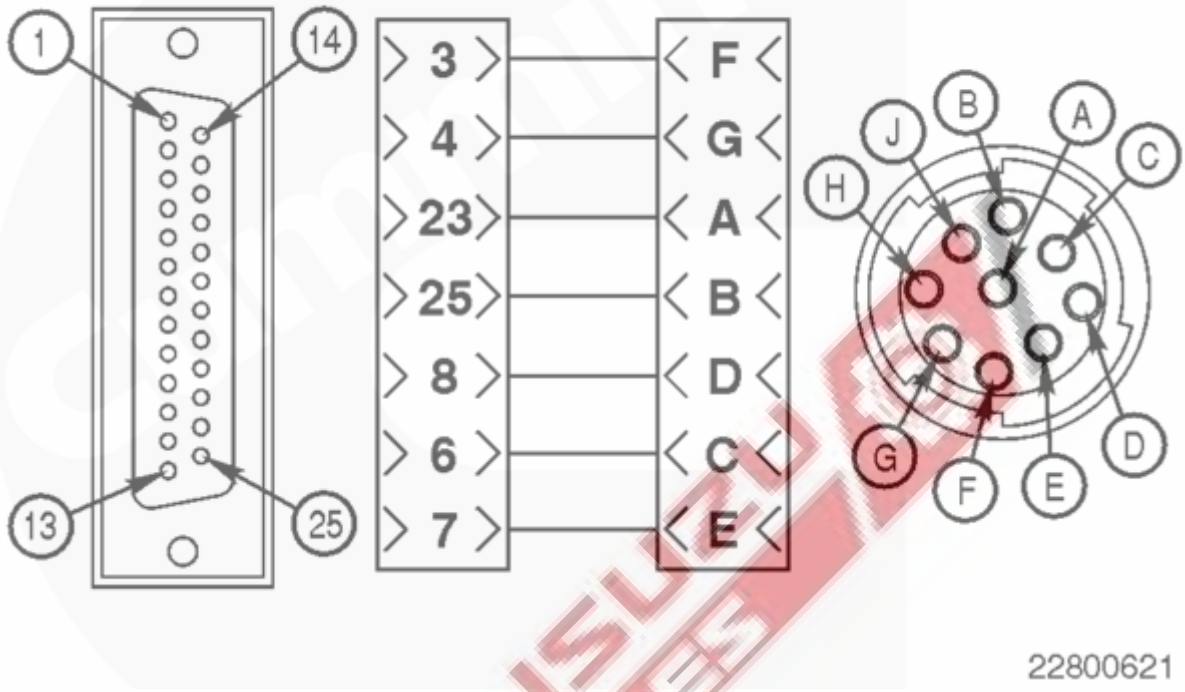
Bench Calibration Cable

1. J1939 data link (+)
2. J1939 data link shield
3. Battery (+)
4. Battery (-)
5. Keyswitch
6. J1939 data link (-)
7. J1708 data link (+)
8. J1708 data link (-).
9. ECM Connector (See wiring diagram for ECM connector pin identification).

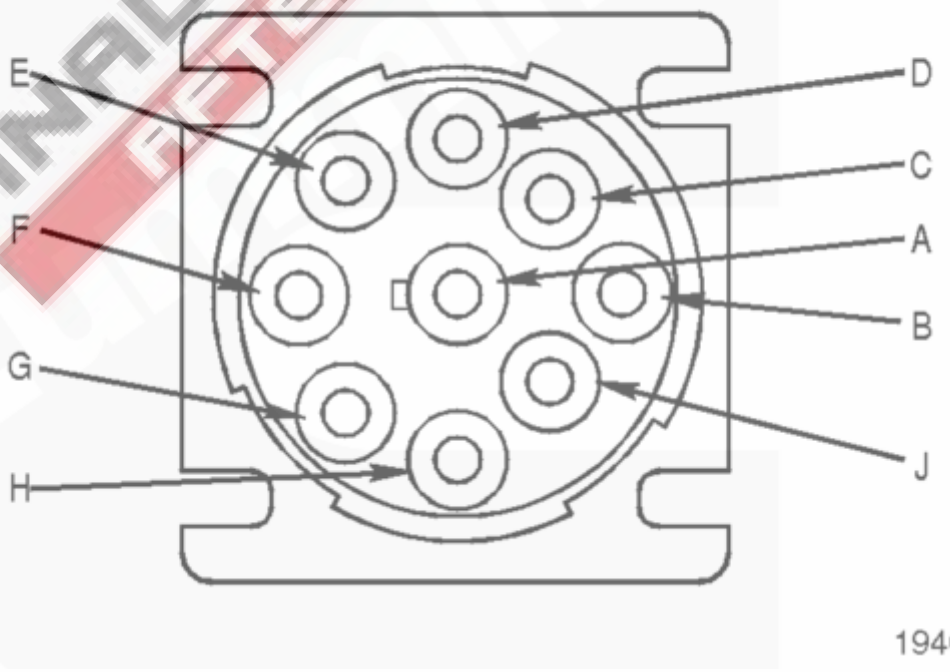
- Measure the resistance from each pin in the 8 pin connector to the corresponding location in the ECM connector. See wiring diagram for the ECM for connector pin identification. The multimeter **must** show a closed circuit (10 ohms or less). If a circuit is **not** closed, replace the bench calibration cable.

⚠ CAUTION ⚠

To avoid the possibility of damage to connector pins, use male test lead, Part Number 3823993, on the 9 pin Deutsch™ connector. Use male test lead, Part Number 3822758, on the 25 pin connector.



9 Pin Data Link Cable, Part Number 3165159



9 Pin In-Cab Data Link Connector

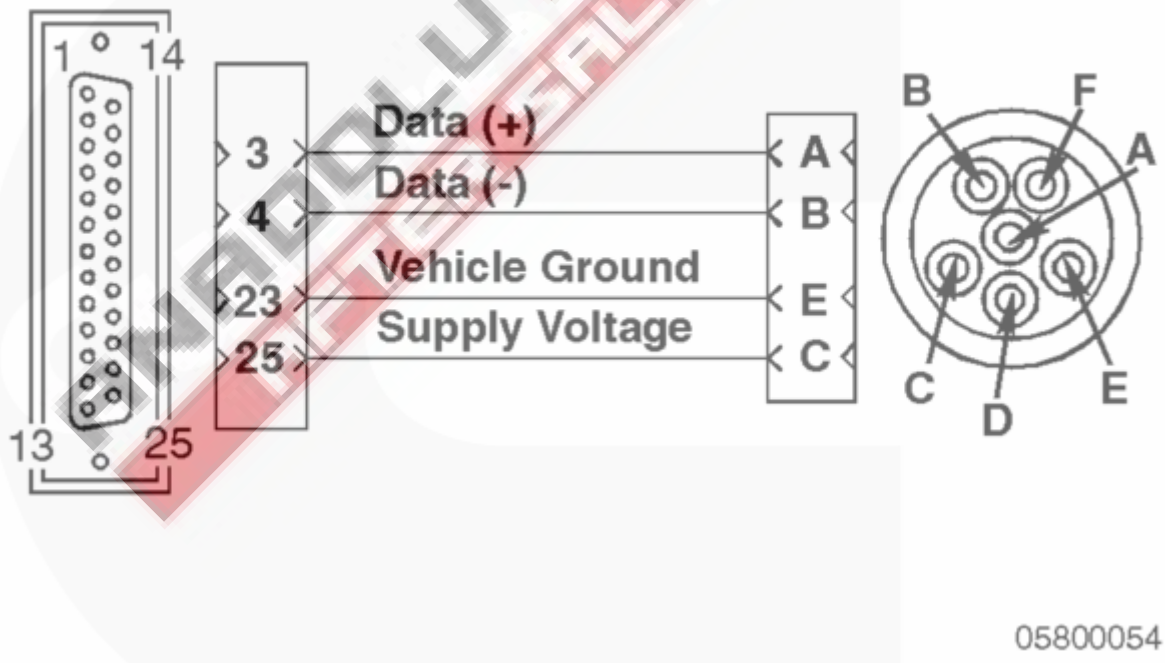
- A. Ground

- B. Battery (+)
- C. J1939 data link (+)
- D. J1939 data link (-)
- E. J1939 data link shield
- F. J1708 data link (+)
- G. J1708 data link (-)
- H. Open
- J. Open

- Measure the resistance from pins A, B, C, D, E, F, and G in the 9 pin connector to the corresponding location in the 25 pin connector, as shown. The multimeter **must** show a closed circuit (10 ohms or less). If a circuit is **not** closed, replace the data link cable.

⚠ CAUTION ⚠

To avoid the possibility of damage to connector pins, use male test lead, Part Number 3824811, on the 6 pin Deutsch™ connector. Use male test lead, Part Number 3822758, on the 25 pin connector.



6 Pin Data Link Cable, Part Number 3165160

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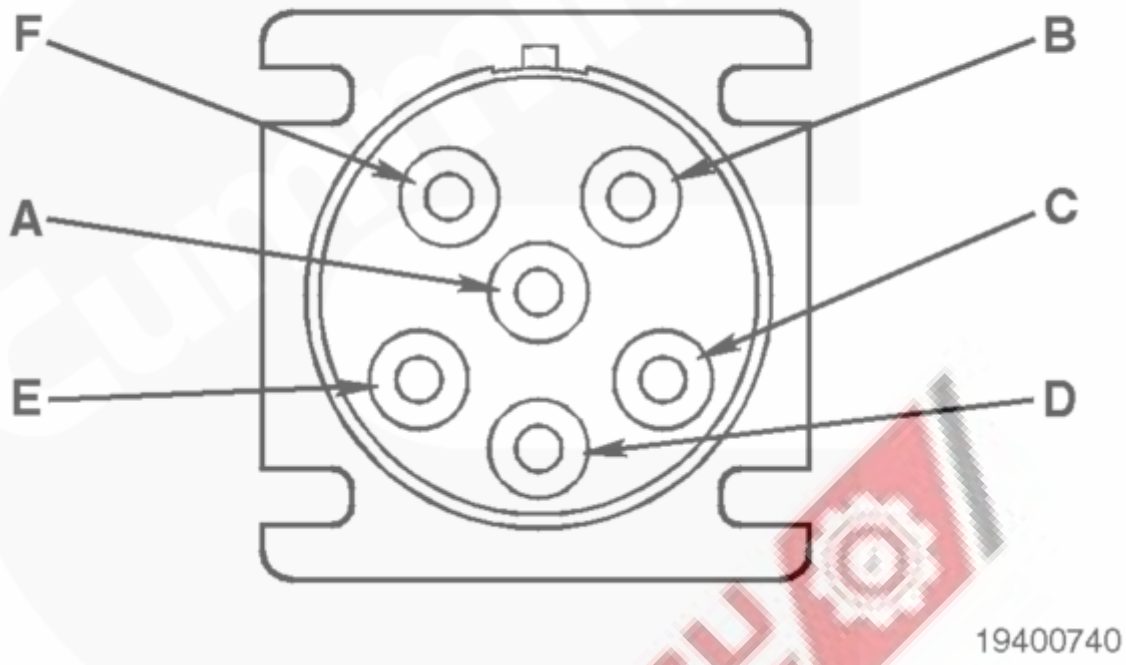

6 Pin In-Cab Data Link Connector

A. J1708 data link (+)
B. J1708 data link (-)
C. Battery (+)
D. Open
E. Ground
F. Open.

- Measure the resistance from pins A, B, C, and E in the 6 pin connector to the corresponding location in the 25 pin connector, as shown. The multimeter **must** show a closed circuit (10 ohms or less). If a circuit is **not** closed, replace the data link cable.

⚠ CAUTION ⚠

To avoid the possibility of damage to the connector pins, use male test lead, Part Number 3822758, on the 25 pin connector. Use female test lead, Part Number 3823994, on the 3 pin connector. Use male test lead, Part Number 3822995, on the 2 pin power connector.

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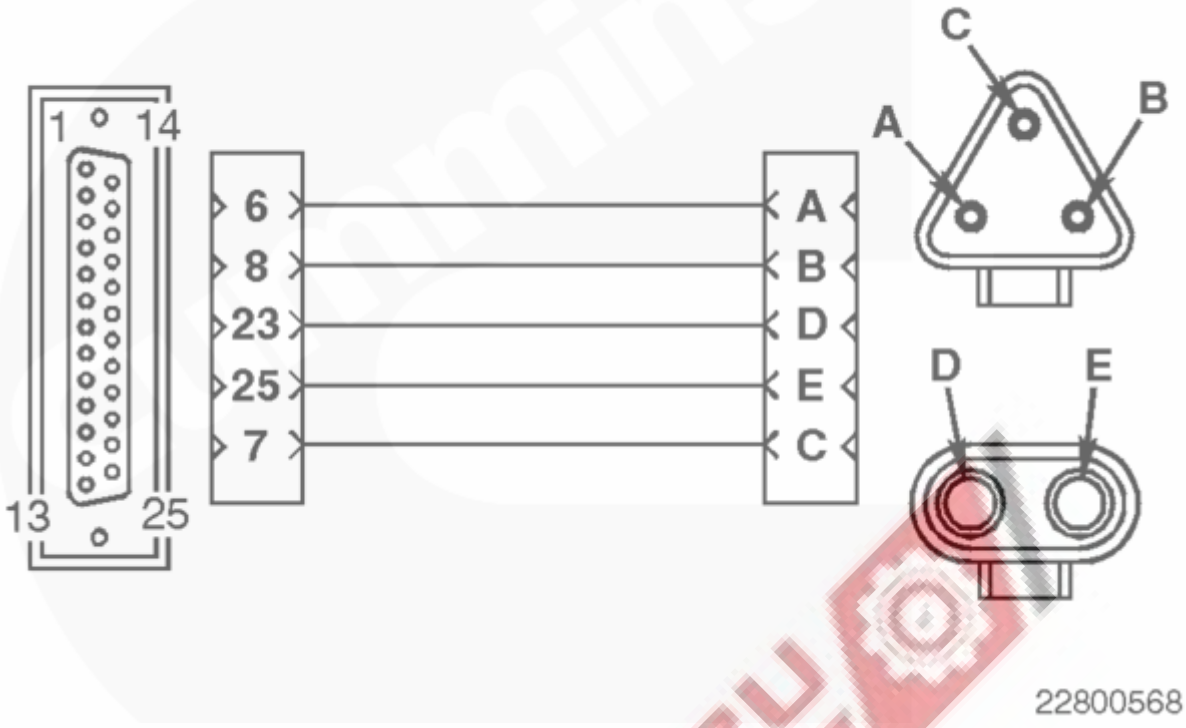
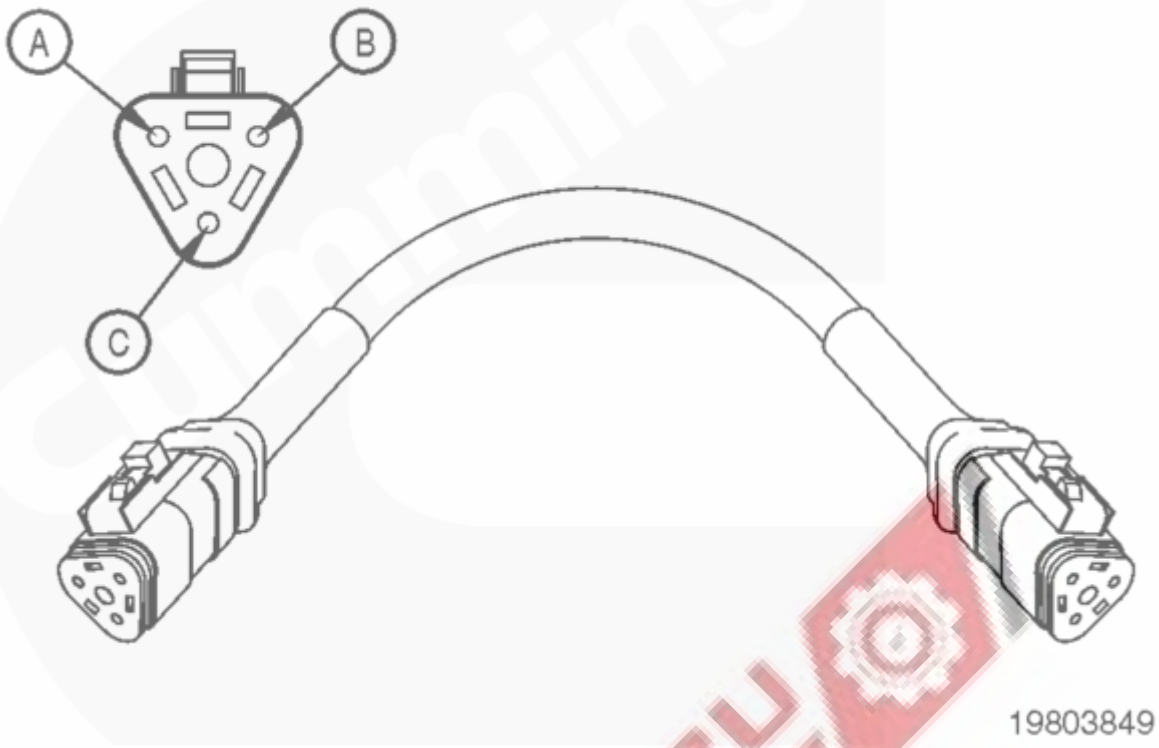


3 Pin Data Link Cable, Part Number 3165141

- Measure the resistance from pins A, B, and C in the 3 pin connector to the corresponding location in the 25 pin connector, as shown. Measure the resistance from pins D and E in the 2 pin power supply connector to the corresponding location in the 5 pin connector, as shown. The multimeter **must** show a closed circuit (10 ohms or less). If a circuit is **not** closed, replace the data link cable.

⚠ CAUTION ⚠

To avoid the possibility of damage to connector pins, use two male test leads, Part Number 3823993, on each 3 pin connector.



Mini Backbone Cable, Part Number 3163096

- Measure the resistance from pin A in one end of the backbone cable to pin A in the opposite end of the backbone cable. Repeat for pins B and C. The multimeter **must** show a closed circuit (10 ohms or less). If a circuit is **not** closed, replace the backbone cable. Measure the resistance across pins A and B at either end of the cable to measure the terminating resistance. The terminating resistance value **must** measure between 50 to 70 ohms.

⚠ CAUTION ⚠

To avoid the possibility of damage to connector pins, use two female test leads, Part Number 3823994, on each 3 pin connector.

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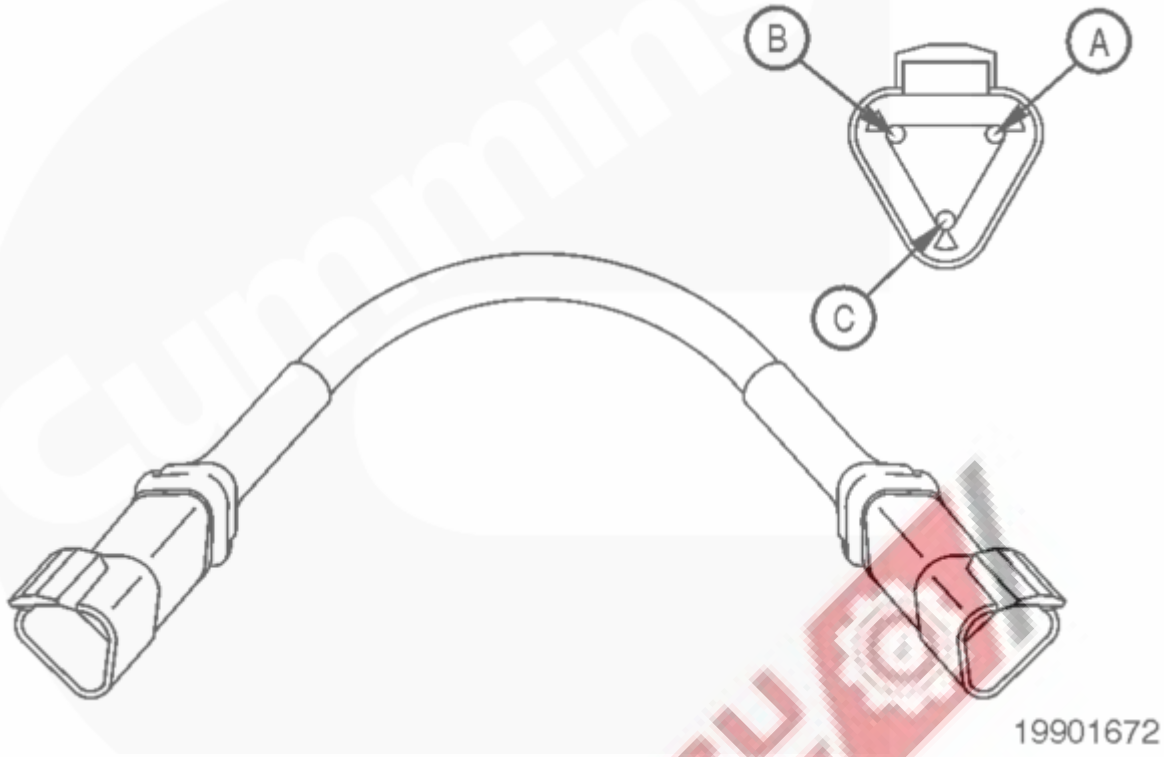
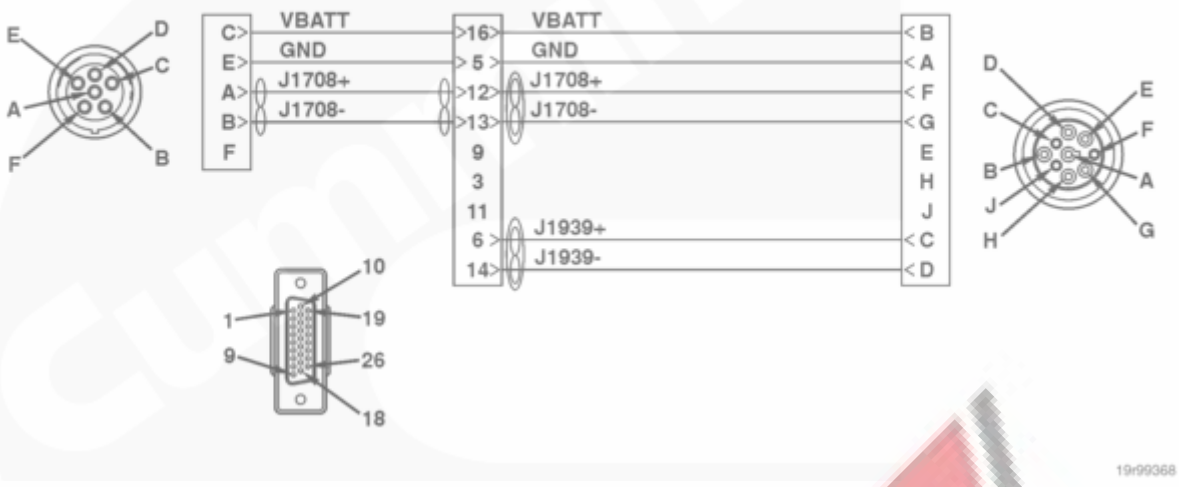


Gender Changer Cable, Part Number 3163597

- Measure the resistance from pin A in one end of the gender changer cable to pin A in the opposite end of the gender changer cable. Repeat for pins B and C. The multimeter **must** show a closed circuit (10 ohms or less). If a circuit is **not** closed, replace the gender changer cable.

⚠ CAUTION ⚠

To avoid the possibility of damage to connector pins, use two male test leads, Part Number 3164113, on the 26 pin connector to the INLINE™ 7. Use male test lead, Part Number 3824811, on the 6 pin Deutsch™ connector. Use male test lead, Part Number 3823993, on the 9 pin Deutsch™ connector.



INLINE™ 7 Data Link Cable

6 Pin Deutsch™ Connector Troubleshooting

- Measure the resistance from pins A, B, C, and E in the 6 pin connector to the corresponding location in the 26 pin connector, as shown. The multimeter **must** show a closed circuit (10 ohms or less). If a circuit is **not** closed, replace the data link cable.

9 Pin Deutsch™ Connector Troubleshooting

- Measure the resistance from pins A, B, C, D, E, F, and G in the 9 pin connector to the corresponding location in the 26 pin connector, as shown. The multimeter **must** show a closed circuit (10 ohms or less). If a circuit is **not** closed, replace the data link cable.

Last Modified: 15-Feb-2021

General Information

This section provides guidance on how to properly disassemble the engine. Cummins Inc. recommends that the product be disassembled according to the disassembly procedure in this section.

If your product is equipped with a component or accessory **not** manufactured or supplied by Cummins Inc., see the removal instructions provided by the component manufacturer.

Always follow general safety instructions when servicing products. See General Safety Instructions procedure in Section I.

Always follow general cleaning instructions when servicing products. See General Cleaning Instructions procedure in Section I.

Prior to beginning engine disassembly, the following should be completed.

- Customer supplied components or accessories should be removed
- Engine removed from chassis and installed on a stand (if applicable). See Engine Removal Procedure in Section 0.

Procedures required to disassemble the engine are listed in order from removing the first item to removing the last item and completing engine disassembly. The procedures can be found using the reference information listed.

Multiple steps are included in procedures for basic repair and troubleshooting information, but **not** all of them should be completed when disassembling an engine. The Engine Disassembly procedure indicates which step(s) should be completed for the designated procedure.

Steps titled “Clean,” “Inspect for Reuse,” or “Clean and Inspect for Reuse” are all covered in one column titled “Clean and Inspect for Reuse.” Perform the steps as applicable in the procedure. If the “Clean and Inspect for Reuse” column is marked, complete the Clean and Inspect for Reuse steps, no matter how they are divided in the procedure.

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Disassemble

Order	Procedure	Procedure Number	Notes	Remove	Disassemble	Clean/Inspect for Reuse
1	Lubricating Oil Filter (Spin-On) (/qs3/pubsys2/xml/en/procedures/425/425-007-013-tr.html)	007-013		x		
2	Coolant Filter (/qs3/pubsys2/xml/en/procedures/425/425-008-006-tr.html)	008-006		x		
3	Fuel Filter (Spin-On Type) (/qs3/pubsys2/xml/en/procedures/425/425-006-015-tr.html)	006-015		x		
4	Drive Belt, Cooling Fan (/qs3/pubsys2/xml/en/procedures/425/425-008-002-tr.html)	008-002		x		

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5	Engine Support Bracket, Front (/qs3/pubsys2/xml/en/procedures/425/425-016-002.html)	016-002		x		x
6	Fan Spacer and Pulley (/qs3/pubsys2/xml/en/procedures/429/429-008-039.html)	008-039		x		x
7	Fan Hub, Belt Driven (/qs3/pubsys2/xml/en/procedures/425/425-008-036.html)	008-036		x		x
8	Belt Tensioner, Automatic (Water Pump) (/qs3/pubsys2/xml/en/procedures/425/425-008-080-tr.html)	008-080		x		

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9	Charging System Alternator (/qs3/pubsys2/xml/en/procedures/425/425-013-001-tr.html)	013-001		x		
10	Charging System Alternator Bracket (/qs3/pubsys2/xml/en/procedures/425/425-013-003.html)	013-003		x		
11	Drive Belt, Refrigerant Compressor (/qs3/pubsys2/xml/en/procedures/425/425-009-052.html)	009-052		x		
12	Refrigerant Compressor Mounting Bracket (/qs3/pubsys2/xml/en/procedures/425/425-009-055.html)	009-055		x		x

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13	Coolant Filter Head (/qs3/pubsys2/xml/en/procedures/425/425-008-007.html)	008-007		x		x
14	Coolant Thermostat (/qs3/pubsys2/xml/en/procedures/425/425-008-013.html)	008-013		x		x
15	Coolant Heater (/qs3/pubsys2/xml/en/procedures/425/425-008-011.html)	008-011		x		x
16	Water Pump (/qs3/pubsys2/xml/en/procedures/425/425-008-062.html)	008-062		x		x
17	Water Inlet Connection (/qs3/pubsys2/xml/en/procedures/425/425-008-082.html)	008-082		x		x

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18	Engine Support Bracket, Rear (/qs3/pubsys2/xml/en/procedures/425/425-016-003.html)	016-003		x		x
19	Starting Motor (/qs3/pubsys2/xml/en/procedures/425/425-013-020-tr.html)	013-020		x		x
20	Flexplate (/qs3/pubsys2/xml/en/procedures/425/425-016-004.html)	016-004		x		
21	Flywheel (/qs3/pubsys2/xml/en/procedures/425/425-016-005.html)	016-005		x	x	x
22	Crankshaft Seal Carrier, Rear (/qs3/pubsys2/xml/en/procedures/100/100-001-104.html)	001-104		x		x

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23	Flywheel Housing (/qs3/pubsys2/xml/en/procedures/425/425-016-006.html)	016-006		x	x	x
24	Lubricating Oil Dipstick Tube (/qs3/pubsys2/xml/en/procedures/425/425-007-011.html)	007-011		x		
25	Turbocharger Compressor Outlet Connection (/qs3/pubsys2/xml/en/procedures/425/425-010-132.html)	010-132		x		x
26	Turbocharger Coolant Hoses (/qs3/pubsys2/xml/en/procedures/425/425-010-041.html)	010-041		x	x	x

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27	Turbocharger Oil Drain Line (/qs3/pubsys2/xml/en/procedures/425/425-010-045.html)	010-045		x	x	x
28	Turbocharger Oil Supply Line (/qs3/pubsys2/xml/en/procedures/425/425-010-046.html)	010-046		x		x
29	Turbocharger (/qs3/pubsys2/xml/en/procedures/425/425-010-033.html)	010-033		x		x
30	Turbocharger Heat Shield (/qs3/pubsys2/xml/en/procedures/425/425-010-076.html)	010-076		x		x
31	EGR Connection Tubes (/qs3/pubsys2/xml/en/procedures/425/425-011-025.html)	011-025		x		x

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32	Exhaust Gas Pressure Sensor Tube (/qs3/pubsys2/xml/en/procedures/425/425-011-027.html)	011-027		x		x
33	Coolant Vent Lines (/qs3/pubsys2/xml/en/procedures/425/425-008-017.html)	008-017		x		x
34	EGR Cooler Coolant Lines (/qs3/pubsys2/xml/en/procedures/425/425-011-031.html)	011-031		x		x
35	EGR Cooler (/qs3/pubsys2/xml/en/procedures/425/425-011-019.html)	011-019		x		
36	Exhaust Manifold, Dry (/qs3/pubsys2/xml/en/procedures/425/425-011-007.html)	011-007		x	x	x

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37	EGR Cooler Mounting Bracket (/qs3/pubsys2/xml/en/procedures/425/425-011-029.html)	011-029		x		x
38	Lubricating Oil Cooler (/qs3/pubsys2/xml/en/procedures/425/425-007-003.html)	007-003		x		x
39	Crankcase Breather Tube (/qs3/pubsys2/xml/en/procedures/425/425-003-018.html)	003-018		x		x
40	EGR Valve (/qs3/pubsys2/xml/en/procedures/425/425-011-022.html)	011-022		x		x
41	Lubricating Oil Cooler (/qs3/pubsys2/xml/en/procedures/429/429-007-003.html)	007-003		x	x	x

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42	Air Intake Connection Adapter (/qs3/pubsys2/xml/en/procedures/425/425-010-131.html)	010-131		x		x
43	Engine Intake Throttle Actuator (/qs3/pubsys2/xml/en/procedures/425/425-010-140.html)	010-140		x		x
44	Air Intake Connection (/qs3/pubsys2/xml/en/procedures/425/425-010-080.html)	010-080		x		x
45	Fuel Supply Lines (/qs3/pubsys2/xml/en/procedures/425/425-006-024.html)	006-024		x		
46	Fuel Drain Lines (/qs3/pubsys2/xml/en/procedures/425/425-006-013.html)	006-013		x		

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47	Fuel Filter Head Bracket (/qs3/pubsys2/xml/en/procedures/425/425-006-018.html)	006-018		x		
48	Injector Supply Lines (High Pressure) (/qs3/pubsys2/xml/en/procedures/425/425-006-051.html)	006-051		x		x
49	Fuel Connector (Head Mounted) (/qs3/pubsys2/xml/en/procedures/425/425-006-052.html)	006-052		x		
50	Fuel Rail (/qs3/pubsys2/xml/en/procedures/425/425-006-060.html)	006-060		x	x	
51	Fuel Pump (/qs3/pubsys2/xml/en/procedures/425/425-005-016.html)	005-016		x		

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52	Air Compressor Coolant Lines (/qs3/pubsys2/xml/en/procedures/425/425-012-004.html)	012-004		x		
53	Air Compressor Oil Supply Line (/qs3/pubsys2/xml/en/procedures/425/425-012-110.html)	012-110		x		x
54	Air Compressor (/qs3/pubsys2/xml/en/procedures/425/425-012-014.html)	012-014		x	x	x
55	Air Intake Manifold (/qs3/pubsys2/xml/en/procedures/425/425-010-023.html)	010-023		x		x

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56	Crankcase Breather (External) (/qs3/pubsys2/xml/en/procedures/425/425-003-001.html)	003-001		x		x
57	Rocker Lever Cover (/qs3/pubsys2/xml/en/procedures/425/425-003-011.html)	003-011		x		x
58	Engine Brake Assembly (/qs3/pubsys2/xml/en/procedures/425/425-020-004-tr.html)	020-004		x		x
59	Rocker Lever (/qs3/pubsys2/xml/en/procedures/425/425-003-008.html)	003-008		x		x
60	Crosshead (/qs3/pubsys2/xml/en/procedures/425/425-002-001.html)	002-001		x		x

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61	Push Rods or Tubes (/qs3/pubsys2/xml/en/procedures/425/425-004-014.html)	004-014		x		x
62	Injector (/qs3/pubsys2/xml/en/procedures/425/425-006-026.html)	006-026		x		x
63	Rocker Lever Housing (/qs3/pubsys2/xml/en/procedures/425/425-003-013.html)	003-013		x		x
64	Cylinder Head (/qs3/pubsys2/xml/en/procedures/425/425-002-004.html)	002-004		x	x	x
65	Crankshaft Adapter (/qs3/pubsys2/xml/en/procedures/425/425-001-017.html)	001-017		x		x

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66	Vibration Damper, Rubber (/qs3/pubsys2/xml/en/procedures/425/425-001-051.html)	001-051		x		
67	Vibration Damper, Viscous (/qs3/pubsys2/xml/en/procedures/425/425-001-052.html)	001-052		x		
68	Crankshaft Seal, Front (/qs3/pubsys2/xml/en/procedures/425/425-001-023.html)	001-023		x		x
69	Gear Cover, Front (/qs3/pubsys2/xml/en/procedures/425/425-001-031.html)	001-031		x		x
70	Lubricating Oil Pump (/qs3/pubsys2/xml/en/procedures/425/425-007-031.html)	007-031		x	x	x

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71	Engine Oil Heater (/qs3/pubsys2/xml/en/procedures/425/425-007-001.html)	007-001		x		
72	Lubricating Oil Pan (/qs3/pubsys2/xml/en/procedures/425/425-007-025.html)	007-025		x		x
73	Lubricating Oil Suction Tube (Block-Mounted) (/qs3/pubsys2/xml/en/procedures/425/425-007-035.html)	007-035		x		x
74	Camshaft (/qs3/pubsys2/xml/en/procedures/425/425-001-008.html)	001-008		x		x
75	Tappet (/qs3/pubsys2/xml/en/procedures/425/425-004-015.html)	004-015		x		x

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76	Gear Housing, Front (/qs3/pubsys2/xml/en/procedures/425/425-001-033.html)	001-033		x		x
77	Piston Cooling Nozzle (/qs3/pubsys2/xml/en/procedures/425/425-001-046.html)	001-046		x		x
78	Piston and Connecting Rod Assembly (/qs3/pubsys2/xml/en/procedures/425/425-001-054.html)	001-054		x	x	x
79	Cylinder Liner (/qs3/pubsys2/xml/en/procedures/425/425-001-028.html)	001-028		x		x
80	Bearings, Main (/qs3/pubsys2/xml/en/procedures/425/425-001-006.html)	001-006		x		x

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81	Crankshaft (/qs3/pubsys2/xml/en/procedures/425/425-001-016.html)	001-016		x		x
82	Camshaft Bushings (/qs3/pubsys2/xml/en/procedures/425/425-001-010.html)	001-010		x		x

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ANADOLU ISUZU AFTER SALES

General Information

This section provides guidance on how to properly assemble the engine. Cummins Inc. recommends that the product be assembled according to the assembly procedure in this section.

If your product is equipped with a component or accessory **not** manufactured or supplied by Cummins Inc., see the installation instructions provided by the component manufacturer.

Always follow general safety instructions when servicing products. See General Safety Instructions procedure in Section I.

Always follow general cleaning instructions when servicing products. See General Cleaning Instructions procedure in Section I.

Procedures required to assemble the engine are listed in order from installing the first item to installing the last item and completing engine assembly. The procedures can be found using the reference information listed.

Multiple steps are included in procedures for basic repair and troubleshooting information, but **not** all of them should be completed when assembling an engine. The Engine Assembly procedure indicates which step(s) should be completed for the designated procedure.

After assembling the engine, the following may need to be performed.

- Validate the engine assembly.
- Install the engine in-chassis. See Engine Installation procedure in Section 0.
- Install customer supplied components or accessories as needed. See equipment manufacturer service information.

For engine storage less than 6 months, complete the following:

- Prevent dirt and moisture from entering the engine.
- Cover all open ports of the engine. Utilize heavy paper, plastic, and tape.
- Cover the engine with plastic.

For engine storage greater than 6 months, follow the specified long term storage instructions. See Engine Storage - Long Term procedure in section 0.

Last Modified: 29-May-2015

Assemble

Order	Procedure	Procedure Number	Notes	Assemble	Install	Measure
1	Crankshaft Seal Carrier, Rear (/qs3/pubsys2/xml/en/procedures/100/100-001-104.html)	001-104			x	
2	Camshaft Bushings (/qs3/pubsys2/xml/en/procedures/425/425-001-010.html)	001-010			x	
3	Crankshaft (/qs3/pubsys2/xml/en/procedures/425/425-001-016.html)	001-016			x	
4	Bearings, Main (/qs3/pubsys2/xml/en/procedures/425/425-001-006.html)	001-006			x	

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5	Cylinder Liner (/qs3/pubsys2/xml/en/procedures/425/425-001-028.html)	001-028			x	
6	Piston and Connecting Rod Assembly (/qs3/pubsys2/xml/en/procedures/425/425-001-054.html)	001-054		x	x	
7	Piston Cooling Nozzle (/qs3/pubsys2/xml/en/procedures/425/425-001-046.html)	001-046			x	
8	Gear Housing, Front (/qs3/pubsys2/xml/en/procedures/425/425-001-033.html)	001-033			x	
9	Tappet (/qs3/pubsys2/xml/en/procedures/425/425-004-015.html)	004-015			x	

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10	Camshaft (/qs3/pubsys2/xml/en/procedures/425/425-001-008.html)	001-008			x	
11	Lubricating Oil Suction Tube (Block-Mounted) (/qs3/pubsys2/xml/en/procedures/425/425-007-035.html)	007-035			x	
12	Lubricating Oil Pan (/qs3/pubsys2/xml/en/procedures/425/425-007-025.html)	007-025			x	
13	Engine Oil Heater (/qs3/pubsys2/xml/en/procedures/425/425-007-001.html)	007-001			x	
14	Lubricating Oil Pump (/qs3/pubsys2/xml/en/procedures/425/425-007-031.html)	007-031		x	x	x

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15	Gear Cover, Front (/qs3/pubsys2/xml/en/procedures/425/425-001-031.html)	001-031			x	
16	Crankshaft Seal, Front (/qs3/pubsys2/xml/en/procedures/425/425-001-023.html)	001-023			x	
17	Vibration Damper, Viscous (/qs3/pubsys2/xml/en/procedures/425/425-001-052.html)	001-052			x	
18	Vibration Damper, Rubber (/qs3/pubsys2/xml/en/procedures/425/425-001-051.html)	001-051			x	
19	Crankshaft Adapter (/qs3/pubsys2/xml/en/procedures/425/425-001-017.html)	001-017			x	

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20	Cylinder Head (/qs3/pubsys2/xml/en/procedures/425/425-002-004.html)	002-004		x	x	
21	Rocker Lever Housing (/qs3/pubsys2/xml/en/procedures/425/425-003-013.html)	003-013			x	
22	Injector (/qs3/pubsys2/xml/en/procedures/425/425-006-026.html)	006-026			x	
23	Flywheel Housing (/qs3/pubsys2/xml/en/procedures/425/425-016-006.html)	016-006		x	x	x
24	Flywheel (/qs3/pubsys2/xml/en/procedures/425/425-016-005.html)	016-005		x	x	x
25	Flexplate (/qs3/pubsys2/xml/en/procedures/425/425-016-004.html)	016-004			x	

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26	Push Rods or Tubes (/qs3/pubsys2/xml/en/procedures/425/425-004-014.html)	004-014			x	
27	Crosshead (/qs3/pubsys2/xml/en/procedures/425/425-002-001.html)	002-001			x	
28	Rocker Lever (/qs3/pubsys2/xml/en/procedures/425/425-003-008.html)	003-008			x	
29	Engine Brake Assembly (/qs3/pubsys2/xml/en/procedures/425/425-020-004-tr.html)	020-004	Adjust		x	
30	Overhead Set (/qs3/pubsys2/xml/en/procedures/425/425-003-004-tr.html)	003-004	Adjust			

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31	Rocker Lever Cover (/qs3/pubsys2/xml/en/procedures/425/425-003-011.html)	003-011			x	
32	Crankcase Breather (External) (/qs3/pubsys2/xml/en/procedures/425/425-003-001.html)	003-001			x	
33	Air Intake Manifold (/qs3/pubsys2/xml/en/procedures/425/425-010-023.html)	010-023			x	
34	Air Compressor (/qs3/pubsys2/xml/en/procedures/425/425-012-014.html)	012-014		x	x	
35	Air Compressor Oil Supply Line (/qs3/pubsys2/xml/en/procedures/425/425-012-110.html)	012-110			x	

ANADOLU ISUZU
PARTS SALES

36	Air Compressor Coolant Lines (/qs3/pubsys2/xml/en/procedures/425/425-012-004.html)	012-004			x	
37	Fuel Pump (/qs3/pubsys2/xml/en/procedures/425/425-005-016.html)	005-016			x	
38	Fuel Rail (/qs3/pubsys2/xml/en/procedures/425/425-006-060.html)	006-060	x		x	
39	Fuel Connector (Head Mounted) (/qs3/pubsys2/xml/en/procedures/425/425-006-052.html)	006-052			x	
40	Injector Supply Lines (High Pressure) (/qs3/pubsys2/xml/en/procedures/425/425-006-051.html)	006-051			x	

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41	Fuel Filter Head Bracket (/qs3/pubsys2/xml/en/procedures/425/425-006-018.html)	006-018			x	
42	Fuel Drain Lines (/qs3/pubsys2/xml/en/procedures/425/425-006-013.html)	006-013			x	
43	Fuel Supply Lines (/qs3/pubsys2/xml/en/procedures/425/425-006-024.html)	006-024			x	
44	Air Intake Connection (/qs3/pubsys2/xml/en/procedures/425/425-010-080.html)	010-080			x	
45	Engine Intake Throttle Actuator (/qs3/pubsys2/xml/en/procedures/425/425-010-140.html)	010-140			x	

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46	Air Intake Connection Adapter (/qs3/pubsys2/xml/en/procedures/425/425-010-131.html)	010-131			x	
47	EGR Valve (/qs3/pubsys2/xml/en/procedures/425/425-011-022.html)	011-022			x	
48	Crankcase Breather Tube (/qs3/pubsys2/xml/en/procedures/425/425-003-018.html)	003-018			x	
49	Lubricating Oil Cooler (/qs3/pubsys2/xml/en/procedures/425/425-007-003.html)	007-003			x	
50	EGR Cooler Mounting Bracket (/qs3/pubsys2/xml/en/procedures/425/425-011-029.html)	011-029			x	

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51	Exhaust Manifold, Dry (/qs3/pubsys2/xml/en/procedures/425/425-011-007.html)	011-007		x	x	
52	EGR Cooler (/qs3/pubsys2/xml/en/procedures/425/425-011-019.html)	011-019			x	
53	EGR Cooler Coolant Lines (/qs3/pubsys2/xml/en/procedures/425/425-011-031.html)	011-031			x	
54	Exhaust Gas Pressure Sensor Tube (/qs3/pubsys2/xml/en/procedures/425/425-011-027.html)	011-027			x	
55	Coolant Vent Lines (/qs3/pubsys2/xml/en/procedures/425/425-008-017.html)	008-017			x	

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56	EGR Connection Tubes (/qs3/pubsys2/xml/en/procedures/425/425-011-025.html)	011-025			x	
57	Turbocharger Heat Shield (/qs3/pubsys2/xml/en/procedures/425/425-010-076.html)	010-076			x	
58	Turbocharger (/qs3/pubsys2/xml/en/procedures/425/425-010-033.html)	010-033			x	
59	Turbocharger Oil Supply Line (/qs3/pubsys2/xml/en/procedures/425/425-010-046.html)	010-046			x	
60	Turbocharger Oil Drain Line (/qs3/pubsys2/xml/en/procedures/425/425-010-045.html)	010-045		x	x	

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61	Turbocharger Coolant Hoses (/qs3/pubsys2/xml/en/procedures/425/425-010-041.html)	010-041		x	x	
62	Turbocharger Compressor Outlet Connection (/qs3/pubsys2/xml/en/procedures/425/425-010-132.html)	010-132			x	
63	Lubricating Oil Dipstick Tube (/qs3/pubsys2/xml/en/procedures/425/425-007-011.html)	007-011			x	
64	Crankshaft Seal, Rear (/qs3/pubsys2/xml/en/procedures/100/100-001-024.html)	001-024			x	

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65	Starting Motor (/qs3/pubsys2/xml/en/procedures/425/425-013-020-tr.html)	013-020			x	x
66	Engine Support Bracket, Rear (/qs3/pubsys2/xml/en/procedures/425/425-016-003.html)	016-003			x	
67	Water Inlet Connection (/qs3/pubsys2/xml/en/procedures/425/425-008-082.html)	008-082			x	
68	Water Pump (/qs3/pubsys2/xml/en/procedures/425/425-008-062.html)	008-062			x	
69	Coolant Heater (/qs3/pubsys2/xml/en/procedures/425/425-008-011.html)	008-011			x	

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70	Coolant Thermostat (/qs3/pubsys2/xml/en/procedures/425/425-008-013.html)	008-013			x	
71	Coolant Filter Head (/qs3/pubsys2/xml/en/procedures/425/425-008-007.html)	008-007			x	
72	Water Inlet Connection (/qs3/pubsys2/xml/en/procedures/425/425-008-082.html)	008-082			x	
73	Refrigerant Compressor Mounting Bracket (/qs3/pubsys2/xml/en/procedures/425/425-009-055.html)	009-055			x	

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74	Drive Belt, Refrigerant Compressor (/qs3/pubsys2/xml/en/procedures/425/425-009-052.html)	009-052			x	
75	Charging System Alternator Bracket (/qs3/pubsys2/xml/en/procedures/425/425-013-003.html)	013-003			x	
76	Charging System Alternator (/qs3/pubsys2/xml/en/procedures/425/425-013-001-tr.html)	013-001			x	
77	Belt Tensioner, Automatic (Water Pump) (/qs3/pubsys2/xml/en/procedures/425/425-008-080-tr.html)	008-080			x	

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78	Fan Hub, Belt Driven (/qs3/pubsys2/xml/en/procedures/425/425-008-036.html)	008-036			x	
79	Fan Spacer and Pulley (/qs3/pubsys2/xml/en/procedures/425/425-008-039.html)	008-039			x	
80	Engine Support Bracket, Front (/qs3/pubsys2/xml/en/procedures/425/425-016-002.html)	016-002			x	
81	Drive Belt, Cooling Fan (/qs3/pubsys2/xml/en/procedures/425/425-008-002-tr.html)	008-002			x	

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82	Fuel Filter (Spin-On Type) (/qs3/pubsys2/xml/en/procedures/425/425-006-015-tr.html)	006-015			x	
83	Coolant Filter (/qs3/pubsys2/xml/en/procedures/425/425-008-006-tr.html)	008-006			x	
84	Lubricating Oil Filter (Spin-On) (/qs3/pubsys2/xml/en/procedures/425/425-007-013-tr.html)	007-013			x	x

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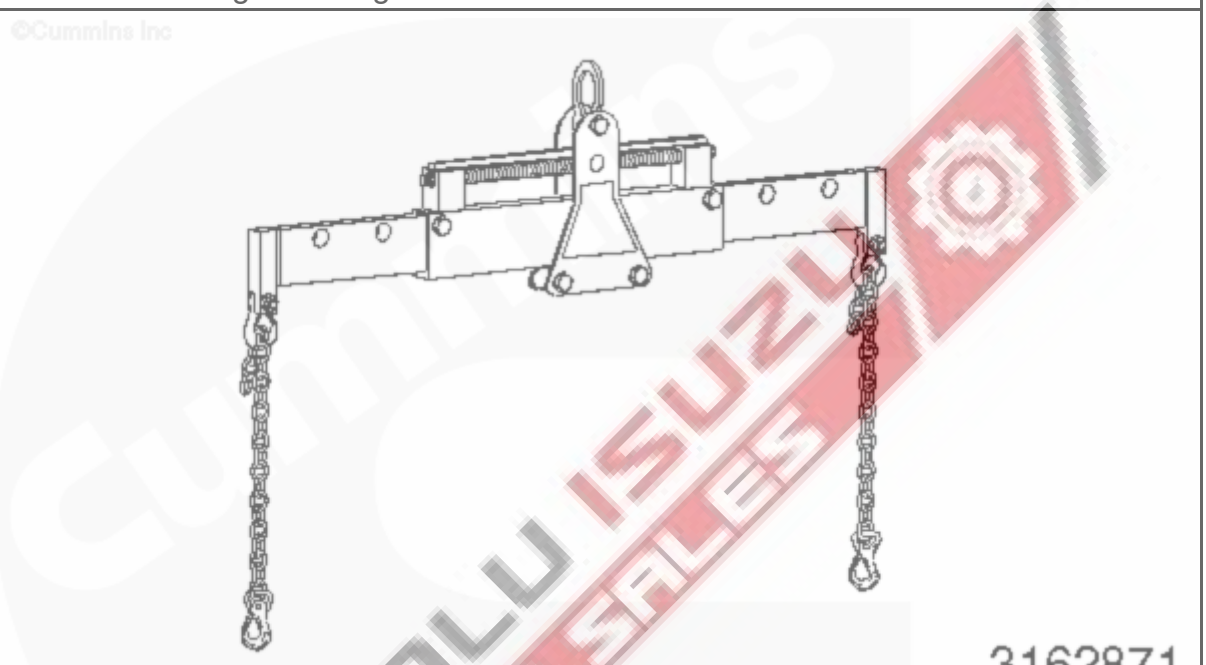
Last Modified: 24-Sep-2018

Engine Disassembly/Assembly

Tool Number
3162871
Engine Lifting Fixture Used to lift the engine during removal and installation.


Tool Number
3375194 or 3375193
Engine Rebuild Stand Part Number 3375194 is a portable stand with iron wheels. Part Number 3375193 is a stationary stand.

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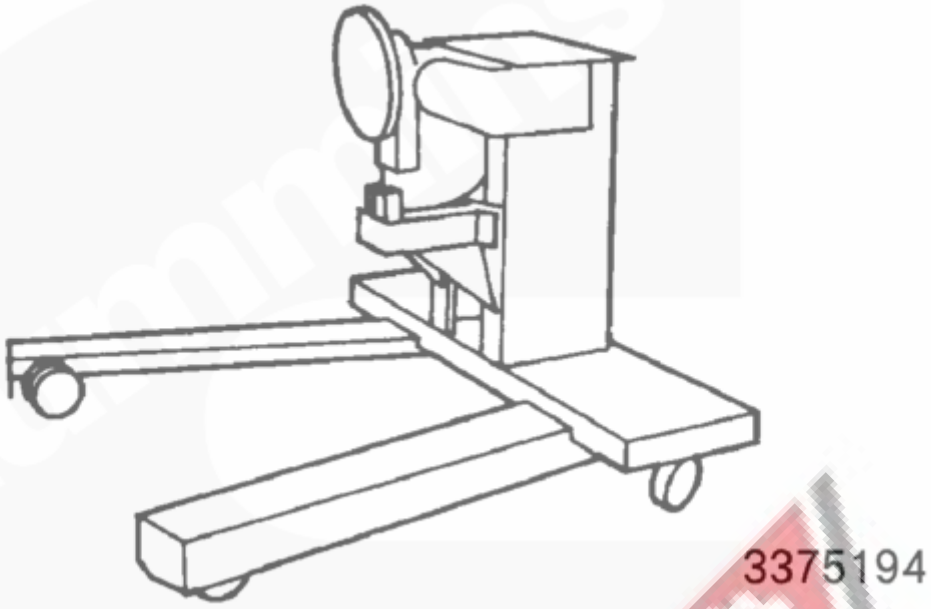
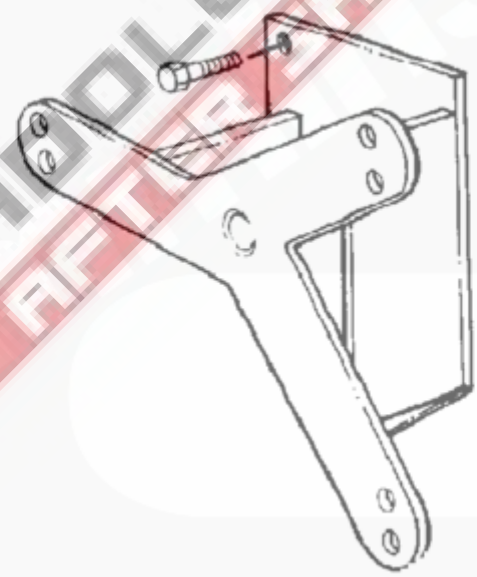


Tool Number

3822607

Engine Stand Adapter Plate

Used to mount the engine to the rebuild stand.



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Select Service Tools

Recommended Cummins® Service Tools

- No Cummins® Service Tools required.

Additional Service Items

- No additional service items required.

Remove

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.



⚠ WARNING ⚠

Do not remove the pressure cap from a hot engine. Wait until the coolant temperature is below 50°C [120°F] before removing the pressure cap. Heated coolant spray or steam can cause personal injury.

⚠ WARNING ⚠

Coolant is toxic. Keep away from children and pets. If not reused, dispose of in accordance with local environmental regulations.

⚠ WARNING ⚠

To reduce the possibility of personal injury, avoid direct contact of hot oil with your skin.

⚠ WARNING ⚠

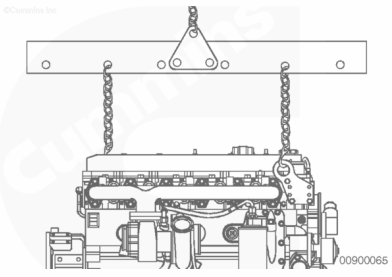
Some state and federal agencies have determined that used engine oil can be carcinogenic and cause reproductive toxicity. Avoid inhalation of vapors, ingestion, and prolonged contact with used engine oil. If not reused, dispose of in accordance with local environmental regulations.

- Place a tag on all hoses, lines, linkages, and electrical connections as they are removed to identify their locations.
- Disconnect the batteries. See equipment manufacturer service information.
- Drain the engine coolant. Refer to Procedure 008-018 in Section 8. (/qs3/pubsys2/xml/en/procedures/425/425-008-018-tr.html)
- Drain the lubricating oil. Refer to Procedure 007-037 in Section 7. (/qs3/pubsys2/xml/en/procedures/425/425-007-037.html)
- Disconnect the starter cable, engine ground straps, cab or chassis to engine hoses, tubing, electrical wires, wire harnesses, and hydraulic lines.
- Disconnect the drive units from the flywheel. See equipment manufacturer service information.
- Remove all chassis components necessary to remove the engine from the equipment.
- Cover all engine openings to prevent dirt and debris from entering the engine.

Note : On applications where the rear engine mounts are attached to the transmission, it will often be necessary to remove the engine and transmission as an assembly. See equipment manufacturer service information.

⚠ WARNING ⚠

The engine lifting equipment must be designed to lift the engine and transmission as an assembly without causing personal injury.



Use a properly rated hoist and engine lifting fixture, attached to the engine-mounted lifting brackets, to remove the engine. Refer to Procedure 018-015 in Section V. (/qs3/pubsys2/xml/en/procedures/425/425-018-015.html)

Note : If the transmission is **not** removed with the engine, place a support under the transmission to prevent it from falling before removing the engine.

Place the engine on suitable engine support stands.

Remove all remaining accessories and brackets to use with the replacement engine.

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Select Service Tools

Recommended Cummins® Service Tools

- No Cummins® Service Tools required.

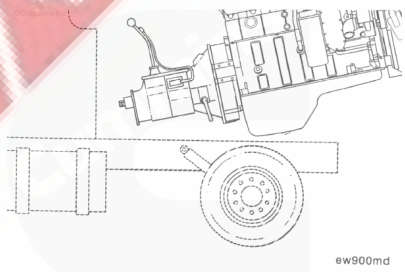
Additional Service Items

- No additional service items required.

Install

⚠ WARNING ⚠

The engine lifting equipment must be designed to lift the engine and transmission as an assembly without causing personal injury.



Install all accessories and brackets removed.

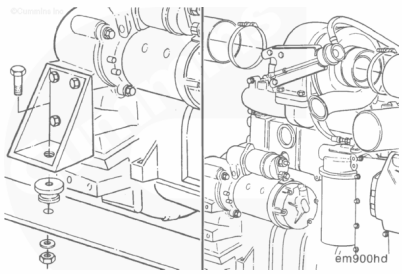
Note : On applications where the rear engine mounts are attached to the transmission, it will often be necessary to install the engine and transmission as an assembly.

Use a properly rated hoist and engine lifting fixture, attached to the engine-mounted lifting brackets, to install the engine.

Use the following procedure for engine weights. Refer to Procedure 018-015 in Section V. (/qs3/pubsys2/xml/en/procedures/425/425-018-015.html)

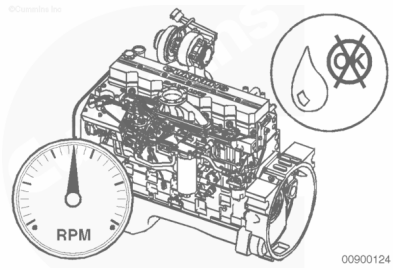
Align the engine in the chassis. Tighten the engine-mounting capscrews. See equipment manufacturer service information for torque specifications.

Connect all engine- and chassis-mounted accessories removed.



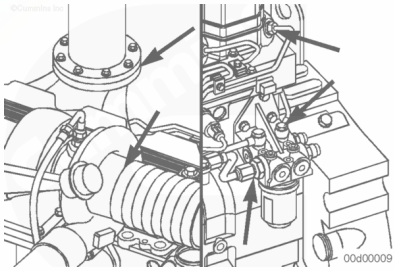
Note : Make sure all lines, hoses and tubes are properly routed and fastened to prevent damage.

Make sure the air intake and exhaust pipe connections are tight and free of leaks.



- Uncover all engine openings.
- Connect the drive units to the flywheel. See equipment manufacturer service information.
- Connect the starter cable, engine ground straps, cab or chassis to engine hoses, tubing, electrical wires, wire harnesses, and hydraulic lines.
- Fill the lubricating oil system. Refer to Procedure 007-037 in Section 7. (/qs3/pubsys2/xml/en/procedures/425/425-007-037.html)
- Fill the engine cooling system. Refer to Procedure 008-018 in Section 8. (/qs3/pubsys2/xml/en/procedures/425/425-008-018-tr.html)
- Connect the batteries. See equipment manufacturer service information.
- Remove all tags on all hoses, lines, linkages, and electrical connections.

Perform a final inspection to make sure all hoses, wires, linkages, and components have been properly installed and tightened.

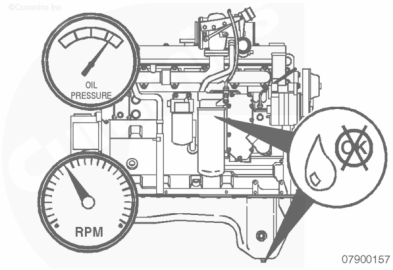


Crank the engine until the oil pressure gauge indicates a positive pressure.

Operate the engine at low idle for two to three minutes.

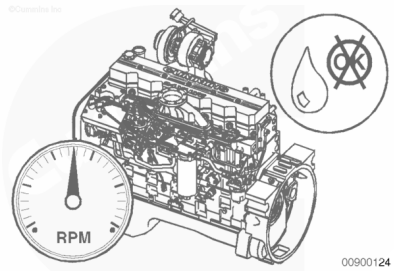
Shut off the engine. Wait five to seven minutes for the oil to drain to the oil pan. Check the oil and coolant levels again.

Fill the engine to the correct oil and coolant levels, if necessary.



Operate the engine at 1000 to 1200 rpm for eight to 10 minutes. Check for proper operation, unusual noises, coolant, or oil leaks.

Repair all leaks and component problems. Refer to Procedure 014-008 in Section 14. (/qs3/pubsys2/xml/en/procedures/425/425-014-008.html)



ANADOLU ISUZU AFTER SALES

Last Modified: 25-Jul-2016



General Information

Introduction

This procedure describes the proper method for placing an engine into long-term storage (more than 1 year), and returning a stored engine to service. The storage procedure applies to engines in running condition and applies whether the engine will remain in the equipment or will be removed for storage.

⚠ WARNING ⚠

Do not remove the pressure cap from a hot engine. Wait until the coolant temperature is below 50°C [122°F] before removing the pressure cap. Heated coolant spray or steam can cause personal injury.

⚠ WARNING ⚠

Coolant is toxic. Keep away from children and pets. If not reused, dispose of in accordance with local environmental regulations.

⚠ WARNING ⚠

To reduce the possibility of personal injury, avoid direct contact of hot oil with your skin.

⚠ WARNING ⚠

Some state and federal agencies have determined that used engine oil can be carcinogenic and cause reproductive toxicity. Avoid inhalation of vapors, ingestion, and prolonged contact with used engine oil. If not reused, dispose of in accordance with local environmental regulations.

⚠ CAUTION ⚠

Never use diesel fuel containing bio components for internal preservation of fuel system for engine storage. Fuel degradation may cause damage and lead to malfunction of fuel system components.

Preparing Spare or Rebuilt Engine for Long Term Storage

The steps below **only** apply to engines that are received directly from a Cummins Inc. assembly plant or a Master Rebuild Center.

- Apply a lightweight lubricant or rust preventative to machined surfaces that are **not** painted.

- Apply a lightweight lubricant or rust preventative to any internal cast surfaces, such as coolant inlet and outlet connections, that are visible and **not** painted.
- Cover engine and component openings with clean care caps or heavy paper and tape to prevent dirt and moisture from entering engine.
- Remove all external drive belts.
- Install appropriate desiccant on engine to absorb any moisture.
- Cover entire engine with plastic.
- Move engine or equipment to an appropriate storage area.
    - Storage area **must** be dry with uniform temperature. Recommended storage temperature is between -12˚C [10˚F] and 49˚C [120˚F], with relative humidity less than 60 percent.

Preparing an In-Use Engine for Long Term Storage

To prepare an engine for long term storage, complete the following steps. Reference corresponding service procedures as necessary.

- Change engine lubricating oil.
- Replace engine lubricating oil filters.
- Replace fuel filters.
- Verify fuel supply contains less than 5% bio components.
- Start engine. Operate engine under normal operating conditions for 25 minutes.
    - For further information on engine operating instructions, see corresponding Operation and Maintenance Manual. Reference Section 1.
- Turn engine off.
- If engine has been removed from equipment:
    - Drain engine lubricating oil.
    - Drain coolant.
    - Apply a lightweight lubricant or rust preventative to machined surfaces that are **not** painted.
    - Apply a lightweight lubricant or rust preventative to any internal cast surfaces, such as coolant inlet and outlet connections, that are visible and **not** painted.
- If engine has **not** been removed from equipment:
    - Verify cooling system is filled with an approved, fully formulated coolant.
    - Measure supplemental coolant additive (SCA) concentration and adjust, if necessary.
    - Check coolant quality annually during storage.
- If engine is equipped with a marine heat exchanger:
    - Drain raw water system
    - Flush raw water system
    - Drain water
- Cover all of engine and component openings with clean care caps or heavy paper and tape to prevent dirt and moisture from entering engine.
- Remove all external drive belts.
- Cover entire engine with plastic.
- Move engine or equipment to an appropriate storage area.
    - Storage area **must** be dry with uniform temperature. Recommended storage temperature is between -12˚C [10˚F] and 49˚C [120˚F], with relative humidity less than 60 percent.

ANADOLU ISUZU PARTS SALES

Preparing Aftertreatment Components for Long Term Storage

- For Engine with a displacement of 19 L and above refer to Service Bulletin, Storage of Individual UL2 Aftertreatment Diesel Exhaust Fluid (DEF) System Components, Bulletin 5504262 (/qs3/pubsys2/xml/en/bulletin/5504262.html) for instructions on preparing aftertreament components for long term storage. Refer to procedure 011-143 in Section 11 for instructions on Purging the Diesel Exhaust Fluid in preparation for storage.

Refer to procedure 011-143 Aftertreatment Diesel Exhaust Fluid Dosing Unit Manual Purge, for instructions on Purging the Diesel Exhaust Fluid in preparation for storage

Removing Engine from Long Term Storage

To remove the engine from long term storage, complete the following steps below. Also reference corresponding Service Manual procedures.

- Install new fuel and coolant filters, if equipped.
- Fill engine to high mark with engine lubricating oil.
- Cooling system procedures:
    - If engine cooling system was drained:
        - Fill cooling system with coolant. See Coolant Recommendations and Specifications procedure in Section V of corresponding Owners or Operation and Maintenance manual for cooling system specifications.
    - If engine was stored with fully formulated coolant:
        - Check coolant quality. Replace coolant if necessary.
        - Measure SCA concentration and adjust, if necessary.
        - Verify cooling system is properly filled. See Coolant Recommendations and Specifications procedure in Section V of corresponding Owners or Operation and Maintenance manual for cooling system specifications.
- Prime lubricating oil system.
    - With Prelubricating Oil Pump:
        - Complete a pre-lubricating oil system cycle.
        - Rotate crankshaft 240 degrees.
        - Complete a pre-lubricating oil system cycle.
        - Rotate crankshaft 300 degrees.
        - Complete a pre-lubricating oil system cycle.
        - Rotate crankshaft 240 degrees.
        - Complete a pre-lubricating oil system cycle.
    - Without Pre-lubricating Oil Pump:
        - Install oil pressure gauge or pressure transducer in the engine lubricating oil system as far downstream of the lubricating oil pump as possible.
        - Crank engine without firing for 30 seconds while observing oil pressure.
        - Pause for 3 minutes.
        - Repeat steps 2 and 3 above until nominal oil pressure is observed.
- Install all external drive belts.
- Replace all spark plugs, if applicable.
- If engine is equipped with a marine heat exchanger:
    - Open raw water supply valves
    - Prime raw water pump
- Verify all fuel supply hoses have been tightened.

- Verify all fuel supply and return shutoff valves are open.
- Install all aftertreatment components, if applicable.
- Start engine. See Normal Starting Procedure in Section 1 of corresponding Owners or Operation and Maintenance Manual.
- For electronically controlled engines, troubleshoot any active fault codes.

Removing Aftertreatment Components for Long Term Storage

For Engine with a displacement of 19 L and above refer to Service Bulletin, Storage of Individual UL2 Aftertreatment Diesel Exhaust Fluid (DEF) System Components, Bulletin 5504262 (/qs3/pubsys2/xml/en/bulletin/5504262.html) for instructions on preparing aftertreament components for removing from long term storage.

Last Modified: 17-Nov-2020

ANADOLU ISUZU AFTER SALES

Select Service Tools

Recommended Cummins® Service Tools

- No Cummins® Service Tools required.

Additional Service Items

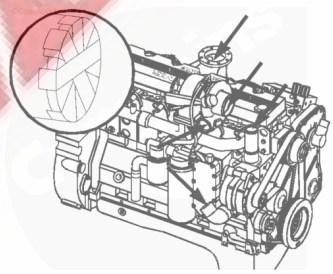
- No additional service items required.

Preparatory Steps

Remove all belts from the engine.

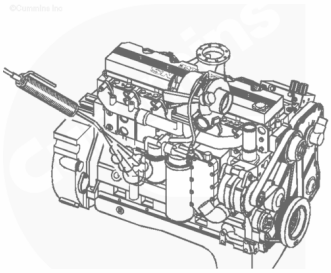
Cover the following parts of the engine:

- Exhaust and intake openings
- Electrical components
- Fuel inlet and drain connections.



⚠ WARNING ⚠

When using a steam cleaner, wear safety glasses or a face shield, as well as protective clothing. Hot steam can cause serious personal injury.



⚠ WARNING ⚠

Wear appropriate eye and face protection when using compressed air. Flying debris and dirt can cause personal injury.

Note : Make sure all engine surfaces are clean and dry before painting the engine.

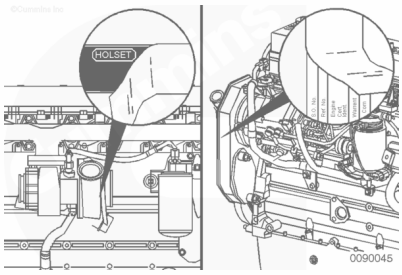
Clean the engine. Use steam.

Dry with compressed air.

Avoid prolonged direct steam or water spray on electrical components.

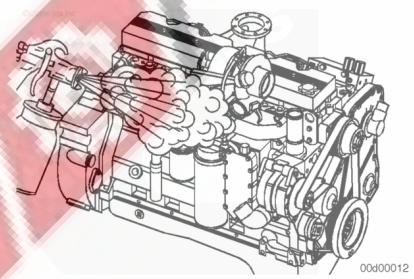
ANADOLU ISUZU SPARE PARTS

Protect the following components from the paint:



- All dataplates (engine, engine control module (ECM), fuel pump, turbocharger, air compressor, etc.)
- Exhaust manifold
- Turbocharger turbine housing
- Flywheel
- Flywheel housing transmission mounting surface
- Electrical connections
- All decals
- All pulley belt surfaces
- Any exposed fittings, threads, and electrical wire terminals.

Paint the engine.



ANADOLU ISUZU
AFTER SALES

Last Modified: 25-Jul-2016

Select Service Tools

Recommended Cummins® Service Tools

- No Cummins® Service Tools required.

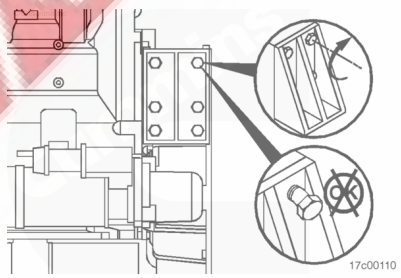
Additional Service Items

- No additional service items required.

Inspect

⚠ CAUTION ⚠

Damaged engine mounts and brackets can cause engine misalignment. Driveline component damage can result in vibration complaints.



Inspect all rubber-cushioned mounts for cracks or damage.

Inspect all mounting brackets for cracks or damaged bolt holes.

Check the torque on the engine-mounting nuts and bolts. Tighten any that are loose. See equipment manufacturer service information for torque specifications.

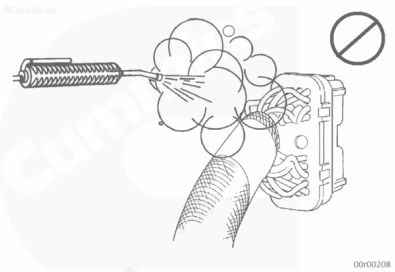
ANADOLU ISUZU

Last Modified: 25-Jul-2016

Clean

⚠ WARNING ⚠

When using a steam cleaner, wear safety glasses or a face shield, as well as protective clothing. Hot steam can cause serious personal injury.



⚠ CAUTION ⚠

Steam ingress into electrical components can cause damage.

Steam is the recommended method of cleaning a dirty engine or a piece of equipment.

Protect all electrical components, openings, and wiring from the full force of the cleaner spray nozzle.

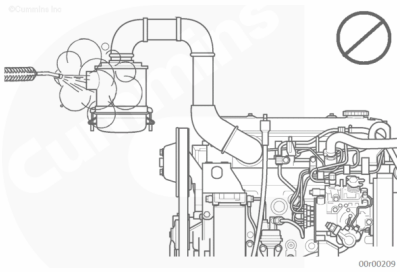
Components to protect include, but are **not** limited to the following:

- Electrical components and connectors
- Wiring harnesses
- Electronic control module (ECM) and connectors, if equipped.
- Belts and hoses
- Bearings (ball or taper roller)

For additional cleaning information. Refer to Procedure 204-008 in Section i. (/qs3/pubsys2/xml/en/procedures/99/99-204-008.html)

⚠ CAUTION ⚠

Soap, solvent, or water ingress into air intake system can cause engine damage.



Do **not** directly spray or allow soap, solvent, or water to enter any passages, ports, or cowlings that lead to the engine air intake system.

ANADOLU ISUZU DEALER SALES

Last Modified: 06-Mar-2017



Select Service Tools

Recommended Cummins® Service Tools

- Barring tool, Part Number 3824591, or equivalent

Additional Service Items

- No additional service items required.

General Information

⚠ WARNING ⚠

Do not pull or pry on the fan to manually rotate the engine. To do so can damage the fan blades. Damaged fan blades can cause premature fan failures which can result in serious personal injury or property damage.

This procedure instructs how to rotate the engine for service events.

Note : The illustrations in this procedure are generic and may **not** represent the hardware on all engines.

Preparatory Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

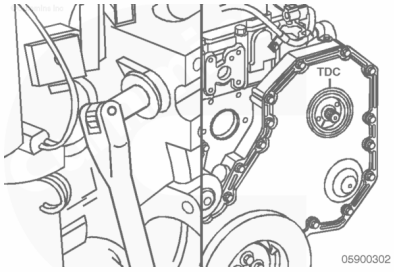
- Disconnect the batteries. See equipment manufacturer service information.

Rotate

Remove the access cover from the flywheel housing.

Use barring tool, Part Number 3824591, or equivalent, to rotate the engine by hand.

Rotate the engine **clockwise** when viewed from the front of the engine.



Finishing Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

- Remove all tools.
- Connect the batteries. See equipment manufacturer service information.

ANADOLU ISUZU AFTER SALES

Last Modified: 25-Jul-2016

Cylinder Block

Tool Number

2892501

Lifting Sling

Aids in removal and installation of the crankshaft, flywheel, and other heavy components up to 1000 kg [2205 lb].



3375957

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Tool Number

3162253

Camshaft Bushing Installation/Removal Kit

Used to remove and install camshaft bushings.

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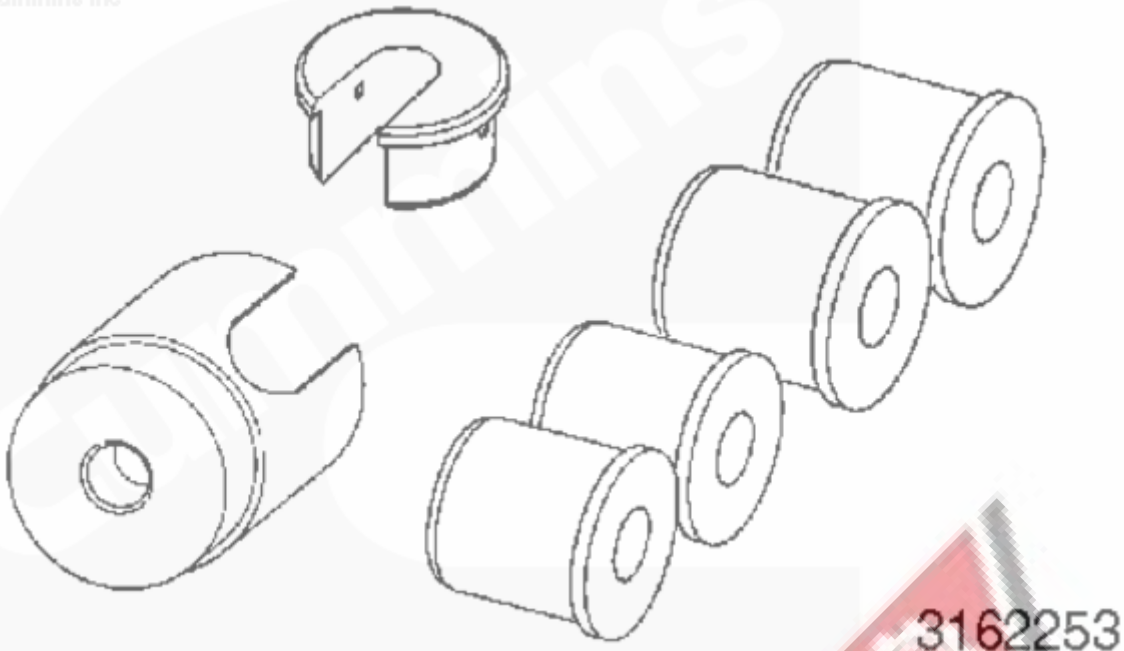
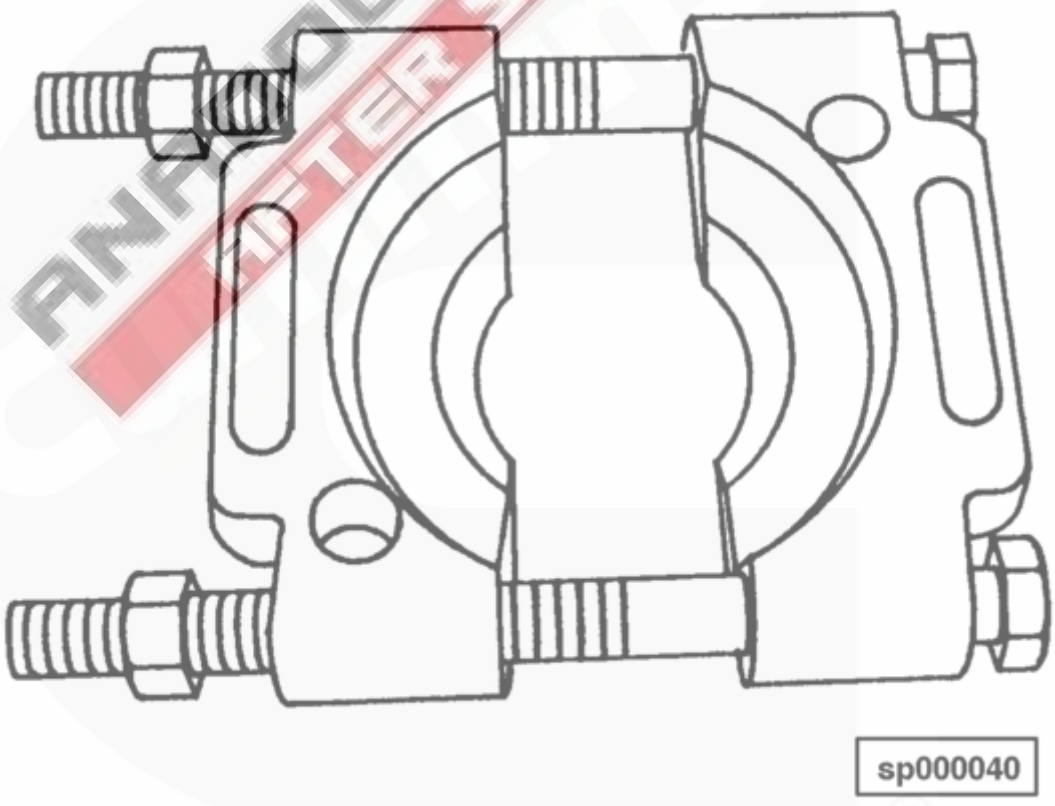


Tool Number

3162427

Bearing Separator

This tool is used when pressing the shaft through the bearings during the disassembly process.

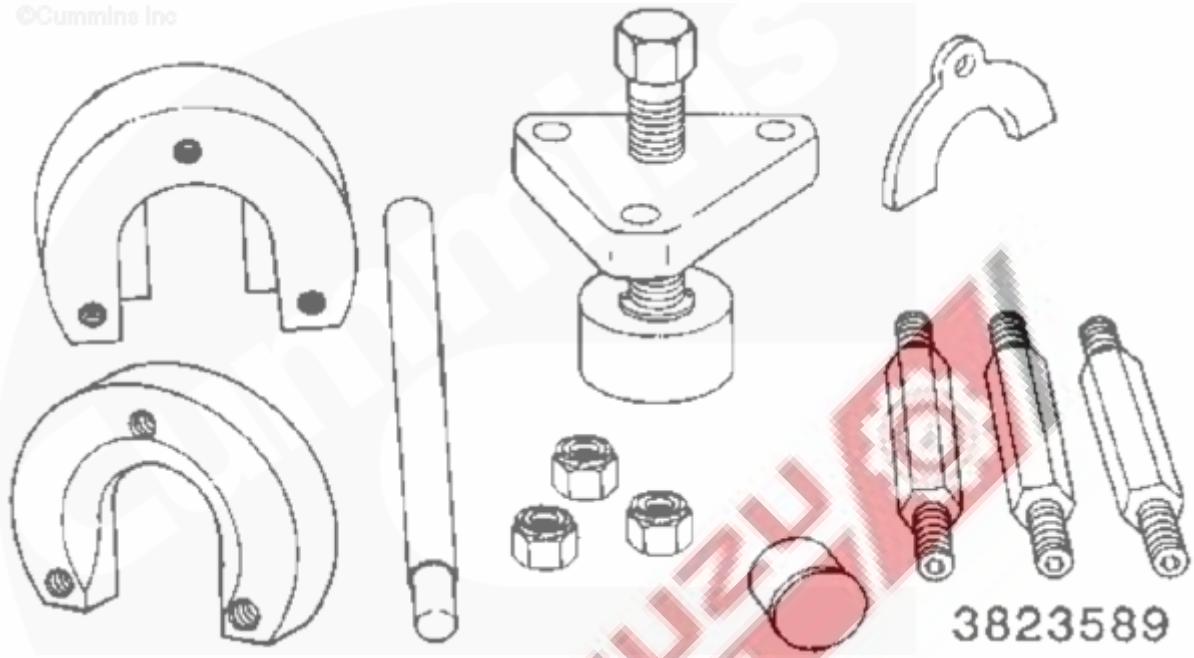


Tool Number

3163054

Camshaft Gear Installation and Removal Tool

Used to remove and install the camshaft gear. Engines without a tapped hole in the camshaft will require partial camshaft removal in order to remove the camshaft gear.

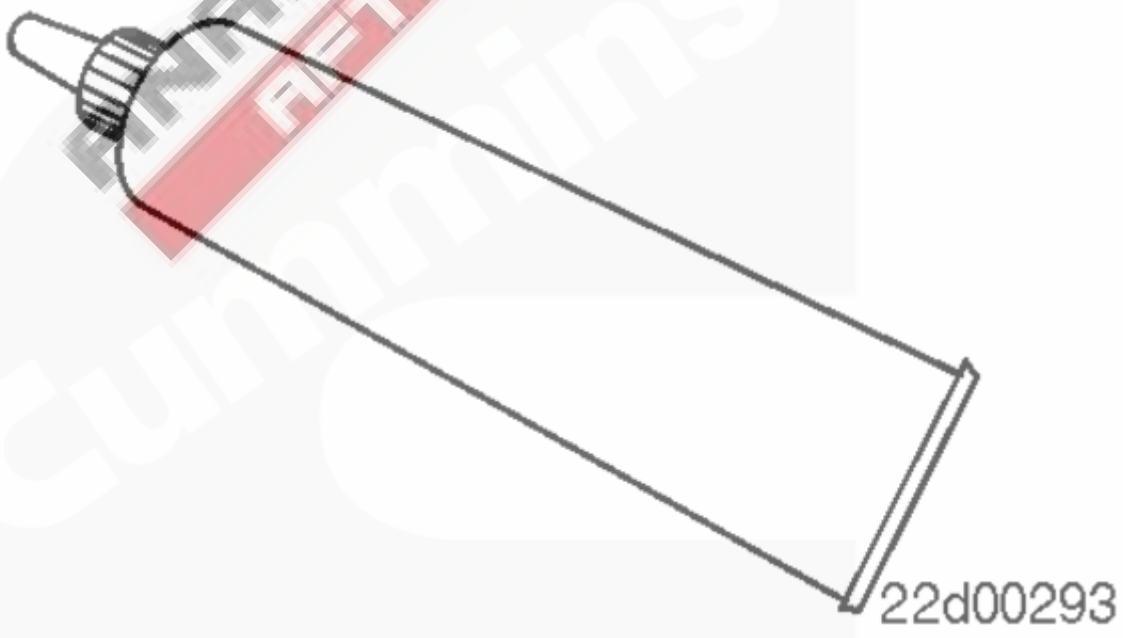


Tool Number

3163087

Assembly Lubricant

A 10 ounce tube of multi-purpose lubricant.

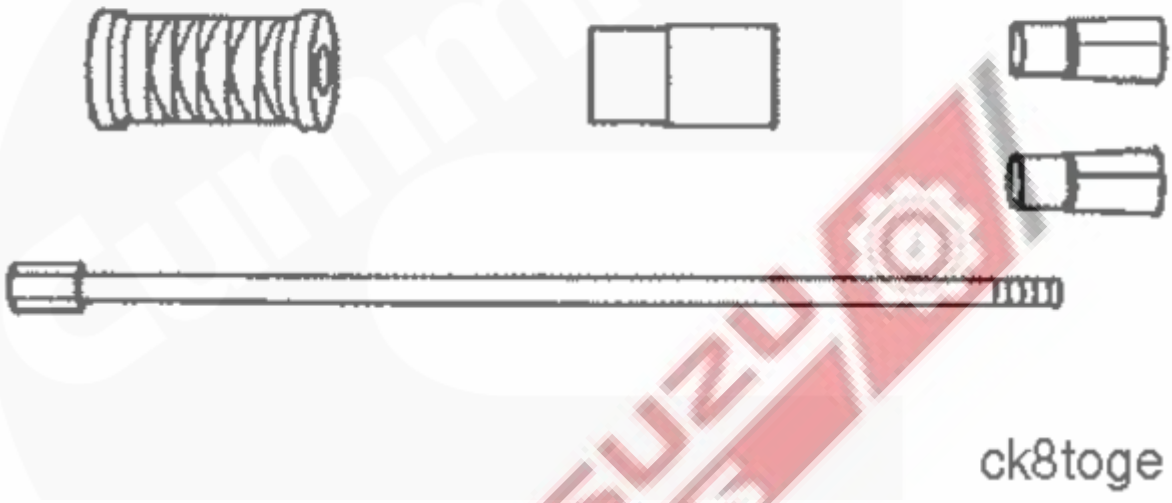


Tool Number

3163720

Dowel Pin Extractor Kit

Used to remove solid locating pins from the cylinder block. Kit includes Society of Automotive Engineers (SAE) and metric sizes.

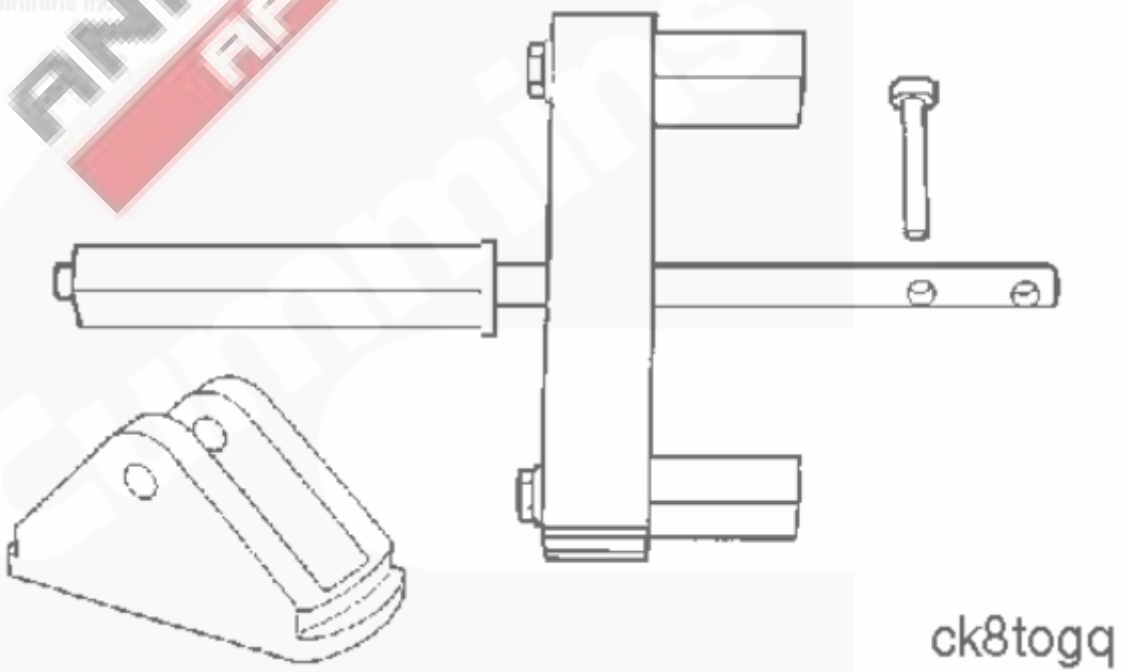


Tool Number

3163745

Cylinder Liner Puller

Used to remove cylinder liners from the cylinder block. Requires cylinder liner puller plate, Part Number 3822786.



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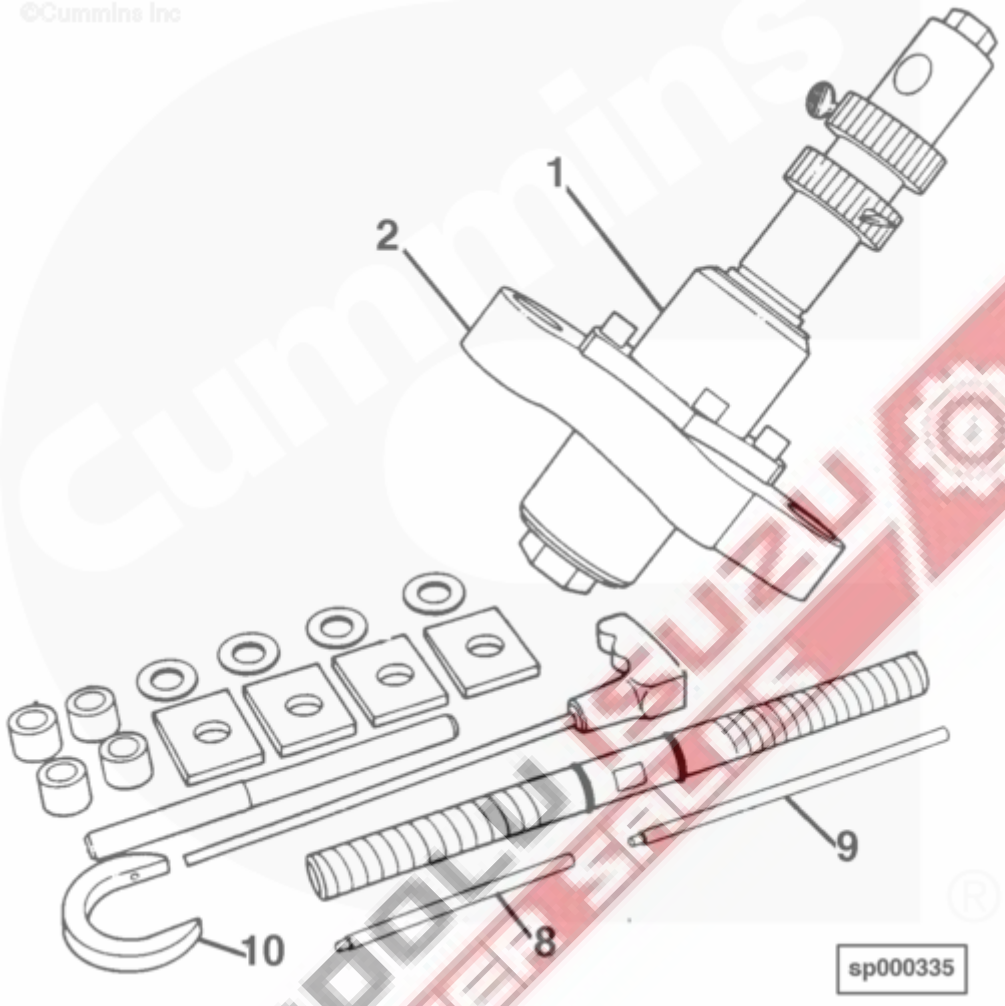
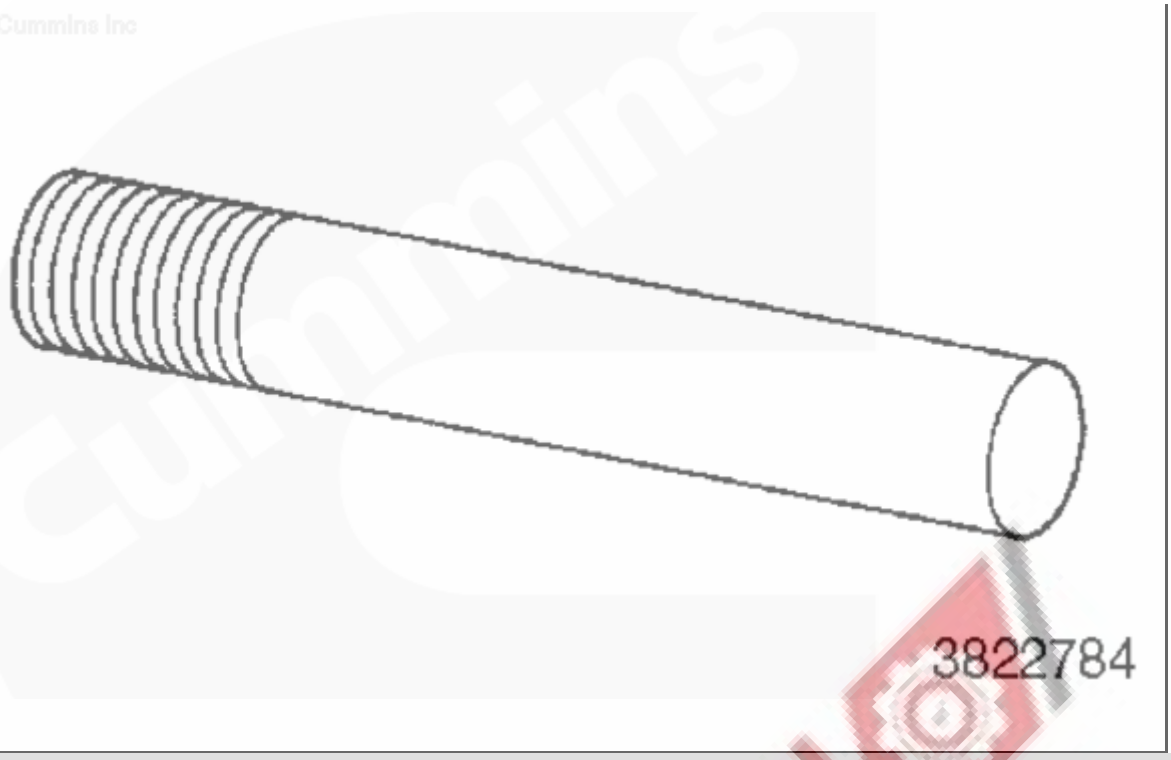
Tool Number
3163785
Counterbore, Ledge Cutter This counterbore tool is designed to resurface the counterbore ledge area.



Tool Number
3163934
Assembly Guide Pin M12 x 1.75

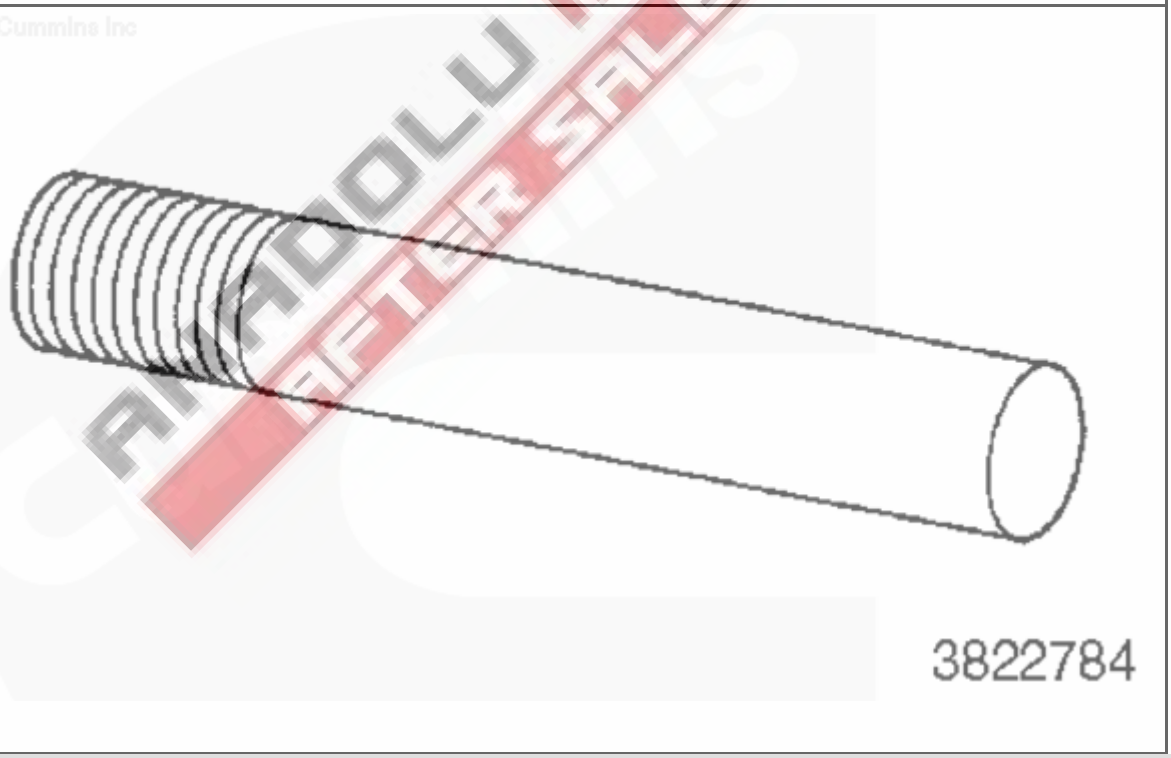


Tool Number

3163935

Assembly Guide Pin

M10 x 1.25

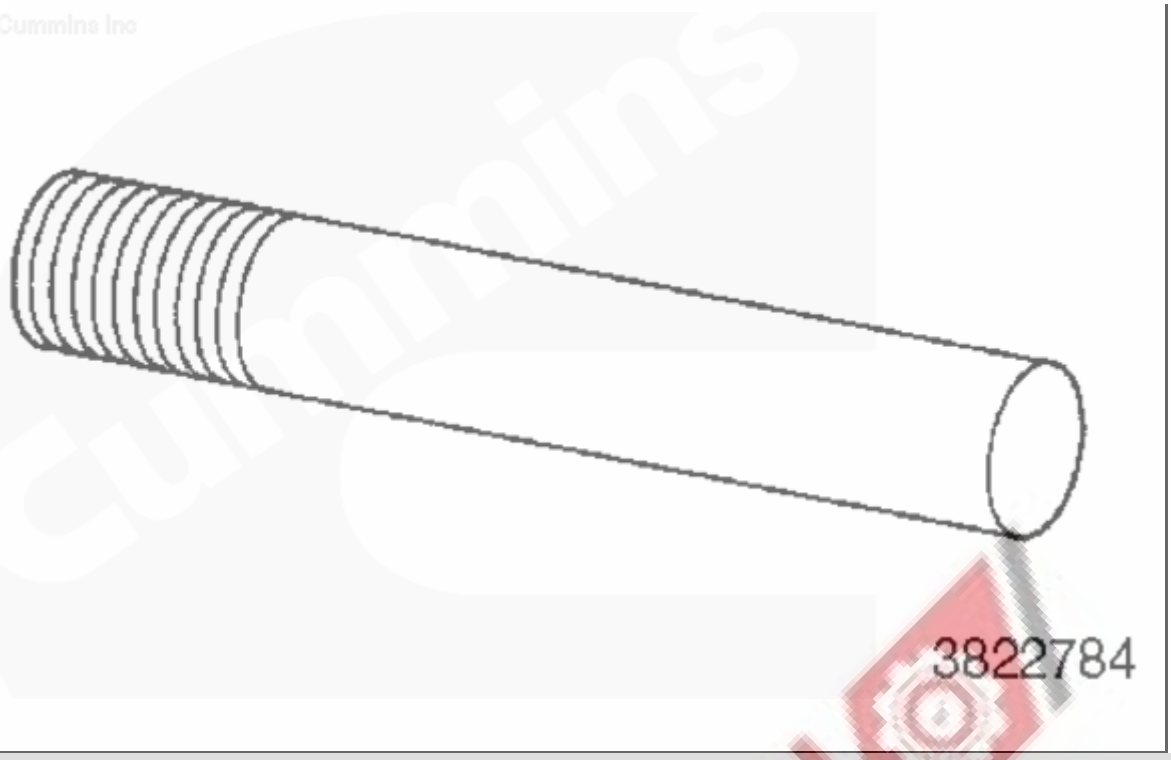


Tool Number

3163936

Assembly Guide Pin

M8 x 1.0

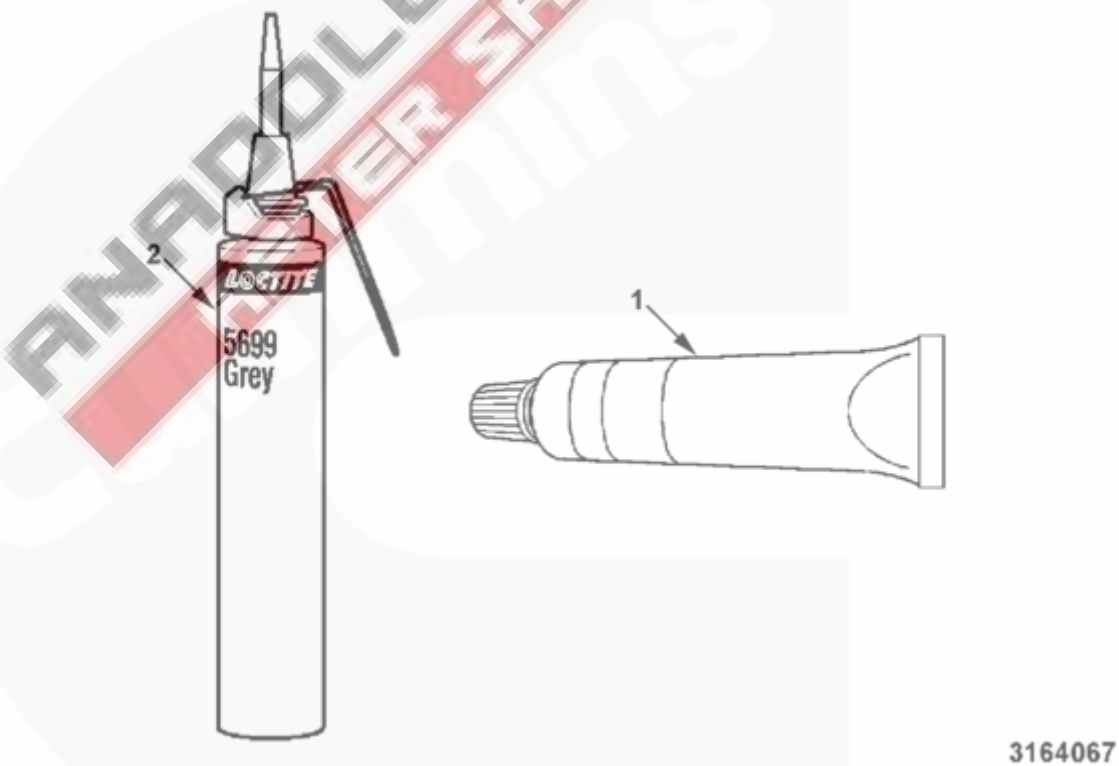


Tool Number

3164067

Silicone Sealant

Loctite® 5699 Grey RTV silicone sealant can provide a seal in the Tee gasket joint on lubricating oil pan gaskets.

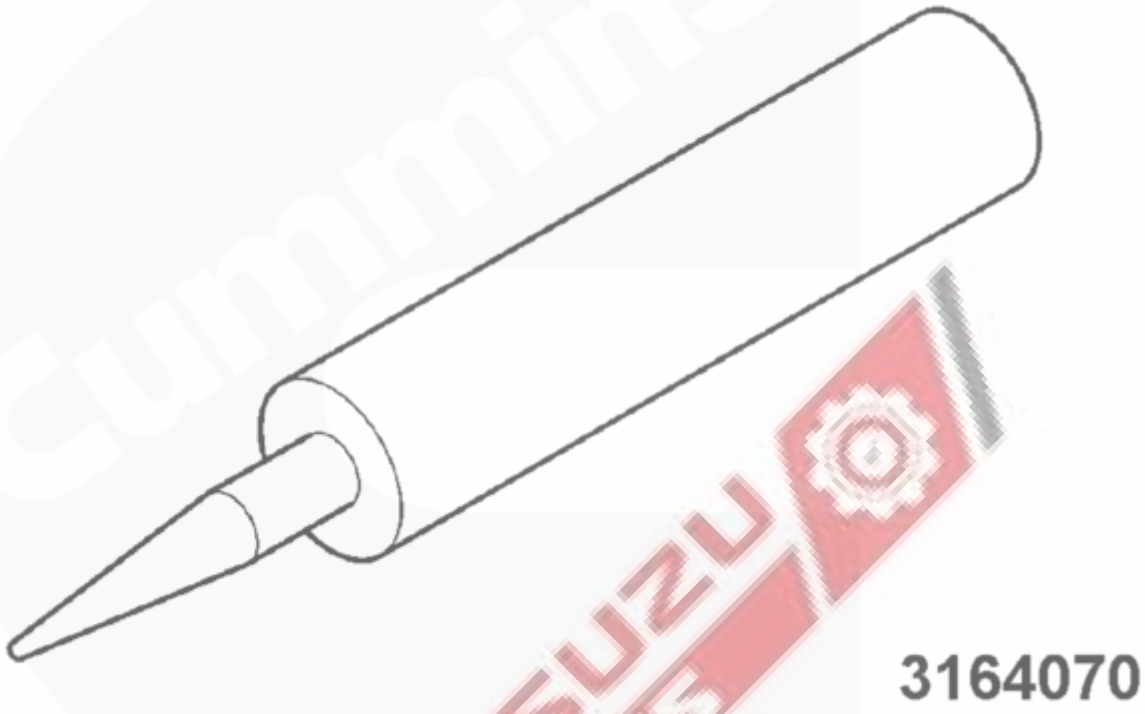


Tool Number

3164070

Sealant

This sealant is used for the rear gear housing to block joint in product production and service.

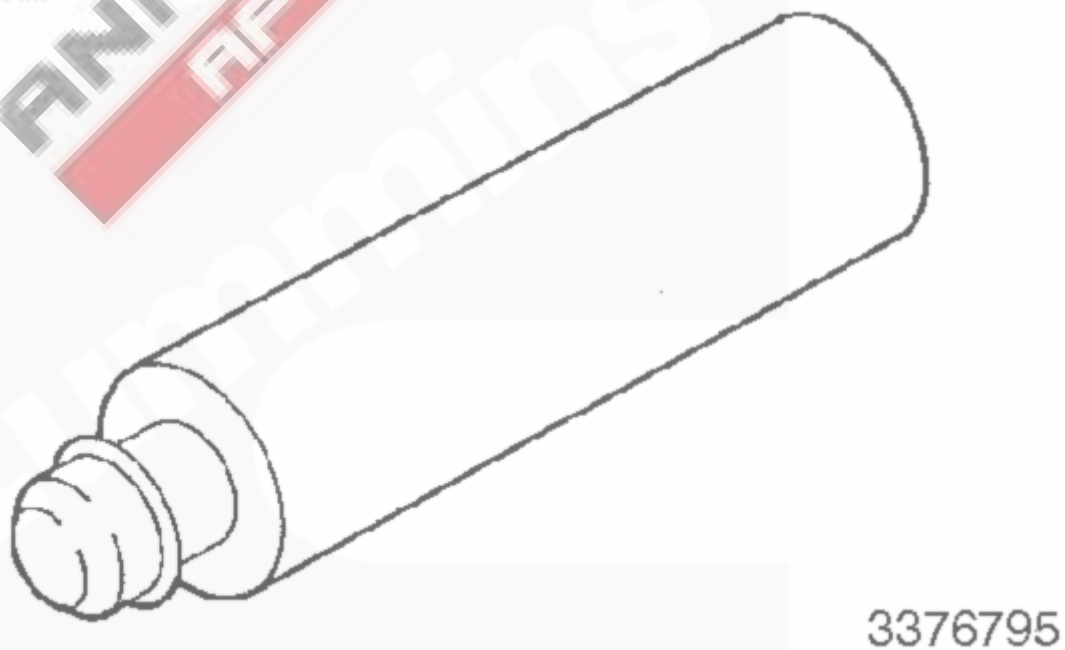


Tool Number

3164085

Expansion Plug Driver Handle

Used with all expansion plug drivers larger than 9.525 mm [0.375 in] diameter.

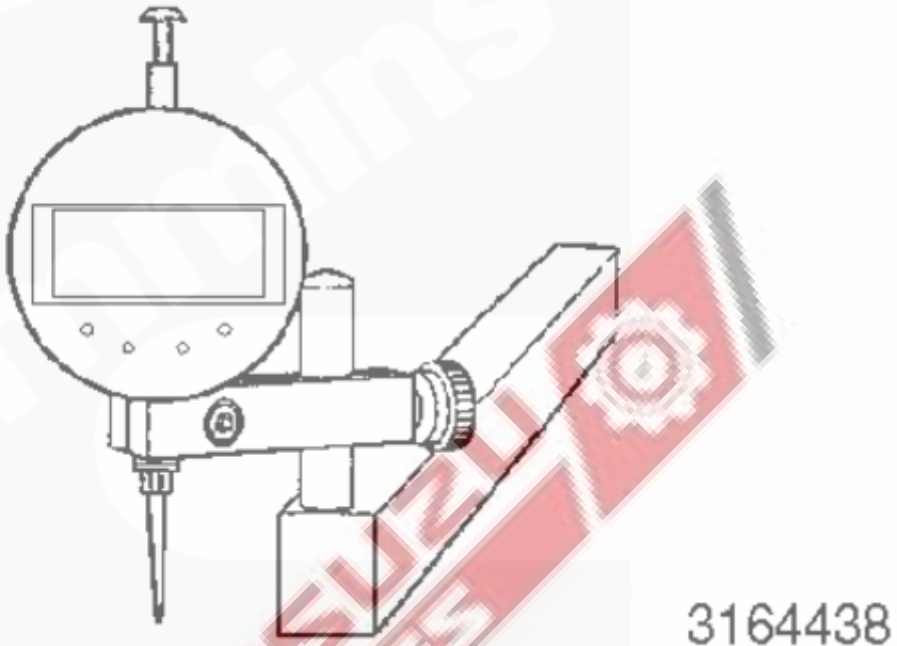


Tool Number

3164438

Depth Gauge Assembly

Used to measure cylinder liner protrusion, cylinder block counterbore depths, and valve intrusion and or protrusion. Equipped with an electronic digital indicator.

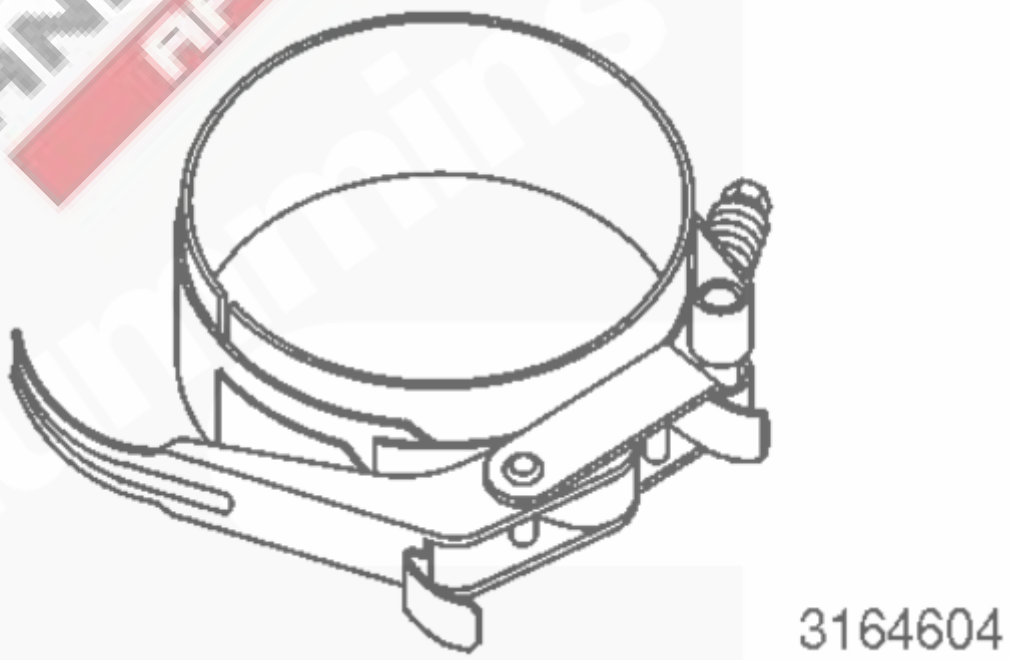


Tool Number

3164604

Piston Ring Compressor

Used to compress the piston rings while installing the pistons into the cylinder bores.



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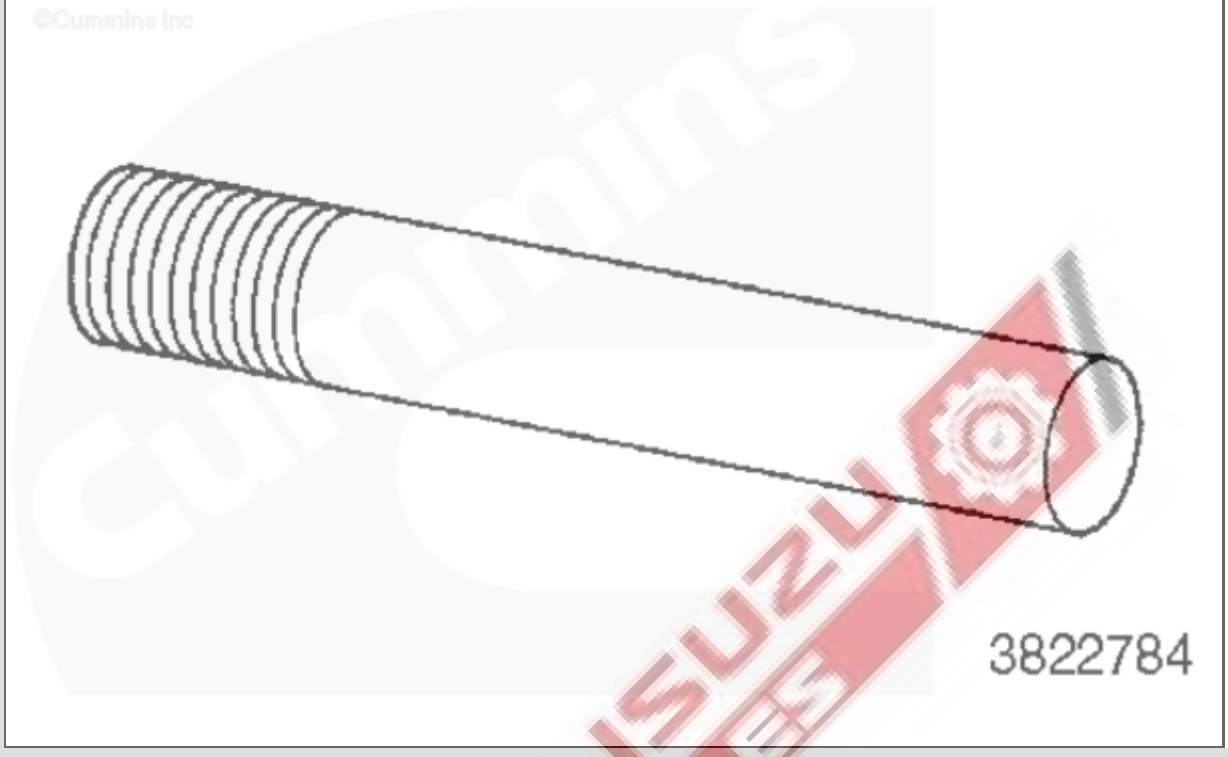
Tool Number

3164977

Assembly Guide Pin

M8 x 1.25

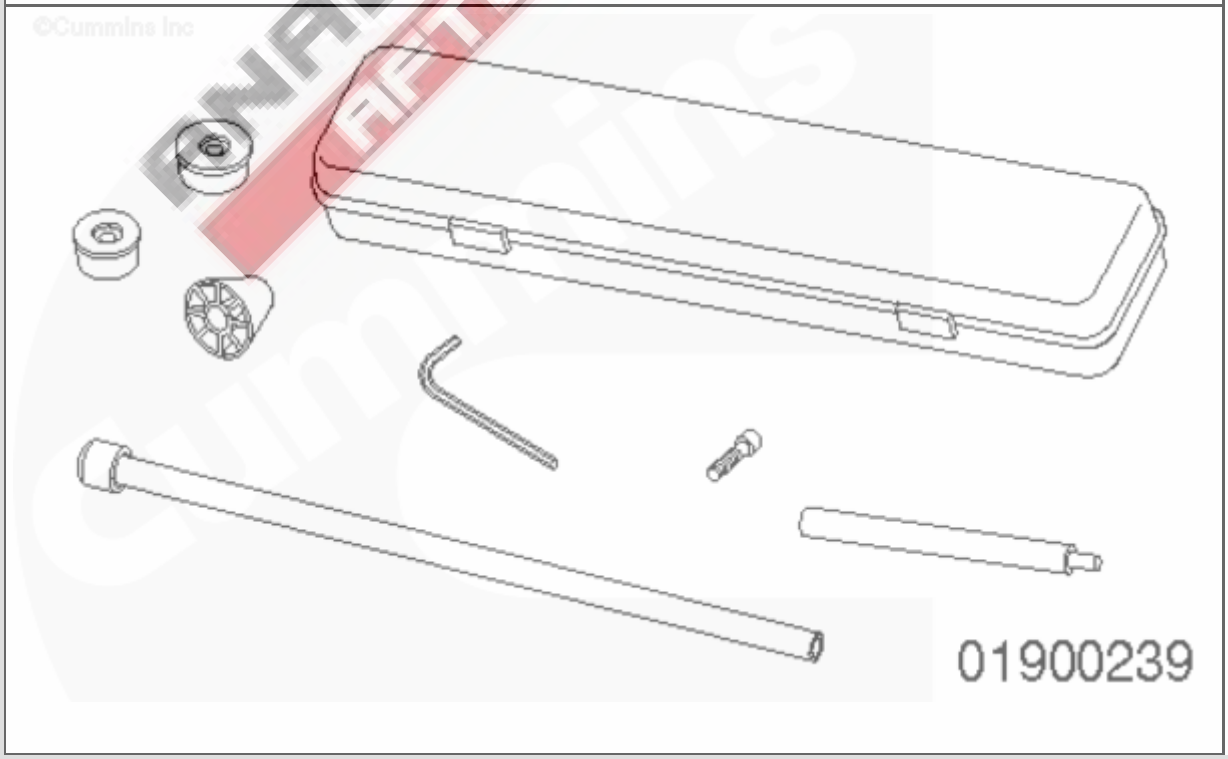


Tool Number

3165045

Camshaft Bushing Tool

Used to remove and install camshaft bushings.



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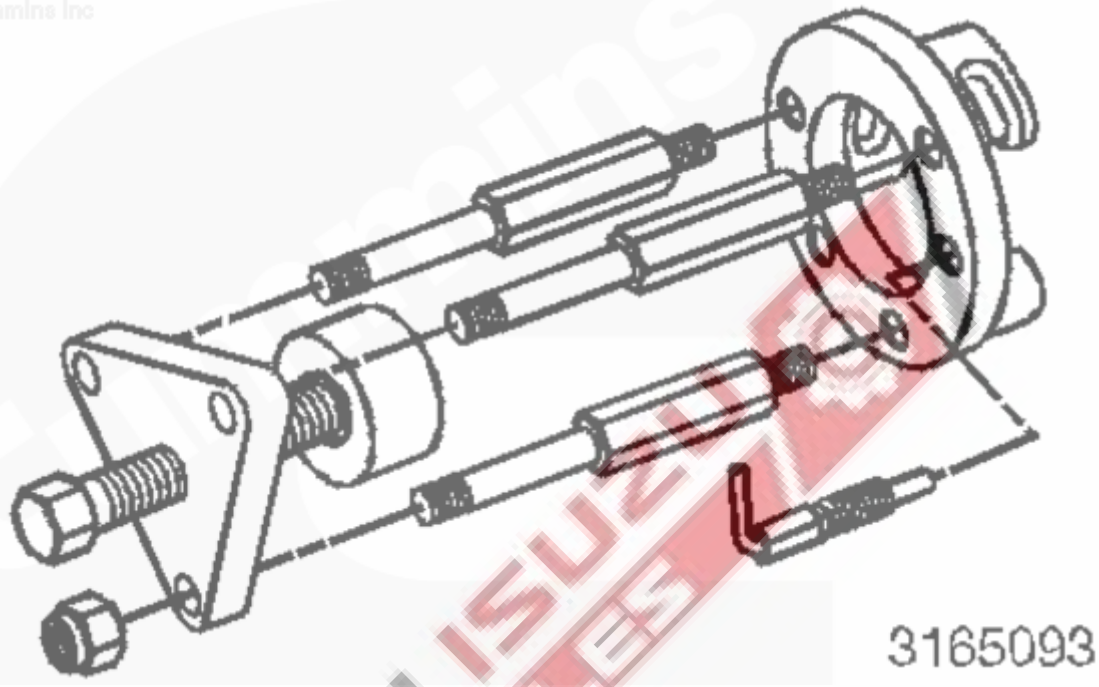
AFTER SALES

Tool Number

3165093

Camshaft Gear Installation and Removal Tool

Used to remove and install the camshaft gear without removing the camshaft. Can only be used on engines with a tapped hole in the camshaft. Use with camshaft gear installation and removal tool, Part Number 3163054.

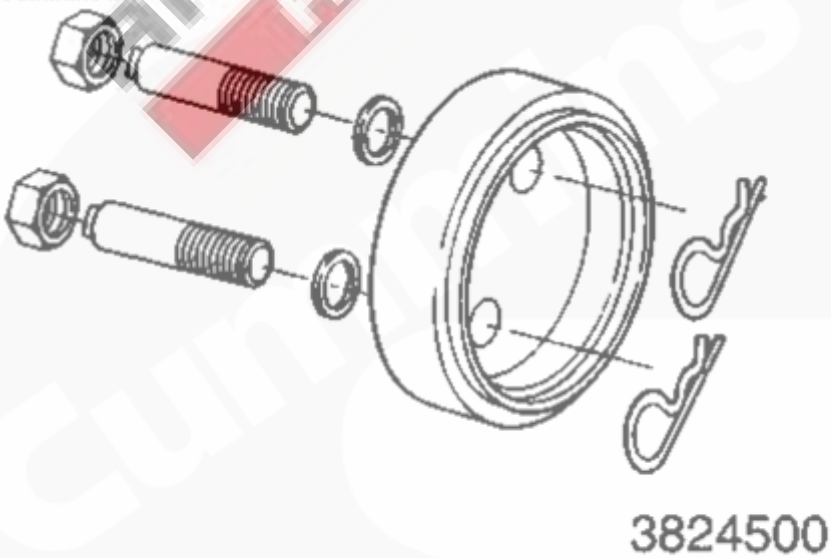


Tool Number

3165112

Wear Sleeve Installation Tool

Used to install the crankshaft front oil wear sleeves.



Tool Number

3375068

Cup Plug Sealant

Used when installing pipe plugs and cup plugs, to prevent leaks.



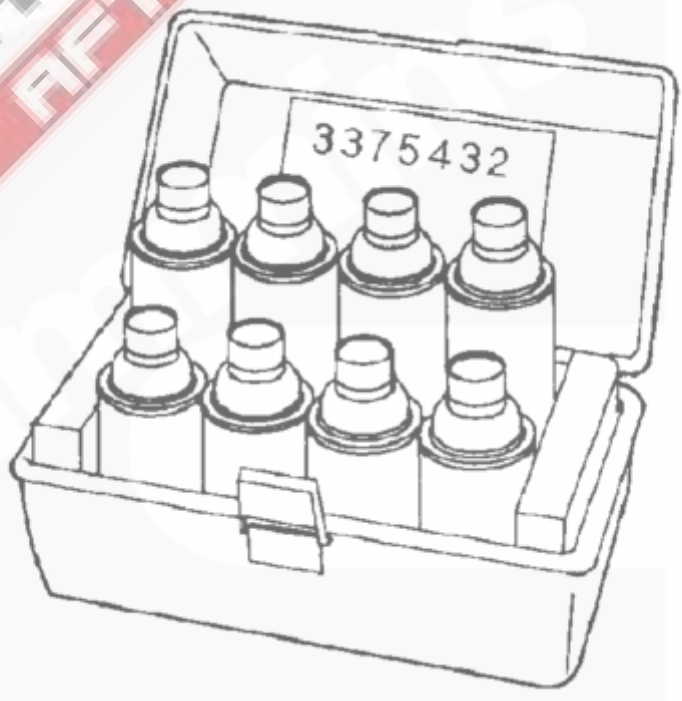
bp8togk

Tool Number

3375432

Crack Detection Kit

Used to locate cracks in cylinder blocks, cylinder heads; as well as in other engine components.



3375432

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Tool Number

3375434

Crack Detection Penetrant

This is a non-magnetic crack detection test kit to detect cracks in engine components.

Tool Number

3376015

Cylinder Liner Puller (Universal)

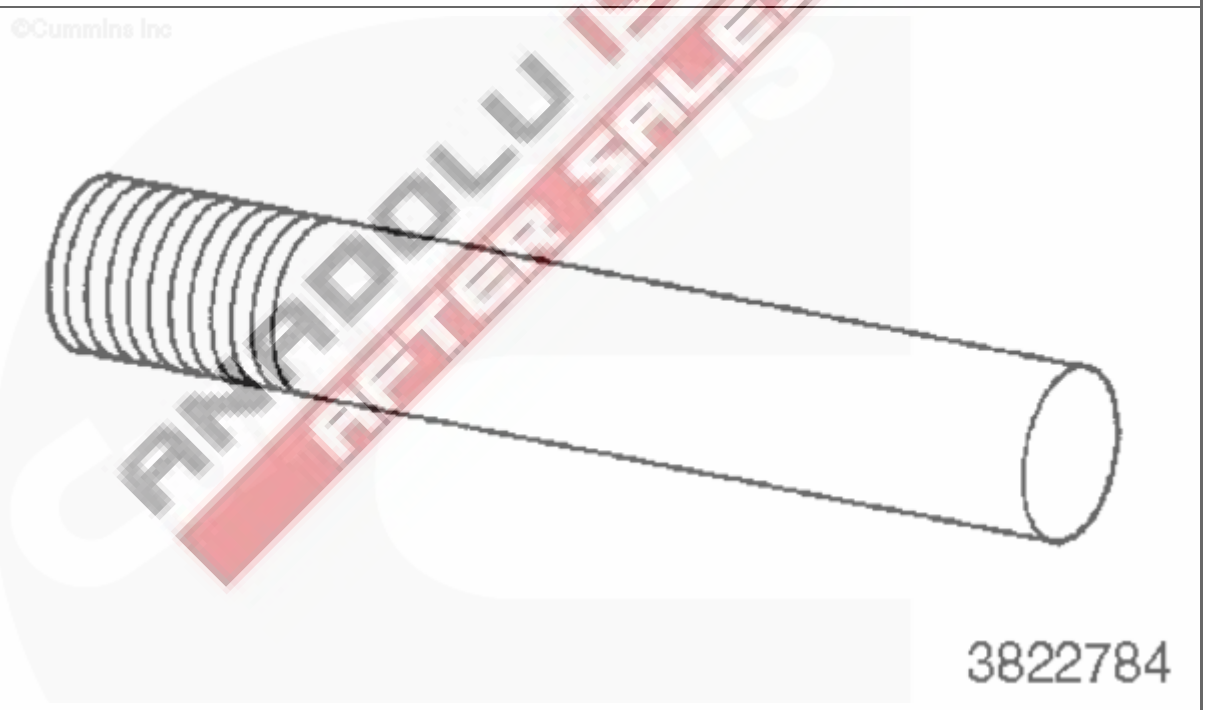
Used to remove cylinder liners from the cylinder block. Requires two puller arm extension feet, Part Number 3376649.

Tool Number

3376488

Assembly Guide Pin

M10 x 1.5



Tool Number

3376619

Dial Bore Gauge Kit

This kit measures diameters of bores from 76 mm [3 in] up to 203 mm [8 in]. The dial face is dimensioned in inches and millimeters.

Tool Number 3376816
Expansion Plug Driver Used to install 25.4 mm [1.00 in] expansion plug to specified depth. Use with expansion plug driver handle, Part Number 3164085.

Tool Number 3376891
Fluorescent Tracer This special dye, when mixed in the cooling system or lubricating system, will help determine the source of the leaks. Used with Leak Test Kit, Part Number 2892320. Black lights must be used to illuminate the fluorescent dye.

Tool Number 3377399
Dial Indicator Magnetic Base Used in conjunction with dial indicator, Part Number 3824564 (metric), or Part Number 4918289 (SAE).

Tool Number 3822503
Cylinder Liner Clamp Set Used to clamp the liner into the bore of the cylinder block. Requires two cylinder head capscrews not included in clamp set.

Tool Number 3822709
Metric Thread Insert Kit (Closed End) Used to repair several sizes of cylinder block threads.

Tool Number

ANADOLU ISUZU
WEB SALES

3823137
Piston Ring Expander Used to install piston rings onto pistons without damaging or distorting the rings.

Tool Number 3823258
Abrasive Hand Pad Used to remove corrosion or carbon buildup.

Tool Number 3823286
Connecting Rod Mandrel Set Locating mandrels are used to locate the connecting rod in connection rod checking fixture, Part Number ST 561. The small mandrels fit in the piston pin bore and the large expanding mandrel fits in the crankpin bore.

Tool Number 3823521
Expansion Plug Driver Used to install 20.638 mm [0.8125 in] expansion plug to specified depth. Use with expansion plug driver handle, Part Number 3164085.

Tool Number 3823522
Expansion Plug Driver Used to install 30.16 mm [1.1875 in] expansion plug to specified depth. Used with expansion plug driver handle, Part Number 3376795.

Tool Number 3823523
Expansion Plug Driver

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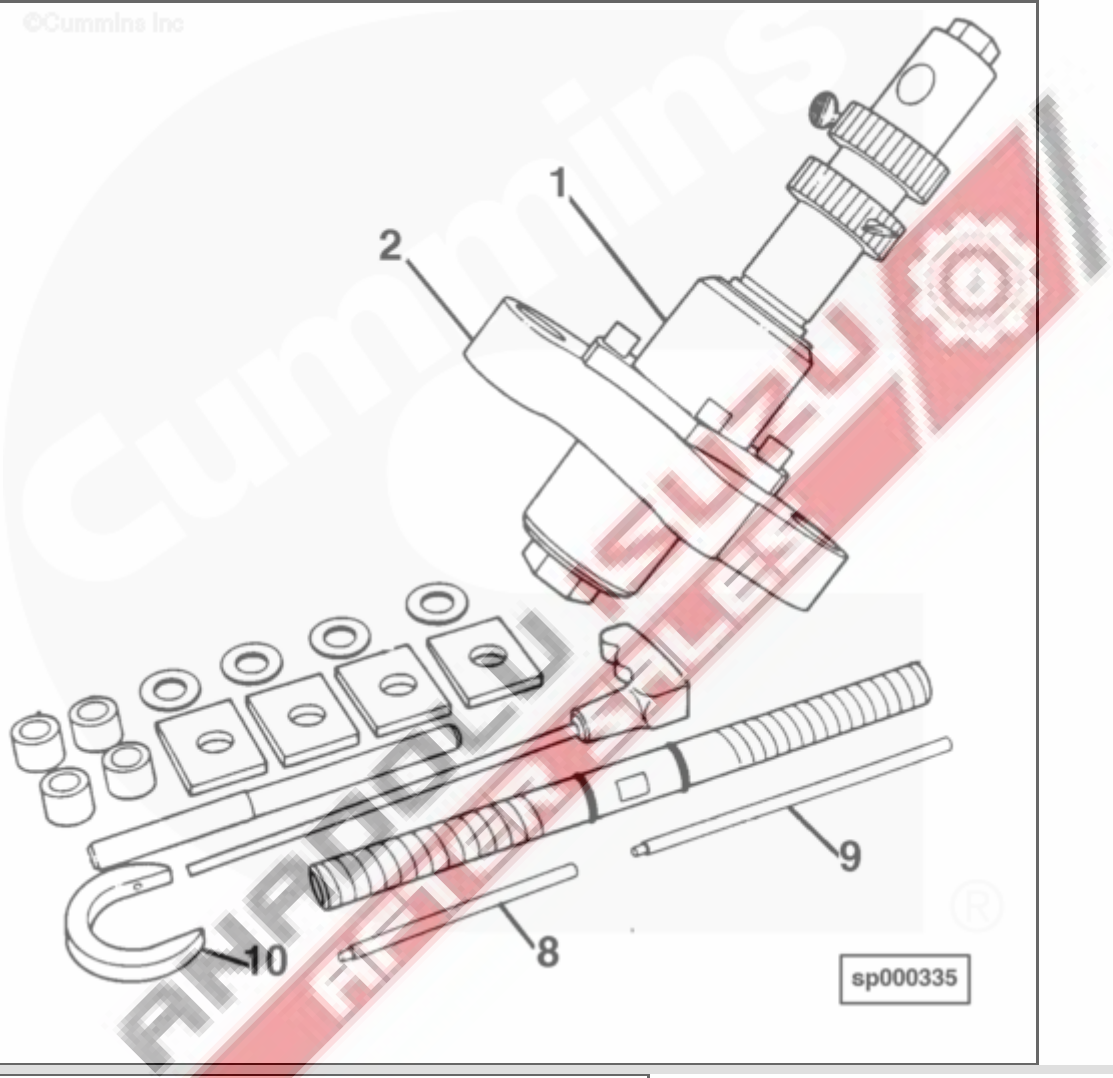
Used to install 34.925 mm [1.375 in] expansion plug to specified depth. Used with expansion plug driver handle, Part Number 3376795.

Tool Number

3823567

Cutter Plate

This counterbore tool is designed to resurface the counterbore ledge area.



Tool Number

3823621

Hydraulic Actuator Kit

Used to remove and install camshaft bushings.

Tool Number

3823818

Main Bearing Rollout Tool

Used to remove and install main bearings with the crankshaft installed.

Tool Number

3824038

Loctite® 271

This is an all purpose medium strength thread locker. This is ideal for all cup plugs or nut and bolt applications ¼ in. or larger. It eliminates the need for stocking expensive locknuts and lockwashers. Threadlocker locks and seals while preventing parts from loosening due to vibration. It also protects threads from corrosion.

Tool Number

3824078

Rear Wear Sleeve Installation Tool

Used to install the rear crankshaft lubricating oil seal wear sleeve.

Tool Number

3824496

Connecting Rod Guide Pins

Used to prevent damage to the crankshaft during piston installation on engines built with connecting rod studs.

Tool Number

3824499

Lubricating Oil Seal Installation Tool

Used to install the front crankshaft lubricating oil seal in the front cover seal carrier.

Tool Number

3824510

Contact Cleaner

This is an alcohol based precision cleaner that is 100 percent free of CFC's. This product is ideal for application where lower flash-point solvents may be used. It evaporates rapidly and completely and is harmless to most plastics. Use this when cleaning electrical/electronics connections. (Flammable).

ANADOLU ISUZU AFTERSALES

Tool Number 3824564
Dial Indicator, Metric Used with indicator base, Part Number 3377399.

Tool Number 4918219
Gauge, Straight Edge This 889 mm [35 in] long precision straight edge can be used for checking components for surface flatness.

Tool Number 5299073
Engine Barring Gear Used to engage the flywheel ring gear to rotate the crankshaft.

Tool Number 5395259
Crankshaft Seal Installation Kit, Rear Used to install laydown lip seal.

Tool Number 5395330
Crankshaft Seal Removal Kit, Rear Used to remove laydown lip seal.

Tool Number 5395409
Carrier Centering Tool, Rear Crankshaft Used to align the rear carrier on front gear train engines only.

ANADOLU ISUZU AFTER SALES

Tool Number ST 561
Connectiong Rod Checking Fixture This special fixture is used to check the connecting rod length, bend and twist. The connecting rod must have the cap assembled for this test. Dial indicators show if the length and bore alignment are acceptable. A feeler gauge is used to check twist. Use appropriate locating mandrels, See ST 562.

Tool Number ST 647
Standard Puller Used to remove drive pulleys, impellers, and air compressor counterweights.

Tool Number ST 1229
Cylinder Liner Driver Used to install cylinder liners into the cylinder block.

ANADOLU ISUZU AFTER SALES

Last Modified: 24-Sep-2018

Select Service Tools

Recommended Cummins® Service Tools

- Abrasive pad, Part Number 3823258, or equivalent

Additional Service Items

- No additional service items required.

Preparatory Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

⚠ WARNING ⚠

To reduce the possibility of personal injury, avoid direct contact of hot oil with your skin.

⚠ WARNING ⚠

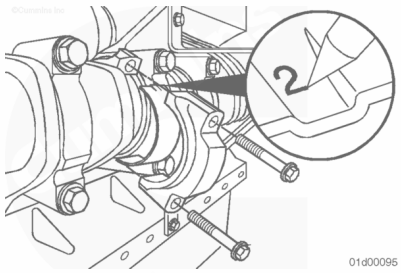
Some state and federal agencies have determined that used engine oil can be carcinogenic and cause reproductive toxicity. Avoid inhalation of vapors, ingestion, and prolonged contact with used engine oil. If not reused, dispose of in accordance with local environmental regulations.

- Disconnect the batteries. See equipment manufacturer service information.
- Drain the lubricating oil. Refer to Procedure 007-037 in Section 7. (/qs3/pubsys2/xml/en/procedures/425/425-007-037.html)
- Remove the lubricating oil pan and gasket. Refer to Procedure 007-025 in Section 7. (/qs3/pubsys2/xml/en/procedures/425/425-007-025.html)
- Remove the lubricating oil suction tube. Refer to Procedure 007-035 in Section 7. (/qs3/pubsys2/xml/en/procedures/425/425-007-035.html)

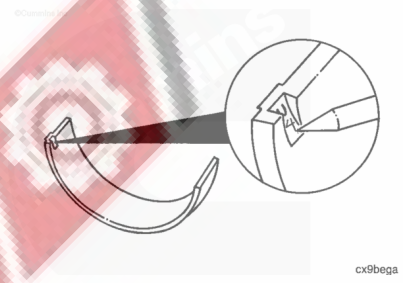
Remove

Note : The cylinder head does **not** need to be removed if the connecting rod bearings are being inspected or replaced.

Remove the connecting rod caps. Refer to Procedure 001-054 in Section 1. (/qs3/pubsys2/xml/en/procedures/425/425-001-054.html)



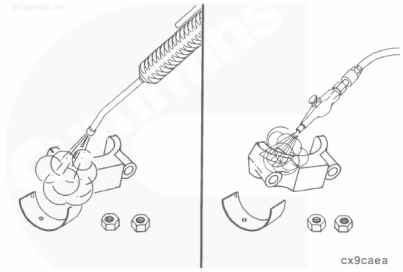
Remove the upper bearing shell. Mark it with the letter "U" (upper) and the cylinder number from where it was removed.



Clean and Inspect for Reuse

⚠ WARNING ⚠

Wear appropriate eye and face protection when using compressed air. Flying debris and dirt can cause personal injury.



Wash the bearing and connecting rod caps.

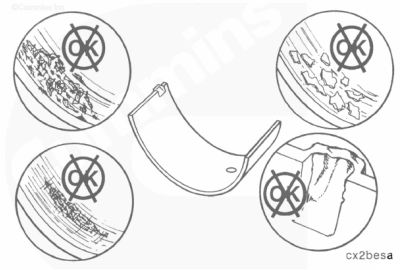
Dry with compressed air.

Inspect the connecting rod caps, connecting rod bearing saddles, and capscrews for nicks, cracks, burrs, scratches, or fretting.

Inspect the bearings for damage.

Replace any bearings with the following damage:

- Pitting
- Flaking
- Corrosion
- Lock tang damage



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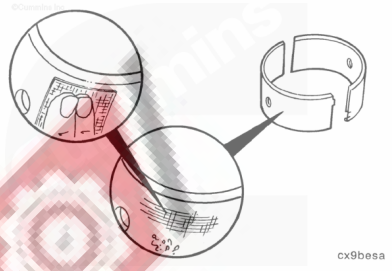
AFTER SALES

- Scratches
- Exposed bronze lining material.

Note : Some engines can be built with a red polymer coating on the upper rod bearing which gives the bearing a red texture finish.

Note : Some engines may be built with a dark grey overlay on the upper rod bearing which could appear green due to oxidation. Oxidation is **not** detrimental to bearing performance.

Inspect the bearing shell seating surface for nicks or burrs.

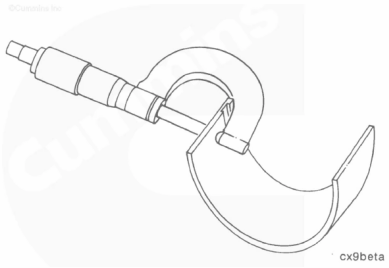


If nicks or burrs can **not** be removed with abrasive pad, Part Number 3823258, or equivalent, the bearings **must** be replaced.

Note : If bearings are damaged, they **must** be replaced as a set.

Note : For more detailed information of bearing damage, see Service Bulletin, Analysis and Prevention of Bearing Failures, Bulletin 3810387 (/qs3/pubsys2/xml/en/bulletin/3810387.html).

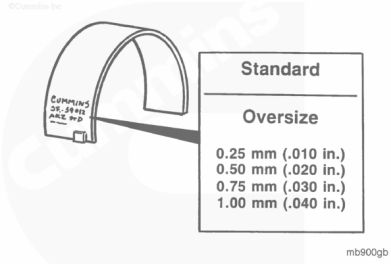
Measure the rod bearing shell thickness with an outside micrometer that has a ball tip.



Connecting Rod Bearing Dimensions			
	mm		in
Standard	2.457	MIN	0.0968
	2.469	MAX	0.0972

Discard a bearing shell if its thickness is below the minimum specification.

Note : Connecting rod bearings are identified with a part number and size stamped on the back side.

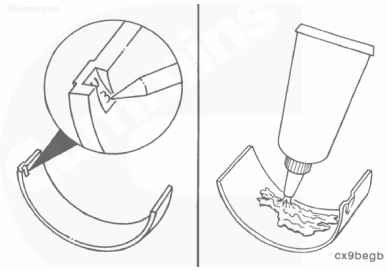


Determine the size of the removed rod bearing. Obtain a set of the same size.

Oversize service rod bearings are available for use with crankshafts machined undersize. See the appropriate parts catalog.

Install

For connecting rod bearing installation instructions use the following. Refer to Procedure 001-054 in Section 1. (/qs3/pubsys2/xml/en/procedures/425/425-001-054.html)



Finishing Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

- Install the lubricating oil suction tube. Refer to Procedure 007-035 in Section 7. (/qs3/pubsys2/xml/en/procedures/425/425-007-035.html)
- Install the lubricating oil pan and gasket. Refer to Procedure 007-025 in Section 7. (/qs3/pubsys2/xml/en/procedures/425/425-007-025.html)
- Fill the lubricating oil pan. Refer to Procedure 007-037 in Section 7. (/qs3/pubsys2/xml/en/procedures/425/425-007-037.html)
- Connect the batteries. See equipment manufacturer service information.
- Operate the engine. Check for leaks.

ANADOLU ISUZU

Last Modified: 14-Oct-2020

Select Service Tools

Recommended Cummins® Service Tools

- Dial indicator, Part Number 3824564
- Magnetic base, Part Number 3377399, or equivalent
- Main bearing replacer, Part Number 3823818
- Abrasive pad, Part Number 3823258, or equivalent
- Assembly lubricant, Part Number 3163086, or equivalent
- Barring tool, Part Number 3824591
- Barring tool, Part Number 5299073

Additional Service Items

- Awl
- Screwdriver

Preparatory Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

⚠ WARNING ⚠

To reduce the possibility of personal injury, avoid direct contact of hot oil with your skin.

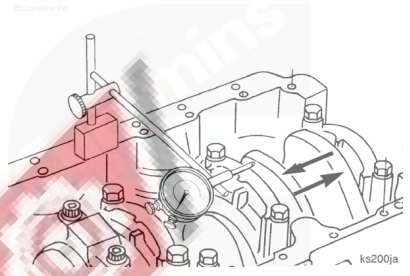
⚠ WARNING ⚠

Some state and federal agencies have determined that used engine oil can be carcinogenic and cause reproductive toxicity. Avoid inhalation of vapors, ingestion, and prolonged contact with used engine oil. If not reused, dispose of in accordance with local environmental regulations.

- Disconnect the batteries. See equipment manufacturer service information.
- Drain the lubricating oil. Refer to Procedure 007-037 in Section 7. (/qs3/pubsys2/xml/en/procedures/425/425-007-037.html)

- Remove the lubricating oil pan and gasket. Refer to Procedure 007-025 in Section 7. (/qs3/pubsys2/xml/en/procedures/425/425-007-025.html)
- Remove the lubricating oil suction tube. Refer to Procedure 007-035 in Section 7. (/qs3/pubsys2/xml/en/procedures/425/425-007-035.html)

Initial Check



The thrust bearing consists of an upper bearing shell and two thrust flanges. The thrust flanges are spot welded for ease of assembly and designed to separate from the bearing shell during engine operation.

The dimensions of the thrust bearing and crankshaft journal determine end clearance.

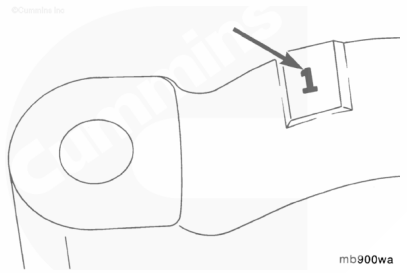
Note : If performing a bearing inspection while the engine is in chassis, avoid removing the thrust bearing. If the thrust bearing is removed for inspection, it **must** be replaced with a new thrust bearing.

Measure the crankshaft end clearance. Use dial indicator, Part Number 3824564, and magnetic base, Part Number 3377399, or equivalent.

Crankshaft End Clearance Limits		
mm		in
0.085	MIN	0.003
0.385	MAX	0.015

If the crankshaft end clearance is **not** within specification, make sure to inspect the crankshaft and thrust bearing surfaces for damage.

Remove

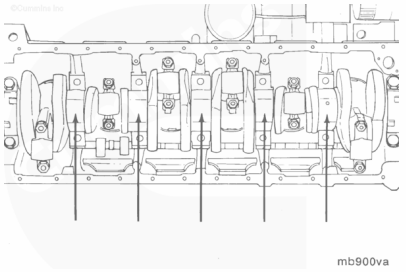


Before removing the main bearing caps, make certain the caps are clearly marked for their location on the intake side of the main bearing cap.

The number one cap is at the front of the engine.

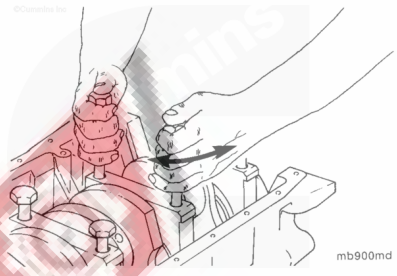
When replacing bearings in chassis, replace number 2 through number 6 while the number 1 and number 7 caps support the crankshaft. After replacing number 2 through number 6, replace number 1 and number 7.

Remove all main bearing caps except the number 1 and number 7 main bearing caps.



⚠ CAUTION ⚠

Do not pry on the main bearing caps to free them from the cylinder block. Damage to the main bearing caps and cylinder block can result.



Loosen the main bearing capscrews completely, but do **not** remove.

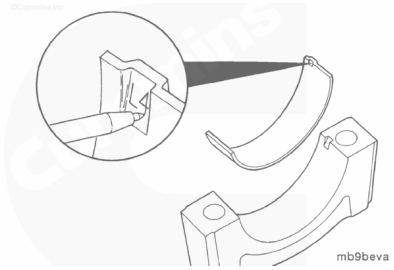
Use two of the main bearing cap bolts to wiggle the main bearing cap loose, being careful **not** to damage the bolt threads.

Remove the main bearing cap.

Mark the main bearings for position and number as they are removed.

Mark the bearing position in the tang area. Use an awl.

Note : Marking the bearing position is for future identification or possible future analysis.



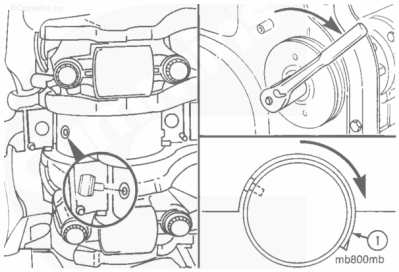
To remove the upper main bearings, install main bearing replacer, Part Number 3823818, in the oil hole of the crankshaft main bearing journal.

Rotate the crankshaft so the replacer contacts the upper main bearing on the side opposite the tang.

Continue to rotate the crankshaft in the direction that will remove the tang side (1) of the upper main bearing first.

Remove the bearing.

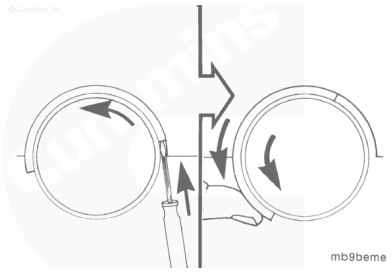
Follow this procedure to remove the other main bearings except for number 1 front main bearing.



ANADOLU ISUZU AFTER SALES

⚠ CAUTION ⚠

Use care so the screwdriver does not damage the crankshaft or cylinder block.



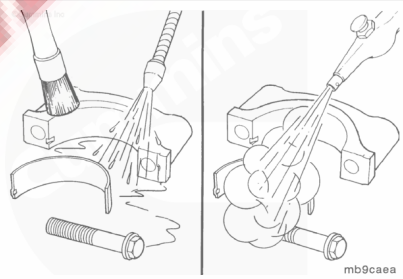
Note : The front main bearing, number 1, does **not** have a hole in the journal, so the tool can **not** be used to replace the bearing.

Use a flat blade screwdriver to gently bump the end of the bearing to loosen it from the cylinder block. Then, use finger pressure against the main bearing shell and rotate the crankshaft to roll the main bearing out.

Clean and Inspect for Reuse

⚠ WARNING ⚠

When using a steam cleaner, wear safety glasses or a face shield, as well as protective clothing. Hot steam can cause serious personal injury.



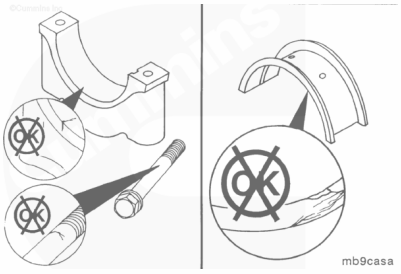
⚠ WARNING ⚠

Wear appropriate eye and face protection when using compressed air. Flying debris and dirt can cause personal injury.

Clean the main bearing caps. Use steam. Dry with compressed air.

Inspect all main bearing caps and main bearing crankshaft journals for deep scoring, overheating, etc.

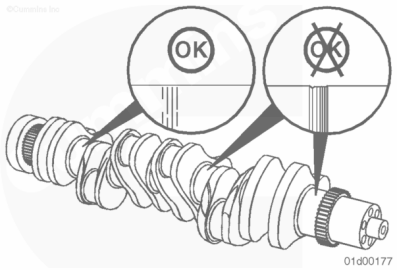
Replace any damaged components. If the main bearing cap is damaged, the block **must** be replaced.



Check the crankshaft main bearing journals for damage or excessive wear. Minor scratches are acceptable.

ANADOLU ISUZU PARTS SALES

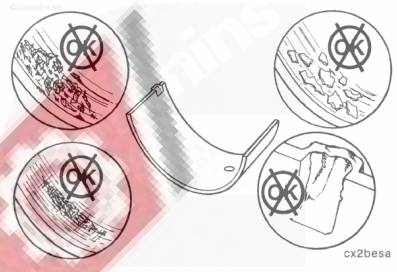
If crankshaft end clearance measured during the initial check was found to be out of specification, make sure to inspect the crankshaft thrust surface for excessive wear or damage. Minor scratches are acceptable.



If damage is found, the crankshaft **must** be removed. Refer to Procedure 001-016 in Section 1. (/qs3/pubsys2/xml/en/procedures/425/425-001-016.html)

Also inspect the thrust bearing surfaces for excessive wear. Replace the thrust bearing(s) if excessive wear is found.

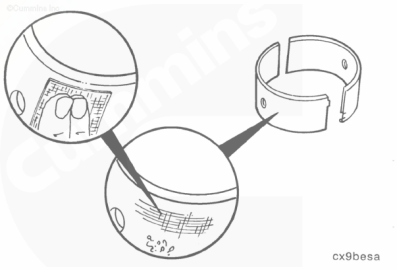
Inspect the bearings for damage.



Replace any bearings with the following damage:

- Pitting
- Flaking
- Corrosion
- Lock tang damage
- Scratches.

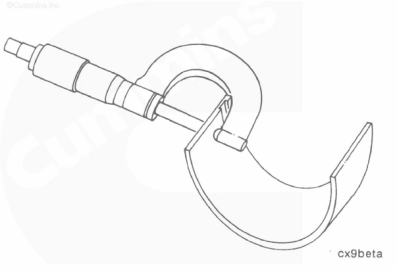
Inspect the bearing shell seating surfaces for nicks or burrs. If nicks or burrs can **not** be removed with abrasive pad, Part Number 3823258, or equivalent, the bearings **must** be replaced.



Note : If bearings are damaged, they **must** be replaced as a set.

Note : For more detailed information on bearing damage, see Analysis and Prevention of Bearing Failures, Bulletin 3810387.

Measure the main bearing shell thickness with an outside micrometer that has a ball tip.



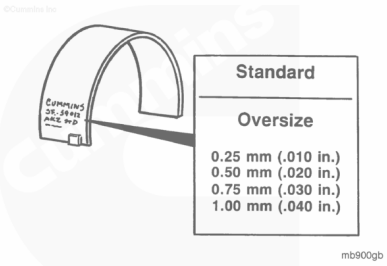
Main Bearing Dimensions			
	mm		in
Standard	3.446	MIN	0.1357
	3.454	MAX	0.1360

Discard a bearing shell if its thickness is below the minimum specification.

Note : Main bearings are identified with a part number and size stamped on the back side.

If replacing the bearings, determine the size of the removed main bearings. Obtain a set of the same size.

Oversize service main bearings are available for use with crankshafts machined undersize. See the appropriate parts catalog.



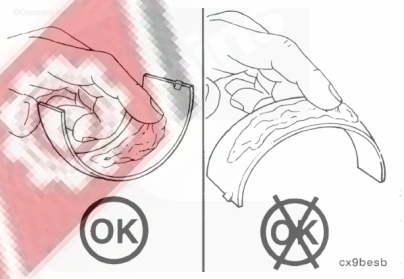
Install

Upper Main Bearings

Do **not** lubricate the side against the cylinder block.

Note : Make sure the main bearing being installed is same size as the main bearing removed. The size is engraved on the back of the main bearing.

Apply a coat of assembly lubricant, Part Number 3163086, or equivalent, to the crankshaft side of the main bearings.



Note : For in-chassis bearing replacement, it can be necessary to use clean engine oil to lubricate the bearing shell.

Note : The crankshaft thrust bearing **must** be installed in the number four position.

Note : The upper and lower main bearing shells of some engines are **not** interchangeable. The backs of the main bearings are marked with the proper orientation, if required.

Insert the side of the main bearing opposite the tang first. Install as far as possible by hand.

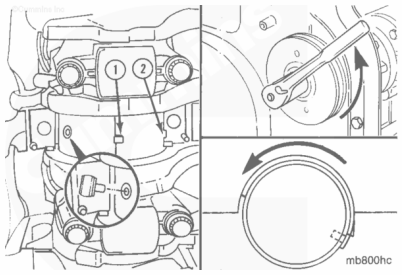
When installing the thrust bearing in the number four journal, it could be necessary to push the crankshaft to the front or rear of the cylinder block.



If reuse guidelines are met for the thrust bearing and the crankshaft has been removed, the thrust bearing can be reused. To aid in assembly, add assembly lubricant, Part Number 3163087, to the back of thrust flanges to help hold them in place.

If the crankshaft has **not** been removed, a new thrust bearing **must** be used.

Follow this step to finish installing the upper main bearings, except for number 1 front main bearing.



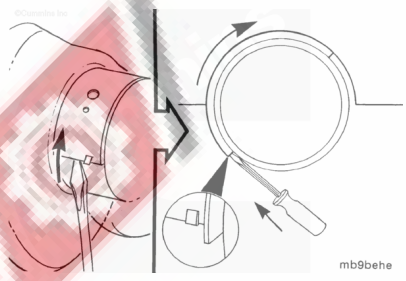
Make sure the pin does not slide under the bearing.

Use main bearing replacer, Part Number 3823818, to finish installing the main bearing by rotating the crankshaft. Rotate the crankshaft. Use barring tool, Part Number 3824591.

Make sure the tang (1) on the main bearing is located in the notch (2) of the cylinder block.

Finish pushing the main bearing into position.

Note : The front main, number 1, does **not** have a hole in the journal so the pin can **not** be used to replace the bearing.



Lubricate and install the number 1 main bearing.

Insert the side of the main bearing opposite the tang first. Install as far as possible by hand.

Use the screwdriver to push the main bearing into position as you rotate the crankshaft.

Lower Main Bearings



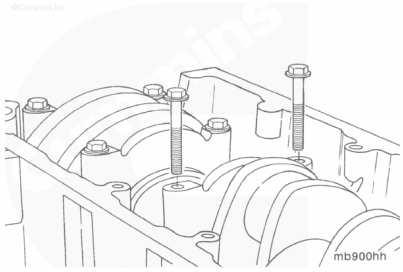
The backside of the bearings **must** be clean and free of debris.

Install the lower main bearings into the main bearing caps.

Align the tangs of the bearings with the tangs on the main bearing caps.

Apply a coat of assembly lubricant, Part Number 3163086, or equivalent, to the crankshaft side of the main bearings.

Note : The main bearing caps are numbered for location. Number 1 starts with the front of the block. Install the cap so numbers face the intake side of the engine.



The main bearing cap surfaces between the main bearing cap and block **must** be clean and free of debris.

Install a main bearing cap after each upper main bearing is installed to keep the main bearing in place while the other uppers are installed.

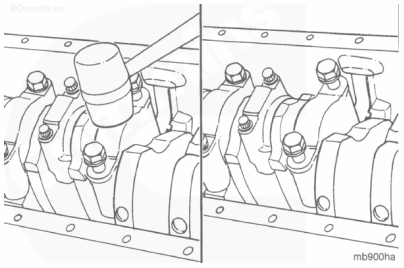
Lubricate the main bearing capscrew under the cap. Lubricate the main bearing capscrew threads. Use clean engine oil.

Gently tap the main bearing cap into position with a plastic or rubber mallet.

When seated, install the main bearing capscrews. Tighten.

Torque Value: 50 n•m [37 ft-lb]

Do **not** tighten to the final torque value at this time. The final torque **must** be applied after all main bearing caps are installed.

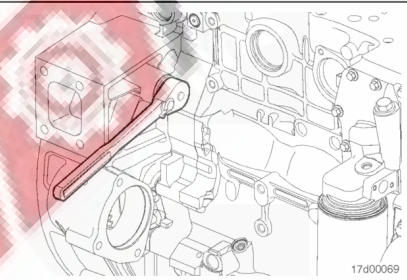


Use barring tool, Part Number 5299073, to make sure the crankshaft rotates freely after installing the main bearing caps.

While applying final torque to the main bearing capscrews, frequently check that the crankshaft rotates freely.

If the crankshaft does **not** rotate freely:

1. Confirm the crankshaft is **not** contacting one of the connecting rods.
2. Confirm the correct main bearing caps were installed correctly.
3. Confirm the main bearing cap ring dowels or mounting surfaces were **not** damaged during installation.
4. Confirm the correct main bearings were installed.

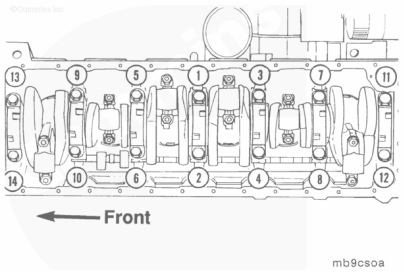


Tighten the main bearing capscrews evenly and in sequence.

Torque Value:

1. 170 n•m [125 ft-lb]
2. Loosen all capscrews.
3. 50 n•m [37 ft-lb]
4. Rotate 120 degrees.

Check the main bearing installation and the size of the main bearings if the crankshaft does **not** rotate freely.



The dimensions of the thrust bearing and crankshaft journal determine end clearance.

Measure the crankshaft end clearance. Use dial indicator, Part Number 3824564, and magnetic base, Part Number 3377399.

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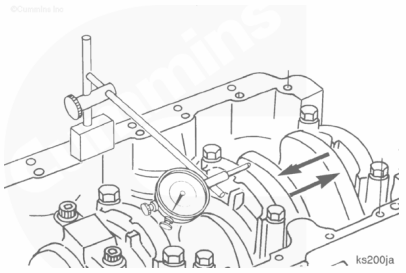
Crankshaft End Clearance Limits		
mm		in
0.085	MIN	0.003
0.385	MAX	0.015



If the crankshaft end clearance is **not** within specification:

1. If the crankshaft end clearance is below specification, check if there are any obstructions limiting crankshaft travel (lubricating oil pump, connecting rod, etc.)
2. If the crankshaft end clearance is above specification, inspect the crankshaft thrust bearing surface. Also, check if the correct thrust bearing(s) were installed.

Note : Oversize thrust bearings are available if the end clearance is **not** within specifications. See the appropriate parts catalog.

Finishing Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

- Install the lubricating oil suction tube. Refer to Procedure 007-035 in Section 7. (/qs3/pubsys2/xml/en/procedures/425/425-007-035.html)
- Install the lubricating oil pan and gasket. Refer to Procedure 007-025 in Section 7. (/qs3/pubsys2/xml/en/procedures/425/425-007-025.html)
- Fill the lubricating oil pan. Refer to Procedure 007-037 in Section 7. (/qs3/pubsys2/xml/en/procedures/425/425-007-037.html)
- Connect the batteries. See equipment manufacturer service information.
- Operate the engine. Check for leaks.

ANADOLU ISUZU PARTS


ANADOLU ISUZU
AFTER SALES

Select Service Tools

Recommended Cummins® Service Tools

- Assembly lubricant, Part Number 3163087, or equivalent
- Gauge, Part Number 3824564
- Magnetic base, Part Number 3377399

Additional Service Items

- No additional service items required.

Preparatory Steps

⚠ WARNING ⚠

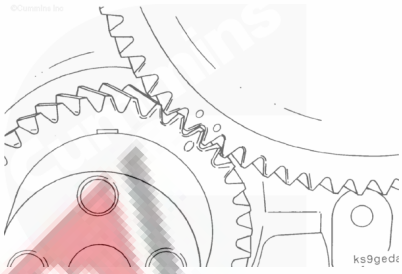
Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

- Disconnect the batteries. See equipment manufacturer service information.
- Remove the rocker lever cover. Refer to Procedure 003-011 in Section 3. (/qs3/pubsys2/xml/en/procedures/425/425-003-011.html)
- Remove the engine brakes, if equipped. Refer to Procedure 020-004 in Section 20. (/qs3/pubsys2/xml/en/procedures/425/425-020-004-tr.html)
- Remove the rocker lever housing, if equipped. Refer to Procedure 003-013 in Section 3. (/qs3/pubsys2/xml/en/procedures/425/425-003-013.html)
- Remove the rocker levers. Refer to Procedure 003-008 in Section 3. (/qs3/pubsys2/xml/en/procedures/425/425-003-008.html)
- Remove the push rods. Refer to Procedure 004-014 in Section 4. (/qs3/pubsys2/xml/en/procedures/425/425-004-014.html)
- Remove the drive belt. Refer to Procedure 008-002 in Section 8. (/qs3/pubsys2/xml/en/procedures/425/425-008-002-tr.html)
- Remove the rubber vibration damper, if installed. Refer to Procedure 001-051 in Section 8. (/qs3/pubsys2/xml/en/procedures/425/425-001-051.html)
- Remove the viscous vibration damper, if installed. Refer to Procedure 001-052 in Section 1. (/qs3/pubsys2/xml/en/procedures/425/425-001-052.html)
- Remove the gear cover. Refer to Procedure 001-031 in Section 1. (/qs3/pubsys2/xml/en/procedures/425/425-001-031.html)

- Raise the tappets. Refer to Procedure 004-015 in Section 4. (/qs3/pubsys2/xml/en/procedures/425/425-004-015.html)

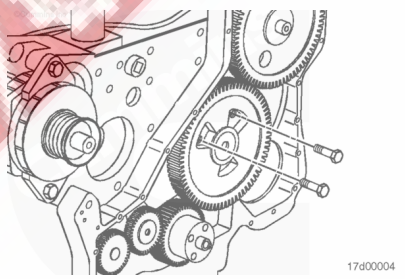
Remove

Rotate the crankshaft to align the crankshaft to camshaft timing marks.



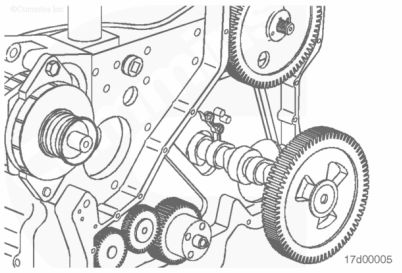
Note : Because the thrust plate extends more than 180 degrees around the camshaft, the thrust plate can **only** be removed from the camshaft after removing the cam gear from the camshaft.

Remove the capscrews from the thrust plate.



Remove the camshaft and thrust plate together.

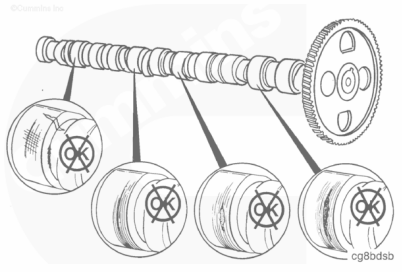
Note : Rotate the camshaft as it is being removed. Use extreme care to make sure the camshaft bushings are **not** damaged during the camshaft removal process.



Clean and Inspect for Reuse

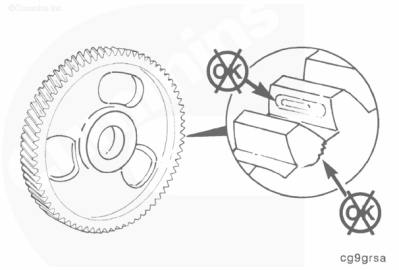
Inspect the valve lobes and bearing journals for cracking, pitting, and scoring.

See Service Bulletin, Camshaft Reuse Guidelines for Cummins® Engines with Roller Followers or Roller Tappets, Bulletin 3666052. (/qs3/pubsys2/xml/en/bulletin/3666052.html)



See Service Bulletin, Camshaft and Tappet Reuse Guidelines, Bulletin 3666475. (/qs3/pubsys2/xml/en/bulletin/3666475.html)

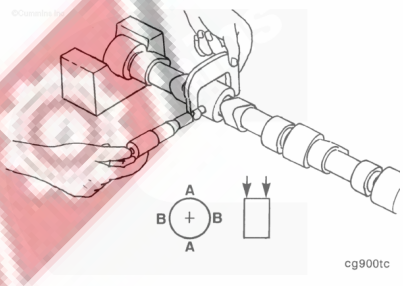
Inspect the camshaft gear. Replace if necessary. Refer to Procedure 001-013 in Section 1. (/qs3/pubsys2/xml/en/procedures/425/425-001-013.html)



Note : Replace the camshaft if the outside diameter of any bearing surface is less than 59.962 mm [2.3607 in].

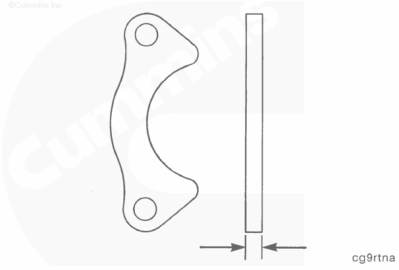
Measure the bearing journals.

Measure the seven camshaft bushing journals.



Camshaft Bearing Journal Diameter		
mm		in
59.962	MIN	2.3607
60.013	MAX	2.3627

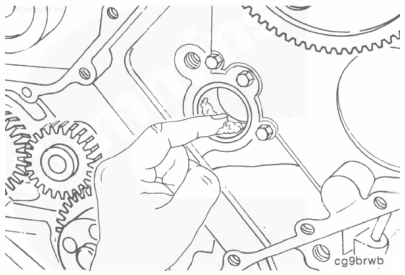
Measure camshaft thrust plate thickness.



Camshaft Thrust Plate		
mm		in
9.40	MIN	0.370
9.60	MAX	0.378

Install

Apply a coat of assembly lubricant, Part Number 3163087, or equivalent, to the front camshaft bore.



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Lubricate the camshaft lobes, journals and thrust plate. Use assembly lubricant, Part Number 3163087, or equivalent.

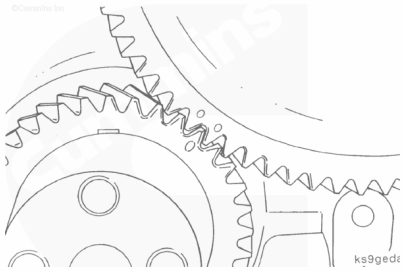
⚠ CAUTION ⚠

Do not try to force the camshaft into the camshaft bore as damage to the camshaft bushing can result.

Install the camshaft. While pushing in slightly, rotate the camshaft and carefully work the camshaft through the camshaft bushings. As each camshaft journal passes through a bushing, the camshaft will drop slightly and the camshaft lobes will catch on the bushings. Rotating the camshaft will free the lobe from the bushing and allow the camshaft to be installed.

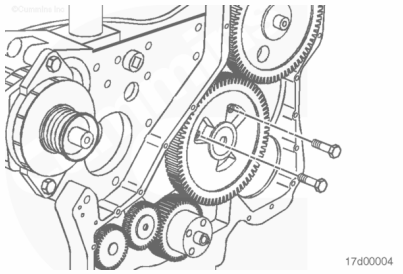
Before the camshaft gear engages the crankshaft gear, check the camshaft for ease of rotation. When installed properly, the camshaft **must** rotate freely.

Align the timing marks as illustrated. Finish installing the camshaft.



Install the thrust plate capscrews.

Torque Value: 24 n•m [212 in-lb]



Use gauge, Part Number 3824564, and magnetic base, Part Number 3377399, to verify the camshaft has proper end clearance and backlash.

Camshaft End Clearance (A)		
mm		in
0.12	MIN	0.005

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Camshaft End Clearance (A)		
mm		in
0.50	MAX	0.020

Camshaft Gear Backlash Limits (B)		
mm		in
0.08	MIN	0.003
0.33	MAX	0.013

Finishing Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

- Install the gear cover. Refer to Procedure 001-031 in Section 1. (/qs3/pubsys2/xml/en/procedures/425/425-001-031.html)
- Install the rubber vibration damper, if removed. Refer to Procedure 001-051 in Section 1. (/qs3/pubsys2/xml/en/procedures/425/425-001-051.html)
- Install the viscous vibration damper, if removed. Refer to Procedure 001-052 in Section 1. (/qs3/pubsys2/xml/en/procedures/425/425-001-052.html)
- Install the drive belt. Refer to Procedure 008-002 in Section 8. (/qs3/pubsys2/xml/en/procedures/425/425-008-002-tr.html)
- Release the tappets. Refer to Procedure 004-015 in Section 4. (/qs3/pubsys2/xml/en/procedures/425/425-004-015.html)
- Install the push rods. Refer to Procedure 004-014 in Section 4. (/qs3/pubsys2/xml/en/procedures/425/425-004-014.html)
- Install the rocker levers. Refer to Procedure 003-008 in Section 3. (/qs3/pubsys2/xml/en/procedures/425/425-003-008.html)
- Adjust the valve lash. Refer to Procedure 003-004 in Section 3. (/qs3/pubsys2/xml/en/procedures/425/425-003-004-tr.html)
- Install the rocker lever cover. Refer to Procedure 003-011 in Section 3. (/qs3/pubsys2/xml/en/procedures/425/425-003-011.html)
- Connect the batteries. See equipment manufacturer service information.
- Operate the engine. Check for leaks.

Last Modified: 01-Nov-2016



Select Service Tools

Recommended Cummins® Service Tools

- Camshaft Bushing Replacer Kit, Part Number 3165045
- Hydraulic Actuator Kit, Part Number 3823621
- Camshaft Bushing Kit, Part Number 3162253

Additional Service Items

- Felt tip pen

General Information

The engine has seven camshaft bushings, starting with camshaft bushing 1 at the front of the engine.

Camshaft bushings 1 through 6 can be replaced through the front of the engine by driving them towards the rear of the engine.

Replacing camshaft bushing 7 requires the flywheel housing and the cup plug at the rear face of the block adjacent to the camshaft be removed to drive camshaft bushing 7 forward for replacement.

Preparatory Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

- Disconnect the batteries. See equipment manufacturer service information.
- Drain the lubricating oil. Refer to Procedure 007-037 in Section 7. (/qs3/pubsys2/xml/en/procedures/425/425-007-037.html)
- Drain the lubricating oil pan. Refer to Procedure 007-025 in Section 7. (/qs3/pubsys2/xml/en/procedures/425/425-007-025.html)

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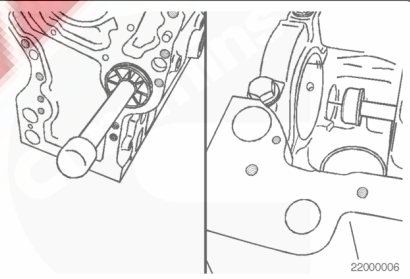
- Remove the starting motor. Refer to Procedure 013-020 in Section 13. (/qs3/pubsys2/xml/en/procedures/425/425-013-020-tr.html)
- Remove the flexplate, if installed. Refer to Procedure 016-004 in Section 16. (/qs3/pubsys2/xml/en/procedures/425/425-016-004.html)
- Remove the flywheel, if installed. Refer to Procedure 016-005 in Section 16. (/qs3/pubsys2/xml/en/procedures/425/425-016-005.html)
- Remove the flywheel housing. Refer to Procedure 016-006 in Section 16. (/qs3/pubsys2/xml/en/procedures/425/425-016-006.html)
- Remove the camshaft. Refer to Procedure 001-008 in Section 1. (/qs3/pubsys2/xml/en/procedures/425/425-001-008.html)
- Remove the rear camshaft cup plug. Refer to Procedure 017-002 in Section 17. (/qs3/pubsys2/xml/en/procedures/425/425-017-002.html)

Remove

Remove the camshaft bushings. Use Camshaft Bushing Replacer Kit, Part Number 3165045.



The following kits are also available for camshaft bushing installation and removal:

- Hydraulic Actuator Kit, Part Number 3823621.
- Camshaft Bushing Kit, Part Number 3162253.

Slide the drive bar through the centering guide and insert the drive bar from the rear of the cylinder block through the camshaft bores.

Insert the camshaft bushing replacer and drive the front camshaft bushing from the cylinder block.

Remove the replacer and drive bar from the cylinder block.

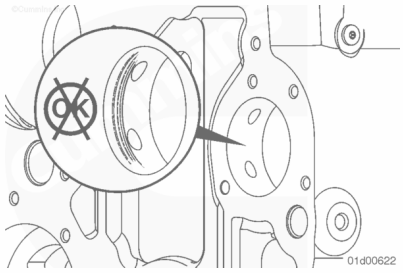
Insert the drive bar, camshaft bushing replacer, and centering guide from the front of the cylinder block.

Drive the remaining camshaft bushings from the cylinder block in succession, starting with the number 2 camshaft bushing.

Remove the drive bar, replacer, and guide from the front of the cylinder block.

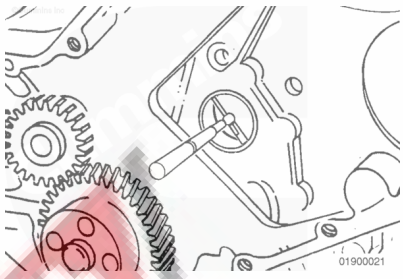
Clean and Inspect for Reuse

Inspect the camshaft bore for damage and excessive wear. Refer to Procedure 001-026 in Section 1. (/qs3/pubsys2/xml/en/procedures/425/425-001-026.html)



Measure the camshaft bore.

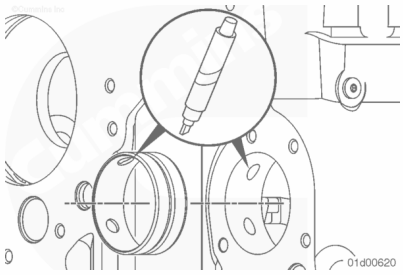
Camshaft Bore Diameter (Maximum)				
	mm		in	
Without bushing		64.013	MAX	2.5202
With bushing		60.120	MAX	2.3669



Install

Mark the oil holes on the camshaft bushing and cylinder block with a felt tip pen. This aids proper alignment of the bushing and bore during installation.

Note : The top hole on the front and rear camshaft bushings will **not** line up with the top hole of the cylinder block bores. **Only** the bottom hole will line up for the front and rear camshaft bushings.

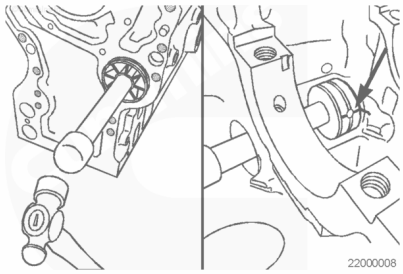


Slide the camshaft bushing on the replacer. Position the notch on the edge of the bushing to the top rear of the block. Align the marks on the camshaft bushing and cylinder block.

Drive the rearmost camshaft bushing to the correct installed depth. The correct installed depth is when the camshaft bushing oil hole aligns with the cylinder block oil hole.

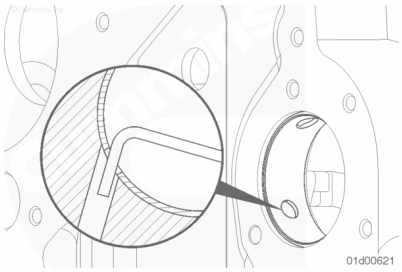
Install the remaining camshaft bushings in succession, starting at the rear of the cylinder block and working toward the front.

Remove the drive bar, replacer, and guide from the cylinder block.



Make sure the lubricating oil holes in the camshaft bushing are aligned with the oil holes in the camshaft bore. For the front and rear camshaft bushings, **only** the bottom hole will line up with the hole in the cylinder block.

A 3.2 mm [0.128 in] diameter rod **must** be able to pass through the lubricating oil holes.



Finishing Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

- Install the rear camshaft cup plug. Refer to Procedure 017-002 in Section 17. (/qs3/pubsys2/xml/en/procedures/425/425-017-002.html)
- Install the camshaft. Refer to Procedure 001-008 in Section 1. (/qs3/pubsys2/xml/en/procedures/425/425-001-008.html)
- Install the flywheel housing. Refer to Procedure 016-006 in Section 16. (/qs3/pubsys2/xml/en/procedures/425/425-016-006.html)
- Install the flexplate, if installed. Refer to Procedure 016-004 in Section 16, if installed. (/qs3/pubsys2/xml/en/procedures/425/425-016-004.html)
- Install the flywheel, if installed. Refer to Procedure 016-005 in Section 16. (/qs3/pubsys2/xml/en/procedures/425/425-016-005.html)
- Install the starting motor. Refer to Procedure 013-020 in Section 13. (/qs3/pubsys2/xml/en/procedures/425/425-013-020-tr.html)
- Install the lubricating oil pan. Refer to Procedure 007-025 in Section 7. (/qs3/pubsys2/xml/en/procedures/425/425-007-025.html)
- Fill the lubricating oil system. Refer to Procedure 007-037 in Section 7. (/qs3/pubsys2/xml/en/procedures/425/425-007-037.html)
- Connect the batteries. See equipment manufacturer service information.
- Operate the engine. Check for leaks.

ANADOLU ISUZU

Last Modified: 02-Oct-2020


ANADOLU ISUZU
AFTER SALES

Select Service Tools

Recommended Cummins® Service Tools

- Camshaft gear removal and installation tool, Part Number 3163054
- Camshaft gear installation and removal tool, Part Number 3165093
- Abrasive pad, Part Number 3823258
- Lubricant, Part Number 3163087, or equivalent
- Dial indicator assembly, Part Number 3824564, or equivalent
- Magnetic base indicator holder, Part Number 3377399, or equivalent
- Nuts, Part Number 3164753
- Handle, Part Number 3164907

Additional Service Items

- Wrench
- Parts oven
- Protective gloves
- Feeler gauge
- Pry bar

Preparatory Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

- Disconnect the batteries. See equipment manufacturer service information.
- Remove the drive belt. Refer to Procedure 008-002 in Section 8. (/qs3/pubsys2/xml/en/procedures/425/425-008-002-tr.html)
- Remove the rubber vibration damper, if installed. Refer to Procedure 001-051 in Section 1. (/qs3/pubsys2/xml/en/procedures/425/425-001-051.html)
- Remove the viscous vibration damper, if installed. Refer to Procedure 001-052 in Section 1. (/qs3/pubsys2/xml/en/procedures/425/425-001-052.html)
- Remove the gear cover. Refer to Procedure 001-031 in Section 1. (/qs3/pubsys2/xml/en/procedures/425/425-001-031.html)
- Remove the rocker lever cover. Refer to Procedure 003-011 in Section 3. (/qs3/pubsys2/xml/en/procedures/425/425-003-011.html)

ANADOLU ISUZU AFTER SALES

- Loosen the rocker lever assemblies. Refer to Procedure 003-008 in Section 3. (/qs3/pubsys2/xml/en/procedures/425/425-003-008.html)

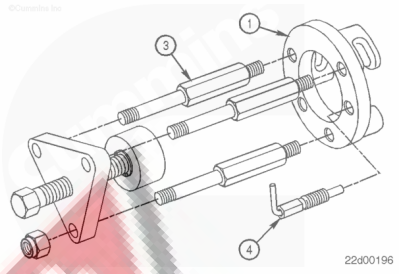
Remove

Use camshaft gear removal and installation tool, Part Number 3163054, and camshaft gear installation and removal tool, Part Number 3165093, or equivalent, to remove the camshaft gear from the camshaft.

Install the studs (3) into the gear remover (1). Hand tighten the studs.

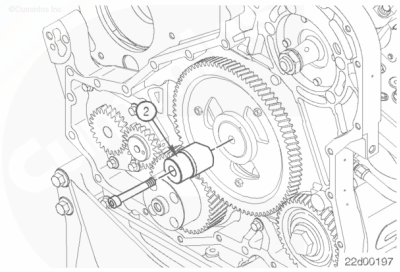
Install the replacer screw assembly on the studs. Install nuts, Part Number 3164753, onto the studs. Hand tighten.

Install the spring plungers (4), if required.



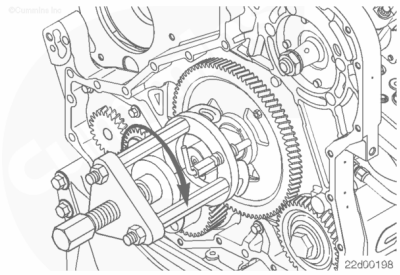
Loosen the thrust plate capscrews approximately two turns. Rotate the camshaft gear until the keyway is located at the 1 o'clock position.

Place the camshaft pilot (2) on the end of the camshaft. Install the socket head capscrew. Hand tighten.



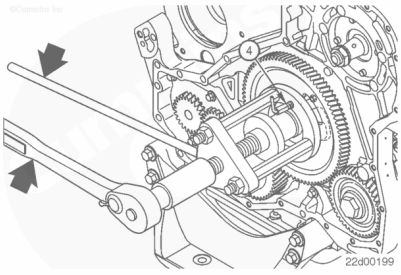
Install the camshaft gear replacer assembly onto the camshaft gear.

Rotate **clockwise** until the camshaft gear replacer assembly is fully engaged in the camshaft gear slots.



Install handle, Part Number 3164907, in the replacer screw assembly.

Using a wrench, turn the replacer screw **clockwise** while holding the handle to prevent gear rotation. Remove the camshaft gear.

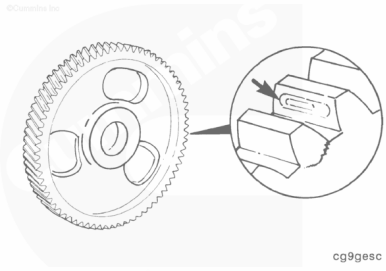


Clean and Inspect for Reuse

Inspect the camshaft gear for cracked, chipped, or broken teeth.

Inspect the camshaft bore for fretting or burrs.

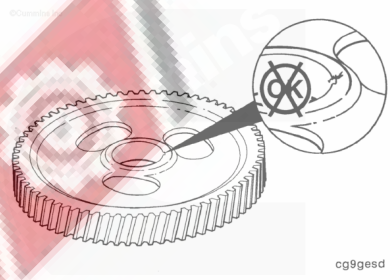
Note : If the fretting, burrs, or raised material can **not** be removed with abrasive pad, Part Number 3823258, or equivalent, replace the camshaft gear.



Inspect the camshaft gear keyway for burrs.

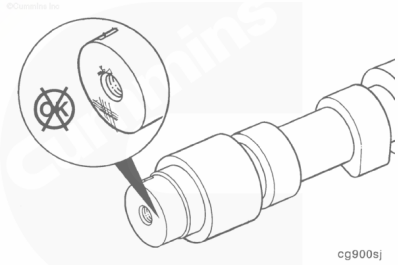
Remove burrs. Use abrasive pad, Part Number 3823258, or equivalent.

Note : If the keyway is damaged or the burrs can **not** be removed, the camshaft gear **must** be replaced.



Inspect the camshaft nose for fretting or burrs.

Note : If fretting or burrs can **not** be removed with abrasive pad, Part Number 3823258, or equivalent, replace the camshaft. Refer to Procedure 001-008 in Section 1. (/qs3/pubsys2/xml/en/procedures/425/425-001-008.html)



Install

Lubricate the camshaft surface. Use assembly lubricant, Part Number 3163087, or equivalent.

Install the key into the camshaft nose.

Tighten the thrust plate capscrews.

Torque Value: 24 n•m [212 in-lb]

⚠ CAUTION ⚠

The camshaft gear will be permanently distorted if overheated. The oven temperature should never exceed 204°C [400°F].

Heat the camshaft gear for 45 minutes.

Measurements		
	celsius	fahrenheit
Oven Temperature	204	400

Use camshaft gear removal and installation tool, Part Number 3163054, and puller assembly, Part Number 3165093, or equivalent, to install the camshaft gear onto the camshaft.

Wear protective gloves to reduce the possibility of personal injury when handling parts that have been heated.

Install the camshaft gear with the timing marks away from the camshaft.

Note : Make sure the gear is seated against camshaft shoulder.

Use a 0.02 mm [0.001] feeler gauge, to see if the feeler gauge can be inserted between the camshaft gear and the shoulder on the camshaft. Insert the feeler gauge in multiple locations. If the feeler gauge can be inserted, the camshaft gear is **not** properly seated.

Use dial indicator assembly, Part Number 3824564, and magnetic base, Part Number 3377399, or equivalent, to verify the camshaft has proper backlash and end clearance.

Camshaft End Clearance (A)		
mm		in
0.12	MIN	0.005
0.50	MAX	0.020

Camshaft Gear Backlash Limits (B)		
mm		in
0.08	MIN	0.003
0.33	MAX	0.013

Finishing Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

- Install the gear cover. Refer to Procedure 001-031in Section 1. (/qs3/pubsys2/xml/en/procedures/425/425-001-031.html)
- Install the rubber vibration damper, if installed. Refer to Procedure 001-051 in Section 1. (/qs3/pubsys2/xml/en/procedures/425/425-001-051.html)
- Install the viscous vibration damper, if installed. Refer to Procedure 001-052 in Section 1. (/qs3/pubsys2/xml/en/procedures/425/425-001-052.html)
- Install the drive belt. Refer to Procedure 008-002 in Section 8. (/qs3/pubsys2/xml/en/procedures/425/425-008-002-tr.html)
- Tighten the rocker lever assemblies. Refer to Procedure 003-008 in Section 3. (/qs3/pubsys2/xml/en/procedures/425/425-003-008.html)
- Adjust the valve lash. Refer to Procedure 003-004 in Section 3. (/qs3/pubsys2/xml/en/procedures/425/425-003-004-tr.html)
- Install the rocker lever cover. Refer to Procedure 003-011 in Section 3. (/qs3/pubsys2/xml/en/procedures/425/425-003-011.html)
- Connect the batteries. See equipment manufacturers service information.
- Operate the engine. Check for proper operation.

ANADOLU DİESEL

Select Service Tools

Recommended Cummins® Service Tools

- Abrasive pad, Part Number 3823259, or equivalent
- Assembly lubricant, Part Number 3163087, or equivalent

Additional Service Items

- Feeler gauge

Preparatory Steps

⚠ WARNING ⚠

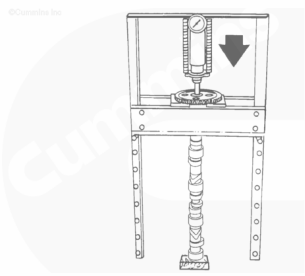
Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

- Disconnect the batteries. See equipment manufacturer service information.
- Remove the camshaft. Refer to Procedure 001-008 in Section 1. (/qs3/pubsys2/xml/en/procedures/425/425-001-008.html)

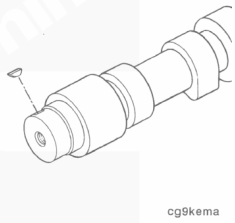
Remove

Remove the gear by using a press.

Remove the thrust plate.



Remove the camshaft key.

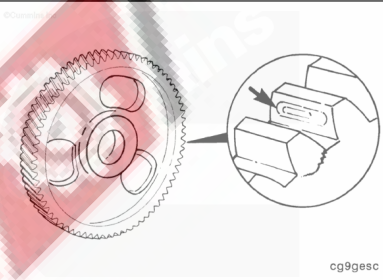

cg9kema

Clean and Inspect for Reuse

Inspect the camshaft gear for cracked, chipped, or broken teeth.

Inspect the camshaft bore for fretting or burrs.

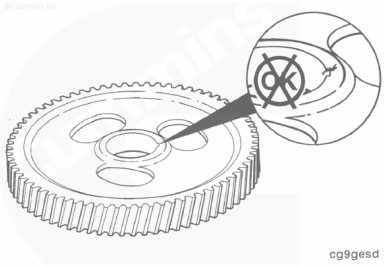
Note : If the fretting, burrs, or raised material can **not** be removed with abrasive pad, Part Number 3823258, or equivalent, replace the camshaft gear.


cg9gesc

Inspect the camshaft gear keyway for burrs.

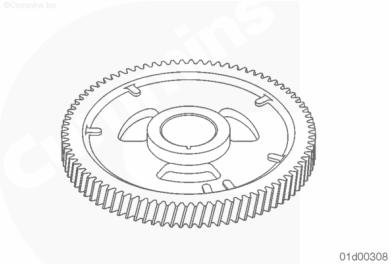
Remove burrs. Use abrasive pad, Part Number 3823258, or equivalent.

Note : If the keyway is damaged or the burrs can **not** be removed, the camshaft gear **must** be replaced.


cg9gesd

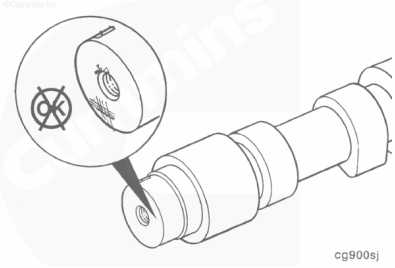
Inspect the camshaft gear and speed sensor targets.

Replace the camshaft gear if any damage is found.


01d00308

Inspect the camshaft nose for fretting or burrs.

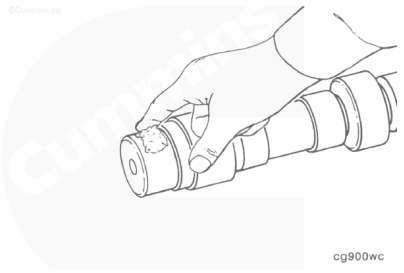
Note : If fretting or burrs can **not** be removed with abrasive pad, Part Number 3823258, or equivalent, replace the camshaft.


cg900sj

ANADOLU ISUZU PARTS

Install

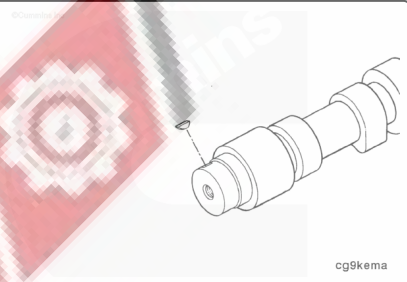
Lubricate the camshaft surface. Use assembly lubricant, Part Number 3163087, or equivalent.



Install the key.

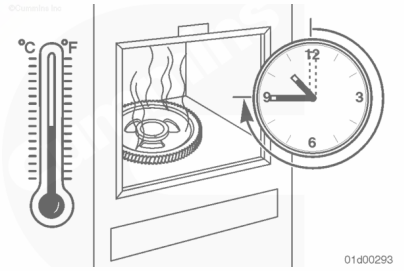
Install the thrust plate.

Note : Because the thrust plate extends more than 180 degrees around the camshaft, the thrust plate **must** be installed before installing the cam gear on the camshaft.



⚠ CAUTION ⚠

The camshaft gear will be permanently distorted if overheated. The oven temperature should never exceed 204°C [400°F].

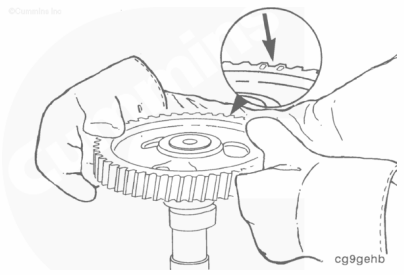


Heat the camshaft gear for 45 minutes.

Measurements		
	celsius	fahrenheit
Oven Temperature	204	400

⚠ WARNING ⚠

To reduce the possibility of personal injury, wear protective gloves when handling parts that have been heated.



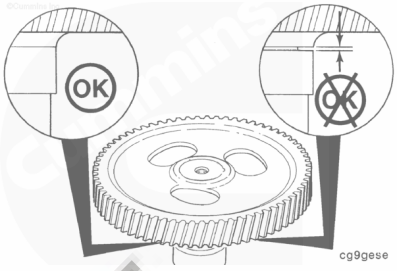
Note : When clamping the camshaft to install the gear, do **not** place clamps directly on the camshaft lobes or journals, which could damage the surfaces. Clamp **only** the cast surfaces between the lobes, or

place padding between the clamps and the camshaft surfaces.

Install the camshaft gear with the timing marks away from the camshaft.

Note : Make sure the gear is seated against camshaft shoulder.

Use a 0.02 mm [0.001 in] feeler gauge, to see if the feeler gauge can be inserted between the camshaft gear and the shoulder on the camshaft. If the feeler gauge can be inserted, the camshaft gear is **not** properly seated.



Finishing Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

- Install the camshaft. Refer to Procedure 001-008 in Section 1. (/qs3/pubsys2/xml/en/procedures/425/425-001-008.html)
- Connect the batteries. See equipment manufacturer service information.
- Operate the engine. Check for leaks.

ANADOLU ISUZU

Last Modified: 01-Nov-2016

Select Service Tools

Recommended Cummins® Service Tools

- Connecting rod checking fixture, Part Number ST 561
- Connecting rod mandrel set, Part Number 3823286
- Mandrel, Part Number 3823283
- Mandrel, Part Number 3823284
- Mandrel, Part Number 3823303

Additional Service Items

- Nylon bristle brush
- Feeler gauge

General Information

The engine uses straight (horizontal) fracture-split connecting rods.

Connecting rods with a fracture-split or serrated surface **must** be treated with caution. The two pieces of the connecting rod can **not** be rubbed together, as this will damage the mating surfaces. Use care to **not** drop either piece of the connecting rod.

The connecting rods can **not** be mixed with previous product for ISC/ISL engines.

Preparatory Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

⚠ WARNING ⚠

Do not remove the pressure cap from a hot engine. Wait until the coolant temperature is below 50°C [120°F] before removing the pressure cap. Heated coolant spray or steam can cause personal injury.

⚠ WARNING ⚠

Coolant is toxic. Keep away from children and pets. If not reused, dispose of in accordance with local environmental regulations.

⚠ WARNING ⚠

To reduce the possibility of personal injury, avoid direct contact of hot oil with your skin.

⚠ WARNING ⚠

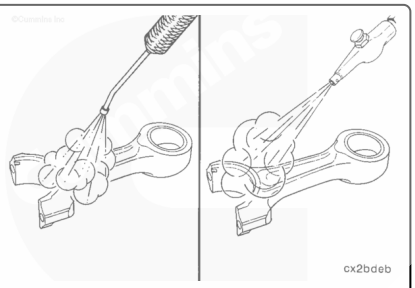
Some state and federal agencies have determined that used engine oil can be carcinogenic and cause reproductive toxicity. Avoid inhalation of vapors, ingestion, and prolonged contact with used engine oil. If not reused, dispose of in accordance with local environmental regulations.

- Disconnect the batteries. See equipment manufacturer service information.
- Drain the cooling system. Refer to Procedure 008-018 in Section 8. (/qs3/pubsys2/xml/en/procedures/425/425-008-018-tr.html)
- Drain the lubricating oil. Refer to Procedure 007-037 in Section 7. (/qs3/pubsys2/xml/en/procedures/425/425-007-037.html)
- Remove the cylinder head. Refer to Procedure 002-004 in Section 2. (/qs3/pubsys2/xml/en/procedures/425/425-002-004.html)
- Remove the lubricating oil pan and gasket. Refer to Procedure 007-025 in Section 7. (/qs3/pubsys2/xml/en/procedures/425/425-007-025.html)
- Remove the lubricating oil suction tube. Refer to Procedure 007-035 in Section 7. (/qs3/pubsys2/xml/en/procedures/425/425-007-035.html)
- Remove the piston cooling nozzles. Refer to Procedure 001-046 in Section 1. (/qs3/pubsys2/xml/en/procedures/425/425-001-046.html)
- Remove the piston and connecting rod, and disassemble. Refer to Procedure 001-054 in Section 1. (/qs3/pubsys2/xml/en/procedures/425/425-001-054.html)

Clean and Inspect for Reuse

⚠ WARNING ⚠

When using a steam cleaner, wear safety glasses or a face shield, as well as protective clothing. Hot steam can cause serious personal injury.



⚠ WARNING ⚠

When using solvents, acids, or alkaline materials for cleaning, follow the manufacturer's recommendations for use. Wear goggles and protective clothing to reduce the possibility of personal injury.

⚠ WARNING ⚠

Some solvents are flammable and toxic. Read the manufacturer's instructions before using.

⚠ WARNING ⚠

Wear appropriate eye and face protection when using compressed air. Flying debris and dirt can cause personal injury.

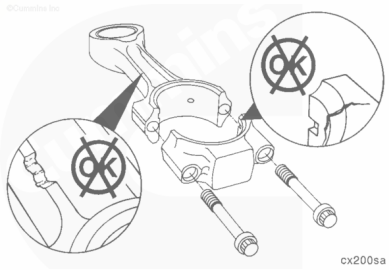
Clean the oil drillings. Use a nylon bristle brush.

Clean the connecting rods. Use steam or solvent.

Dry with compressed air.

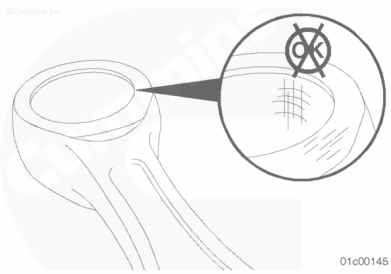
Inspect the connecting rods and connecting rod caps for damage.

Replace the connecting rod if the “I-beam” is nicked or otherwise damaged.



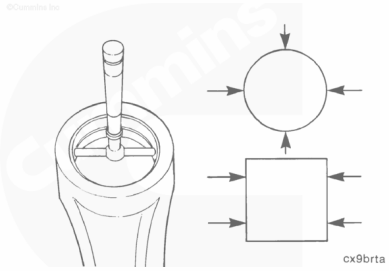
Inspect the piston pin bore for damage or misalignment of the oil passage and bushing.

Replace the connecting rod if any damage is found.



Measure the connecting rod piston pin bushing inside diameter.

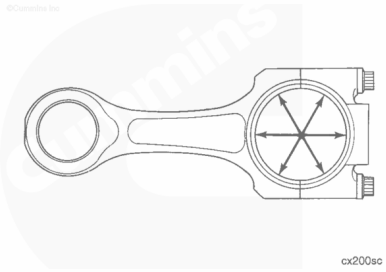
Connecting Rod Piston Pin Bushing Diameter		
mm		in
45.023	MIN	1.7726
45.035	MAX	1.7730



ANADOLU ISUZU DEALER SALES

If the connecting rod piston pin bushing inside diameter is out of specification, replace the connecting rod.

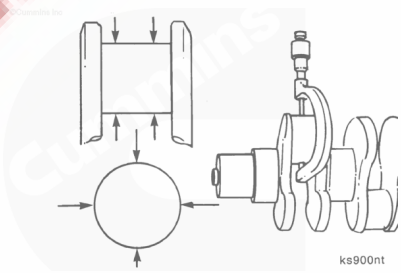
Measure the connecting rod crankshaft bore with the bearing shells removed and the caps tightened to the proper torque value. Refer to Procedure 001-054 in Section 1. (/qs3/pubsys2/xml/en/procedures/425/425-001-054.html)



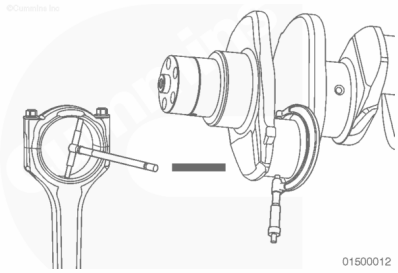
Connecting Rod Crank Bore Diameter (Bearings Removed)		
mm		in
80.987	MIN	3.1885
81.013	MAX	3.1895

If the connecting rod crank bore diameter is out of specification, replace the connecting rod.

Measure the diameter of the rod journal on the crankshaft. Refer to Procedure 001-016 in Section 1. (/qs3/pubsys2/xml/en/procedures/425/425-001-016.html)



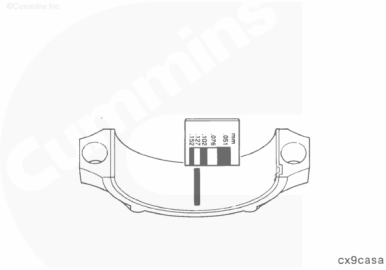
Bearing Clearance		
mm		in
0.038	MIN	0.0015
0.116	MAX	0.0045



Bearing clearance: rod inside diameter (with bearing) minus crankshaft journal diameter.

Bearing clearance can also be determined with a plastigauge during engine assembly.

Note : If the clearance is found to be out of specification, replace or try another set of connecting rod bearings.



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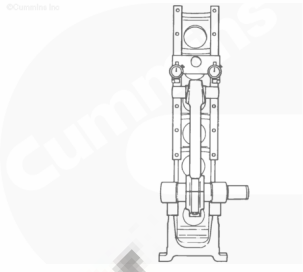
Bend and Twist Inspect

Calibration Procedure

Use connecting rod checking fixture, Part Number ST 561, and connecting rod mandrel set, Part Number 3823286, to inspect the bend and twist of the rods.

Calibrate the checking fixture with a new rod measured for correct center to center length, 215.975 to 216.025 mm [8.5029 to 8.5040 in].

Assemble the connecting rod cap to the rod, as described previously in this procedure.

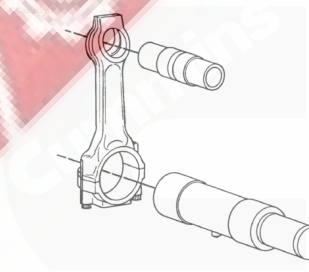


Install the piston pin mandrel from mandrel set, Part Number 3823286, into the piston pin bore.

Note : Use mandrel, Part Number 3823283, if a piston bushing has been removed or mandrel, Part Number 3823284, if the bushing is still in place.

Install mandrel, Part Number 3823303, into the crankshaft bore and expand the mandrel.

Note : Make sure the pin on the mandrel is down and locked in position in the center of the connecting rod.

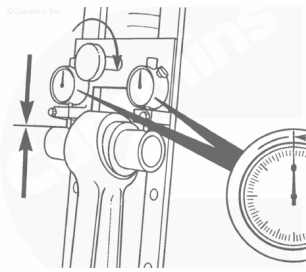


Install the connecting rod into the fixture.

Move the dial holder to position the contact points of the indicators on the mandrel in the piston pin bore.

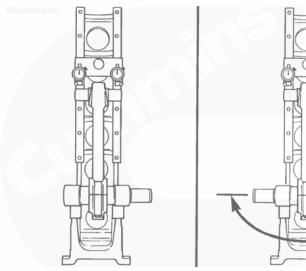
Tighten the bracket to hold the indicators in position.

Set the dial indicators to zero.



Remove the connecting rod from the fixture.

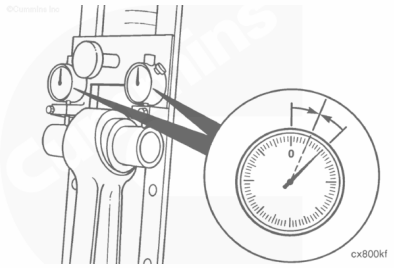
Turn the rod 180 degrees horizontally. Install the rod into the fixture again.



Check the dial indicators for zero position again.

If the dial indicators show any change from zero, adjust the dials to half the indicated reading.

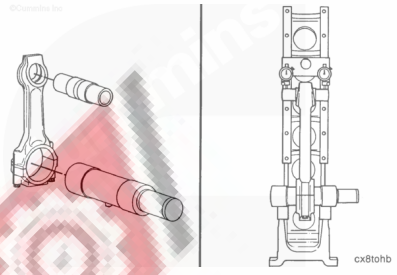
The fixture is now calibrated to allow the connecting rod to be installed into the fixture in either direction. The dials will indicate an equal defection on either side or zero.



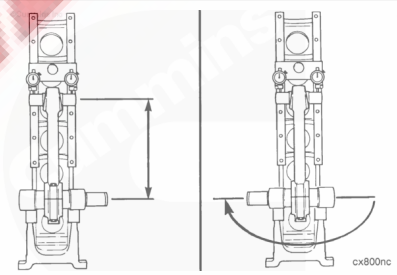
Test

Install the mandrel and arbor into the connecting rod to be inspected.

Install the connecting rod into the fixture.



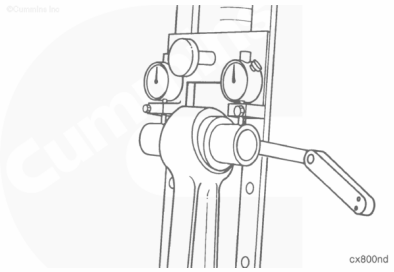
Measure the connecting rod length and bend (alignment).



Straight Split Connecting Rod Length		
mm		in
215.975	MIN	8.5029
216.025	MAX	8.5049

Connecting Rod Bend (Alignment)				
	mm		in	
Bushing Removed		0.20	MAX	0.008
Bushing Installed		0.15	MAX	0.006

Install a feeler gauge between the mandrel and dial indicator holding plate, as shown in the illustration.



Connecting Rod Twist				
	mm		in	
Bushing Removed		0.20	MAX	0.008

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Bushing Installed		0.30	MAX	0.012

Finishing Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

- Assemble and install the pistons and connecting rod assemblies. Refer to Procedure 001-054 in Section 1. (/qs3/pubsys2/xml/en/procedures/425/425-001-054.html)
- Install the piston cooling nozzles. Refer to Procedure 001-046 in Section 1. (/qs3/pubsys2/xml/en/procedures/425/425-001-046.html)
- Install the lubricating oil suction tube. Refer to Procedure 007-035 in Section 7. (/qs3/pubsys2/xml/en/procedures/425/425-007-035.html)
- Install the lubricating oil pan and gasket. Refer to Procedure 007-025 in Section 7. (/qs3/pubsys2/xml/en/procedures/425/425-007-025.html)
- Install the cylinder head. Refer to Procedure 002-004 in Section 2. (/qs3/pubsys2/xml/en/procedures/425/425-002-004.html)
- Fill the lubricating oil system. Refer to Procedure 007-037 in Section 7. (/qs3/pubsys2/xml/en/procedures/425/425-007-037.html)
- Fill the cooling system. Refer to Procedure 008-018 in Section 8. (/qs3/pubsys2/xml/en/procedures/425/425-008-018-tr.html)
- Connect the batteries. See equipment manufacturer service information.
- Operate the engine. Check for leaks.

ANADOLU ISUZU

Last Modified: 25-Jul-2016

Select Service Tools

Recommended Cummins® Service Tools

- Nylon lifting sling, Part Number 2892501
- Threaded Insert Kit, Part Number 3822709
- Assembly lubricant, Part Number 3163087, or equivalent
- Barring tool, Part Number 3824591, or equivalent

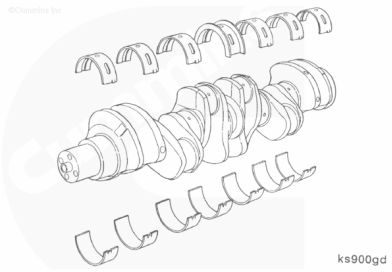
Additional Service Items

- Hoist
- Awl
- Fine crocus cloth
- Mircometer

General Information

The crankshaft uses forged counterweights.

Oversize main bearings, thrust bearings, and connecting rod bearings are available for service. Cummins Inc. recommends regrinding all main or the connecting rod journals when one requires regrinding. See the appropriate parts catalog.



Preparatory Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

- Disconnect the battery. See equipment manufacturer service information.
- Remove the engine and place on an engine stand. Refer to Procedure 000-001 in Section 0. (/qs3/pubsys2/xml/en/procedures/425/425-000-001.html)

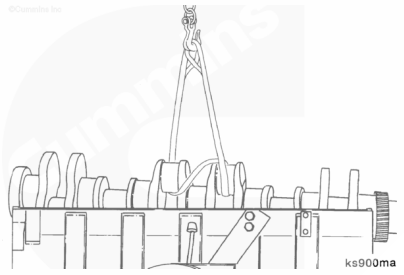
- Remove the drive belt. Refer to Procedure 008-002 in Section 8. (/qs3/pubsys2/xml/en/procedures/425/425-008-002-tr.html)
- Remove the rubber vibration damper, if installed. Refer to Procedure 001-051 in Section 1. (/qs3/pubsys2/xml/en/procedures/425/425-001-051.html)
- Remove the viscous vibration damper, if installed. Refer to Procedure 001-052 in Section 1. (/qs3/pubsys2/xml/en/procedures/425/425-001-052.html)
- Remove the front cover. Refer to Procedure 001-031 in Section 1. (/qs3/pubsys2/xml/en/procedures/425/425-001-031.html)
- Remove the starting motor. Refer to Procedure 013-020 in Section 13. (/qs3/pubsys2/xml/en/procedures/425/425-013-020-tr.html)
- Remove the flexplate, if installed. Refer to Procedure 016-004 in Section 16. (/qs3/pubsys2/xml/en/procedures/425/425-016-004.html)
- Remove the flywheel, if installed. Refer to Procedure 016-005 in Section 16. (/qs3/pubsys2/xml/en/procedures/425/425-016-005.html)
- Remove the flywheel housing. Refer to Procedure 016-006 in Section 16. (/qs3/pubsys2/xml/en/procedures/425/425-016-006.html)
- Remove the rear crankshaft seal carrier. Refer to Procedure 001-067 in Section 1. (/qs3/pubsys2/xml/en/procedures/425/425-001-067.html)
- Remove the lubricating oil pan. Refer to Procedure 007-025 in Section 7. (/qs3/pubsys2/xml/en/procedures/425/425-007-025.html)
- Remove the lubricating oil suction tube. Refer to Procedure 007-035 in Section 7. (/qs3/pubsys2/xml/en/procedures/425/425-007-035.html)
- Remove the fuel pump. Refer to Procedure 005-016 in Section 5. (/qs3/pubsys2/xml/en/procedures/425/425-005-016.html)
- Remove the air compressor, if required. Refer to Procedure 012-014 in Section 12. (/qs3/pubsys2/xml/en/procedures/425/425-012-014.html)
- Remove the camshaft gear. Refer to Procedure 001-012 in Section 1. (/qs3/pubsys2/xml/en/procedures/425/425-001-012.html)
- Remove the front gear housing. Refer to Procedure 001-033 in Section 1. (/qs3/pubsys2/xml/en/procedures/425/425-001-033.html)
- Remove the connecting rod caps. Refer to Procedure 001-005 in Section 1. (/qs3/pubsys2/xml/en/procedures/425/425-001-005.html)
- Remove the main bearing caps. Refer to Procedure 001-006 in Section 1. (/qs3/pubsys2/xml/en/procedures/425/425-001-006.html)

Remove

Note : Lift the crankshaft straight up to avoid damage to the crankshaft and cylinder block.

Install nylon lift sling, Part Number 2892501, around the number 3 and number 4 rod bearing journals.

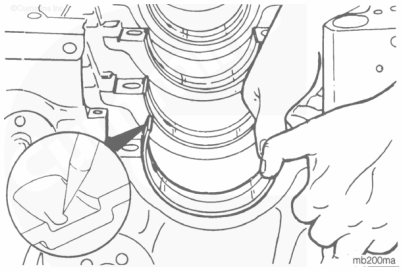
Attach the sling to a hoist. Remove the crankshaft.



Note : Mark the bearing position for future identification or possible failure analysis.

Remove the upper main bearings.

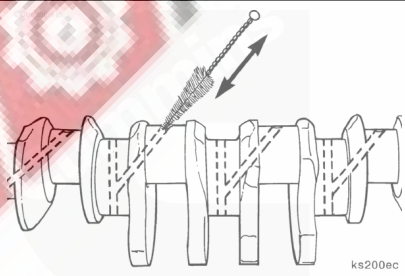
Use an awl to mark the bearing position in the tang area.



Clean and Inspect for Reuse

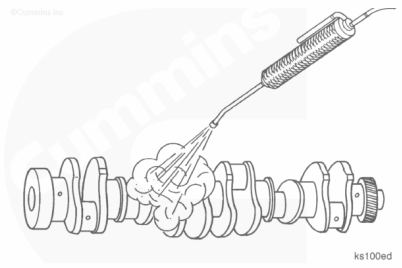
Polish the machined surfaces. Use fine crocus cloth.

Clean the oil drillings. Use a bristle brush.



⚠ WARNING ⚠

When using a steam cleaner, wear safety glasses or a face shield, as well as protective clothing. Hot steam can cause serious personal injury.



⚠ WARNING ⚠

Wear appropriate eye and face protection when using compressed air. Flying debris and dirt can cause personal injury.

Clean the crankshaft. Use steam. Dry with compressed air.

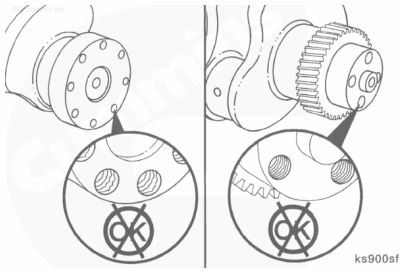
Make sure to blow out the threaded holes on each end of the crankshaft and oil drillings.

Inspect the threaded capscrew holes for damage.

Use one of the following methods to repair any damaged threaded holes:

- Chase the threads.
- Use Threaded Insert Kit, Part Number 3822709.

Note : A maximum of one front crankshaft threaded hole and three rear crankshaft holes can be repaired. If more than one threaded hole in the front of the crankshaft or three threaded holes in the rear of the crankshaft requires repair, the crankshaft can **not** be salvaged.



Measure the front and rear oil seal contact areas for a wear groove.

Crankshaft Front and Rear Oil Seal Wear Groove		
mm		in
0.25	MAX	0.010

Inspect the crankshaft connecting rod and main journals for deep scoring, overheating, etc. Minor scratches are acceptable.

Measure the connecting rod journals. Use a micrometer.

Crankshaft Connecting Rod Journal Diameter		
mm		in
76.000	MIN	2.9921
76.026	MAX	2.9931

Crankshaft Connecting Rod Out of Roundness		
mm		in
0.050	MAX	0.002

Crankshaft Connecting Rod Journal Taper		
mm		in
0.013	MAX	0.0005

Note : If the crankshaft connecting rod journals are **not** within the given specifications, the crankshaft **must** be reground. Always grind all journals when one is **not** within specifications. Oversize connecting rod bearings are available; see the appropriate parts catalog.

Measure the crankshaft main bearing journals. Use a micrometer.

Crankshaft Main Bearing Journal Diameter		
mm		in
97.987	MIN	3.8585
98.013	MAX	3.8595

Crankshaft Main Bearing Journal Out of Roundness		
mm		in
0.050	MAX	0.002

Crankshaft Main Bearing Journal Taper		
mm		in
0.013	MAX	0.0005

Note : If the crankshaft main bearing journals are **not** within the given specifications, the crankshaft **must** be reground. Always grind all of the journals when one is **not** within specifications. Oversize connecting rod bearings are available; see the appropriate parts catalog.

Measure the thrust face width. Minor scratches are acceptable. Polish the machined surfaces. Use a fine crocus cloth.

Crankshaft Thrust Face Width (Standard)		
mm		in
42.98	MIN	1.692
43.08	MAX	1.696

Note : Oversize thrust bearings are available if the thrust distance is **not** within specifications. See the appropriate parts catalog.

Measure the rear oil seal flange outside diameter.

Crankshaft Rear Oil Seal Flange Outside Diameter		
mm		in
129.98	MIN	5.117
130.03	MAX	5.119

Measure the damper pilot outside diameter.

Crankshaft Damper Pilot Outside Diameter		
mm		in
23.92	MIN	0.942
24.00	MAX	0.945

Measure the crankshaft gear journal outside diameter.

Crankshaft Gear Journal Outside Diameter		
mm		in
75.987	MIN	2.9916
76.006	MAX	2.9924

Note : If the crankshaft is **not** going to be used immediately, protect the part with a plastic cover to prevent dirt from sticking to the oil.

Lubricate the crankshaft to prevent rust. Use a light preservative oil.

Install

⚠ CAUTION ⚠

The tang (1) on the bearing shell must be in the slot (2) of the bearing saddle to correctly position the bearing and prevent engine damage.

Upper Main Bearings

Do **not** lubricate the side of the main bearing against the cylinder block.

Apply a coat of assembly lubricant, Part Number 3163087, or equivalent, to the crankshaft side of the upper main bearings.

Note : Make sure the main bearing being installed is the same size as the main bearing that was removed. The size is engraved on the back of the main bearing.

Note : The crankshaft thrust bearing **must** be installed in the number four position.

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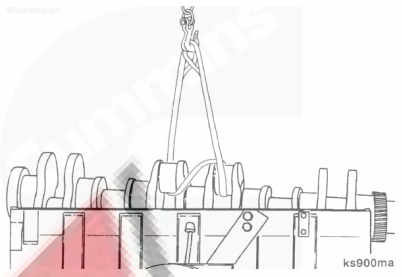
Note : The upper and lower main bearing shells of some engines are **not** interchangeable. The backs of the main bearings are marked with the proper orientation, if required.

Note : If used bearing shells are to be installed, they **must** be installed in their original locations, as marked during disassembly.

Use a hoist and nylon list sling, Part Number 2892501.

Install the sling around the number 3 and number 4 connecting rod bearing journals.

Install the crankshaft.



Finishing Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

- Install the main bearing caps. Refer to Procedure 001-006 in Section 1. (/qs3/pubsys2/xml/en/procedures/425/425-001-006.html)
- Install the connecting rod caps. Refer to Procedure 001-005 in Section 1. (/qs3/pubsys2/xml/en/procedures/425/425-001-005.html)
- Install the rear crankshaft seal carrier. Refer to Procedure 001-067 in Section 1. (/qs3/pubsys2/xml/en/procedures/425/425-001-067.html)
- Install the front gear housing. Refer to Procedure 001-033 in Section 1. (/qs3/pubsys2/xml/en/procedures/425/425-001-033.html)
- Install the camshaft gear. Refer to Procedure 001-012 in Section 1. (/qs3/pubsys2/xml/en/procedures/425/425-001-012.html)
- Install the fuel pump. Refer to Procedure 005-016 in Section 5. (/qs3/pubsys2/xml/en/procedures/425/425-005-016.html)
- Install the air compressor, if required. Refer to Procedure 012-014 in Section 12. (/qs3/pubsys2/xml/en/procedures/425/425-012-014.html)
- Install the lubricating oil suction tube. Refer to Procedure 007-035 in Section 7. (/qs3/pubsys2/xml/en/procedures/425/425-007-035.html)
- Install the lubricating oil pan. Refer to Procedure 007-025 in Section 7. (/qs3/pubsys2/xml/en/procedures/425/425-007-025.html)

- Install the flywheel housing. Refer to Procedure 016-006 in Section 16. (/qs3/pubsys2/xml/en/procedures/425/425-016-006.html)
- Install the flexplate, if removed. Refer to Procedure 016-004 in Section 16. (/qs3/pubsys2/xml/en/procedures/425/425-016-004.html)
- Install the flywheel, if removed. Refer to Procedure 016-005 in Section 16. (/qs3/pubsys2/xml/en/procedures/425/425-016-005.html)
- Install the front cover. Refer to Procedure 001-031 in Section 1. (/qs3/pubsys2/xml/en/procedures/425/425-001-031.html)
- Install the rubber vibration damper, if removed. Refer to Procedure 001-051 in Section 1. (/qs3/pubsys2/xml/en/procedures/425/425-001-051.html)
- Install the viscous vibration damper, if removed. Refer to Procedure 001-052 in Section 1. (/qs3/pubsys2/xml/en/procedures/425/425-001-052.html)
- Install the drive belt. Refer to Procedure 008-002 in Section 8. (/qs3/pubsys2/xml/en/procedures/425/425-008-002-tr.html)
- Check the engine rotation. See the Rotation Check section of this procedure.
- Install the engine. Refer to Procedure 000-002 in Section 0. (/qs3/pubsys2/xml/en/procedures/425/425-000-002.html)
- Connect the batteries. See equipment manufacturer service information.
- Operate the engine. Check for leaks.

Rotation Check

With the engine fully assembled, check to make sure the engine rotates freely. Use barring tool, Part Number 3824591, or equivalent.

Insert the barring tool into the flywheel housing. Engage the flywheel/flexplate ring gear. The crankshaft can then be rotated by hand, using a 1/2 inch ratchet or breaker bar.

If the engine does **not** rotate freely, check for any external obstructions (flywheel/flexplate, engine-driven accessories, etc.). If no obstructions are found, remove the oil pan and look for internal damage.

ANADOLU ISUZU AFTERSALES

Select Service Tools

Recommended Cummins® Service Tools

- No Cummins® Service Tools required.

Additional Service Items

- 240 grit abrasive cloth

Preparatory Steps

⚠ WARNING ⚠

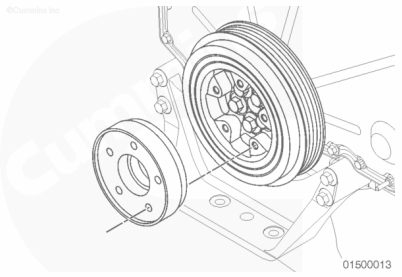
Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

- Disconnect the batteries. See equipment manufacturer service information.
- Remove the fan and fan shroud assembly, if necessary. Refer to Procedure 008-038 in Section 8. (/qs3/pubsys2/xml/en/procedures/425/425-008-038.html)
- Remove the fan belt. Refer to Procedure 008-002 in Section 8. (/qs3/pubsys2/xml/en/procedures/425/425-008-002-tr.html)
- Remove the crankshaft pulley. Refer to Procedure 001-022 in Section 1. (/qs3/pubsys2/xml/en/procedures/425/425-001-022.html)

Remove

Remove the capscrews.

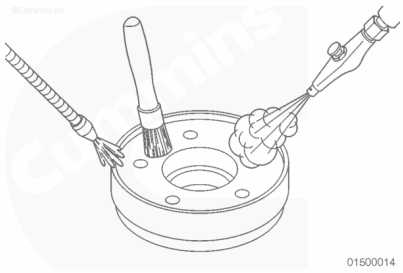
Remove the crankshaft adapter.



Clean and Inspect for Reuse

⚠ WARNING ⚠

When using solvents, acids or alkaline materials for cleaning, follow the manufacturer's recommendations for use. Wear goggles and protective clothing to reduce the possibility of personal injury.



⚠ WARNING ⚠

Wear appropriate eye and face protection when using compressed air. Flying debris and dirt can cause personal injury.

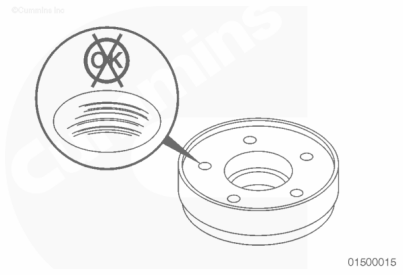
⚠ WARNING ⚠

When using a steam cleaner, wear safety glasses or a face shield, as well as protective clothing. Hot steam can cause personal injury.

Clean the part. Use solvent or steam. Dry with compressed air.

⚠ CAUTION ⚠

The mounting pilots and surfaces control the center and spacing of the vibration damper and the pulleys. Do not repair the part by machining. It will cause an out-of-balance condition or a crankshaft failure.



Check all mounting pilots and surfaces for damage from fretting.

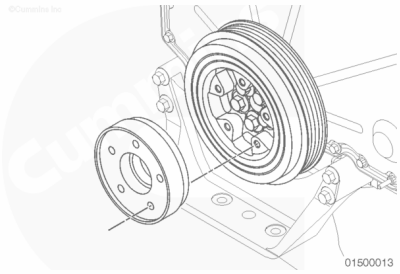
If it is **not** possible to remove the damage with a 240 grit abrasive cloth, the part **must** be replaced.

Install

Use clean engine oil to lubricate the capscrew threads.

Install the capscrews.

Tighten the capscrews in a star pattern.



Torque Value:
M14 Capscrews 180 n•m [133 ft-lb]

Torque Value:
M12 Capscrews 77 n•m [57 ft-lb]

Torque Value:
M10 Capscrews 65 n•m [48 ft-lb]

Finishing Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

- Install the crankshaft pulley. Refer to Procedure 001-022 in Section 1. (/qs3/pubsys2/xml/en/procedures/425/425-001-022.html)
- Install and adjust the drive belt. Refer to Procedure 008-002 in Section 8. (/qs3/pubsys2/xml/en/procedures/425/425-008-002-tr.html)
- Install the fan and fan shroud assembly. Refer to Procedure 008-038 in Section 8. (/qs3/pubsys2/xml/en/procedures/425/425-008-038.html)
- Connect the batteries. See equipment manufacturer service information.
- Operate the engine. Check for proper operation.

ANADOLU ISUZU

Last Modified: 14-Sep-2016

Select Service Tools

Recommended Cummins® Service Tools

- Bearing separator, Part Number 3162427
- Assembly lubricant, Part Number 3163087, or equivalent

Additional Service Items

- Fine crocus cloth
- Soft hammer

Preparatory Steps

⚠ WARNING ⚠

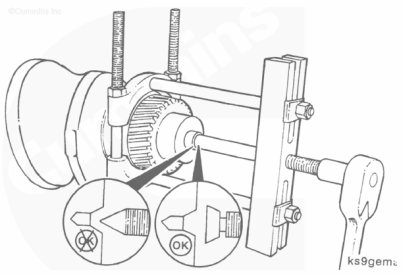
Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

- Disconnect the batteries. See equipment manufacturer service information.
- Remove the crankshaft. Refer to Procedure 001-016 in Section 1. (/qs3/pubsys2/xml/en/procedures/425/425-001-016.html)

Remove

⚠ CAUTION ⚠

Do not try to split the front crankshaft gear to remove. The gear is made out of steel and will not split. Damage to the tool and the crankshaft can result.



Note : If a front crankshaft seal wear sleeve has been installed during a previous repair, it **must** be removed before the crankshaft gear is removed. Refer to Procedure 001-025 in Section 1.

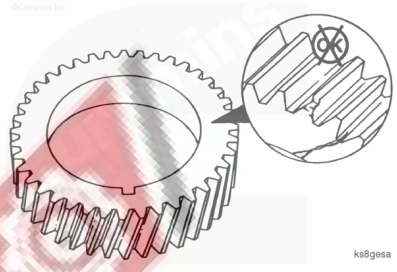
(/qs3/pubsys2/xml/en/procedures/425/425-001-025.html)

Use heavy-duty bearing separator, Part Number 316427, or gear puller, as illustrated, to remove the crankshaft gear.

Clean and Inspect for Reuse

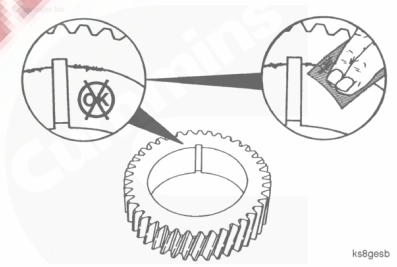
Inspect for cracks, broken, or chipped teeth.

The gear **must** be replaced if it is damaged.



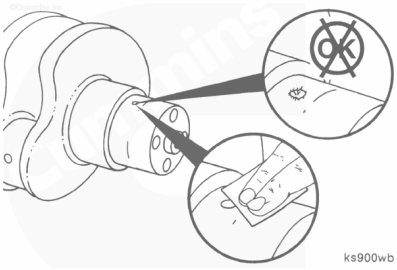
Inspect the gear and keyway for nicks or burrs.

Remove nicks and burrs. Use a fine crocus cloth.



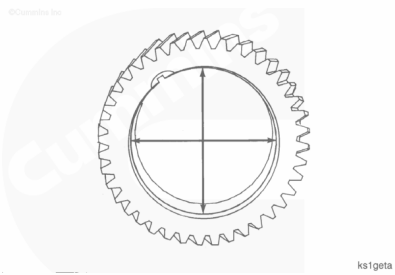
Inspect the crankshaft gear journal and gear alignment dowel pin hole for burrs or damage.

Remove burrs. Use a fine crocus cloth.



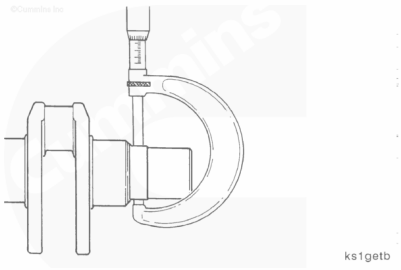
Measure the crankshaft gear bore inside diameter.

Crankshaft Gear Bore Inside Diameter		
mm		in
75.898	MIN	2.9881
75.923	MAX	2.9891



ANADOLU ISUZU PARTS SALES

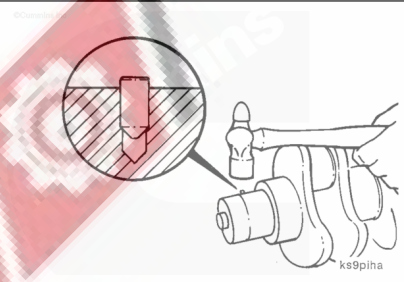
Measure the crankshaft gear journal outside diameter. Refer to Procedure 001-016 in Section 1. (/qs3/pubsys2/xml/en/procedures/425/425-001-016.html)



Install

⚠ CAUTION ⚠

Do not exceed the specified heating time or temperature. The crankshaft teeth can be damaged.



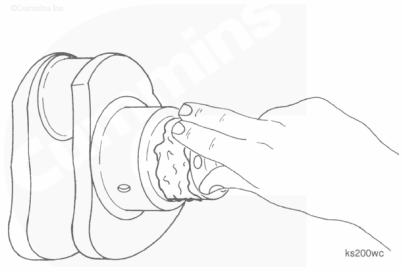
Install the gear alignment dowel into the crankshaft. Use a soft hammer.

The pin **must** be 1.02 mm [0.040 in] above the crankshaft surface.

Heat the gear in an oven for a minimum of 45 minutes, but **not** more than 2 hours.

Measurements			
		celsius	fahrenheit
Temperature	Steel Gear	177	350

Lubricate the outside diameter of the crankshaft gear journal. Use assembly lubricant, Part Number 3163087, or equivalent.



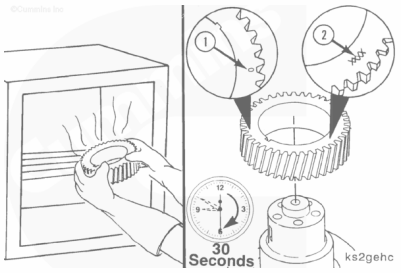
⚠ WARNING ⚠

To reduce the possibility of personal injury, wear protective gloves when handling parts that have been heated.

ANADOLU ISUZU PARTS SALES

⚠ CAUTION ⚠

The timing mark (1) and part number (2) on the gear must be facing away from the crankshaft after the gear is installed. Engine damage can result if the gear is installed backwards.



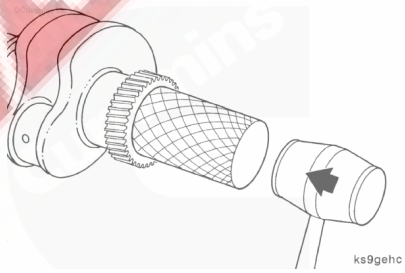
⚠ CAUTION ⚠

Do not use water or oil to reduce the cooling time. The gear can crack. Allow the gear to air cool.

Remove the gear from the oven.

Align the keyway of the gear with the alignment dowel pin in the crankshaft. Install the gear within 30 seconds.

If the gear cools and stops on the crankshaft before it is fully installed, use a driver to complete the installation.



Finishing Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

- Install the crankshaft. Refer to Procedure 001-016 in Section 1. (/qs3/pubsys2/xml/en/procedures/425/425-001-016.html)
- Connect the batteries. See equipment manufacturer service information.
- Operate the engine. Check for leaks.

ANADOLU ISUZU AFTER SALES


ANADOLU ISUZU
AFTER SALES

Select Service Tools

Recommended Cummins® Service Tools

- No Cummins® Service Tools required.

Additional Service Items

- No additional service items required.

Preparatory Steps

⚠ WARNING ⚠

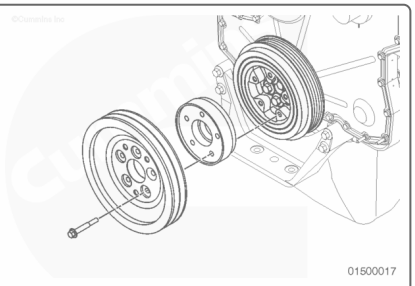
Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

- Disconnect the batteries. See equipment manufacturer service information.
- Remove the fan and fan shroud assembly, if necessary. Refer to Procedure 008-038 in Section 8. (/qs3/pubsys2/xml/en/procedures/425/425-008-038.html)
- Remove the drive belt. Refer to Procedure 008-002 in Section 8. (/qs3/pubsys2/xml/en/procedures/425/425-008-002-tr.html)

Remove

Remove the crankshaft pulley mounting capscrews.

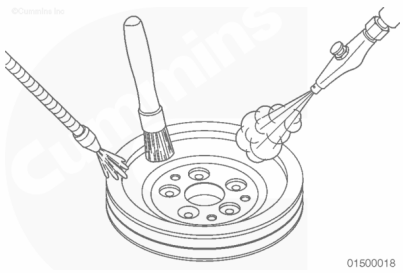
The crankshaft adapter will be removed at the same time.



Clean and Inspect for Reuse

⚠ WARNING ⚠

When using solvents, acids or alkaline materials for cleaning, follow the manufacturer's recommendations for use. Wear goggles and protective clothing to reduce the possibility of personal injury.



⚠ WARNING ⚠

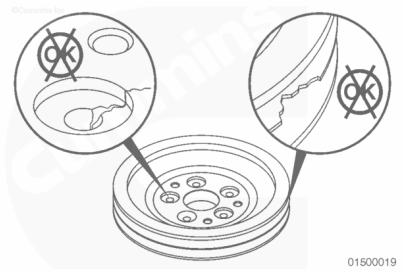
When using a steam cleaner, wear safety glasses or a face shield, as well as protective clothing. Hot steam can cause personal injury.

⚠ WARNING ⚠

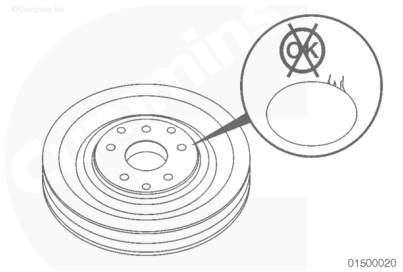
Wear appropriate eye and face protection when using compressed air. Flying debris and dirt can cause personal injury.

Clean the parts. Use solvent or steam. Dry with compressed air.

Inspect the pulley for cracks, excessive wear in the belt grooves, or other damage.



Make sure the mounting surfaces of the crankshaft adapter and pulley are clean, dry, and free of burrs.



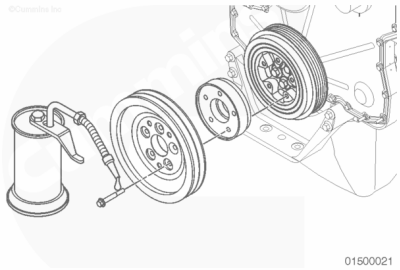
Install

Lubricate the capscrew threads. Use clean engine oil.

Install the adapter and pulley.

Install the capscrews.

Tighten the capscrews in a star pattern.



Torque Value:
M14 Capscrews 180 n•m [133 ft-lb]

Torque Value:
M10 Capscrews 50 n•m [37 ft-lb]

Finishing Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

- Install the drive belt. Refer to Procedure 008-002 in Section 8. (/qs3/pubsys2/xml/en/procedures/425/425-008-002-tr.html)
- Install the fan and fan shroud assembly, if necessary. Refer to Procedure 008-038 in Section 8. (/qs3/pubsys2/xml/en/procedures/425/425-008-038.html)
- Connect the batteries. See equipment manufacturer service information.
- Operate the engine. Check for proper operation.

ANADOLU ISUZU

Last Modified: 14-Sep-2016

Select Service Tools

Recommended Cummins® Service Tools

- Seal installer, Part Number 3824499

Additional Service Items

- Sealant

Preparatory Steps

⚠ WARNING ⚠

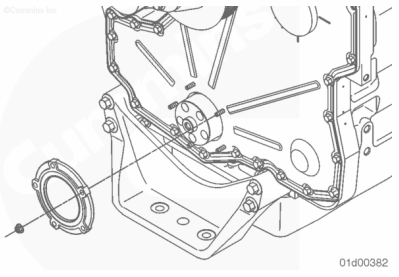
Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

- Disconnect the batteries. See equipment manufacturer service information.
- Remove the drive belt. Refer to Procedure 008-002 in Section 8. (/qs3/pubsys2/xml/en/procedures/425/425-008-002-tr.html)
- Remove the rubber vibration damper, if installed. Refer to Procedure 001-051 in Section 1. (/qs3/pubsys2/xml/en/procedures/425/425-001-051.html)
- Remove the viscous vibration damper, if installed. Refer to Procedure 001-052 in Section 1. (/qs3/pubsys2/xml/en/procedures/425/425-001-052.html)

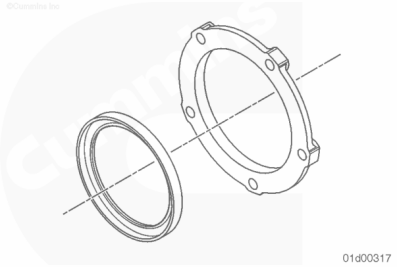
Remove

Remove the dust shield, if installed. Inspect for reuse.

Remove the front crankshaft seal carrier.



Remove the oil seal from the carrier. Drive the oil seal from the back side of the carrier toward the front side of the carrier, while supporting the carrier.



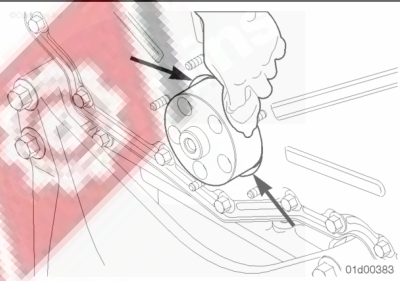
Clean and Inspect for Reuse

Clean the front gear cover seal bore and the crankshaft surface of all oil and seal residue.

Clean the residual sealant from the front gear cover and oil seal carrier surface.

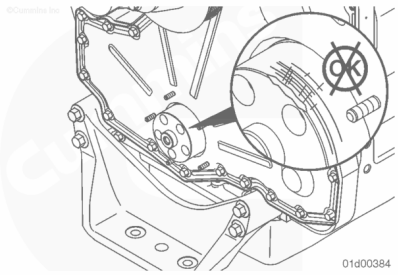
Clean front gear cover surface that contacts the oil seal carrier with isopropyl alcohol, parts cleaner, or contact cleaner.

Clean the oil seal carrier surface with isopropyl alcohol, parts cleaner, or contact cleaner.



Inspect the crankshaft for excessive wear.

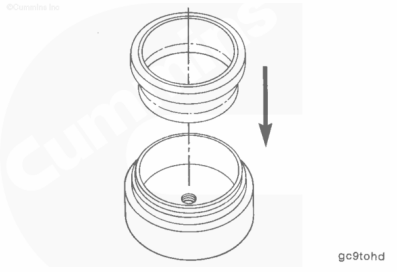
Note : If the crankshaft has excessive wear, a service wear sleeve is available. Refer to Procedure 001-025 in Section 1. (/qs3/pubsys2/xml/en/procedures/425/425-001-025.html)



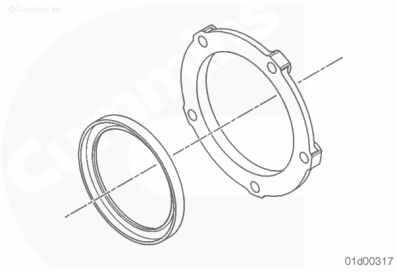
Install

Leave the plastic pilot installation tool in the lubricating oil seal.

Position the seal on Seal installer, Part Number 3824499, with the lubricating oil seal dust lip facing outward.



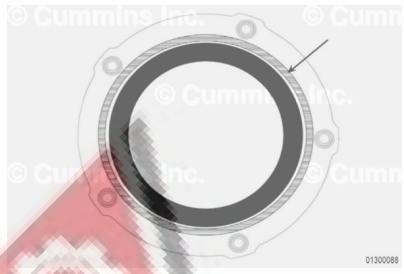
Note : Properly support the carrier lubricating oil seal flange to prevent damage to the lubricating oil seal and carrier.



Press the lubricating oil seal into the carrier from the back side of the carrier toward the front side of the carrier.

Press the lubricating oil seal until the seal is flush on front of the carrier.

Apply a continuous bead of sealant, approximately 4 mm [0.16 in] thick and 4 mm [0.16 in] wide, around the inside of the seal carrier, between the mounting holes and the seal.



Sealant bead should lie within the gray hatch zone as indicated by the arrow in the figure. It should **not** fall on the inside edge by the lubricating oil seal nor should it fall inside the mounting holes.

Apply a bead of sealant, approximately 4 mm [0.16 in] thick and 4 mm [0.16 in] wide, around all stud seams on the front gear cover.

Install the seal carrier on the front gear cover within 10 minutes of applying sealant.

Remove the plastic installation tool.

Starting with the upper left stud, tighten the carrier mounting nuts in a star pattern (as shown in the graphic).

Torque Value: 8 n•m [71 in-lb]

Install the dust shield 1 mm [0.04 in] away from the lubricating oil seal face.

ANADOLU ISUZU GENUINE PARTS

Finishing Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

- Install the rubber vibration damper, if installed. Refer to Procedure 001-051 in Section 1. (/qs3/pubsys2/xml/en/procedures/425/425-001-051.html)

- Install the viscous vibration damper, if installed. Refer to Procedure 001-052 in Section 1. (/qs3/pubsys2/xml/en/procedures/425/425-001-052.html)
- Install the drive belt. Refer to Procedure 008-002 in Section 8. (/qs3/pubsys2/xml/en/procedures/425/425-008-002-tr.html)
- Connect the batteries. See equipment manufacturer service information.
- Operate the engine. Check for leaks.

Last Modified: 02-Mar-2020

ANADOLU ISUZU AFTER SALES

Select Service Tools

Recommended Cummins® Service Tools

- Rear Crankshaft Seal Replacer Kit, Part Number 3164660, for unitized rear crankshaft seals **only**
- Rear Crankshaft Seal Installation Kit, Part Number 5395259, for rear crankshaft lip seals **only**
- Rear Crankshaft Seal Removal Kit, Part Number 5395330, for rear crankshaft lip seals **only**
- Rear crankshaft seal carrier centering guide, Part Number 5395409, for front gear train engines **only**
- P-80 lubricant, Part Number 3824878, or mild soapy water

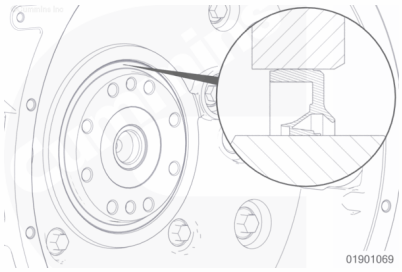
Additional Service Items

- Safety solvent
- Anti-seize compound or a suitable grease

General Information

Lip Seal

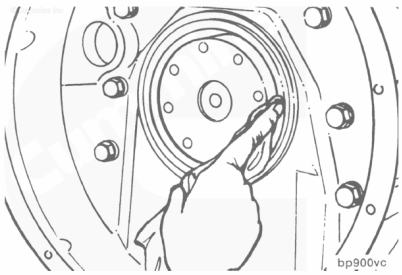
Engines covered by this procedure use a lip style rear crankshaft seal (shown). The rotating portion of the sealing occurs at the contact surface between the lip of the seal and the crankshaft. The seal is installed into the flywheel housing/seal carrier bore using required service tools, Rear Crankshaft Seal Installation Kit, Part Number 5395259, and Rear Crankshaft Seal Removal Kit, Part Number 5395330.



Some rust prevention oils applied at the factory have fluorescent tracer dyes added to them and can provide false test results when checking for external oil leaks using a black light.

Clean the area around the rear seal with solvent.

Check the area with a black light to insure there is **not** already fluorescent dye present before adding tracer dye to the lubricating oil.



BURDOLU ISUZU PARTS SALES

Unitized Seal

Some engines used to use a unitized seal, which has a metal inner diameter that allows the inner and outer diameter of the seal to press-fit onto the crankshaft and the flywheel housing respectively, requiring service tool, Part Number 3164660, to remove.

Preparatory Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

⚠ WARNING ⚠

This component or assembly weighs greater than 23 kg [50 lb]. To prevent serious personal injury, be sure to have assistance or use appropriate lifting equipment to lift this component or assembly.

Note : Use a container that can hold at least 26 liters [27 qt] of lubricating oil.

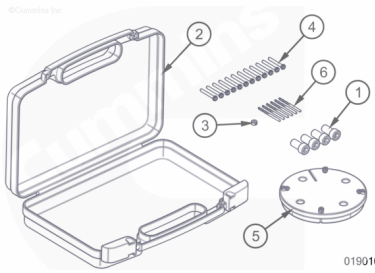
- Disconnect the batteries. See equipment manufacturer service information.
- If equipped with a wet flywheel housing, drain the oil from the flywheel housing by removing the plug in the bottom of the flywheel housing.
- Remove the transmission and all related components, if equipped. See equipment manufacturer service information.
- Remove the flywheel, if installed. Reference Procedure 016-005 in Section 16.
- Remove the flexplate, if installed. Reference Procedure 016-004 in Section 16.

Remove

Lip Seal

⚠ CAUTION ⚠

This procedure must not be used on engines with a unitized seal.



Note : Lip style rear crankshaft seals are **only** to be removed using Rear Crankshaft Seal Removal Kit, Part Number 5395330.

Table 1, Rear Crankshaft Seal Removal Kit, Part Number 5395330

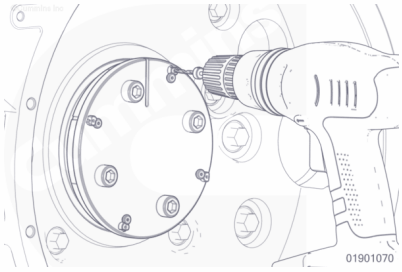
Item Number	Part Number	Description	Quantity
1	3164174	Screw, Socket Head Cap	4
2	3165143	Case, Storage	1
3	5395324	Collar, Stop	1
4	5395325	Screw, Self Tapping Metal	12
5	5395329	Remover, Crankshaft Seal	1
6	5395410	Bit, Drill	6

Use the groove on the face of the rear crankshaft seal remover to set the depth on the drill bit stop collar.

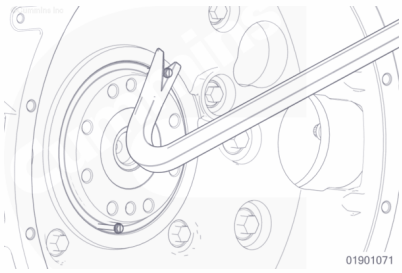
Install the crankshaft seal remover toward the end of the crankshaft with socket head capscrews.

Use the stop collar and drill bushings to drill two holes 180 degrees apart.

Remove the crankshaft seal remover from the crankshaft.



Use a driver to install the self tapping metal screw into the drilled holes. Use a forked prybar to pull the rear crankshaft seal out.

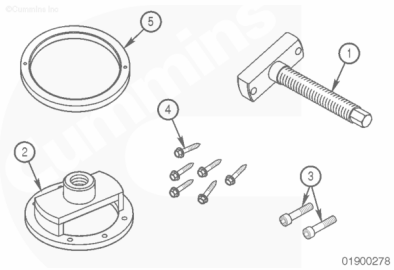


Unitized Seal

For engines with unitized seals, use service tool Part Number 3164660.

Table 2. Rear Crankshaft Seal Replacer Kit, Part Number 3164660

Item Number	Part Number	Description	Quantity
1	3164666	Replacer screw assembly	1
2	3164664	Crankshaft seal replacer	1
3	3164174	Socket head capscrew, M12 x 1.25x 25 mm	2
4	3164217	Sheet metal screw, Number 10x25.4 mm [1 in] long	25 (7 shown)
5	-	Disposable plastic driver (purchased with rear crankshaft seal kit)	1



With the rear crankshaft seal installed onto the crankshaft flange as described earlier in this procedure, mount the replacer screw assembly (1) onto the rear of the crankshaft.

Install the two M12 x 1.25 x 60-mm socket head capscrews (3).

⚠ CAUTION ⚠

Do not use an impact wrench or air tools. Doing so can damage the tool.

Lubricate the replacer screw with anti-seize compound or a suitable grease.

Hold the replacer screw and install the crankshaft seal replacer (2) onto the replacer screw assembly. Advance the crankshaft seal replacer toward the seal by rotating it

clockwise until the attached disposable driver is positioned against the rear crankshaft seal. Then insert small screws into the crankshaft seal replacer tool.

⚠ CAUTION ⚠

Do not overtighten the replacer screw assembly after the crankshaft seal replacer contacts the flywheel housing. Doing so can damage the tool.

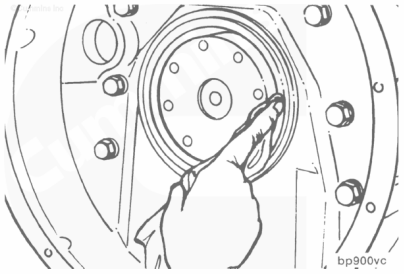
While holding the crankshaft seal replacer, rotate the replacer screw **counterclockwise** until the disposable driver attached to the crankshaft seal replacer makes contact with the flywheel housing.

Remove the service tools.

Clean and Inspect for Reuse

⚠ WARNING ⚠

When using solvents, acids, or alkaline materials for cleaning, follow the manufacturer's recommendations for use. Wear goggles and protective clothing to reduce the possibility of personal injury.



⚠ WARNING ⚠

Compressed air used for cleaning should not exceed 207 kPa [30 psi]. Use only with protective clothing, goggles/shield, and gloves to reduce the possibility of personal injury.

⚠ CAUTION ⚠

The seal lip and the sealing surface on the crankshaft must be free from all oil residue to prevent seal leaks.

Clean the rear crankshaft sealing surface and bore with solvent.

Dry the surface with compressed air.

Note : If the crankshaft has excessive wear, a service wear sleeve is available.

Inspect the crankshaft seal contact area for a wear groove. If the groove is deeper than 0.25 mm [0.010 in], a wear sleeve and oversize seal **must** be used. Reference Procedure 001-067 in Section 1.

Install

Note : For engines using a lip seal rear crankshaft seal, the use of Rear Crankshaft Seal Installation Kit, Part Number 5395259, is required.

Table 3, Rear Crankshaft Seal Installation Kit, Part Number 5395259

Item Number	Part Number	Description	Quantity
1	3163741	Nut, Regular Hexagon	4
2	5395257	Pin, Guide	4
3	5395258	Installer, Crankshaft Seal	1

⚠ CAUTION ⚠

The seal lip/bore and the sealing surface on the crankshaft must be free from all oil residue to prevent seal leaks.

To aid in installation, apply a mild soap (recommended 50/50 water to soap volumetric ratio) or P-80, Part Number 3824878, to the outside diameter of the seal case (A)

Note : A seal pilot (B) is provided with the new seal. The seal **must** be left on the seal pilot while installing the seal onto the nose of the crankshaft. This will make sure the lips of the seal do **not** get damaged during installation.

Place the new rear crankshaft seal, with tapered end of the seal pilot, over the crankshaft nose and slide it by hand toward the flywheel housing.

Note : Make sure the seal is positioned square with the crankshaft.

Remove the seal pilot.

Note : For rear gear train engines, the rear crankshaft seals for the wet flywheel housing applications do **not** come with a disposable seal driver. Service tool, Part Number 3824078, **must** be used to install the rear crankshaft seal for the wet flywheel housing. This is the same service tool used for installing the rear crankshaft seal and wear sleeve assembly. Reference Procedure 001-067 in Section 1.

Table 4: Rear Crankshaft Seal Installation Kit, Part Number 3824078

Item Number	Part Number	Description
1	3163734	Plate
2	3163628	Stud
3	3163741	Hex Nut

Install the rear crankshaft seal using Rear Crankshaft Seal Installation Kit, Part Number 5395259.

Install guide pins toward the end of the crankshaft with the slotted side facing away from the engine.

Note : On C Series and L Series engines **only**, if the seal carrier is removed for any repair purposes, use centering guide service tool, Part Number 5395409, to align the seal carrier to the cylinder block with reference to the centerline of the crankshaft. Reference Procedure 001-104 in Section 1.

Slide the crankshaft seal installer over the guide pins until it is touching the rear crankshaft seal.

Install the hex nuts onto the guide pins until the hex nuts bottom out on the crankshaft seal installer.

Use a deep well socket and tighten the hex nuts in a crisscross pattern until the crankshaft seal installer bottoms out on the crankshaft. Tighten all four nuts to the specification below to verify the crankshaft seal installer bottoms out with the crankshaft.

Torque Value: 10 to 12 n•m [89 to 106 in-lb]

Note : The rear crankshaft seal installs deeper using the Crankshaft Seal Installation Kit compared to disposable service kits.

Finishing Steps

⚠ WARNING ⚠

This component or assembly weighs greater than 23 kg [50 lb]. To prevent serious personal injury, be sure to have ssistance or use appropriate lifting equipment to lift this component or assembly.

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

- Install the flywheel, if removed. Reference Procedure 016-005 in Section 16.
- Install the flexplate, if removed. Reference Procedure 016-004 in Section 16.
- Install the transmission and all related components, if equipped. See equipment manufacturer service information.
- Connect the batteries. See equipment manufacturer service information.
- Start and operate the engine. Check for leaks.

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Last Modified: 27-Aug-2018

Select Service Tools

Recommended Cummins® Service Tools

- Weat Sleeve Installation Kit, Part Number 3165112, or equivalent

Additional Service Items

- Hammer
- Chisel
- Crocus cloth

Preparatory Steps

⚠ WARNING ⚠

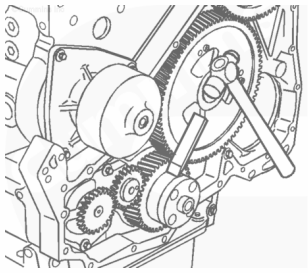
Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) cable first and attach the negative (-) cable last.

- Disconnect the batteries. See equipment manufacturer service information.
- Remove the drive belt. Refer to Procedure 008-002 in Section 8. (/qs3/pubsys2/xml/en/procedures/425/425-008-002-tr.html)
- Remove the rubber vibration damper, if installed. Refer to Procedure 001-051 in Section 1. (/qs3/pubsys2/xml/en/procedures/425/425-001-051.html)
- Remove the viscous vibration damper, if installed. Refer to Procedure 001-052 in Section 1. (/qs3/pubsys2/xml/en/procedures/425/425-001-052.html)
- Remove the front crankshaft seal. Refer to Procedure 001-023 in Section 1. (/qs3/pubsys2/xml/en/procedures/425/425-001-023.html)
- Remove the front cover. Refer to Procedure 001-031 in Section 1. (/qs3/pubsys2/xml/en/procedures/425/425-001-031.html)

Remove

⚠ CAUTION ⚠

Do not nick or gouge the crankshaft with the chisel. If the crankshaft is severely damaged, it must be replaced.

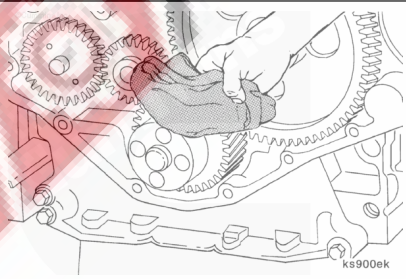


Use a hammer and a chisel **only** as wide as the wear sleeve. Make one or two chisel marks across the wear sleeve. This will expand the wear sleeve allowing the sleeve to be removed.

Clean and Inspect for Reuse

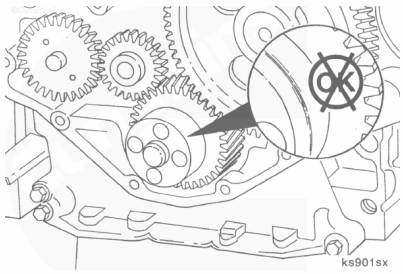
Remove any rust or other deposits from the crankshaft flange. Use a crocus cloth.

Clean the crankshaft flange. Use a clean cloth.



Inspect the seal contact area of the crankshaft for a wear groove. If the seal has worn a groove deep enough to be felt with a sharp object or fingernail, it will be necessary to install a wear sleeve to prevent an oil leak.

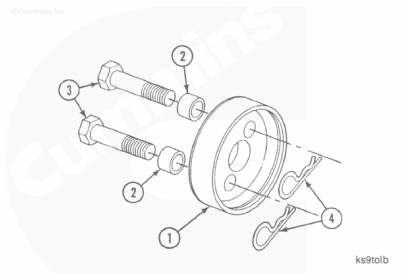
The oil seal used with the wear sleeve has a larger inside diameter than the standard seal. The two seals are **not** interchangeable. See the appropriate parts catalog for the correct part number.



Install

Note : Engines with four capscrew holes on the front of the crankshaft use two capscrews with the sleeve installation kit, engines with five capscrew holes on the front of the crankshaft use three capscrews with the sleeve installation kit.

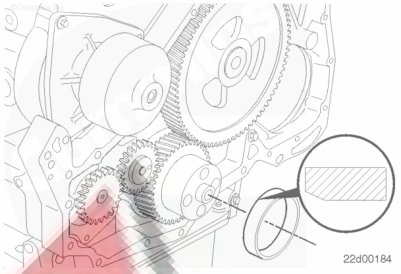
Install the wear sleeve to the correct position on the crankshaft. Use Wear Sleeve Installation Kit, Part Number 3165112, or equivalent. The kit consists of the following:



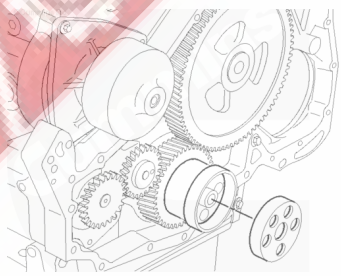
Reference Number	Description	Quantity
1	Driver	1
2	Spacer	3
3	Capscrew M14 x 1.5 x 60 mm	3

Apply a thin coat of clean engine lubricating oil to the crankshaft flange.

Position the chamfered end of the wear sleeve onto the end of the crankshaft.

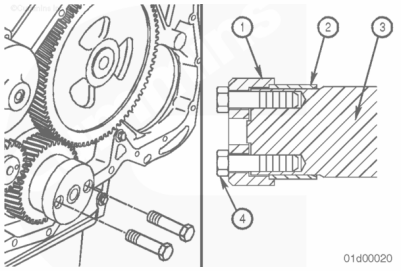


Position the counterbore end of the driver onto the wear sleeve.



Install the capscrews (without spacers) through the driver and into the crankshaft capscrew holes. Align the wear sleeve and driver perpendicular with the crankshaft. Tighten the capscrews finger-tight.

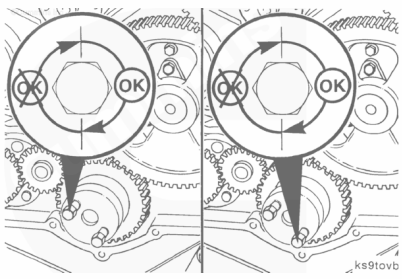
1. Driver
2. Wear Sleeve
3. Crankshaft
4. Capscrew.



Note : To prevent damage to the wear sleeve, do **not** exceed ½ revolution of each capscrew.

Alternately tighten the capscrews until the sleeve is installed to a depth of approximately 16 mm [0.625 in].

Torque Value: 20 n•m [177 in-lb]



Remove the capscrews. Iinstall the spacer on each capscrew.

Install the capscrews again.

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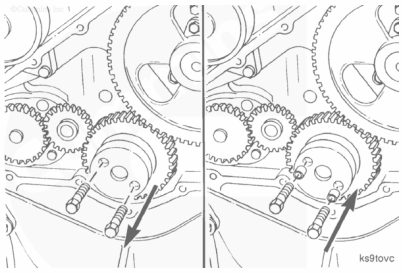
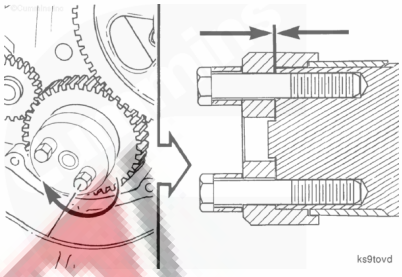
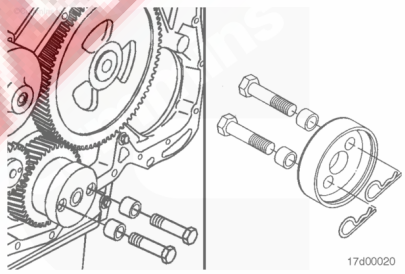


Continue to alternately tighten the capscrews until the bottom of the driver contacts the end of the crankshaft.



Remove the driver.



Finishing Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) cable first and attach the negative (-) cable last.

- Install the gear cover. Refer to Procedure 001-031 in Section 1. (/qs3/pubsys2/xml/en/procedures/425/425-001-031.html)
- Install the front crankshaft seal. Refer to Procedure 001-023 in Section 1. (/qs3/pubsys2/xml/en/procedures/425/425-001-023.html)
- Install the rubber vibration damper, if installed. Refer to Procedure 001-051 in Section 1. (/qs3/pubsys2/xml/en/procedures/425/425-001-051.html)
- Install the viscous vibration damper, if installed. Refer to Procedure 001-052 in Section 1. (/qs3/pubsys2/xml/en/procedures/425/425-001-052.html)
- Install the drive belt. Refer to Procedure 008-002 in Section 8. (/qs3/pubsys2/xml/en/procedures/425/425-008-002-tr.html)
- Connect the batteries. See equipment manufacturer service information.

ANADOLU ISUZU AFTER SALES

- Operate the engine. Check for leaks.

Last Modified: 14-Sep-2016



Select Service Tools

Recommended Cummins® Service Tools

- Crack Detection Kit, Part Number 3375432
- Thread Repair Kit, Part Number 3377905 (standard)
- Thread Repair Kit, Part Number 3377903 (metric)
- Counterbore ledge cutter drive unit, Part Number 3163785.

Additional Service Items

- Non-metallic brush.

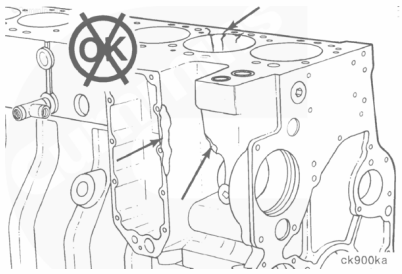
Preparatory Steps

Note : The block has clearance scallops added to accommodate the connecting rod design. Previous product blocks do **not** have the clearance feature. When replacing parts, see the parts list to order the correct parts.

- Remove the engine and place it on an engine stand. Refer to Procedure 000-001 in Section 0. (/qs3/pubsys2/xml/en/procedures/425/425-000-001.html)
- Disassemble the engine. See Section DS - Engine Disassembly.

Initial Check

Before cleaning or further disassembly of the block, perform an inspection to see if there is any damage (cracks, fretting, etc.) that would prohibit reuse. Give special attention to areas of the block that include:



- Main bearing caps and bores
- Camshaft bores
- Cylinder bores
- Tappet bores
- Cylinder block combustion deck
- Oil pan mounting surface
- Lubricating oil pump mounting area
- Water pump mounting area
- Front and rear of block sealing surfaces

- Lubricating oil cooler cavity.

Clean and Inspect for Reuse

Inspect all pipe plugs, expansion plugs, and straight thread plugs for signs of damage or leaks.



If it is necessary to thoroughly clean the cylinder block for reuse, remove all pipe plugs, expansion plugs, and straight thread plugs, as necessary. This will make sure all oil and coolant passages can be cleaned out.

Refer to Procedure 017-002 in Section 17. (/qs3/pubsys2/xml/en/procedures/425/425-017-002.html)

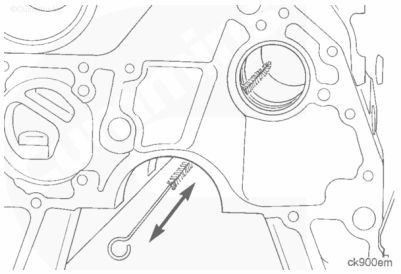
Refer to Procedure 017-007 in Section 17. (/qs3/pubsys2/xml/en/procedures/99/99-017-007.html)

Refer to Procedure 017-011 in Section 17. (/qs3/pubsys2/xml/en/procedures/100/100-017-011.html)

Refer to Procedure 017-015 in Section 17. (/qs3/pubsys2/xml/en/procedures/425/425-017-015.html)

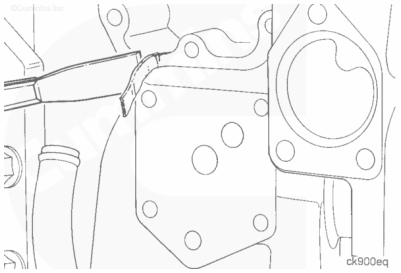
⚠ WARNING ⚠

When using solvents, acids or alkaline materials for cleaning, follow the manufacturer's recommendations for use. Wear goggles and protective clothing to reduce the possibility of personal injury.



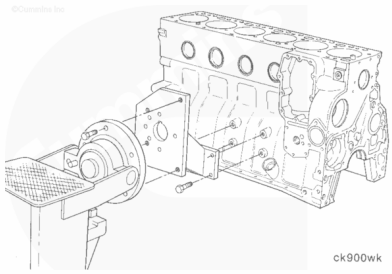
Clean the block oil drillings. Use clean solvent and a non-metallic brush.

Thoroughly clean all gasket sealing surfaces of any remaining gasket residue.



⚠ WARNING ⚠

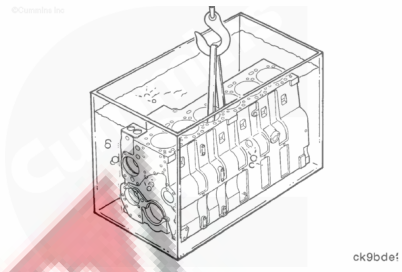
This component or assembly weighs greater than 23 kg [50 lb]. To prevent personal injury, be sure to have assistance or use appropriate lifting equipment to lift this component or assembly.



Remove the block from the engine stand.

⚠ CAUTION ⚠

If the camshaft bushings have not been removed, make sure to use a cleaning solution that will not damage the camshaft bushing(s).



Follow manufacturer operating instructions for the cleaning tank.

Follow solvent manufacturer instructions for using solvent.

Note : Cummins Inc. does **not** recommend any specific cleaning solution. Experience has shown the best results are obtained by the use of a cleaning solution that can be heated from 80 to 95°C [176 to 203°F] and a cleaning tank that will mix and filter the cleaning solution.

Clean the cylinder block in the cleaning tank.

⚠ WARNING ⚠

When using a steam cleaner, wear safety glasses or a face shield, as well as protective clothing. Hot steam can cause serious personal injury.

⚠ CAUTION ⚠

To reduce the possibility of engine damage, make sure all debris is removed from the capscrew holes and oil passages.

Remove the block from the cleaning tank.

Clean the block thoroughly. Use steam.

Use compressed air to dry the block.

With the cylinder block cleaned, inspect the cylinder block for signs of cracks, fretting, and discoloration that would prohibit reuse.

To help identify cracks in the cylinder block, use Crack Detection Kit, Part Number 3375432.

Give special attention to areas of the block that include:

- Main bearing caps and bores
- Camshaft bores
- Cylinder bores
- Tappet bores
- Cylinder block combustion deck
- Oil pan mounting surface
- Lubricating oil pump mounting area
- Water pump mounting area
- Front and rear of block sealing surfaces
- Lubricating oil cooler cavity.

Make sure to inspect the main bearing caps and main bearing saddle areas for cracks, fretting and signs of discoloration.

If any cracks are found, the block **must** be replaced.

Inspect all threaded capscrew holes for damaged threads. Coiled thread inserts can be used to repair any damaged threads.

Cummins® service tool thread repair kits are available:

1. Part Number 3377905, for standard threads.
2. Part Number 3377903, for metric threads.

Note : Coiled thread inserts should **not** be used to repair main bearing saddle threaded capscrew holes. If damaged, the block **must** be replaced.

Inspect the camshaft bores for scoring, scuffing, or excessive wear.

If the camshaft bore is damaged, the cylinder block **must** be replaced. Oversize cam bushings are **not** available.

Inspect the cylinder block counterbore for cracks, fretting, or pitting.

- Cracks (1) in the cylinder block counterbore are **not** acceptable and are **not** able to be machined. If cracks in the counterbore are observed, the cylinder block **must** be replaced.
- Fretting (2) on the cylinder block counterbore is **not** acceptable. Fretted cylinder block counterbores **must** be machined if possible and shims **must** be installed for the correct cylinder liner protrusion. Reference the repair section of this procedure.

Pitting on the cylinder block counterbore is acceptable if:

- Pitting (3, 4) is more than ¼ of the cylinder block counterbore width away from the inner edge of the cylinder block counterbore
- The pitted area (5, 6, 7) covers less than 20 percent of the total area of the cylinder block counterbore
- Correct cylinder liner protrusion can be obtained.

If pitting is observed which does **not** meet the above criteria, the cylinder block counterbore **must** be machined until the above criteria is met and a shim installed to maintain cylinder liner protrusion. Reference the repair section of this procedure. If the criteria are **not** able to be met with the available shims the cylinder block **must** be replaced.

Measure

All measurements of the cylinder block **must** be made when the cylinder block is positioned on a flat surface with the main bearing caps installed.

If the cylinder block is mounted on the engine stand and/or the main bearing caps are **not** installed, the measurements can be incorrect because of distortion to the cylinder bores, main bearing bores, camshaft bores, etc.

Inspect the cylinder block head deck for damage.

Check the cylinder block head deck for flatness between each cylinder.

Cylinder Block Flatness Specification		
mm		**in**
0.075	End-to-end	0.003
0.075	Side-to-side	0.003

Inspect for any localized dips or imperfections. If any damage is detected, or the flatness is out of specification, the cylinder block **must** be replaced.

Measure the cylinder liner bore in the block.

Cylinder Liner Bore in Block (Press Fit Bore)		
mm		in
130.900	MIN	5.1535
130.950	MAX	5.1555

Note : If any of the cylinder liner bores are out of specification, the cylinder block **must** be replaced.

Measure the liner counterbore depth.

Cylinder Block Counterbore Depth from Cylinder Block Head Deck		
mm		in
122.930	MIN	4.8397
123.000	MAX	4.8425

Note : If any of the liner counterbore depths are out of specification, the counterbore can be machined and shims installed. See the Repair section of this procedure.

Measure the camshaft bores without the camshaft bushing installed.

Camshaft Bore Diameter (Without Bushing)		
mm		in
64.01	MAX	2.520

Note : If any of the camshaft bore diameters are out of specification, the cylinder block **must** be replaced.

Inspect the tappet bores for scoring or excessive wear.

Measure the tappet bores.

Tappet Bore Diameter		
mm		in
31.295	MIN	1.2321
31.325	MAX	1.2333

Note : If any of the tappet bores are out of specification, the cylinder block **must** be replaced.

Install the main bearing caps without the main bearings. Refer to Procedure 001-006 in Section 1. (/qs3/pubsys2/xml/en/procedures/425/425-001-006.html)

Tighten the main bearing cap capscrews.

Torque Value: 176 n•m [130 ft-lb]

Measure the main bearing bore with the bearings removed.

Main Bearing Bore Diameter		
mm		in
104.982	MIN	4.1331
105.018	MAX	4.1346

Note : The maximum bore misalignment is 0.0127 mm [0.005 in].

Repair

If the counterbores require machining, use counterbore ledge cutter drive unit, Part Number 3163785, to machine the counterbore to the proper depth.

Do **not** machine counterbore ledge to a depth greater than the thickest available shim. Refer to Procedure 001-058 in section 1. (/qs3/pubsys2/xml/en/procedures/425/425-001-058.html)

Cylinder liner shims are available in the following thicknesses.

Use **only** one shim per cylinder.

Cylinder Liner Shim Thickness	
mm	**in**
0.25	0.010
0.38	0.015
0.51	0.020
0.76	0.030
1.00	0.040

If the cylinder block is **not** to be used right away, coat all machined surfaces with a rust preventative solvent.

Make sure to cover the cylinder block to prevent dust and debris from collecting on and in the cylinder block.

New Cylinder Block

If replacing the cylinder block or using a previously stored cylinder block, make sure to clean any oil/rust preventative solvent from the cylinder bores, gasket sealing areas, and main bearing bores prior to use.

Finishing Steps

- Assemble the engine. See Section AS - Engine Assembly.
- Remove the engine from the engine stand and install the engine. Refer to Procedure 000-002 in Section 0. (/qs3/pubsys2/xml/en/procedures/425/425-000-002.html)

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Select Service Tools

Recommended Cummins® Service Tools

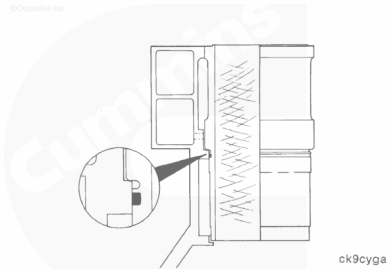
- Liner protrusion gauge, Part Number 3164438
- Cylinder liner puller, Part Number 3376015
- Liner puller, Part Number 3163745
- Remover plate, Part Number 3822786
- Abrasive pad, Part Number 3823258, or equivalent
- Dial bore gauge, Part Number 3376619
- Liner driver, Part Number ST 1229, or equivalent
- Liner clamp, Part Number 3822503, or equivalent - Quantity 2

Additional Service Items

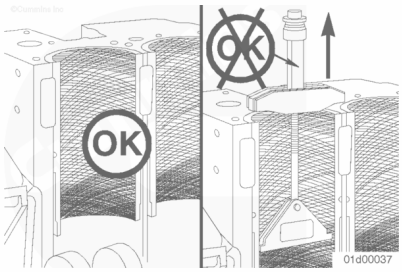
- Gasket scraper
- Feeler gauge

General Information

The cylinder block has a replaceable cylinder liner. A mid-stop design is used to locate the liner in the block. A press fit between the liner and block provides coolant sealing at the top of the liner. A rectangular ring seal (liner seal) is used for sealing at the mid-stop portion of the liner.



Note : Cummins Inc. does **not** recommend removing the cylinder liners to repair an oil consumption problem if the inside diameters of the liners are within the inspection limits included in this procedure. Careful analysis of the condition of the liner bores, piston rings, and pistons can result in the restoration of cylinder sealing with a minimum replacement of parts.



Preparatory Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

⚠ WARNING ⚠

Do not remove the pressure cap from a hot engine. Wait until the coolant temperature is below 50°C [120°F] before removing the pressure cap. Heated coolant spray or steam can cause personal injury.

⚠ WARNING ⚠

Coolant is toxic. Keep away from children and pets. If not reused, dispose of in accordance with local environmental regulations.

⚠ WARNING ⚠

To reduce the possibility of personal injury, avoid direct contact of hot oil with your skin.

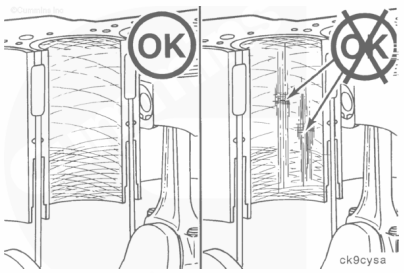
⚠ WARNING ⚠

Some state and federal agencies have determined that used engine oil can be carcinogenic and cause reproductive toxicity. Avoid inhalation of vapors, ingestion, and prolonged contact with used engine oil. If not reused, dispose of in accordance with local environmental regulations.

- Disconnect the batteries. See equipment manufacturer service information.
- Drain the cooling system. Refer to Procedure 008-018 in Section 8. (/qs3/pubsys2/xml/en/procedures/425/425-008-018-tr.html)
- Remove rocker lever cover. Refer to Procedure 003-011 in Section 3. (/qs3/pubsys2/xml/en/procedures/425/425-003-011.html)
- Remove the cylinder head. Refer to Procedure 002-004 in Section 2. (/qs3/pubsys2/xml/en/procedures/425/425-002-004.html)
- Drain the lubricating oil. Refer to Procedure 007-037 in Section 7. (/qs3/pubsys2/xml/en/procedures/425/425-007-037.html)
- Remove the lubricating oil pan. Refer to Procedure 007-025 in Section 7. (/qs3/pubsys2/xml/en/procedures/425/425-007-025.html)
- Remove the lubricating oil suction tube. Refer to Procedure 007-035 in Section 7. (/qs3/pubsys2/xml/en/procedures/425/425-007-035.html)
- Remove the piston and connecting rod assemblies. Refer to Procedure 001-054 in Section 1. (/qs3/pubsys2/xml/en/procedures/425/425-001-054.html)

Initial Check

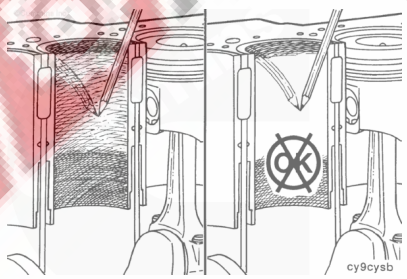
Note : Before removing the cylinder liners, inspect the condition to determine reuse.



Inspect the inside diameters of the liners for cracks, scuffing, and scoring.

Inspect the inside diameters for vertical scratches deep enough to be felt with a fingernail.

Note : If a fingernail catches in the scratch, the liner **must** be replaced.

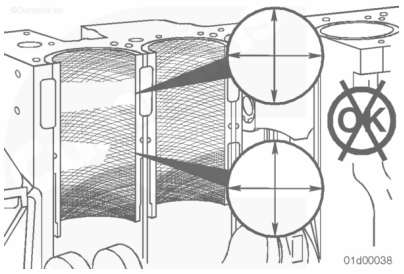


Inspect the inside diameter for liner bore polishing.

A moderate polish produces a bright mirror finish in the worn area with traces of the original hone marks or an indication of an etch pattern.

A heavy polish produces a bright mirror finish in the worn area with no traces of hone marks or an etch pattern.

Do **not** reuse liners exhibiting heavy polish or any indications of particle embedment from a malfunction. Severely worn liners will have a ridge near the top of the liner bore.

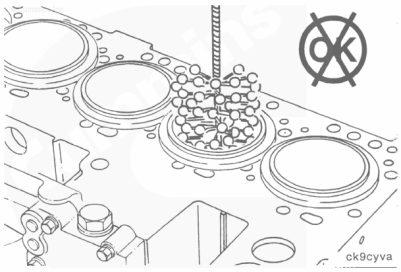


If the wear pattern indicates the liner bore is **not** straight or **not** round, use a dial bore gauge to measure the liner inside diameter in four places 90 degrees apart at the top and bottom of the piston travel area.

Cylinder Liner Dimensions				
	mm		in	
Taper		0.04	MAX	0.0016
Out Of Round		0.04	MAX	0.0016
Bore Diameter		114.04	MAX	4.4898

Note : If a liner bore is **not** acceptable for reuse, it **must** be replaced. Damaged liners can **not** be honed or deglazed. This would destroy the cross-hatch pattern needed for oil control.

Note : Do **not** remove or disturb the liner seals for liners which pass the inspection criteria.



Liner protrusion is the distance the liner protrudes above the block face. Before removing the liners, check the protrusion in the "unclamped" state at four places 90 degrees apart. Use liner protrusion gauge, Part Number 3164438, to measure the liner protrusion.

Cylinder Liner Protrusion		
mm		in
0.026	MIN	0.0010
0.122	MAX	0.0048

The maximum allowable difference between adjacent cylinders is 0.051mm [0.002 in].

If the liner was installed correctly and the liner protrusion is out of limits, it will be necessary to machine the counterbore and add shims to restore to the original specifications.

Remove

Use clean shop rags to cover the crankshaft to prevent debris from falling into the main journal area or into the connecting rod journal oil drilling.

⚠ CAUTION ⚠

The liner puller must be installed and used as described to avoid damage to the cylinder block. The puller must not contact the block casting at points (1), (2), (3), and (4).

Universal Cylinder Liner Puller Method

Cylinder liner puller, Part Number 3376015

Insert the liner puller into the top of the cylinder block.

Note : The liner puller **must** be centered on the top of the cylinder block.

Turn the puller jackscrew **clockwise** to loosen the liner from the cylinder block.

Use both hands to remove the liner.

⚠ CAUTION ⚠

The liner puller must be installed and used as described to reduce the possibility of damage to the cylinder block. The puller plate must be parallel to the main bearing saddles and must not overlap the liner outside diameter.

Standard Liner Puller Method

Liner puller, Part Number 3163745, can be used as an alternative to the standard puller. The universal puller **must** be used with remover plate, Part Number 3822786.

Insert the liner puller into the top of the cylinder block.

Note : The liner puller **must** be centered on the top of the cylinder block.

Turn the puller jackscrew **clockwise** to loosen the liner from the cylinder block.

Use both hands to remove the liner.

Mark the cylinder number on each liner.

Clean and Inspect for Reuse

⚠ CAUTION ⚠

Do not use any abrasives in the ring travel area of the liner. The liner can be damaged.

Use a soft wire brush or a fine fibrous abrasive pad such as abrasive pad, Part Number 3823258, or equivalent, to clean the flange seating area.

⚠ WARNING ⚠

When using a steam cleaner, wear safety glasses or a face shield, as well as protective clothing. Hot steam can cause serious personal injury.

⚠ WARNING ⚠

When using solvents, acids, or alkaline materials for cleaning, follow the manufacturer's recommendations for use. Wear goggles and protective clothing to reduce the possibility of personal injury.

⚠ WARNING ⚠

Some solvents are flammable and toxic. Read the manufacturer's instructions before using.

⚠ WARNING ⚠

Wear appropriate eye and face protection when using compressed air. Flying debris and dirt can cause personal injury.

Clean the liners. Use solvent or steam. Dry with compressed air.

Use clean engine oil to lubricate the inside diameter of the liners.

Allow the oil to soak in the liner for 5 to 10 minutes.

Note : Use "lint-free" paper towels to wipe the oil from the inside of the liners.

Continue to lubricate the inside of the liners. Wipe clean until the paper towel does **not** show gray or black residue.

Inspect the liners for cracks on the inside and outside diameters.

Inspect for cracks under the flange.

Inspect the outside diameter and seat area for excessive corrosion or pitting.

Note : Pits **must not** be more than 1.6 mm [0.06 in] deep.

Replace the liner if the pits are too deep or if the corrosion can **not** be removed with fine emery cloth.

Inspect the inside diameters for vertical scratches deep enough to be felt with a fingernail.

Note : If a fingernail catches in the scratch, the liner **must** be replaced.

Inspect the inside diameter for scuffing or scoring.

Inspect the inside diameter for liner bore polishing.

A moderate polish produces a bright mirror finish in the worn area with traces of the original hone marks or an indication of an etch pattern.

A heavy polish produces a bright mirror finish in the worn area with no traces of hone marks or an etch pattern.

Replace the liner if:

- A heavy polish is present over 20 percent of the piston ring travel area.
- Both moderate and heavy polish over 30 percent of the piston ring travel area and one half (15 percent) is heavy polish.

Use dial bore gauge, Part Number 3376619, to measure the liner inside diameter in four places 90 degrees apart at the top and bottom of the piston travel area.

Cylinder Liner Inside Diameter		
mm		in
114.000	MIN	4.4882
114.040	MAX	4.4898

Measure the outside diameter of the liner top press fit area.

Cylinder Liner Out Diameter (Top Press Fit)		
mm		in
130.938	MIN	5.1550
130.958	MAX	5.1558

Measure the cylinder liner bore in the block. Refer to Procedure 001-026 in Section 1. (/qs3/pubsys2/xml/en/procedures/425/425-001-026.html)

Install

⚠ CAUTION ⚠

Clean all deposits and debris from sealing surfaces A, B, and C. Use abrasive pad, Part Number 3823258 or equivalent, and cleaning solvent to polish the surfaces. Due to the critical machined tolerances, care should be taken not to remove any additional material.

Use the following procedure for inspection, reuse and repair guidelines if surface C has signs of cracking, fretting, or pitting. Refer to Procedure 001-026 in Section 1. (/qs3/pubsys2/xml/en/procedures/425/425-001-026.html)

⚠ WARNING ⚠

When using solvents, acids, or alkaline materials for cleaning, follow the manufacturer's recommendations for use. Wear goggles and protective clothing to reduce the possibility of personal injury.

⚠ WARNING ⚠

Some solvents are flammable and toxic. Read the manufacturer's instructions before using.

Clean the combustion deck. Use a gasket scraper or abrasive pad, Part Number 3823258, or equivalent, and diesel fuel or solvent.

⚠ WARNING ⚠

Wear appropriate eye and face protection when using compressed air. Flying debris and dirt can cause personal injury.

Thoroughly flush the block. Use mineral spirits or cleaning solvent.

Remove the shop rags. Clean the crankshaft. Use a cleaning solvent.

Blow the cylinder bores and crankshaft dry. Wipe them clean with a lint-free cloth.

Lubricate surfaces A and B. Use clean engine oil.

Use clean oil to coat the liner o-ring seals.

Install new o-ring seals on the liners.

When reusing liners, install them in the same cylinder from where they were removed and rotate them 45 degrees (1/8 turn) from their original position. When correctly installed, any liner pitting **must** be positioned as illustrated so the pitted surface is rotated away from the location where pitting occurs.

Install the liner into the bore of the cylinder block. Use liner driver, Part Number ST 1229, or equivalent.

Use two cylinder head capscrews and position two liner clamps, Part Number 3822503, or equivalent, as illustrated.

Tighten the capscrews.

Torque Value: 68 n•m [50 ft-lb]

Remove the clamps. Repeat this procedure until all liners have been clamped and released.

Liner protrusion is the distance the liner protrudes above the block face.

Measure the liner protrusion at four points 90 degrees apart. Use gauge, Part Number 3164438, or equivalent.

Cylinder Liner Protrusion		
mm		in
0.026	MIN	0.0010
0.122	MAX	0.0048

The maximum allowable difference between adjacent cylinders is 0.051mm [0.002 in].

Note : If the liner protrusion varies more than 0.025 mm [0.0010 in] for 180 degrees:

- Install and tighten the liner clamps again.

Torque Value: 68 n•m [50 ft-lb]

- Measure the liner protrusion again.

Note : If the protrusion still varies more than 0.025 mm [0.0010 in]:

- Remove the liner.
- Inspect the liner sealing edge for burrs, dirt, or damage.
- Replace the liner if it is damaged.
- Install the liner again.
- Measure the liner protrusion.

Service Tip: If the out-of-limit condition is minimal, tolerance stack-up can allow the protrusion limits to be obtained by installing other new liners in the out-of-limit bore.

Note : Use the following procedure if the liner protrusion still does **not** meet the specifications. Refer to Procedure 001-058 in Section 1 (/qs3/pubsys2/xml/en/procedures/425/425-001-058.html) to machine the cylinder block liner counterbore for shims.

Use a feeler gauge to inspect the liner to block clearance at the four block casting points.

Cylinder Liner to Block Clearance		
mm		in
0.229	MIN	0.009

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Note : If the clearance is **less** than 0.229 mm [0.009 in]:

- Remove the liner.

- Inspect the liner and cylinder block for dirt or damage.

- Replace the liner if it is damaged.
- Install the liner again.

Measure the liner bore for out-of-roundness at points "C", "D", "E", "F", and "G". Measure each point in the direction "AA" and "BB". The bore **must not** be more than 0.04 mm [0.002 in] out-of-round.

Note : If the liner bore is more than 0.04 mm [0.002 in] out-of-round:

- Remove the liner so the cylinder block liner bore can be measured.

Finishing Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

- Install the pistons and connecting rods. Refer to Procedure 001-054 in Section 1. (/qs3/pubsys2/xml/en/procedures/425/425-001-054.html)
- Install the lubricating oil suction tube. Refer to Procedure 007-035 in Section 7. (/qs3/pubsys2/xml/en/procedures/425/425-007-035.html)
- Install the lubricating oil pan. Refer to Procedure 007-025 in Section 7. (/qs3/pubsys2/xml/en/procedures/425/425-007-025.html)
- Install the cylinder head. Refer to Procedure 002-004 in Section 2. (/qs3/pubsys2/xml/en/procedures/425/425-002-004.html)
- Install the rocker lever cover. Refer to Procedure 003-011 in Section 3. (/qs3/pubsys2/xml/en/procedures/425/425-003-011.html)

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- Fill the cooling system. Refer to Procedure 008-018 in Section 8. (/qs3/pubsys2/xml/en/procedures/425/425-008-018-tr.html)
- Fill lubricating oil system. Refer to Procedure 007-037 in Section 7. (/qs3/pubsys2/xml/en/procedures/425/425-007-037.html)
- Connect the batteries. See equipment manufacturer service information.
- Operate the engine. Check for leaks.

Last Modified: 05-Feb-2019

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Select Service Tools

Recommended Cummins® Service Tools

- RTV sealant, Part Number 3164067, or equivalent

Additional Service Items

- No additional service items required.

Preparatory Steps

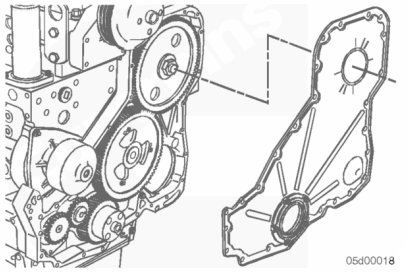
⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

- Disconnect the batteries. See equipment manufacturer service information.
- Remove the drive belt. Refer to Procedure 008-002 in Section 8. (/qs3/pubsys2/xml/en/procedures/425/425-008-002-tr.html)
- Remove the rubber vibration damper, if installed. Refer to Procedure 001-051 in Section 1. (/qs3/pubsys2/xml/en/procedures/425/425-001-051.html)
- Remove the viscous vibration damper, if installed. Refer to Procedure 001-052 in Section 1. (/qs3/pubsys2/xml/en/procedures/425/425-001-052.html)
- Remove the crankshaft front seal. Refer to Procedure 001-023 in Section 1. (/qs3/pubsys2/xml/en/procedures/425/425-001-023.html)

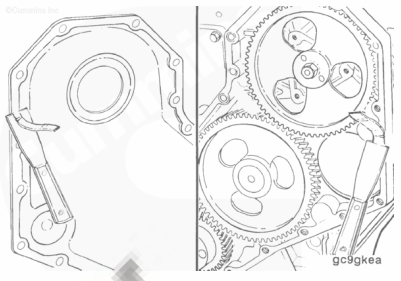
Remove

Remove the front gear cover.

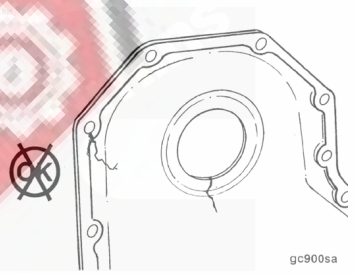


Clean and Inspect for Reuse

Clean sealant from the gear cover and gear housing gasket surface. Clean surfaces with isopropyl alcohol, parts cleaner, or contact cleaner.



Inspect the gear cover for cracks or other damage.

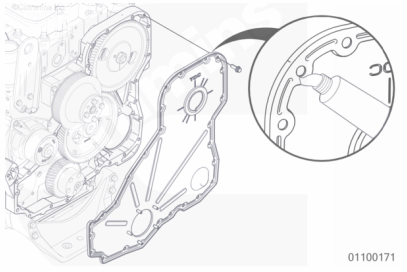


Install

Note : Apply sealant to the inside of the bolt holes.

Apply a thin bead of RTV sealant, Part Number 3164067, or equivalent, 3 to 4 mm [0.12 to 0.16 in] wide, to the engine side of the front cover **only**.

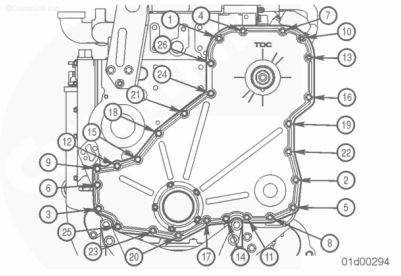
Install the front cover on the engine within 10 minutes.



Tighten the front cover capscrews in the sequence shown.

Torque Value:
Short Front Cover Mounting Capscrews 30 n•m [22 ft-lb]

Torque Value:
Long Front Cover Mounting Capscrews 40 n•m [30 ft-lb]



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Finishing Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

- Install the crankshaft front seal. Refer to Procedure 001-023 in Section 1. (/qs3/pubsys2/xml/en/procedures/425/425-001-023.html)
- Install the rubber vibration damper, if installed. Refer to Procedure 001-051 in Section 1. (/qs3/pubsys2/xml/en/procedures/425/425-001-051.html)
- Install the viscous vibration damper, if installed. Refer to Procedure 001-052 in Section 1. (/qs3/pubsys2/xml/en/procedures/425/425-001-052.html)
- Install the drive belt. Refer to Procedure 008-002 in Section 8. (/qs3/pubsys2/xml/en/procedures/425/425-008-002-tr.html)
- Connect the batteries. See equipment manufacturer service information.
- Operate the engine. Check for leaks.

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Last Modified: 21-Feb-2019

Select Service Tools

Recommended Cummins® Service Tools

- RTV sealant, Part Number 3823494, or equivalent

Additional Service Items

- Feeler gauge
- Common thread or very fine wire

Preparatory Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

⚠ WARNING ⚠

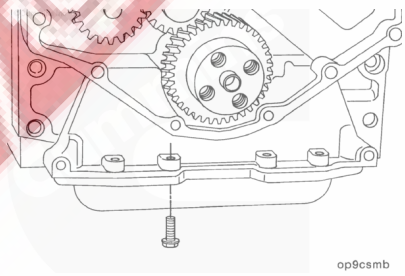
Fuel is flammable. Keep all cigarettes, flames, pilot lights, arcing equipment and switches out of the work area and areas sharing ventilation to reduce the possibility of severe personal injury or death when working on the fuel system.

- Disconnect the batteries. See equipment manufacturer service information.
- Shut off the fuel supply. See equipment manufacturer service information.
- Remove the drive belt. Refer to Procedure 008-002 in Section 8. (/qs3/pubsys2/xml/en/procedures/425/425-008-002-tr.html)
- Remove the rubber vibration damper, if installed. Refer to Procedure 001-051 in Section 1. (/qs3/pubsys2/xml/en/procedures/425/425-001-051.html)
- Remove the viscous vibration damper, if installed. Refer to Procedure 001-052 in Section 1. (/qs3/pubsys2/xml/en/procedures/425/425-001-052.html)
- Remove the gear cover. Refer to Procedure 001-031 in Section 1. (/qs3/pubsys2/xml/en/procedures/425/425-001-031.html)
- Remove the air compressor, if equipped. Refer to Procedure 012-014 in Section 12 (/qs3/pubsys2/xml/en/procedures/425/425-012-014.html)or see equipment manufacturer service information.
- Remove the rocker lever cover. Refer to Procedure 003-011 in Section 3. (/qs3/pubsys2/xml/en/procedures/425/425-003-011.html)

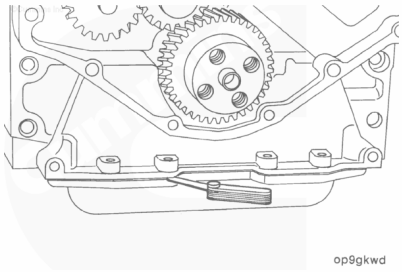
- Remove the rocker levers. Refer to Procedure 003-008 in Section 3. (/qs3/pubsys2/xml/en/procedures/425/425-003-008.html)
- Remove the push rods. Refer to Procedure 004-014 in Section 4. (/qs3/pubsys2/xml/en/procedures/425/425-004-014.html)
- Remove the fuel pump. Refer to Procedure 005-016 in Section 5. (/qs3/pubsys2/xml/en/procedures/425/425-005-016.html)
- Remove the camshaft gear. Refer to Procedure 001-012 in Section 1. (/qs3/pubsys2/xml/en/procedures/425/425-001-012.html)
- Remove or disconnect gear driven accessories, such as air compressor and hydraulic pump.

Remove

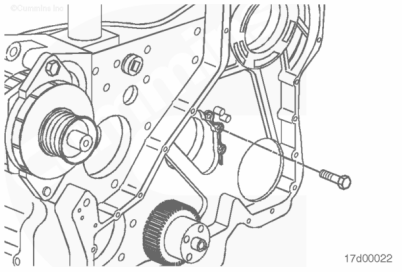
Remove the four front oil pan capscrews.



Separate the lubricating oil pan gasket from the gear housing. Use a feeler gauge.



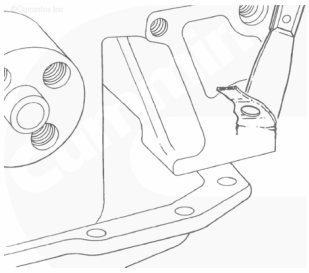
Remove the gear housing capscrews. Remove the gear housing.



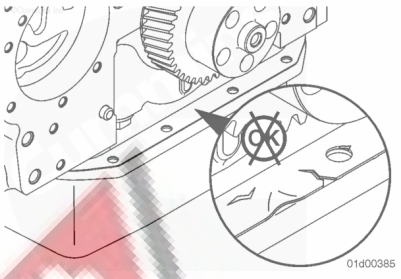
Clean and Inspect for Reuse

ANADOLU ISUZU AFTER SALES

Clean the gasket material from the cylinder block.

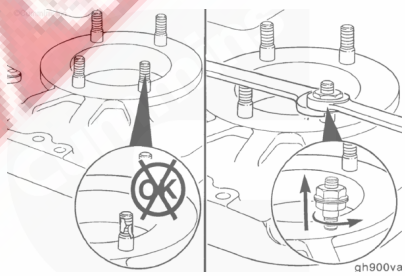


Inspect the lubricating oil pan gasket for tears or other damage. See the Install section of this procedure if the gasket is damaged.



Inspect fuel pump mounting studs for damage.

To install or remove the fuel pump studs, use two nuts locked together on the stud.



Inspect the gear housing sealing surfaces for cracks or other damage. Replace the gear housing if any damage is found.

Install

If the lubricating oil pan gasket is damaged, it can be repaired.

Cut the damaged gasket off even with the front of the cylinder block.

Use the old gasket as a template to cut the front section of a new gasket to the same size.

Note : The gear housing **must** be installed within 10 minutes of applying the sealant.

Clean the sealing surfaces.

ANADOLU ISUZU AFTER SALES

Coat the new gasket on both sides with RTV sealant, Part Number 3823494, or equivalent.

Make sure there is a bead of sealant at the intersecting joint of the cylinder block, oil pan, and gear housing.

Use common thread or a very fine wire to hold the new gasket splice in position as illustrated.

Position the gear housing gasket on the alignment dowels.

Use guide pins (M8 x 1.25 x 50) to assist in aligning the gasket and gear housing. Be sure to remove the guide pins after alignment.

Install the gear housing.

Torque Value: 40 n•m [30 ft-lb]

Start the lubricating oil pan capscrews in the holes **not** being used to tie the gasket in place.

Remove the thread or wire holding the gasket in place.

Install the remaining two lubricating oil pan capscrews. Tighten. Refer to Procedure 007-025 in Section 7. (/qs3/pubsys2/xml/en/procedures/425/425-007-025.html)

Finishing Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

⚠ WARNING ⚠

Fuel is flammable. Keep all cigarettes, flames, pilot lights, arcing equipment and switches out of the work area and areas sharing ventilation to reduce the possibility of severe personal injury or death when working on the fuel system.

- Install the camshaft gear. Refer to Procedure 001-012 in Section 1. (/qs3/pubsys2/xml/en/procedures/425/425-001-012.html)
- Install the push rods. Refer to Procedure 004-014 in Section 4. (/qs3/pubsys2/xml/en/procedures/425/425-004-014.html)
- Install the rocker levers. Refer to Procedure 003-008 in Section 3. (/qs3/pubsys2/xml/en/procedures/425/425-003-008.html)
- Adjust the overhead. Refer to Procedure 003-004 in Section 3. (/qs3/pubsys2/xml/en/procedures/425/425-003-004-tr.html)
- Install the rocker lever cover. Refer to Procedure 003-011 in Section 3. (/qs3/pubsys2/xml/en/procedures/425/425-003-011.html)
- Install the accessory drive or air compressor, if equipped. Refer to Procedure 012-014 in Section 12 (/qs3/pubsys2/xml/en/procedures/425/425-012-014.html) or see equipment manufacturer service information.
- Install the gear cover. Refer to Procedure 001-031 in Section 1. (/qs3/pubsys2/xml/en/procedures/425/425-001-031.html)
- Install the front crankshaft seal. Refer to Procedure 001-023 in Section 1. (/qs3/pubsys2/xml/en/procedures/425/425-001-023.html)
- Install the rubber vibration damper, if installed. Refer to Procedure 001-051 in Section 1. (/qs3/pubsys2/xml/en/procedures/425/425-001-051.html)
- Install the viscous vibration damper, if installed. Refer to Procedure 001-052 in Section 1. (/qs3/pubsys2/xml/en/procedures/425/425-001-052.html)
- Install the drive belt. Refer to Procedure 008-002 in Section 8. (/qs3/pubsys2/xml/en/procedures/425/425-008-002-tr.html)
- Install the fuel pump. Refer to Procedure 005-016 in Section 5. (/qs3/pubsys2/xml/en/procedures/425/425-005-016.html)
- Install or connect gear driven or accessories. See equipment manufacturer service information.
- Open the fuel valve. See equipment manufacturer service information.
- Connect the batteries. See equipment manufacturer service information.
- Operate the engine. Check for leaks.

ANADOLU DIESEL

Last Modified: 03-Aug-2016

Select Service Tools

Recommended Cummins® Service Tools

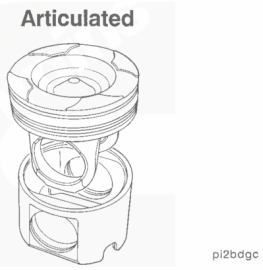
- No Cummins® Service Tools required.

Additional Service Items

- Non-metallic brush
- Feeler gauge

General Information

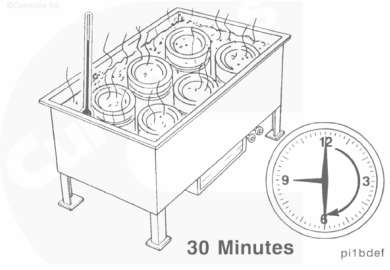
Some engines are equipped with articulated pistons. The articulated piston is a two (2) piece piston consisting of a forged steel crown and an aluminum skirt. An open chamber oil gallery is located on the underside of the crown of the piston to provide more oil contact with the piston and give better piston cooling.



Clean and Inspect for Reuse

⚠ WARNING ⚠

When using solvents, acids, or alkaline materials for cleaning, follow the manufacturer's recommendations for use. Wear goggles and protective clothing to reduce the possibility of personal injury.



⚠ CAUTION ⚠

Do not use the bead blast method to clean the piston. The piston will be damaged by blast material embedded in the aluminum.

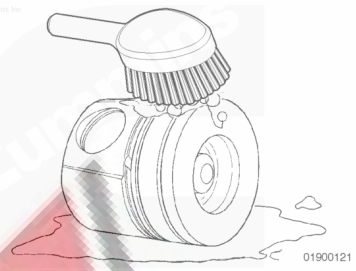
⚠ CAUTION ⚠

Do not clean the pistons and connecting rods in an acid tank.

Allow the piston to soak for a minimum of 30 minutes in a tank containing a cleaning solvent suitable for steel and aluminum.

⚠ CAUTION ⚠

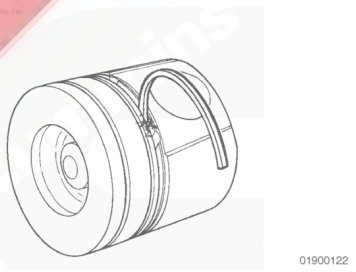
Do not use a metal brush. A metal brush will damage the piston ring grooves.



Wash the pistons and connecting rods in a strong solution of laundry detergent in hot water. Use a non-metallic brush to remove carbon deposits.

⚠ CAUTION ⚠

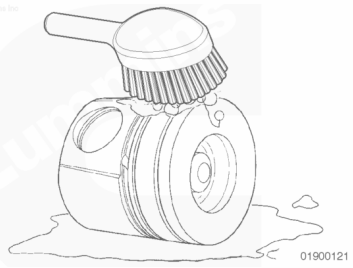
Do not use a ring groove cleaner to clean the ring grooves. Do not to scratch the ring sealing surface in the piston groove.



Clean the remaining deposits from the ring grooves with the square end of a broken piston ring.

⚠ WARNING ⚠

When using solvents, acids, or alkaline materials for cleaning, follow the manufacturer's recommendations for use. Wear goggles and protective clothing to reduce the possibility of personal injury.



⚠ WARNING ⚠

Some solvents are flammable and toxic. Read the manufacturer's instructions before using.

⚠ WARNING ⚠

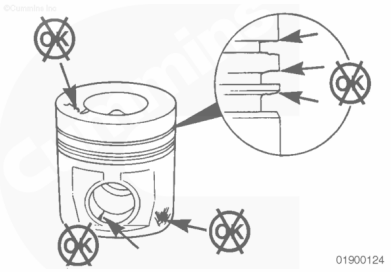
Wear appropriate eye and face protection when using compressed air. Flying debris and dirt can cause personal injury.

Wash the pistons again in a detergent solution or solvent.

PARDOLU ISUZU PARTS SALES

After rinsing, used compressed air to dry.

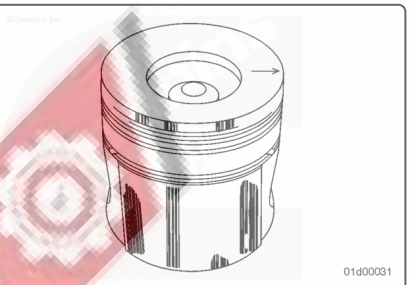
Failure Analysis Inspection



Inspect the piston for damage and excessive wear. Check the top, ring grooves, skirt, and pin bore for cracks or damage.

Note : If severe piston damage has occurred, check the turbocharger and other exhaust components for damage from debris.

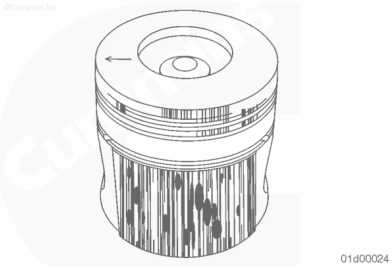
Abrasive and/or Debris Wear



Scratching on the piston skirt with material embedded in the piston can be caused by:

1. Ingested abrasive material
2. Inadequate cleaning during a previous repair
3. Particles embedded in the cylinder bore
4. Improper maintenance of the lubrication system
5. Debris in the lubrication oil system from another failure
6. Scuffing and scoring.

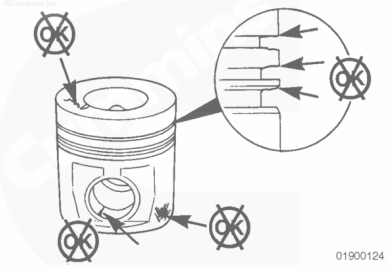
Scuffing and scoring can be caused by:



1. Engine overheating
2. Oil dilution
3. Improper maintenance of the lubrication system
4. Piston cooling nozzle malfunction
5. Oil rung plugged by deposits
6. Injector overfueling/engine running on an alternative fuel source, i.e. oil in the intake system.

Note : Scuffing and scoring on the piston rings indicates a breakdown of the oil film on the cylinder bore wall, causing transfer of material from the piston ring face to the cylinder bore wall.

Other Types of Piston Failures



Hydraulic Lock

Hydraulic locks (oil, fuel, or water) can cause the piston to split in half, or the lands can break and the connecting rods can be bent.

Dustouts

ANADOLU ISUZU AFTER SALES

Particular attention to the wear pattern of the intermediate (second) ring is required for diagnosis of a dustout piston scuff.

The ring will have a polished appearance on the full-face ear of the intermediate ring, where the blackened areas of the ring become more polished.

The polished area starts at the bottom of the ring and continues upward on the tapered ring.

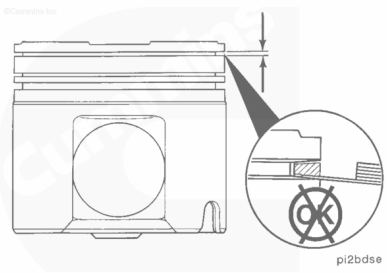
Occasionally, the edges of the rings are razor sharp, and the block cylinder bore has indications of ridges approximately 1-1/2 inches below the top deck.

Top of Piston Meltdown

The top of the piston appears to be melted down, and the failure resembles an overfueling situation such as a stuck injector. A plugged piston cooling nozzle can resemble this failure as well.

Measure

The ring groove can be inspected with a new ring and a feeler gauge.

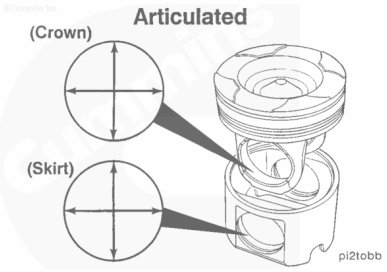


Hold a new ring in the groove even with the outside diameter of the piston.

Install a 0.15 mm [0.006 in] feeler gauge.

If the feeler gauge enters the groove without resistance, there is too much wear. Replace the piston.

Articulated Pistons

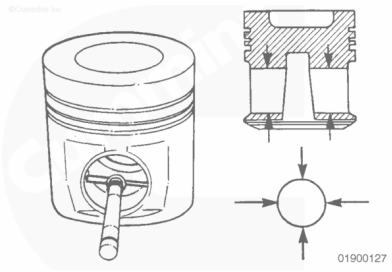


Measure the piston pin bore inside diameter on both the crown and skirt.

Articulated Piston Pin Bore Inside Diameter			
	mm		in
Crown	45.016	MIN	1.7723
	45.036	MAX	1.7731
Skirt	45.012	MIN	1.7721
	45.026	MAX	1.7727

ANADOLU ISUZU Genuine Parts

Single Piece Pistons

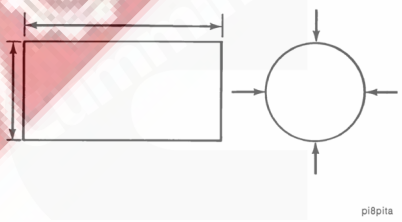


Measure the pin bore when the piston temperature is at 20°C [68°F].

Piston Pin Bore Diameter		
mm		in
45.010	MIN	1.7720
45.016	MAX	1.7723

Note : Add 0.013 mm or 0.0005 in to the bore diameter per 5°C [10°F] temperature rise up to 32°C [90°F].

Inspect the piston pin for nicks, gouges, and excessive wear.



Measure the piston pin outside diameter.

Piston Pin Diameter		
mm		in
44.997	MIN	1.7715
45.003	MAX	1.7718

Replace the piston pin if it is more than 0.003 mm [0.0001 in] out of round.

Last Modified: 25-Jul-2016

ANADOLU ISUZU AFTER SALES

Select Service Tools

Recommended Cummins® Service Tools

- No Cummins® Service Tools required.

Additional Service Items

- Crow's foot socket

Preparatory Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

⚠ WARNING ⚠

To reduce the possibility of personal injury, avoid direct contact of hot oil with your skin.

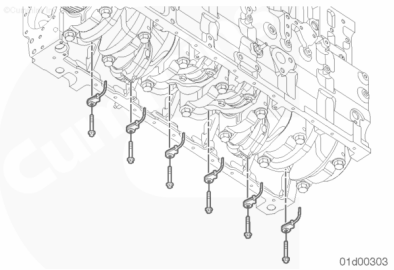
⚠ WARNING ⚠

Some state and federal agencies have determined that used engine oil can be carcinogenic and cause reproductive toxicity. Avoid inhalation of vapors, ingestion, and prolonged contact with used engine oil. If not reused, dispose of in accordance with local environmental regulations.

- Disconnect the batteries. See equipment manufacturer service information.
- Drain the lubricating oil. Refer to Procedure 007-037 in Section 7. (/qs3/pubsys2/xml/en/procedures/425/425-007-037.html)
- Remove the lubricating oil pan. Refer to Procedure 007-025 in Section 7. (/qs3/pubsys2/xml/en/procedures/425/425-007-025.html)
- Remove the lubricating oil suction tube. Refer to Procedure 007-035 in Section 7. (/qs3/pubsys2/xml/en/procedures/425/425-007-035.html)

Remove

Remove the piston cooling nozzle capscrews and nozzles.



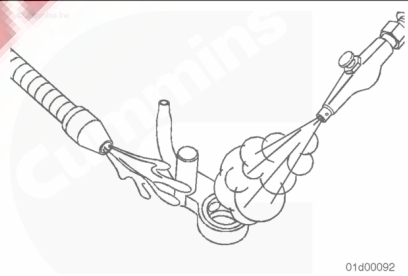
Note : The crankshaft **must** be rotated to allow access to remove the nozzles.

Note : The number six (6) piston cooling nozzle can **not** be removed without first disconnecting the connecting rod from the crankshaft and moving the piston out of the way. Also, a crow's foot socket will be required to access the capscrew.

Clean and Inspect for Reuse

⚠ WARNING ⚠

When using solvents, acids, or alkaline materials for cleaning, follow the manufacturer's recommendations for use. Wear goggle and protective clothing to reduce the possibility of personal injury.



⚠ WARNING ⚠

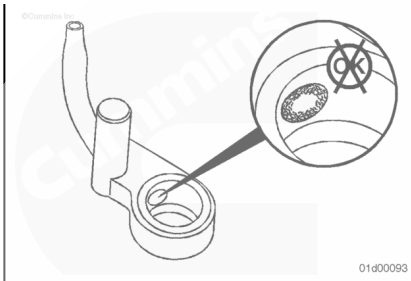
Some solvents are flammable and toxic. Read the manufacturer's instructions before using.

⚠ WARNING ⚠

Wear appropriate eye and face protection when using compressed air. Flying debris and dirt can cause personal injury.

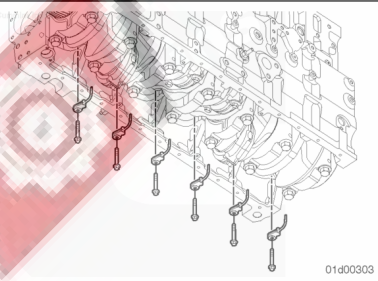
Clean the piston cooling nozzles and capscrew. Use solvent. Dry with compressed air.

Inspect the piston cooling nozzles for flow restriction or any other damage. Replace if necessary.



Install

Note : The crankshaft **must** be rotated to allow access to install the nozzles.



Install the piston cooling nozzles and capscrews.

Tighten the capscrews.

Torque Value: 33 n•m [24 ft-lb]

Finishing Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

- Install the lubricating oil suction tube. Refer to Procedure 007-035 in Section 7. (/qs3/pubsys2/xml/en/procedures/425/425-007-035.html)
- Install the lubricating oil pan. Refer to Procedure 007-025 in Section 7. (/qs3/pubsys2/xml/en/procedures/425/425-007-025.html)
- Fill the engine with lubricating oil. Refer to Procedure 007-037 in Section 7. (/qs3/pubsys2/xml/en/procedures/425/425-007-037.html)
- Connect the batteries. See equipment manufacturer service information.
- Operate the engine. Check for oil leaks.

ANADOLU ISUZU AFTER SALES


ANADOLU ISUZU
AFTER SALES

Select Service Tools

Recommended Cummins® Service Tools

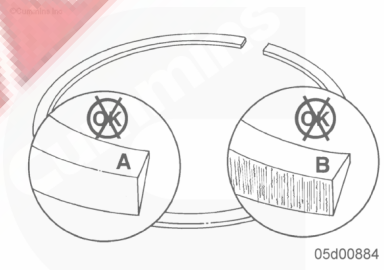
- No Cummins® Service Tools required.

Additional Service Items

- Feeler gauge

Failure Analysis Inspection

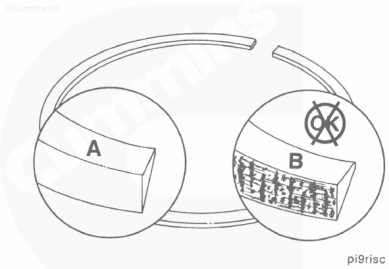
Inspect the piston rings for abrasive wear.



Note : Abrasive wear of the intermediate ring can be indicated by a rapid reduction of the dark finish coating on the front face of the ring, in some cases to the point where the dark finish coating is no longer visible (A). This is commonly referred to as full face ring wear. This rapid reduction will typically leave a sharp edge on the bottom of the intermediate ring. Abrasive wear can also be indicated by concentrated vertical scratches on the top ring (B).

Abrasive wear can be caused by:

1. Ingested abrasive material
2. Inadequate cleaning during a previous repair
3. Particles embedded in the bore
4. High soot content in the lubricating oil from extended oil drain intervals
5. Scuffing and scoring.



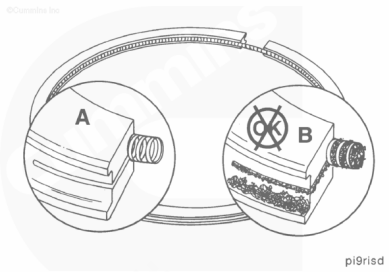
Note : Scuffing and scoring is indicated by heavy scratches, metal discoloration, and voids (B).

Scuffing and scoring can be caused by:

1. Engine overheating
2. Oil dilution
3. Improper maintenance of the lubrication system
4. Piston cooling nozzle malfunction
5. Oil ring plugged by deposits.

Note : Scuffing and scoring on the piston rings indicates a breakdown of the oil film on the cylinder bore wall, causing transfer of material from the piston ring face to the cylinder bore.

Note : Oil ring plugging is indicated by deposits on the oil ring grooves (B).



Oil ring plugging can be caused by:

1. Low engine operating temperatures - long periods of idling or a cooling system malfunction
2. Extended oil change intervals
3. Use of the wrong grade of engine oil
4. Use of a poor quality engine oil.

Note : Plugging of the oil ring drains restricts oil drain-back, which floods the piston ring belt area, resulting in a loss of oil control.

Note : The following measurements are intended for inspecting new piston rings.

Note : Before completing this inspection, make sure the cylinder liner is within specification. Refer to Procedure 001-028 in Section 1. (/qs3/pubsys2/xml/en/procedures/425/425-001-028.html)

Measure the piston ring gap by installing the piston rings into the cylinder bore in which they will be used. Position the rings below the ring reversal area by positioning each ring in the cylinder 89 mm [3.5 in] below the top deck (A). Use a piston to square the rings with the bore.

The installation location for the compression rings can be determined by the finish.

- The top ring has a chrome finish.
- The intermediate ring has a phosphate (black) finish.

The oil control ring is a two-piece ring made of an expander and two rails. The expander is installed between the two rails.

Use a feeler gauge to measure the gap.

Aluminum Piston Ring Gap			
	mm		in
Top Ring	0.300	MIN	0.012

	0.525	MAX	0.021
Intermediate Ring	0.850	MIN	0.033
	1.275	MAX	0.050
Oil Control Ring	0.300	MIN	0.012
	0.725	MAX	0.028

Steel Articulated Piston Ring Gap			
	mm		in
Top Ring	0.300	MIN	0.012
	0.525	MAX	0.021
Intermediate Ring	0.400	MIN	0.016
	0.825	MAX	0.032
Oil Control Ring	0.300	MIN	0.012
	0.725	MAX	0.028

If the piston ring gap is **not** within specification:

1. Verify the correct type and part number piston ring is being used.
2. Verify the cylinder liner is within specification. Refer to Procedure 001-028 in Section 1. (/qs3/pubsys2/xml/en/procedures/425/425-001-028.html)
3. Verify the piston ring gap measurement is being taken 89 mm [3.5 in] below the cylinder block deck.
4. Try another set of piston rings.

ANADOLU ISUZU PARTS SALES

Select Service Tools

Recommended Cummins® Service Tools

- No Cummins® Service Tools required.

Additional Service Items

- No additional service items required.

Preparatory Steps

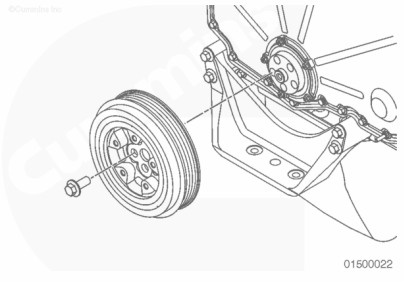
⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

- Disconnect the batteries. See equipment manufacturer service information.
- Remove the fan and fan shroud, if necessary.
- Remove the drive belt. Refer to Procedure 008-002 in Section 8. (/qs3/pubsys2/xml/en/procedures/425/425-008-002-tr.html)
- Remove the crankshaft pulley, if applicable. Refer to Procedure 001-022 in Section 1. (/qs3/pubsys2/xml/en/procedures/425/425-001-022.html)
- Remove the crankshaft adapter, if applicable. Refer to Procedure 001-017 in Section 1. (/qs3/pubsys2/xml/en/procedures/425/425-001-017.html)

Remove

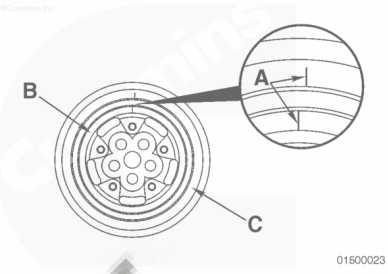
Remove the vibration damper.



Inspect for Reuse

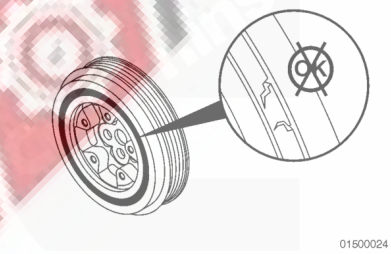
Check the index lines (A) on the damper hub (B) and inertia member (C). If the lines are more than 1.59 mm [1/16 in] out of alignment, replace the damper.

Inspect the vibration damper hub (B) for cracks. Replace the damper if the hub is cracked.



Inspect the rubber member for deterioration. If pieces of rubber are missing or if the elastic member is more than 3.18 mm [1/8 in] below the metal surface, replace the damper.

Note : Also, look for forward movement of the damper ring on the hub. Replace the damper if any movement is detected.

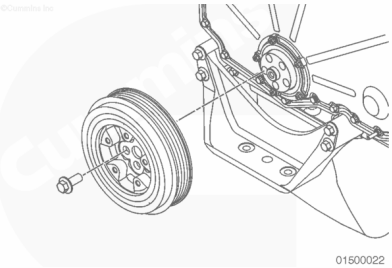


Install

Install the vibration damper.

Tighten the capscrews in a star pattern.

Torque Value: 200 n•m [148 ft-lb]



Finishing Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

ANADOLU ISUZU AFTER SALES

- Remove the crankshaft adapter, if applicable. Refer to Procedure 001-017 in Section 1. (/qs3/pubsys2/xml/en/procedures/425/425-001-017.html)
- Remove the crankshaft pulley, if applicable. Refer to Procedure 001-022 in Section 1. (/qs3/pubsys2/xml/en/procedures/425/425-001-022.html)
- Install the drive belt. Refer to Procedure 008-002 in Section 8. (/qs3/pubsys2/xml/en/procedures/425/425-008-002-tr.html)
- Install the fan and fan shroud, if removed.
- Connect the batteries. See equipment manufacturer service information.
- Operate the engine. Check for proper operation.

Last Modified: 03-Aug-2016

ANADOLU ISUZU AFTER SALES

Select Service Tools

Recommended Cummins® Service Tools

- Insulated gloves, Part Number 3823730, and/or hot clamp pliers, Part Number 3823732

Additional Service Items

- No additional service items required.

Preparatory Steps

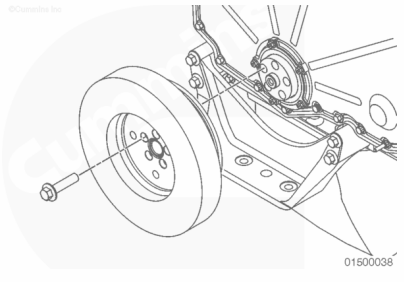
⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

- Disconnect the batteries. See equipment manufacturer service information.
- Remove the fan and fan shroud, if necessary.
- Remove the drive belt. Refer to Procedure 008-002 in Section 8. (/qs3/pubsys2/xml/en/procedures/425/425-008-002-tr.html)
- Remove the crankshaft pulley, if applicable. Refer to Procedure 001-022 in Section 1. (/qs3/pubsys2/xml/en/procedures/425/425-001-022.html)
- Remove the crankshaft adapter, if applicable. Refer to Procedure 001-017 in Section 1. (/qs3/pubsys2/xml/en/procedures/425/425-001-017.html)

Remove

Remove the vibration damper.

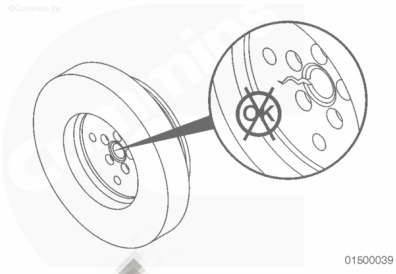


Inspect for Reuse

Check the mounting web for cracks.

Check the housing for dents or raised surfaces.

Replace the damper if any of this damage is identified.

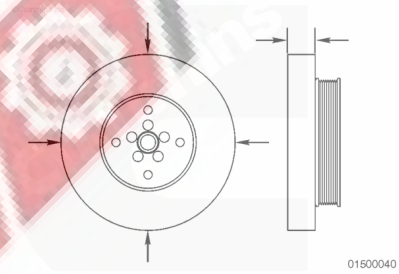


The viscous damper is filled with a silicone fluid. After many hours of use, the silicone fluid can become thicker and expand.

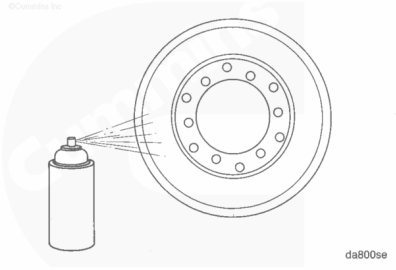
To determine if the damper thickness is correct, remove the paint from the damper in four locations on either side of the damper. Measure and record the thickness of the damper in four places.

Measure the thickness 3.175 mm [0.125 in] from the outside of the damper.

Replace the damper if its thickness varies by more than 0.25 mm [0.010 in].

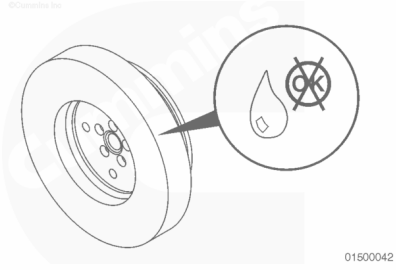


Spray the damper with spot check developer, type SKD-S2, or equivalent.



Check for fluid leakage.

If there is leakage replace the damper.



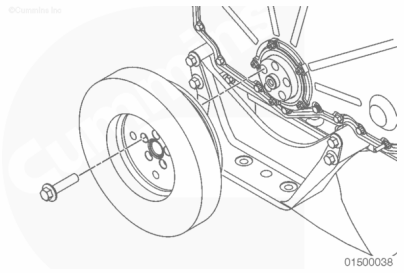
ANADOLU ISUZU AFTER SALES

Install

Install the vibration damper.

Tighten the capscrews in a star pattern.

Torque Value: 200 n•m [148 ft-lb]



Finishing Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

- Install the crankshaft adapter, if applicable. Refer to Procedure 001-017 in Section 1. (/qs3/pubsys2/xml/en/procedures/425/425-001-017.html)
- Install the crankshaft pulley, if applicable. Refer to Procedure 001-022 in Section 1. (/qs3/pubsys2/xml/en/procedures/425/425-001-022.html)
- Install the drive belt. Refer to Procedure 008-002 in Section 8. (/qs3/pubsys2/xml/en/procedures/425/425-008-002-tr.html)
- Install the fan and fan shroud, if removed.
- Connect the batteries. See equipment manufacturer service information.
- Operate the engine and check for proper operation.

RHODES ISUZU

Last Modified: 20-Apr-2017

Select Service Tools

Recommended Cummins® Service Tools

- Abrasive pad, Part Number 3823258, or equivalent
- Connecting rod guide pin, Part Number 3824496 - Quantity 2
- Piston ring expander, Part Number 3823137
- Assembly lubricant, Part Number 3163087, or equivalent
- Piston ring compressor, Part Number 3164604

Additional Service Items

- Rubber hammer
- Internal snap ring pliers
- Marked socket
- Torque wrench

Preparatory Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

⚠ WARNING ⚠

To reduce the possibility of personal injury, avoid direct contact of hot oil with your skin.

⚠ WARNING ⚠

Some state and federal agencies have determined that used engine oil can be carcinogenic and cause reproductive toxicity. Avoid inhalation of vapors, ingestion, and prolonged contact with used engine oil. If not reused, dispose of in accordance with local environmental regulations.

⚠ WARNING ⚠

Do not remove the pressure cap from a hot engine. Wait until the coolant temperature is below 50°C [120°F] before removing the pressure cap. Heated coolant spray or steam can cause personal injury.

⚠ WARNING ⚠

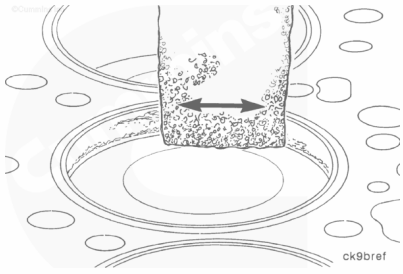
Coolant is toxic. Keep away from children and pets. If not reused, dispose of in accordance with local environmental regulations.

- Disconnect the batteries. See equipment manufacturer service information.
- Drain the lubricating oil. Refer to Procedure 007-037 in Section 7. (/qs3/pubsys2/xml/en/procedures/425/425-007-037.html)
- Drain the coolant. Refer to Procedure 008-018 in Section 8. (/qs3/pubsys2/xml/en/procedures/425/425-008-018-tr.html)
- Remove the lubricating oil pan. Refer to Procedure 007-025 in Section 7. (/qs3/pubsys2/xml/en/procedures/425/425-007-025.html)
- Remove the lubricating oil suction tube. Refer to Procedure 007-035 in Section 7. (/qs3/pubsys2/xml/en/procedures/425/425-007-035.html)
- Remove the piston cooling nozzles, if required. Refer to Procedure 001-046 in Section 1. (/qs3/pubsys2/xml/en/procedures/425/425-001-046.html)
- Remove the cylinder head. Refer to Procedure 002-004 in Section 2. (/qs3/pubsys2/xml/en/procedures/425/425-002-004.html)

Remove

⚠ WARNING ⚠

When using solvents, acids, or alkaline materials for cleaning, follow the manufacturer's recommendations for use. Wear goggles and protective clothing to reduce the possibility of personal injury.



⚠ WARNING ⚠

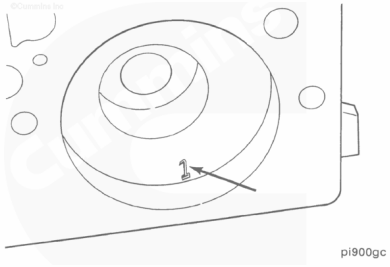
Some solvents are flammable and toxic. Read the manufacturer's instructions before using.

Rotate the crankshaft until the pistons are just below the carbon deposits found above the ring travel area.

Use abrasive pad, Part Number 3823258, or equivalent, and solvent to remove the carbon deposits.

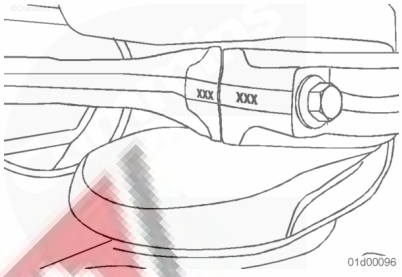
ANADOLU ISUZU DEALER SALES

Mark each piston according to the cylinder location.



Rotate the crankshaft to position the rod cap at bottom dead center (BDC) for removal.

A unique number (**not** cylinder number) is stamped on the connecting rod and matching cap. When the rods and caps are installed in the engine, the numbers on the rods and caps **must** match and be installed on the same side of the engine. Before the rods are removed they should be marked for position (numbers 1 through 6) and orientation (front of engine) so they are installed in the same orientation.



Loosen the connecting rod capscrews.

Note : Do **not** remove the capscrews from the rods at this time.

Use a rubber hammer to hit the connecting rod capscrews to loosen the caps from the dowels.

Remove the capscrews, connecting rod cap, and lower connecting rod bearing.

Mark the cylinder number and the letter "L" (lower) on the flat surface of the bearing tang.

⚠ CAUTION ⚠

Do not damage the fracture-split surface on the connecting rod or connecting rod cap while the connecting rod caps are removed. If the fractured split surface is damaged, the connecting rod and connecting rod cap must be replaced to help reduce the possibility of engine damage. Incorrect assembly can damage the rod.

Install two connecting rod guide pins, Part Number 3824496.

Use a "T-handle" piston pusher to push the rod away from the crankshaft.

ANADOLU ISUZU PARTS SALES

Push the connecting rod and piston assembly out of the cylinder bore. Care **must** be taken to **not** damage the connecting rod or bearing.

Remove the upper rod bearing.

Mark the cylinder number and the letter "U" (upper) on the flat surface of the bearing tang.

Use both hands to remove the piston and connecting rod assembly.

If parts are reused, the piston and connecting rod assemblies **must** be installed in the same cylinder locations from which they were removed to provide the proper fit of worn mating surfaces.

Use tags to mark the piston and connecting rod assembly locations as they are removed.

Place the rod and piston assemblies in a container to protect them from damage.

Disassemble

Use piston ring expander, Part Number 3823137, to remove the piston rings.

Use internal snap ring pliers to remove the snap rings from both sides of the piston.

Remove the piston pin.

Note : Heating the piston is **not** required.

⚠ CAUTION ⚠

Do not use a hammer to remove the piston pins. The piston can distort, causing it to seize in the liner.

If the piston pin can not be easily removed by hand:

- Install the piston and rod assembly in a container of water.

PARDOLU ISUZU PARTS SALES

- Heat the piston in boiling water for 15 minutes.
- Use a blunt tool to push the piston pin from the piston and rod assembly.

Note : When the piston pin is removed from an articulated piston, the skirt will separate from the crown. Use care to prevent damage to the piston.

Mark the parts with the number of the cylinder from which the piston, crown, skirt, and pin were removed to make sure they are installed in the correct cylinder location, if they are to be reused.

Clean and Inspect for Reuse

Clean the pistons. Refer to Procedure 001-043 in Section 1. (/qs3/pubsys2/xml/en/procedures/425/425-001-043.html)

Inspect the pistons. Refer to Procedure 001-043 in Section 1. (/qs3/pubsys2/xml/en/procedures/425/425-001-043.html)

Inspect the connecting rods. Refer to Procedure 001-014 in Section 1. (/qs3/pubsys2/xml/en/procedures/425/425-001-014.html)

Assemble

Single-Piece Piston

Install the retaining ring in the pin groove on one side of the piston.

Lubricate the pin and pin bores. Use engine lubricating oil.

⚠ CAUTION ⚠

Make sure "front" marking on the piston and the numbers on the rod and cap are oriented as illustrated.

ANADOLU ISUZU

Align the pin bore of the rod with the pin bore of the piston skirt. Install the piston pin.

⚠ CAUTION ⚠

Do not use a hammer to install the piston pin. The piston can distort, causing it to seize in the liner.

- Install the pin through the piston and connecting rod.

Note : Pistons do **not** require heating to install the pin. However, the pistons do need to be at room temperature or above.

Install the second retaining ring.

⚠ CAUTION ⚠

Most piston rings look similar but have significant difference. Make sure the correct part number is being used for the engine.

The top surface of the upper and intermediate rings are identified either with the word "TOP" or a supplier identification mark, such as a dot. Assemble with the word "TOP" or the supplier mark facing upward.

The bottom, or oil control ring, can be installed with either side up.

Note : The two-piece oil control ring **must** be installed with the expander ring gap 180 degrees from the gap of the oil ring.

Use piston ring expander, Part Number 3823137, to install the rings on the piston.

Position the oil ring expander in the oil control ring groove.

Articulated Piston

Note : If the pistons are being reused, the crown, skirt, and pin **must** be matched as they were when

they were removed.

Position the skirt over the piston crown.

Note : It is **not** necessary to heat the articulated pistons before assembly. The piston pin is a slip fit.

Install the retaining ring in the pin groove on one side of the piston.

⚠ CAUTION ⚠

Do not use a hammer to install the piston pin. The piston can distort, causing it to seize in the liner.

Lubricate the pin and pin bores. Use engine lubricating oil.

Align the pin bore of the rod with the pin bore of the piston skirt and crown. Install the piston pin.

⚠ CAUTION ⚠

The snap ring must be seated completely in the piston groove to prevent engine damage during engine operation.

Install the second retaining ring.

⚠ CAUTION ⚠

Most piston rings look similar but have significant difference. Make sure the correct part number is being used for the engine.

The top surface of the upper and intermediate rings are identified either with the word "TOP" or a supplier identification mark, such as a dot. Assemble with the word "TOP" or the supplier mark facing upward.

The bottom, or oil control ring, can be installed with either side up.

Note : The two-piece oil control ring **must** be installed with the expander ring gap 180 degrees from the gap of the oil ring.

ANADOLU ISUZU SPARE PARTS SALES

Use piston ring expander, Part Number 3823137, to install the rings on the piston.

Position the oil ring expander in the oil control ring groove.

Install

The cylinder block and all parts **must** be clean before assembly. Inspect the cylinder liners for reuse.

Refer to Procedure 001-028 in Section 1. (/qs3/pubsys2/xml/en/procedures/425/425-001-028.html)

Clean the connecting rods and bearing shells. Use a clean, lint-free cloth.

Do **not** lubricate the backside of the bearing shells. The operating clearance of the bearing will be reduced and the bearing can be damaged during engine operation.

If new bearings are **not** used, the used bearings **must** be installed on the same connecting rod and location from where they were removed.

The 180 degree thrust washers are designed to separate from the main bearing shell in operation. If reuse guidelines are met for the thrust bearing, the thrust bearing can be reused. Use the following procedure for more information. Refer to Procedure 001-006 in section 1. (/qs3/pubsys2/xml/en/procedures/425/425-001-006.html)

Install the upper bearing shell into the connecting rod.

The tang of the bearing shell (1) **must** be in the slot of the rod (2). The end of the bearing shell **must** be even with the cap mounting surface.

Use assembly lubricant, Part Number 3163087, or equivalent, to coat the inside circumference of the bearing shell.

Apply a film of clean engine oil to the cylinder liner.

Lubricate the rings and piston skirts. Use clean engine lubricating oil.

Rotate the rings to position the ring gaps, as shown.

Note : The ring gap of each ring **must not** be aligned with the piston pin, or with any other ring. If the ring gaps are **not** aligned correctly, the rings will **not** seal properly.

Use piston ring compressor, Part Number 3164604, to compress the rings.

Install connecting rod guide pins, Part Number 3824496.

Rotate the crankshaft so the connecting rod journal of the connecting rod being installed is at BDC.

⚠ CAUTION ⚠

Omission of this step will result in extensive engine damage.

Note : For all piston types make sure that the "FRONT" marking on the piston crown is pointed toward the front of the engine block.

A unique number (**not** cylinder number) is stamped on the connecting rod and matching cap. When the rods and caps are installed in the engine, the numbers on the rods and caps **must** match and be installed on the same side of the engine. The rods **must** be installed in the same position (numbers 1 through 6) and orientation (front of engine) from which they were removed.

Align the piston crown deep valve pocket on the exhaust side of the engine.

Insert the connecting rod through the cylinder liner until the ring compressor contacts the top of the liner.

Hold the ring compressor against the cylinder liner.

Push the piston through the ring compressor and into the cylinder liner.

Push the piston until the top ring is completely in the cylinder liner.

Note : If the piston does **not** move freely, remove the piston and inspect for broken or damaged rings.

Carefully push the piston into the bore while guiding the connecting rod to the crankshaft journal.

Note : If new bearings are **not** used, the used bearings **must** be installed on the same connecting rod cap from which they were removed.

Install the bearing in the connecting rod cap.

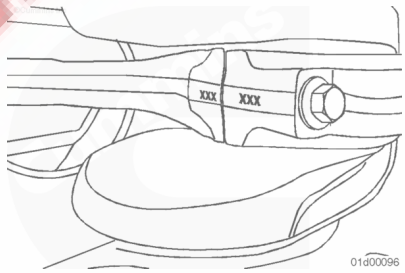
The tang of the bearing (2) **must** be in the slot of the cap (1).

Use assembly lubricant, Part Number 3163087, or equivalent, to coat the inside diameter of the bearing shell.

Use clean engine oil to lubricate the connecting rod capscrew threads.

⚠ CAUTION ⚠

Do not damage the fracture-split surface on the connecting rod or connecting rod cap while the connecting rod cap is removed. If the fracture-split surface is damaged, the connecting rod and connecting rod cap must be replaced to help reduce the possibility of engine damage.



The connecting rod and cap **must** have the same number and **must** be installed in the proper cylinder. The connecting rod cap number and rod number **must** be on the same side of the connecting rod to prevent engine damage during engine operation.

- Install the connecting rod cap and capscrews.
- Use a marked socket and torque wrench to tighten the connecting rod capscrews.
- Use the torque plus angle method to tighten the connecting rod capscrews in alternating sequence.

Torque Value:

Connecting Rod Capscrews

1. 60 n•m [44 ft-lb]
2. Loosen capscrews.
3. 30 n•m [22 ft-lb]
4. 50 n•m [36 ft-lb]

5. Advance 60 degrees.

Note : Do **not** measure the clearance between the rod cap and crankshaft.

Measure the side clearance between the connecting rod and crankshaft.

Connecting Rod and Crankshaft Side Clearance		
mm		in
0.10	MIN	0.004
0.30	MAX	0.012

Check for freedom of rotation as the connecting rod caps are installed. If the crankshaft does **not** rotate freely, check the installation of the connecting rod bearings and bearing size.

Finishing Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

- Install the piston cooling nozzles, if required. Refer to Procedure 001-046 in Section 1. (/qs3/pubsys2/xml/en/procedures/425/425-001-046.html)
- Install the lubricating oil suction tube. Refer to Procedure 007-035 in Section 7. (/qs3/pubsys2/xml/en/procedures/425/425-007-035.html)
- Install the lubricating oil pan. Refer to Procedure 007-025 in Section 7. (/qs3/pubsys2/xml/en/procedures/425/425-007-025.html)
- Install the cylinder head. Refer to Procedure 002-004 in Section 2. (/qs3/pubsys2/xml/en/procedures/425/425-002-004.html)
- Fill the engine with lubricating oil. Refer to Procedure 007-037 in Section 7. (/qs3/pubsys2/xml/en/procedures/425/425-007-037.html)
- Fill the cooling system. Refer to Procedure 008-018 in Section 8. (/qs3/pubsys2/xml/en/procedures/425/425-008-018-tr.html)
- Connect the batteries. See equipment manufacturer service information.
- Operate the engine. Check for leaks.

Last Modified: 14-Sep-2016



Select Service Tools

Recommended Cummins® Service Tools

- No Cummins® Service Tools required.

Additional Service Items

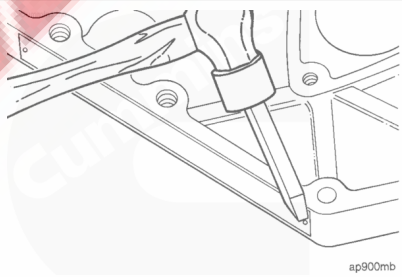
- Hammer
- Chisel

Remove

Remove the rivets securing the engine dataplate.

Note : If the dataplate is to be reused, care **must** be taken **not** to damage the data on the plate.

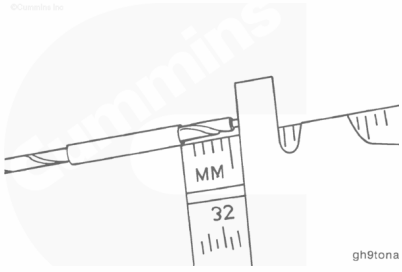
Pry out the rivet by using a hammer to drive a flat chisel under the head of the rivet.



Install

⚠ CAUTION ⚠

When drilling holes for the dataplate location, do not completely drill through the mounting location. Drill only deep enough to install the new blind rivets. Drilling through will result in an oil leak.



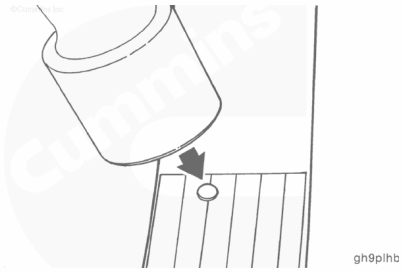
If attaching the dataplate to a new component or if the old rivet locations are damaged, drill new 2 mm [0.066 in] diameter holes and attach with new blind rivets.

Note : The dataplate should be located in the same area as it was previously installed.

Note : Mark the drill bit at 6.0 mm [0.236 in] to avoid drilling too deep in the gear housing.

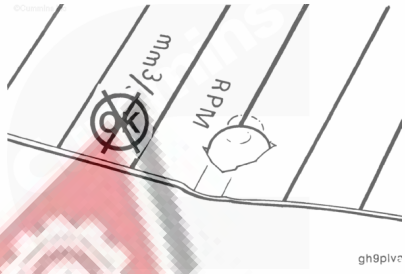
ANADOLU ISUZU AFTERSALES

Drive the rivets in until they contact the dataplate.



⚠ CAUTION ⚠

If the rivets are driven in too far, they will cut through the dataplate.



Last Modified: 25-Jul-2016

ANADOLU ISUZU AFTER SALES

Select Service Tools

Recommended Cummins® Service Tools

- Cylinder Block Counterbore Cutting Kit, Part Number 5299988
  - Cylinder bore plug, Part Number 5299991
  - Protective plug, Part Number 5299207
  - Locating gauge, Part Number 5299989
  - Mounting plate, Part Number 5299990
  - Cutter plate, Part Number 5299993.
- Depth gauge assembly, Part Number 3164438
- Counterbore ledge cutter drive unit, Part Number 3163785
- Cutter bit, Part Number 5296531
- Chip removing unit, Part Number 3823461.
- Depth gauge assembly, Part Number 3164438
- Crack Detection Kit, Part Number 3375432, or equivalent.

Additional Service Items

- No additional service items required.

PARDOLU ISUZU AFTER SALES

Preparatory Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

⚠ WARNING ⚠

Coolant is toxic. Keep away from children and pets. If not reused, dispose of in accordance with local environmental regulations.

⚠ WARNING ⚠

This component or assembly weighs greater than 23 kg [50 lb]. To prevent serious personal injury, be sure to have assistance or use appropriate lifting equipment to lift this component or assembly.

⚠ WARNING ⚠

To reduce the possibility of personal injury, avoid direct contact of hot oil with your skin.

⚠ WARNING ⚠

Some state and federal agencies have determined that used engine oil can be carcinogenic and cause reproductive toxicity. Avoid inhalation of vapors, ingestion, and prolonged contact with used engine oil. If not reused, dispose of in accordance with local environmental regulations.

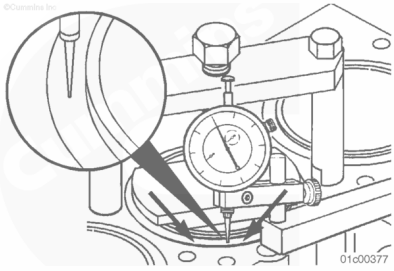
- Disconnect the batteries. See equipment manufacturer service information.
- Drain the cooling system. Refer to Procedure 008-018 in Section 8. (/qs3/pubsys2/xml/en/procedures/425/425-008-018-tr.html)
- Drain the lubricating oil. Refer to Procedure 007-037 in Section 7. (/qs3/pubsys2/xml/en/procedures/425/425-007-037.html)
- Remove the cylinder head. Refer to Procedure 002-004 in Section 2. (/qs3/pubsys2/xml/en/procedures/425/425-002-004.html)
- Remove the lubricating oil pan. Refer to Procedure 007-025 in Section 7. (/qs3/pubsys2/xml/en/procedures/425/425-007-025.html)
- Remove the lubricating oil suction tube. Refer to Procedure 007-035 in Section 7. (/qs3/pubsys2/xml/en/procedures/425/425-007-035.html)
- Remove the block stiffener plate. Refer to Procedure 001-089 in Section 1. (/qs3/pubsys2/xml/en/procedures/425/425-001-089.html)
- Remove the piston cooling nozzles. Refer to Procedure 001-046 in Section 1. (/qs3/pubsys2/xml/en/procedures/425/425-001-046.html)
- Remove the piston and connecting rod assemblies. Refer to Procedure 001-054 in Section 1. (/qs3/pubsys2/xml/en/procedures/425/425-001-054.html)

Initial Check

This repair procedure describes the method for machining the cylinder liner counterbore ledge using the Cylinder Block Counterbore Cutting Kit, Part Number 5299988. The tool is designed to be used for light clean-up cuts.

This procedure can be performed in or out of chassis.

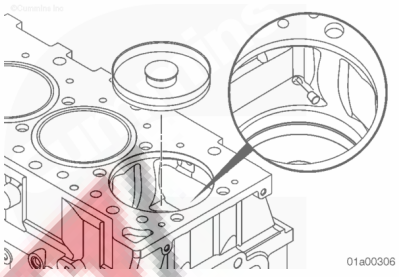
Liner protrusion should be checked and verified. Refer to Procedure 001-028 in Section 1. (/qs3/pubsys2/xml/en/procedures/425/425-001-028.html)



Remove the cylinder liner of the cylinder being cut. Refer to Procedure 001-028 in Section 1. (/qs3/pubsys2/xml/en/procedures/425/425-001-028.html)

Refer to the Cylinder Liner Counterbore Ledge Reuse Guidelines, Bulletin 4383753 (/qs3/pubsys2/xml/en/bulletin/4383753.html), to inspect the counterbore ledge surface areas for signs of pitting, fretting, or wear.

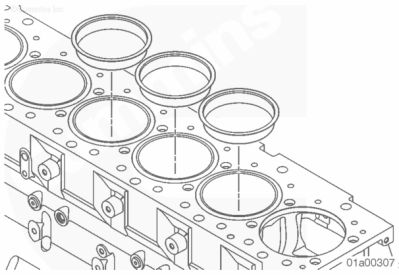
If fretting or wear is present on any cylinder, all six cylinders **must** be machined.



Machine

Cover the crankshaft, and plug any oil hole galleries and coolant passages to prevent machining chips from entering. Install cylinder bore plug, Part Number 5299991, into the cylinder bore.

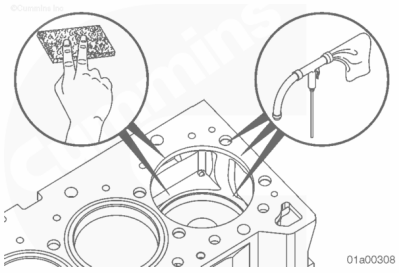
Install protective plug, Part Number 5299207, into the adjacent cylinders that are **not** being cut.



Make sure the top deck of the cylinder block is clean and free of burrs.

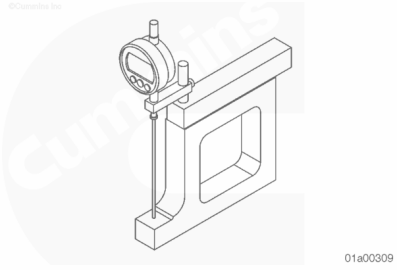
Use a medium grit stone, or equivalent, to clean the deck of the block and the counterbore ledge.

Vacuum and remove any debris from the deck of the block, counterbore ledge, and cylinder head capscrew holes.

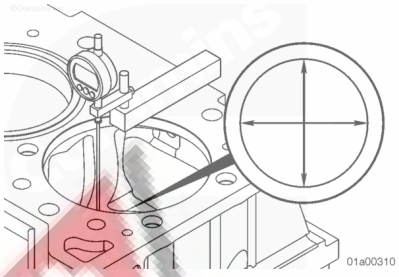


Zero the counterbore depth gauge assembly, Part Number 3164438, with the locating gauge, Part Number 5299989.

This will set the indicator to the original machining depth of 123 mm [4.843 in] from the cylinder deck to the counterbore ledge.

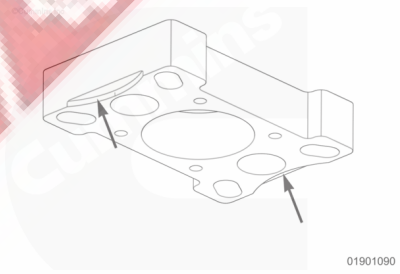


Measure the counterbore ledge in four locations in a crisscross pattern and mark the lowest point. Subtract the lowest number from the highest number. This is the minimum amount to be machined for clean-up to make the counterbore ledge even all the way around.



Use 30W non-detergent oil to lubricate the counterbore ledge cutter drive unit, Part Number 3163785. Fill the reservoir with 30W oil to maintain lubrication on the counterbore drive unit while machining the counterbore ledge. Assemble the mounting plate, Part Number 5299990, to the counterbore drive unit with the four hex key screws provided with the liner scallops facing down and tighten in a crisscross pattern.

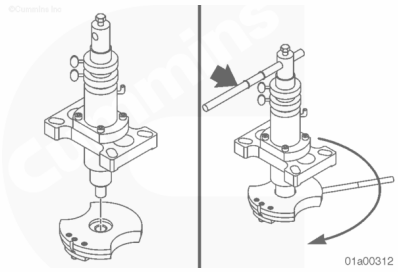
Torque Value: 27 n•m [239 in-lb]



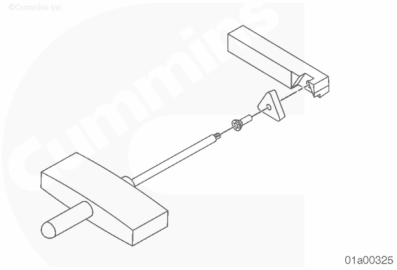
⚠ CAUTION ⚠

Make sure of proper installation of the counterbore cutter bit. Damage will occur if improperly installed.

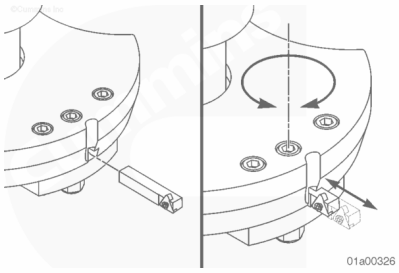
Install the cutter plate, Part Number 5299993, to the counterbore drive unit. Use the cutter plate holder to tighten securely. The hole in the side of the cutter plate accepts the holder.



Position the cutter bit insert so the tapered edge faces the cutter bit. Install the cutter bit screw into the center of the cutter bit insert. The cutter bit insert is machined to allow the cutter bit screw to be fully recessed. Tighten the screw, using the provided cutter bit wrench, until the insert is fully seated against the cutter bit. Loosen the screw and tighten it again until there is no visible air gap around the insert and the bit.



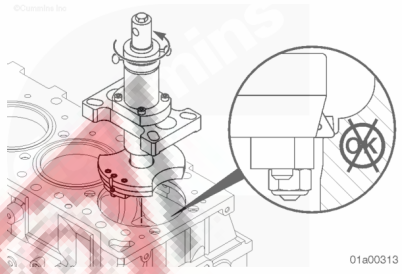
Install the cutter bit, Part Number 5296531, into the cutter plate. The cutter bit must be installed with the part number facing to the left and the cutting edge facing to the left, as viewed from the bottom of the cutter plate. Make sure of proper installation of the cutter bit, as damage will occur if improperly installed.



Fully retract the cutter bit using the provided hex key wrench. Make sure the cutter bit can extend and retract freely.

Make a paint pen mark on the counterbore ledge. This will indicate the machined area during the repair.

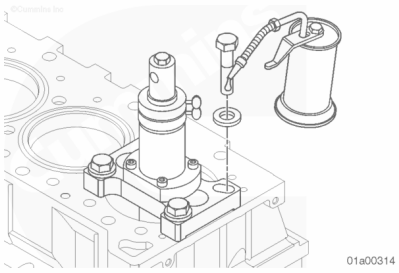
Position the counterbore ledge cutter unit into the cylinder bore by backing off the upper depth set collar and lower depth set collar in a **counterclockwise** direction.



This will allow the counterbore ledge cutting plate to lower and center itself on the counterbore ledge.

Care **must** be taken to verify that the base plate of the counterbore ledge cutting tool is positioned flat on the deck surface of the cylinder block, and the cutting plate is centered into the counterbore ledge with no side-to-side movement.

Secure the base plate to the cylinder block with the capscrews, special washers, and spacers included with the tool. Capscrews need to be lubricated with engine oil, installed hand-tight, and then tightened in a crisscross pattern.



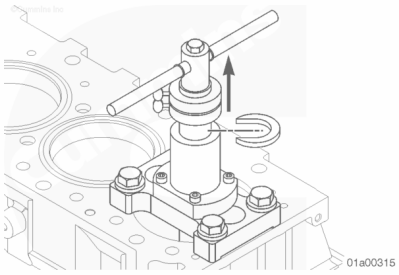
Torque Value: 67 n•m [49 ft-lb]

Install the T-handle onto the counterbore ledge cutter unit and adjust the lower stop collar in a **clockwise** rotation 0.127 mm [0.005 in] (each graduation on the collar is 0.025 mm [0.001 in]) to raise the cutter plate off the counterbore ledge and rotate the tool **clockwise**. Tighten the lower stop collar thumbscrew after every adjustment. No contact should be made with the counterbore ledge.

Note : If adequate clearance is **not** available, a 1/2 inch drive ratchet and 15/16 inch socket can be used in place of the T-handle for counterbore drive unit rotation.

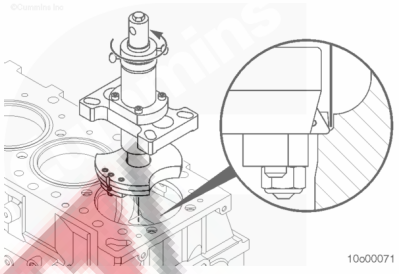
Raise the counterbore ledge cutter by grasping the T-handle and pulling in an upward motion.

Install the depth set collar (C-spacer) below the lower depth set collar and lower the tool until it makes contact with the depth set collar.



⚠ CAUTION ⚠

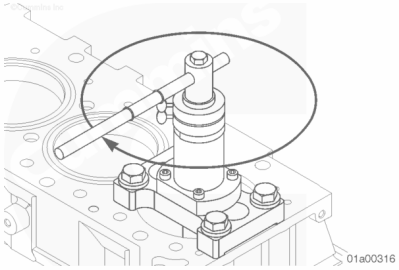
Make sure the cutter bit does not contact the step machined into the counterbore ledge. Damage to the cylinder block will occur during machining if the cutter bit is contacting the step.



Install a 0.812 mm [0.032 in] feeler gauge between the counterbore ledge wall and the cutter bit. This will make sure that the cutter bit does **not** make contact with the step machined into the counterbore ledge.

Extend the cutter bit with the hex key wrench installed in the friction screw until the cutter bit makes contact with the feeler gauge. Lock the bit down by tightening the two cutter bit hold-down capscrews with the hex key wrench.

Note : If adequate clearance is **not** available, a 1/2 inch drive ratchet and 15/16 inch socket can be used in place of the T-handle for counterbore drive unit rotation. The ratchet handle should initially be positioned so that it is directly above the cutter bit or as closely behind it as possible.



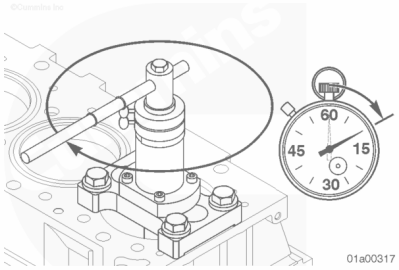
Rotate the counterbore ledge cutter unit **clockwise** for 360 degrees. A slight noise may be heard.

Lower the counterbore ledge cutter unit by adjusting the lower depth set collar in a **counterclockwise** rotation, until the cutter bit makes contact with the counterbore ledge. Raise the counterbore cutter unit 0.127 mm [0.005in] by adjusting the lower depth set collar in a **clockwise** direction.

Tighten the lower depth set collar thumbscrew. Rotate the counterbore ledge cutter unit **clockwise** for 360 degrees. No noise should be heard.

Loosen the two cutter bit hold down capscrews with the hex key wrench and extend the cutter bit until it makes contact with the counterbore ledge wall. Lock the cutter bit.

Lower the counterbore ledge cutter unit by 0.025 mm [0.001 in] at a time, while rotating the unit 360 degrees **clockwise** by adjusting the lower depth set collar in a **counterclockwise** rotation until it makes contact with the counterbore ledge.

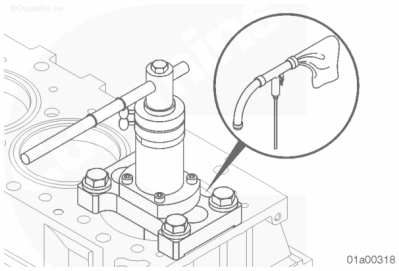


With the cutter bit making full contact with the counterbore ledge, rotate the counterbore ledge cutter unit 360 degrees **clockwise** to clean up the counterbore ledge. Observe the change made to the paint pen mark to confirm correct cutter bit extension.

Note : If adequate clearance is **not** available, a 1/2 inch drive ratchet and 15/16 inch socket can be used in place of the T-handle for counterbore drive unit rotation. The ratchet handle should initially be positioned so that it is directly above the cutter bit or as closely behind it as possible.

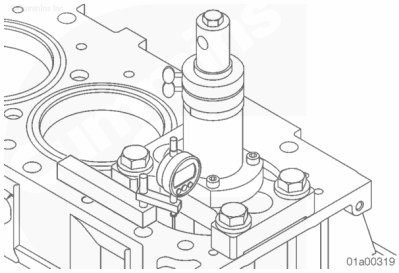
Note : Care **must** be taken to maintain consistent downward pressure on the top of the T-handle or ratchet head during the cutting portion of the stroke. Each 360 degree revolution should take at least 10 seconds. Any deviation in speed will result in chatter on the counterbore ledge.

Remove any chips on the counterbore ledge with a chip removing unit, Part Number 3823461.



With the counterbore depth dial indicator, Part Number 3164438, measure the depth of the counterbore ledge. This will determine what the final cut depth will be.

Note : Counterbore ledge machining should **not** exceed the thickness of the largest available shim.



Adjust the upper depth set collar **counterclockwise** to the final depth cut.

Example: If cutting 0.127 mm [0.005 in], adjust the upper depth set collar to contact the lower depth step collar and then back it off 0.127 mm [0.005 in].

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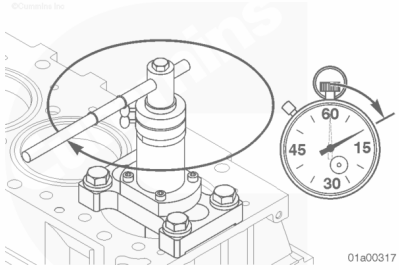
Adjust the lower depth set collar **counterclockwise** 0.025 mm [0.001 in] at a time until the final cut is reached. Tighten the thumbscrew after each adjustment. A cut is complete when the lower depth set collar is firmly contacting the c-ring.

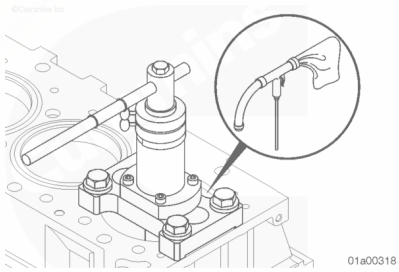


Rotate the counterbore ledge cutter unit **clockwise** with the T-handle positioned so the long portion of the handle is directly above the cutter bit.

Note : If adequate clearance is **not** available, a 1/2 inch drive ratchet and 15/16 inch socket can be used in place of the T-handle for counterbore drive unit rotation. The ratchet handle should initially be positioned so that it is directly above the cutter bit or as closely behind it as possible.

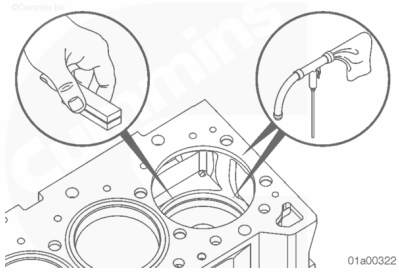
Note : Care **must** be taken to maintain consistent downward pressure on the top of the T-handle or ratchet head during the cutting portion of the stroke. Each 360 degree revolution should take at least 10 seconds. Any deviation in speed will result in chatter on the counterbore ledge.

The counterbore ledge **must** be vacuumed out before each measurement.



Note : It is recommend stopping with 0.025 mm [0.001 in] left to cut and take one final measurement to verify the cutting depth.

Adjust the lower depth set collar by rotating it **clockwise** to raise the cutter plate off the counterbore ledge.



Loosen the two cutter bit hold-down capscrews with the hex key wrench and retract the cutter bit into the cutter plate.

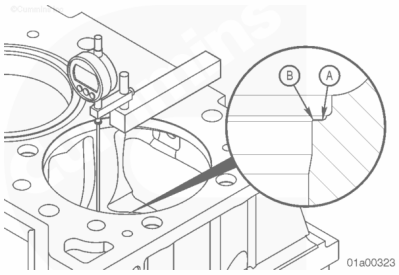
Remove the capscrews that secured the counterbore ledge cutter unit to the deck of the cylinder block and remove the tool from the engine.

Clean any machined chips from the counterbore chip catcher, counterbore ledge, and the deck of the cylinder block. Use a medium grit stone, or equivalent, to clean up the leading edge of the counterbore ledge.

With the counterbore depth gauge assembly, Part Number 3164438, measure the depth of the counterbore ledge and the ledge angle in four places.

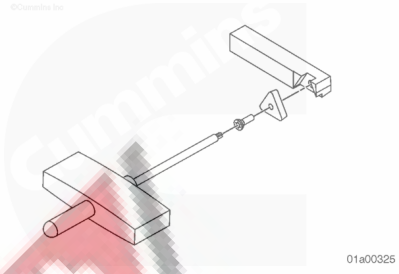
The four measurements **must not** vary more than 0.025 mm [0.001 in]. If the measurements exceed the specifications, the counterbore ledge **must** be machined again.

Dimension A should be 0.0127 mm [0.0005 in] lower or equal to Dimension B.



Remove the chip catcher and any oil gallery or coolant passage plugs that were installed.

Inspect the counterbore seating area for cracking using Crack Detection Kit, Part Number 3375432, or equivalent. If there are any cracks present, the block counterbore ledges may be machined to the next shim thickness, if a thicker shim is offered.

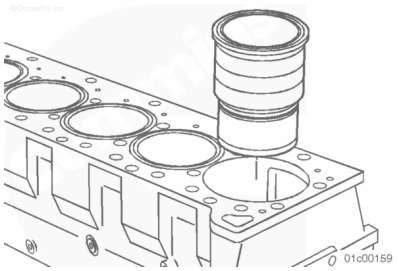


Note : Do **not** remove more material from the counterbore ledge than can be made up with the present shims offered.

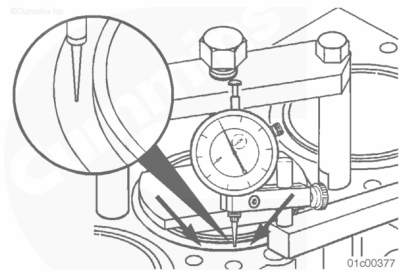
If the counterbore ledge machining is repeated, recheck the seating area for cracking, using Crack Detection Kit, Part Number 3375432, or equivalent. If cracks are still present, the cylinder block will need to be replaced.

Install a hardened bronze shim, Part Number 3924445, 3924446, 3924447, 3924448, or 3924449, into the cylinder that was cut. Do **not** stack shims.

Install a new cylinder liner into the cylinder that was cut. Refer to Procedure 001-028 in Section 1. (/qs3/pubsys2/xml/en/procedures/425/425-001-028.html)



Liner protrusion needs to be checked and verified. Refer to Procedure 001-028 in Section 1. (/qs3/pubsys2/xml/en/procedures/425/425-001-028.html)



ANADOLU ISUZU
PARTS

Finishing Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

⚠ WARNING ⚠

This component or assembly weighs greater than 23 kg [50 lb]. To prevent serious personal injury, be sure to have assistance or use appropriate lifting equipment to lift this component or assembly.

- Install the piston and connecting rod assemblies. Refer to Procedure 001-054 in Section 1. (/qs3/pubsys2/xml/en/procedures/425/425-001-054.html)
- Install the piston cooling nozzles. Refer to Procedure 001-046 in Section 1. (/qs3/pubsys2/xml/en/procedures/425/425-001-046.html)
- Install the block stiffener plate. Refer to Procedure 001-089 in Section 1. (/qs3/pubsys2/xml/en/procedures/425/425-001-089.html)
- Install the lubricating oil suction tube. Refer to Procedure 007-035 in Section 7. (/qs3/pubsys2/xml/en/procedures/425/425-007-035.html)
- Install the lubricating oil pan. Refer to Procedure 007-025 in Section 7. (/qs3/pubsys2/xml/en/procedures/425/425-007-025.html)
- Install the cylinder head. Refer to Procedure 002-004 in Section 2. (/qs3/pubsys2/xml/en/procedures/425/425-002-004.html)
- Fill the cooling system. Refer to Procedure 008-018 in Section 8. (/qs3/pubsys2/xml/en/procedures/425/425-008-018-tr.html)
- Fill the engine with lubricating oil. Refer to Procedure 007-037 in Section 7. (/qs3/pubsys2/xml/en/procedures/425/425-007-037.html)
- Connect the batteries. See equipment manufacturer service information.
- Operate the engine. Check for leaks.

Select Service Tools

Recommended Cummins® Service Tools

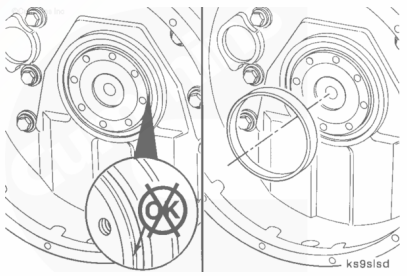
- Rear seal/sleeve installer, Part Number 3824078

Additional Service Items

- Dull chisel
- Hammer
- Crocus cloth
- Loctite® 262 or 271

Initial Check

If the crankshaft seal has worn a groove in the crankshaft flange, a wear sleeve **must** be installed to prevent oil leakage.



Preparatory Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

- Disconnect the batteries. See equipment manufacturer service information.
- If equipped with a wet flywheel housing, drain the oil from the flywheel housing by removing the plug in the bottom of the flywheel housing.
- Remove the starting motor. Refer to Procedure 013-020 in Section 13. (/qs3/pubsys2/xml/en/procedures/425/425-013-020-tr.html)

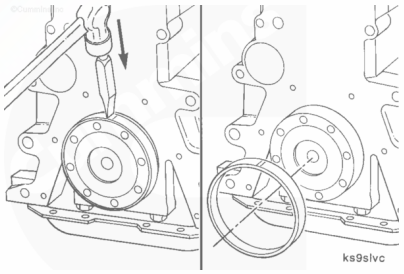
ANADOLU ISUZU AFTER SALES

- Remove the transmission and all related components, if equipped. See equipment manufacturer service information.
- Remove the flywheel. Refer to Procedure 016-005 in Section 16. (/qs3/pubsys2/xml/en/procedures/425/425-016-005.html)
- Remove the flexplate. Refer to Procedure 016-004 in Section 16. (/qs3/pubsys2/xml/en/procedures/425/425-016-004.html)
- Remove any components attached by the original equipment manufacturer (OEM) to the flywheel housing (e.g., mufflers, shift mechanisms, air filters, and so forth). See equipment manufacturer service information.
- Remove the flywheel housing. Refer to Procedure 016-006 in Section 16. (/qs3/pubsys2/xml/en/procedures/425/425-016-006.html)
- Loosen the lubricating oil pan mounting capscrews four revolutions.
- Remove the crankshaft seal carrier and rear seal. Refer to Procedure 001-104 in Section 1. (/qs3/pubsys2/xml/en/procedures/425/425-001-104.html)

Remove

⚠ CAUTION ⚠

Do not nick or gouge the crankshaft with the chisel. If the crankshaft is damaged, it must be replaced.



Note : This step is **only** if a wear sleeve was previously installed.

Use a dull chisel **only** as wide as the wear sleeve.

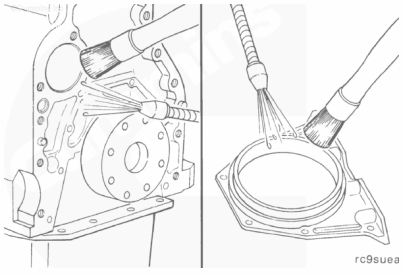
Make one or two soft blows with a hammer to make chisel marks across the wear sleeve. This will expand the wear sleeve allowing the sleeve to be removed.

Clean and Inspect for Reuse

Clean the gasket surface of the cylinder block and rear cover.

Remove any rust or other deposits from the crankshaft flange. Use a crocus cloth.

Clean the crankshaft flange. Use a clean cloth.



Inspect the crankshaft flange for dirt or nicks.

Inspect the rear cover for cracks or other damage.

Install

Note : The oil seal **must** be installed with the lip of the oil seal and crankshaft clean and dry to make sure of proper oil sealing.

Clean any lubricant from the lip of the oil seal and crankshaft.

The combination crankshaft oil seal (A) wear sleeve (B) replacement kit for service usage is installed on the crankshaft as an assembly. The crankshaft rear oil seal should **not** be removed from the crankshaft rear seal wear sleeve.

Note : If the oil pan is installed, loosen the oil pan capscrews to allow clearance for rear cover and gasket clearance.

Note : Use the following procedure if the oil pan gasket was damaged during removal of the rear seal carrier and for the techique to replace the oil pan gasket. Refer to Procedure 001-104 in Ssection 1. (/qs3/pubsys2/xml/en/procedures/425/425-001-104.html)

Install the rear crankshaft seal carrier and gasket. Apply Loctite® 262 or 271. Loosely tighten the rear seal carrier mounting capscrews at this time.

The seal installation is being used to properly align the rear cover. Do **not** push or force the cover in any direction to prevent irregular seal lip position after seal installation.

The oil seal for the flywheel housing requires mild soap solution on the outside diameter of the seal case.

Install oil seal/wear sleeve assembly. Use rear seal/sleeve installer, Part Number 3824078. Install two (2) threaded studs into the crankshaft capscrew holes.

Apply a small amount of clean engine oil to the crankshaft, threaded studs, and inside diameter of the crankshaft rear seal/wear sleeve installation tool.

Position the chamfered end of the wear sleeve (A) onto the end of the crankshaft (B).

Position the counterbore end of installation tool (C) over threaded studs and align with wear sleeve, perpendicular to the end of the crankshaft.

Install the washers (D) and nuts (E) onto the threaded studs.

Alternately tighten the nuts until the installation tool contacts the end of the crankshaft.

Do **not** exceed ½ revolution on each nut to prevent wear sleeve binding and irregular stretch.

Torque Value: 20 n•m [180 in-lb]

Remove the installation tool and threaded studs.

Align the rear cover even with both sides of the oil pan rail on the cylinder block.

Tighten the rear carrier capscrews.

Torque Value: 13 n•m [115 in-lb]

Install the four (4) rear oil pan mounting capscrews to the pan.

Tighten the oil pan capscrews. Refer to Procedure 007-025 in Section 7. (/qs3/pubsys2/xml/en/procedures/425/425-007-025.html)

Finishing Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

- Install the flywheel housing. Refer to Procedure 016-006 in Section 16. (/qs3/pubsys2/xml/en/procedures/425/425-016-006.html)
- Install the flexplate. Refer to Procedure 016-004 in Section 16. (/qs3/pubsys2/xml/en/procedures/425/425-016-004.html)
- Install the flywheel. Refer to Procedure 016-005 in Section 16. (/qs3/pubsys2/xml/en/procedures/425/425-016-005.html)
- Install the starting motor. Refer to Procedure 013-020 in Section 13. (/qs3/pubsys2/xml/en/procedures/425/425-013-020-tr.html)
- Install the transmission and all related components, if equipped. See equipment manufacturer service information.
- If equipped with a wet flywheel housing, fill the flywheel housing with oil. See equipment manufacturer service information.
- If previously removed, install any components attached by the OEM to the flywheel housing (e.g., mufflers, shift mechanisms, air filters, and so forth.) to the flywheel housing. See equipment manufacturer service information.
- Connect the batteries. See equipment manufacturer service information.
- Operate the engine. Check for leaks.

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Last Modified: 14-Sep-2016

Select Service Tools

Recommended Cummins® Service Tools

- Contact cleaner, Part Number 3824510

Additional Service Items

- No additional service items required.

Preparatory Steps

⚠ WARNING ⚠

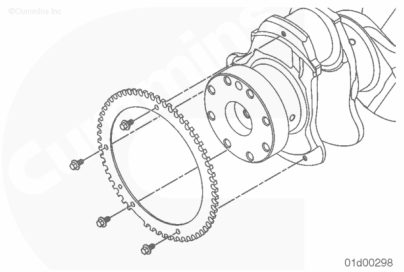
Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

- Disconnect the batteries. See equipment manufacturer service information.
- Remove the crankshaft. Refer to Procedure 001-016 in Section 1. (/qs3/pubsys2/xml/en/procedures/425/425-001-016.html)

Remove

Note : The capscrews are one-time use **only**. They can **not** be used again.

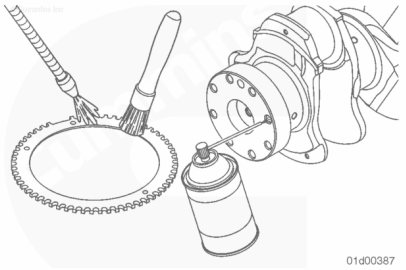
Remove and discard the four crankshaft speed indicator ring mounting capscrews.



Clean and Inspect for Reuse

⚠ WARNING ⚠

When using solvents, acids, or alkaline materials for cleaning, follow the manufacturer's recommendations for use. Wear goggles and protective clothing to reduce the possibility of personal injury.



⚠ WARNING ⚠

Some solvents are flammable and toxic. Read the manufacturer's instructions before using.

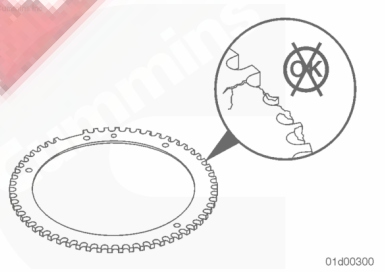
Clean any oil from the speed indicator ring.

Clean the capscrew holes in the crankshaft. Use degreaser solvent such as contact cleaner, Part Number 3824510.

Inspect the speed indicator ring for missing, bent, or damaged teeth.

Inspect for cracks or damaged surfaces.

If any visual damage is found, the speed indicator ring **must** be replaced.



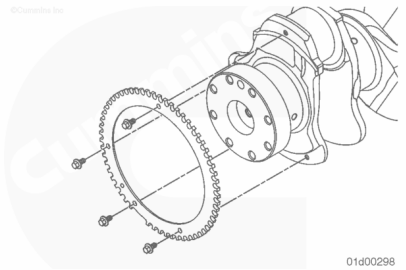
Install

Install the speed indicator ring.

Install new capscrews.

Tighten the capscrews in an alternating pattern.

Torque Value: 8 n•m [71 in-lb]



Finishing Steps

⚠ WARNING ⚠

ANADOLU ISUZU AFTER SALES

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

- Connect the batteries. See equipment manufacturer service information.
- Install the crankshaft. Refer to Procedure 001-016 in Section 1. (/qs3/pubsys2/xml/en/procedures/425/425-001-016.html)
- Operate the engine. Check for leaks and proper operation.

Last Modified: 25-Jul-2016

ANADOLU ISUZU AFTER SALES

Select Service Tools

Recommended Cummins® Service Tools

- No Cummins® Service Tools required.

Additional Service Items

- No additional service items required.

General Information

The block stiffener plate will **only** be found on some engines.

Preparatory Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

⚠ WARNING ⚠

To reduce the possibility of personal injury, avoid direct contact of hot oil with your skin.

⚠ WARNING ⚠

Some state and federal agencies have determined that used engine oil can be carcinogenic and cause reproductive toxicity. Avoid inhalation of vapors, ingestion, and prolonged contact with used engine oil. If not reused, dispose of in accordance with local environmental regulations.

- Disconnect the batteries. See equipment manufacturer service information.
- Drain the lubricating oil. Refer to Procedure 007-037 in Section 7. (/qs3/pubsys2/xml/en/procedures/425/425-007-037.html)

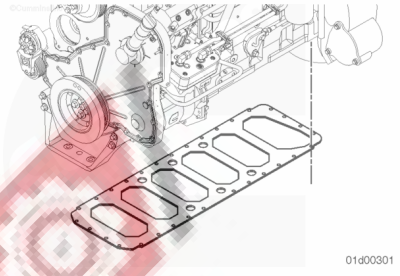
ANADOLU ISUZU GENUINE PARTS

- Remove the lubricating oil pan. Refer to Procedure 007-025 in Section 7. (/qs3/pubsys2/xml/en/procedures/425/425-007-025.html)
- Remove the lubricating oil suction tube. Refer to Procedure 007-035 in Section 7. (/qs3/pubsys2/xml/en/procedures/425/425-007-035.html)

Remove

Remove the block stiffener plate.

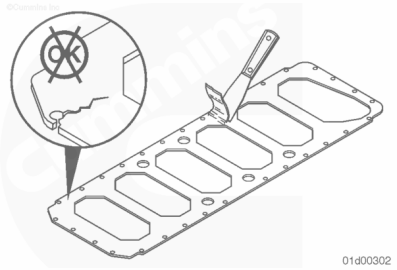
Note : The plate will be loose after the oil pan capscrews are removed.



Clean and Inspect for Reuse

Remove all gasket material from both gasket surfaces.

Inspect the block stiffener plate for cracks or other damage.

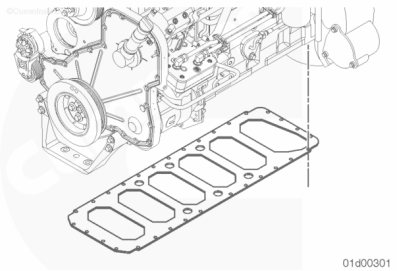


Install

Install the block stiffener plate. Use a new gasket and/or RTV sealant.

Note : The engines use a variety of combinations of gaskets and/or RTV sealant. When installing the oil pan and block stiffenter plate, use the same combination of gaskets and/or RTV sealant.

Note : The block stiffener **must** be held in place while the lubricating oil suction tube is installed. Use a few lubricating oil pan capscrews or wire ties to accomplish this.



ANADOLU ISUZU AFTER SALES

Finishing Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

- Install the lubricating oil suction tube. Refer to Procedure 007-035 in Section 7. (/qs3/pubsys2/xml/en/procedures/425/425-007-035.html)
- Install the lubricating oil pan. Refer to Procedure 007-025 in Section 7. (/qs3/pubsys2/xml/en/procedures/425/425-007-025.html)
- Fill the engine with lubricating oil. Refer to Procedure 007-037 in Section 7. (/qs3/pubsys2/xml/en/procedures/425/425-007-037.html)
- Connect the batteries. See equipment manufacturer service information.
- Operate the engine. Check for leaks.

ANADOLU ISUZU AFTER SALES

Last Modified: 25-Jul-2016

Select Service Tools

Recommended Cummins® Service Tools

- Contact cleaner, Part Number 3824510, or equivalent

Additional Service Items

- No additional service items required.

Initial Check

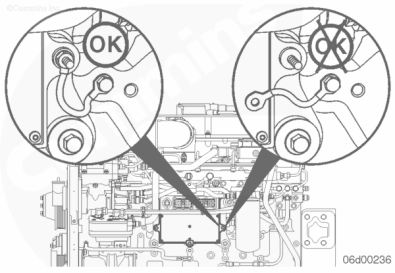
The engine control module (ECM) mounting plate assembly provides a vibration isolated mounting location for the ECM. The mounting plate also incorporates the fuel lift pump. A check valve at the outlet port in the ECM mounting plate makes sure the fuel system is primed while the fuel lift pump is running.

Check the ECM mounting plate for damaged vibration isolators, loose capscrews, or fuel leaks.

Make sure the ground strap is properly installed. A missing or poorly connected ground strap can cause intermittent engine performance problems.

The ground strap **must** be connected between the head of the ECM mounting bolt and the ECM.

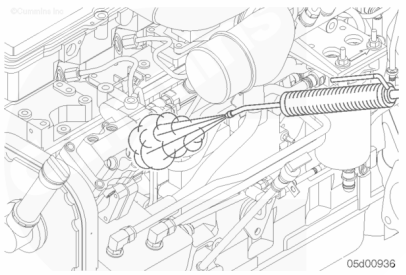
The ground strap **must** be connected to an unpainted block surface free of corrosion.



Preparatory Steps

⚠ WARNING ⚠

Fuel is flammable. Keep all cigarettes, flames, pilot lights, arcing equipment, and switches out of the work area and areas sharing ventilation to reduce the possibility of severe personal injury or death when working on the fuel system.



⚠ WARNING ⚠

Wear appropriate eye and face protection when using compressed air. Flying debris and dirt can cause personal injury.

⚠ WARNING ⚠

When using a steam cleaner, wear safety glasses or a face shield, as well as protective clothing. Hot steam can cause serious personal injury.

⚠ CAUTION ⚠

Clean all fittings before disassembly. Dirt or contaminants can damage the fuel system.

Before servicing **any** fuel system components, (such as fuel lines, fuel pump, injectors, etc.) which would expose the fuel system or internal engine component to potential contaminants prior to disassembly, clean the fittings, mounting hardware, and the area around the component to be removed. Dirt or contaminants can be introduced into the fuel system and engine if the surrounding areas are **not** cleaned, resulting in damage to the fuel system and engine.

- Clean the engine. Refer to Procedure 000-009 in Section 0. (/qs3/pubsys2/xml/en/procedures/99/99-000-009.html) Refer to Procedure 204-008 in Section i. (/qs3/pubsys2/xml/en/procedures/99/99-204-008.html)
- Use contact cleaner, Part Number 3824510, or equivalent, to thoroughly clean all fuel lines before removal from the engine. Clean the connector fittings to remove as much debris as possible. It is very important extra care is taken to keep the fuel connections clean during removal and installation. Refer to Procedure 204-008 in Section i. (/qs3/pubsys2/xml/en/procedures/99/99-204-008.html)
- Make sure debris, water, steam, or cleaning solution does **not** get inside the fuel system.

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce

the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

⚠ WARNING ⚠

Fuel is flammable. Keep all cigarettes, flames, pilot lights, arcing equipment, and switches out of the work area and areas sharing ventilation to reduce the possibility of severe personal injury or death when working on the fuel system.

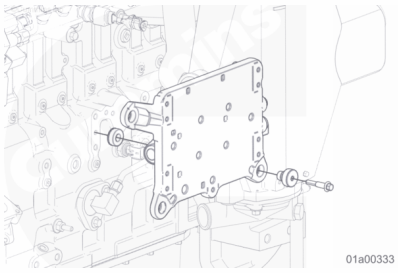
- Disconnect the batteries. See equipment manufacturer service information.
- Shut off the fuel supply and drain valves. See equipment manufacturer service information.
- Disconnect the rail fuel pressure sensor from the engine wiring harness. Refer to Procedure 019-115 in Section 19. (/qs3/pubsys2/xml/en/procedures/425/425-019-115.html)
- Disconnect the ECM ground strap.
- Disconnect the engine harness from the electric priming pump.
- Disconnect the fuel supply lines. Refer to Procedure 006-024 in Section 6. (/qs3/pubsys2/xml/en/procedures/425/425-006-024.html)
- Remove the ECM from the ECM mounting plate. Refer to Procedure 019-031 in Section 19. (/qs3/pubsys2/xml/en/procedures/425/425-019-031.html)

ANADOLU ISUZU GENUINE SALES

Remove

Note : The electric fuel priming pump and priming pump fuel lines will be attached to the ECM mounting plate while the mounting plate is being removed.

Remove the ECM mounting plate capscrews and ECM mounting plate from the engine block.



Disassemble

Remove the following components from the ECM mounting plate:

- Male banjo quick disconnect fitting
- Male banjo check valve fitting
- Fuel lift pump supply lines
- Fuel lift pump brackets
- Fuel lift pump.

Inspect for Reuse

Inspect the ECM mounting plate for leaks.

Replace any damaged vibration isolators.

Inspect for leaks in the electric fuel supply pump priming circuit. Look for cracked fuel tubes, damaged o-rings, or damaged seal washers.

Inspect the check valve for debris or damage.

Assemble

Install the electric fuel priming pump and priming circuit fuel lines. Refer to Procedure 005-045 in Section 5. (/qs3/pubsys2/xml/en/procedures/425/425-005-045.html)

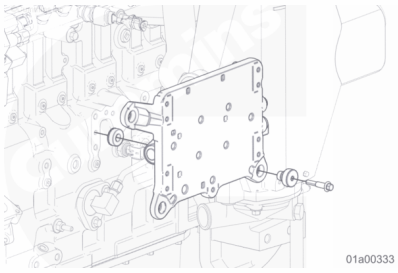
Make sure the lines are supported while tightening the banjo screws. The lines **must not** be permitted to bind.

Be sure the ECM check valve is installed into the bottom (outlet) fitting of the ECM mounting plate.

Install

Install the ECM mounting plate assembly on the engine block. Tighten the capscrews.

Torque Value: 24 n•m [212 in-lb]



Finishing Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

⚠ CAUTION ⚠

Failure to properly install the ECM ground strap can cause intermittent engine symptoms including intermittent engine stalls. One end of the ground strap must be installed between the ECM housing and the head of the bottom most ECM mounting capscrew. The other end of the ground strap must be tightly bolted to an unpainted block surface free from corrosion.

Note : Make sure the vibrations isolators are installed correctly. The isolators fit in a single direction into the chamfered locators.

- Install the ECM on the ECM mounting plate. Refer to Procedure 019-031 in Section 19. (/qs3/pubsys2/xml/en/procedures/425/425-019-031.html)
- Install the suction fuel lines, if removed.
- Connect the fuel supply lines. Refer to Procedure 006-024 in Section 6. (/qs3/pubsys2/xml/en/procedures/425/425-006-024.html)
- Connect the engine harness to the electric fuel priming pump.
- Connect the ECM ground strap.
- Connect the harness connections to the ECM.
- Connect the batteries. See equipment manufacturer service information.
- Open the fuel supply valves, if equipped.
- Cycle the keyswitch. Allow the lift pump to operate for 30 seconds. Afterward, turn the keyswitch OFF and back ON again allowing the lift pump to operate again.
- Allow the lift pump to operate for three or four 30-second cycles before attempting to start the engine.
- Operate the engine. Check for leaks.

Last Modified: 25-Jul-2016



Select Service Tools

Recommended Cummins® Service Tools

- Abrasive pad, Part Number 3823258, or equivalent
- Sealant, Part Number 3164067, or equivalent
- Sealant, Part Number 3164070, or equivalent
- Guide, Centering, Part Number 5395409

Additional Service Items

- Feeler gauge or shim stock
- Fine crocus cloth
- Loctite™ 262 or 271
- Plastic hammer

Preparatory Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

⚠ WARNING ⚠

This component or assembly weighs greater than 23 kg [50 lb]. To prevent serious personal injury, be sure to have assistance or use appropriate lifting equipment to lift this component or assembly.

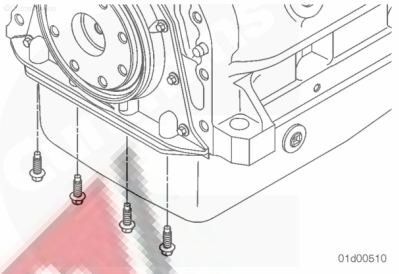
- Disconnect the batteries. See equipment manufacturer service information.
- If equipped with a wet flywheel housing, drain the oil from the flywheel housing by removing the plug in the bottom of the flywheel housing.
- Remove the starting motor. Reference Procedure 013-020 in Section 13.
- Remove the transmission and all related components, if equipped. See equipment manufacturer service information.
- Remove the flywheel, if equipped. Reference Procedure 016-005 in Section 16.
- Remove the flexplate, if equipped. Reference Procedure 016-04 in Section 16.
- Remove any components attached by the original equipment manufacturer (OEM) to the flywheel housing, such as mufflers, shift mechanisms, air filters, and so on. See

equipment manufacturer service information.
- Remove the flywheel housing. Reference Procedure 016-006 in Section 16.

Remove

⚠ CAUTION ⚠

Use extreme care when releasing the lubricating oil pan gasket from the rear cover to prevent damage to the gasket.



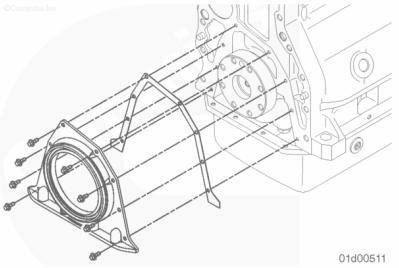
Remove the four lubricating oil pan mounting capscrews that secure the oil pan to the rear cover.

Insert the feeler gauge or shim stock between the rear cover and the oil pan gasket.

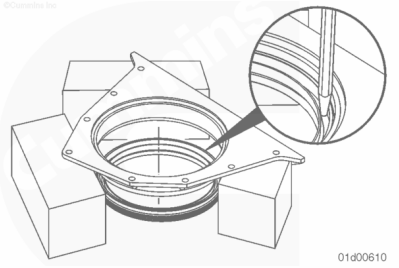
Move the feeler gauge back and forth to release the gasket from the rear cover.

Remove the capscrews from the rear cover.

Remove the cover from the crankshaft flange



Support the rear seal carrier on a flat work surface with wooden blocks. Use a suitable punch and hammer to drive the old seal out of the rear seal carrier.

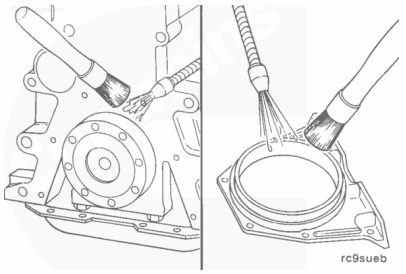


Clean and Inspect for Reuse

⚠ WARNING ⚠

ANADOLU ISUZU AFTER SALES

When using solvents, acids, or alkaline materials for cleaning, follow the manufacturer's recommendations for use. Wear goggles and protective clothing to reduce the possibility of personal injury.



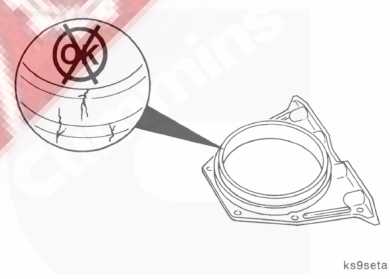
⚠ WARNING ⚠

Wear appropriate eye and face protection when using compressed air. Flying debris and dirt can cause personal injury.

Clean the gasket surface of the cylinder block and rear seal carrier with solvent.

Dry these areas with compressed air.

Inspect the rear seal carrier for cracks or other damage. Replace the rear seal carrier if any damage is found.



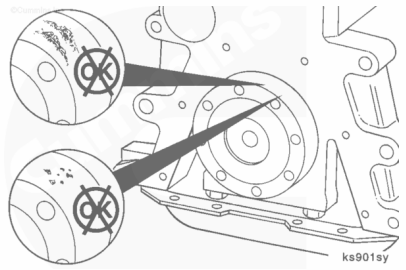
Use a fine crocus cloth to remove any rust or other deposits from the crankshaft flange.

Use a clean cloth and solvent to clean the crankshaft flange.

Inspect the crankshaft flange for nicks or burrs. Use an abrasive pad, Part Number 3823258 or equivalent, to remove any minor damage.

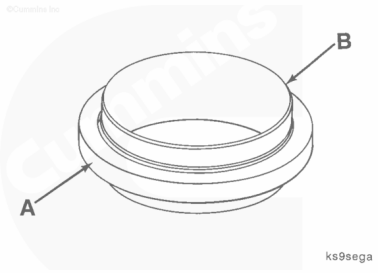
Note : If the cranksahft has excessive wear, a service wear sleeve is available.

For engines equipped with a lip style rear crankshaft seal, inspect the crankshaft seal contact area for a wear groove. If the groove is deeper than 0.25 mm [0.010 in], a wear sleeve and oversize seal **must** be used. Reference Procedure 001-067 in Section 1.



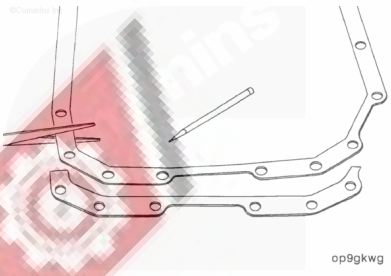
Install

Note : For engines equipped with a wet flywheel housing, make sure to replace the rear crankshaft seal with the correct rear seal. Rear crankshaft seals for wet and dry flywheel housings may **not** be the same.



The new rear crankshaft seal (A) will come installed on a seal pilot (B). The seal **must** be left on the seal pilot while installing the seal onto the nose of the crankshaft. This will keep the lips of the seal from being damaged during installation.

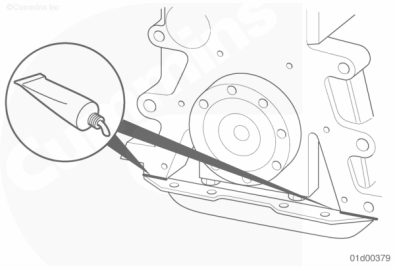
Service Tip:



If the oil pan gasket was damaged during removal of the real seal carrier, remove the damaged gasket and:

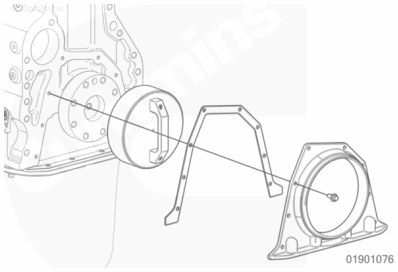
- If previously equipped with a paper oil pan gasket, use the old gasket as a pattern and cut a section of new gasket to the same size. Use a light coat of sealant, Part Number 3164067, or equivalent, to hold the gasket in place.
- If previously equipped with a sealant **only** oil pan gasket, apply a bead of sealant, Part Number 3164070, or equivalent, to the oil pan flange.
- If previously equipped with a suspended oil pan, the oil pan **must** be removed and a new gasket installed. Reference Procedure 007-025 in Section 7.

Note : It can be necessary to trim the rear seal carrier gasket so it is even with the oil pan mounting surface. Test fit the gasket prior to installing.



Apply a thin bead of sealant, Part Number 3164067, or equivalent, at the intersecting joint of the oil pan and cylinder block prior to installing the rear crankshaft seal carrier. The rear crankshaft seal carrier **must** be installed within 10 minutes of applying the sealant.

Install the crankshaft seal carrier using the centering guide, Part Number 5395409.



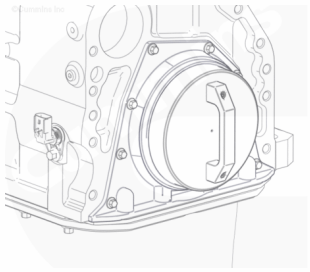
Use the centering guide tool to align the crankshaft seal carrier by using the end of the crankshaft as the pilot.

Install the rear crankshaft seal carrier and gasket. Apply Loctite® 262 or 271 to the mounting capscrews.

Loosely tighten the rear seal carrier to the block.

⚠ CAUTION ⚠

Do not push or force the cover in any direction. This can cause an irregular seal lip position after seal installation. An engine oil leak will result.

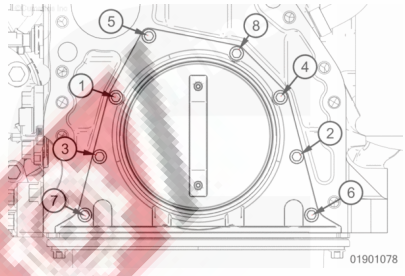


Align the rear cover even with both sides of the oil pan rail on the cylinder block.

Tighten the rear cover capscrews.

The chart below shows the proper torque value when using a 9.8 or a 10 9 grade bolt. The grade is embossed on the top of each bolt.

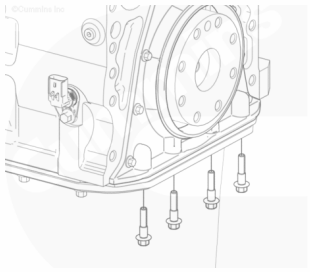
Apply Loctite® 262 or 271 to both part numbers below during installation.



Rear Seal Carrier				
Bolt Number	**Bolt Size**	**Bolt Class**	**Torque**	**Loctite®**
3913638	M-6	9.8	10 N•m [89 in-lb]	Yes
3991306	M-6	10.9	13 N•m [115 in-lb]	Yes

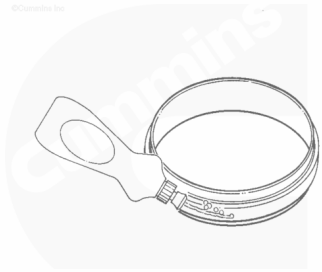
Install the four rear lubricating oil pan mounting capscrews into the rear cover.

Torque Value: 28 n•m [248 in-lb]

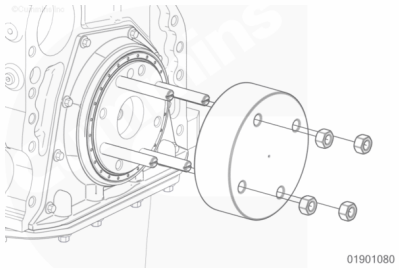


Remove the centering tool.

To aid in installation, the lubricating oil lip seal requires the application of a mild soap or P-80, Part Number 3824878, on the outside diameter of the seal.



Place the new rear crankshaft seal, with tapered end of the crankshaft seal pilot over the crankshaft nose, and slide it by hand toward the crankshaft seal carrier.



Remove the crankshaft seal pilot.

Use Rear Crankshaft Seal Installation Kit, Part Number 5395259, to install the rear crankshaft seal. Refer to Procedure 001-024 in Section 1. (/qs3/pubsys2/xml/en/procedures/100/100-001-024.html)

Finishing Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

- Install the flywheel, if equiped. Reference Procedure 016-005 in Section 16.
- Install the flexplate, if equipped. Reference Procedure 016-04 in Section 16.
- Install the starting motor. Reference Procedure 013-020 in Section 13.
- Install the transmission and all related components, if equipped. See equipment manufacturer service information.
- If equipped with a wet flywheel housing, fill the flywheel housing with oil. See equipment manufacturer service information.
- If previously removed, install any components attached by the OEM to the flywheel housing, such as mufflers, shift mechanisms, air filters, and so on. See equipment manufacturer service information.
- Connect the batteries. See equipment manufacturer service information.
- Operate the engine. Check for proper operation.

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Last Modified: 27-Aug-2018

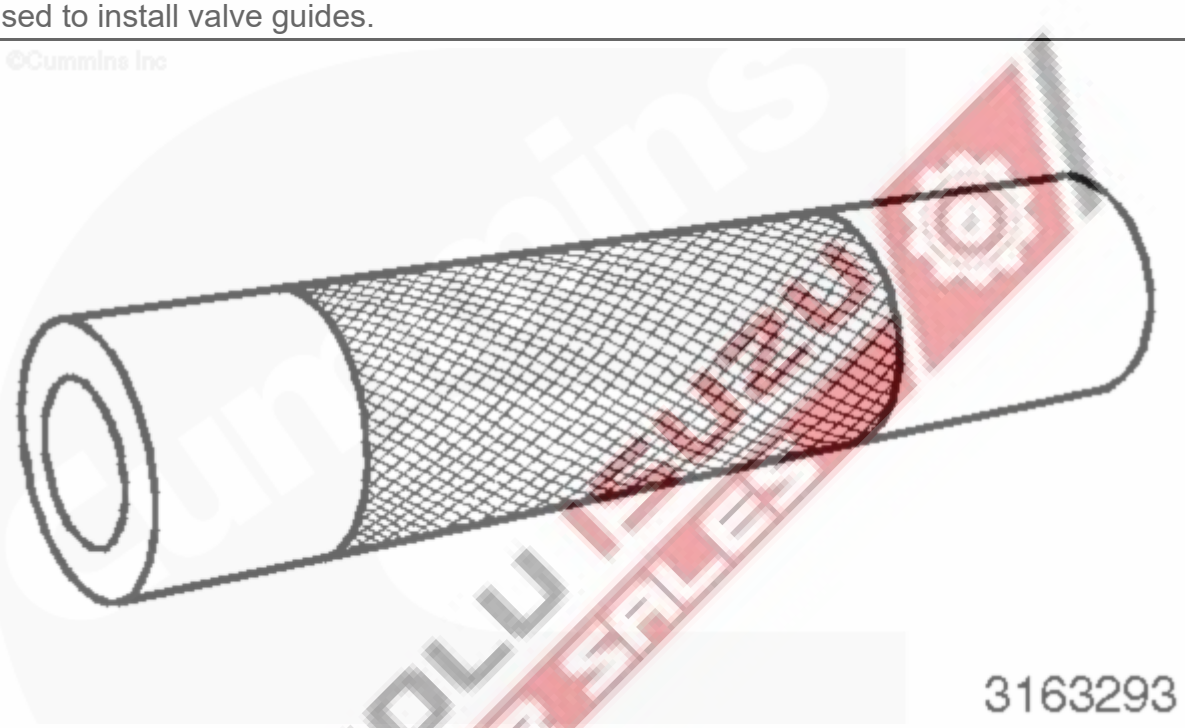
Cylinder Head

Tool Number

3163100

Valve Guide Installer

Used to install valve guides.

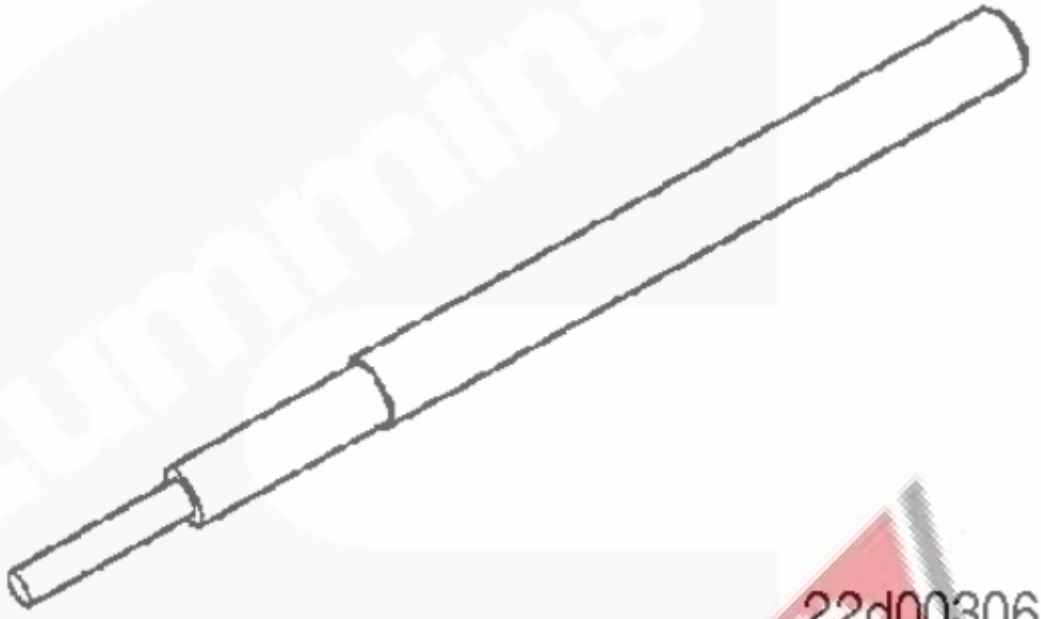


Tool Number

3163101

Valve Guide Remover

Used to remove valve guides.

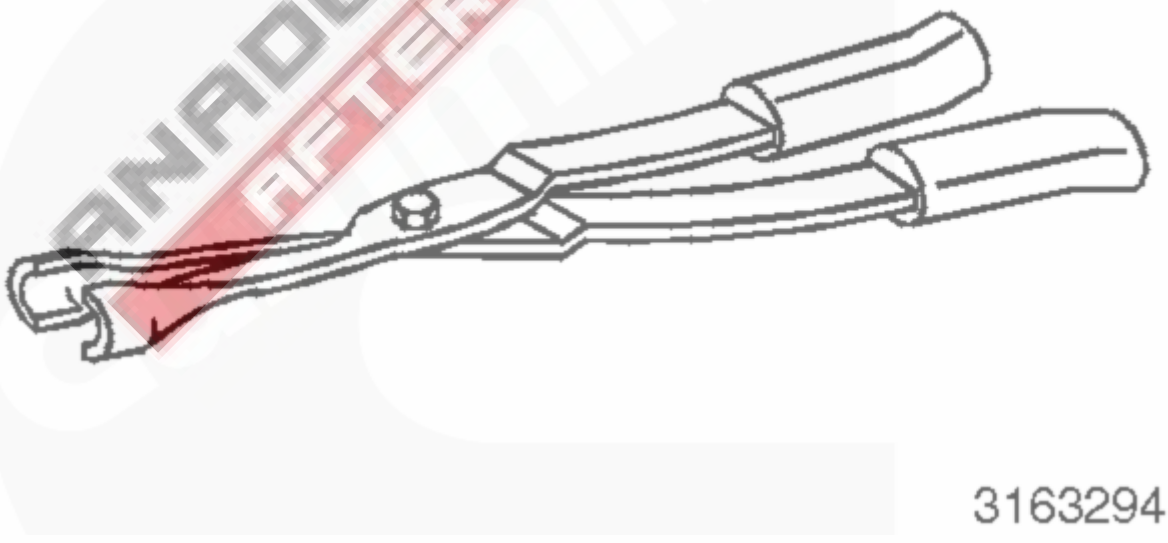


Tool Number

3163293

Boot Pliers

Used to remove valve stem seals. The twist and pull action frees the boot and the serrated jaws provide a secure grip.

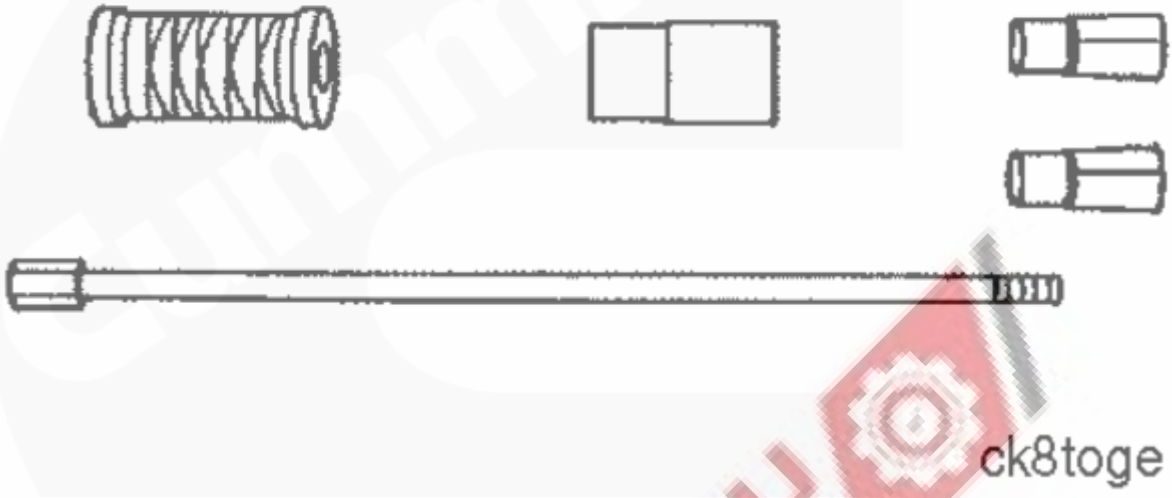


Tool Number

3163720

Dowel Pin Extractor

This puller contains various sized collets to remove crosshead guides or dowels throughout the engine.



Tool Number

3164087

Assembly Lubricant

This is a multi purpose anti-seize lubricant. This is an all purpose anti-seize lubricant that speeds assembly and disassembly of studs, bolts, capscrews, flanges and fittings.



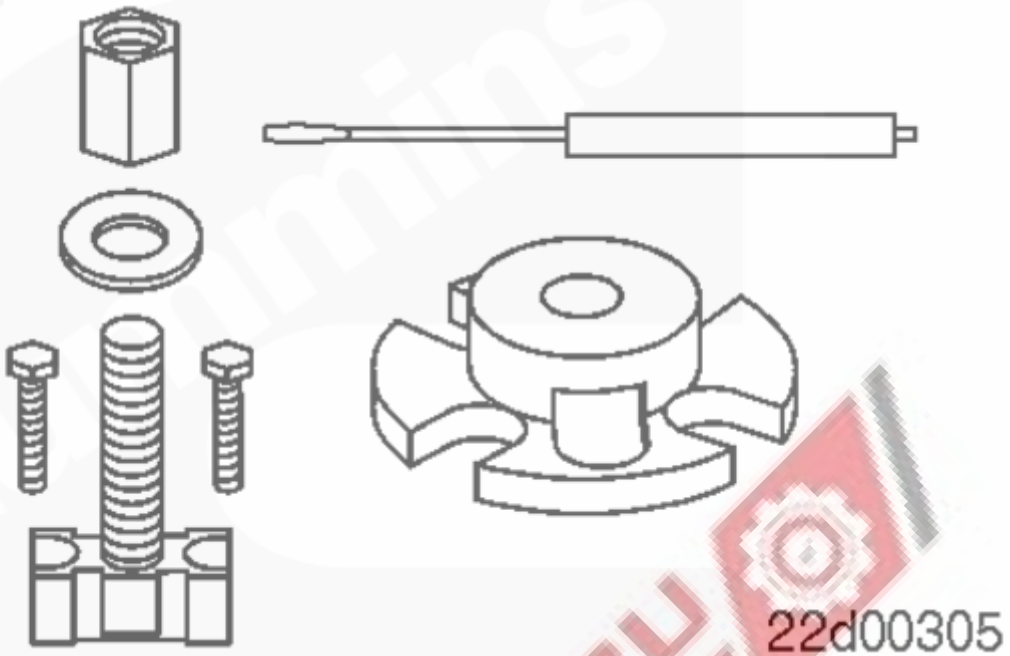
SP000786

Tool Number

3164329

Valve Spring Compressor

Used to remove and install valve collets.

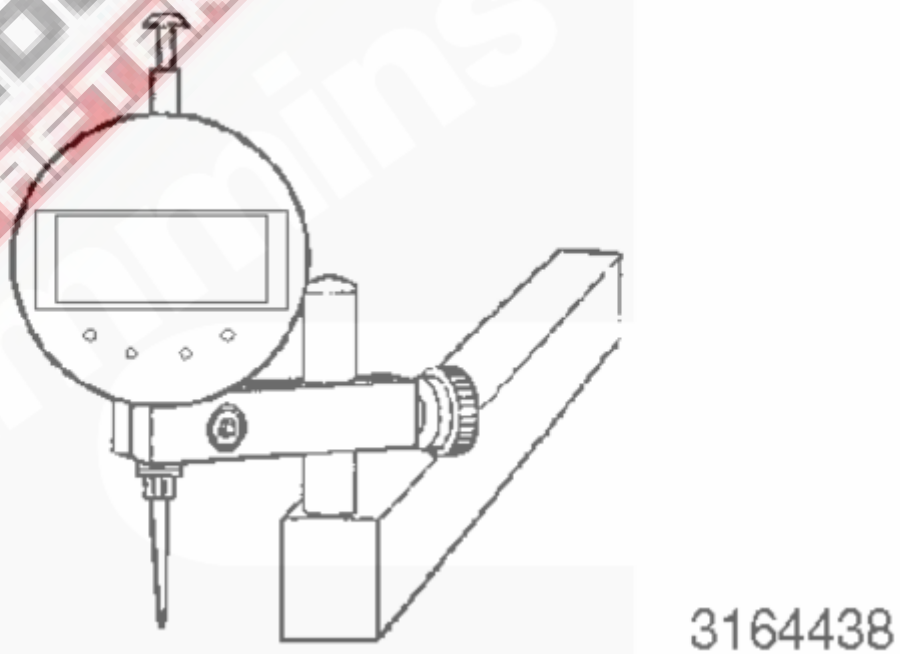


Tool Number

3164438

Depth Gauge Assembly

Used to measure injector protrusion and valve intrusion and/or protrusion. Equipped with electronic digital indicator.



Tool Number

3165113

Intake Valve Seat Extractor Collet

Used with slide hammer, Part Number 3376617. The slide hammer is sold separately.

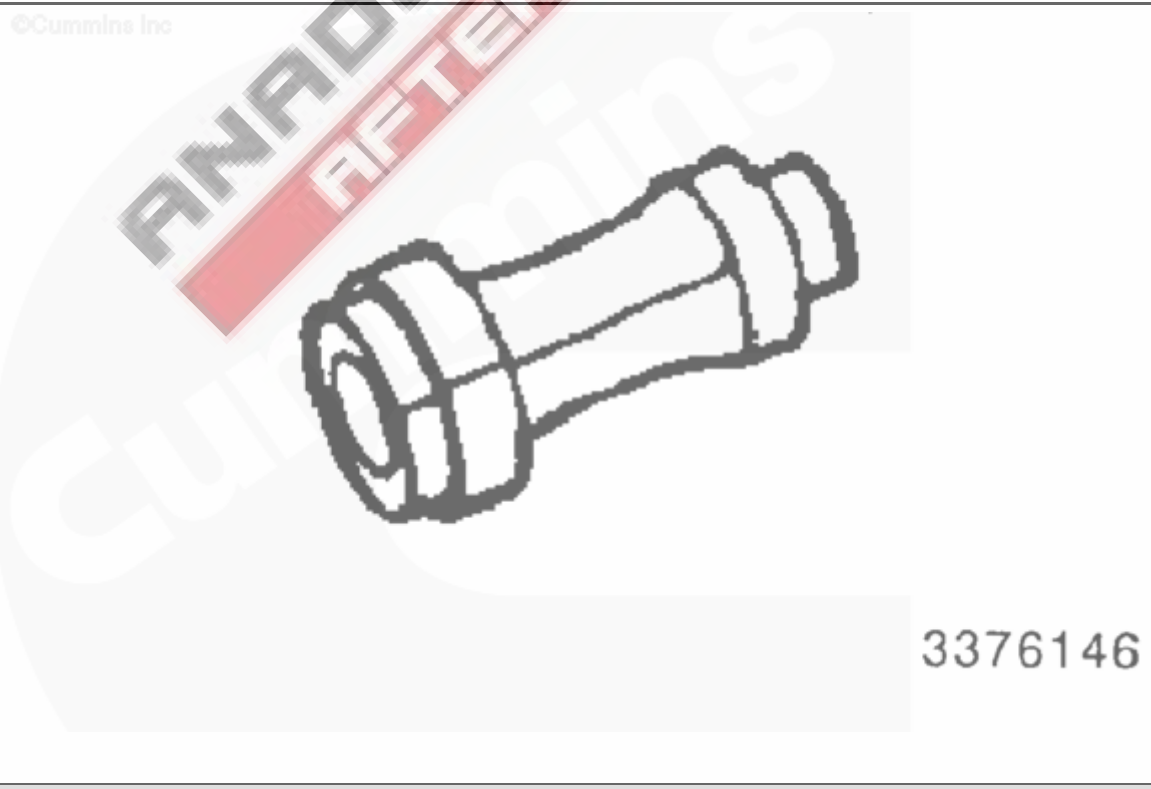


Tool Number

3165114

Exhaust Valve Seat Extractor Collet

Used with slide hammer, Part Number 3376617. The slide hammer is sold separately.



Tool Number

3165115

Valve Seat Installer

Used for installing intake and exhaust valve seats.

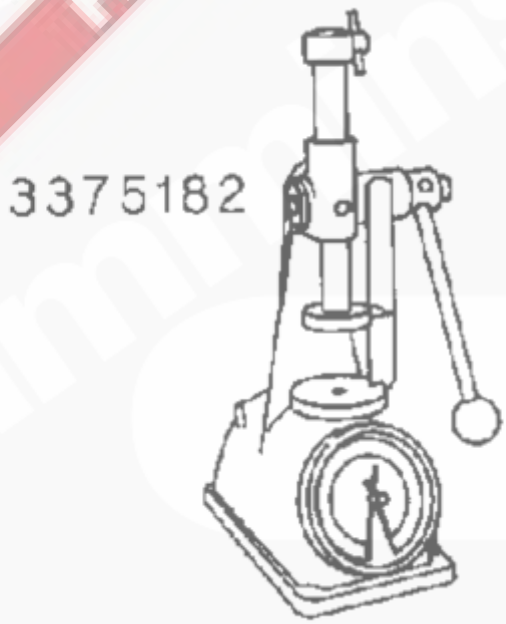


Tool Number

3375182

Valve Spring Tester

Used to check spring tension.



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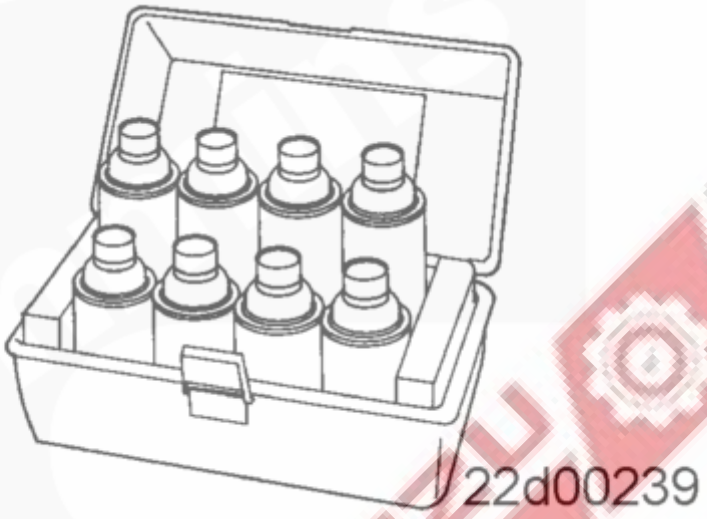
Tool Number

3375432

Crack Detection Kit (Dye Type)

Used to clean and inspect components for cracks.



Tool Number

3375805

Valve Lapping Compound

An abrasive compound used to lap the valves.



Tool Number

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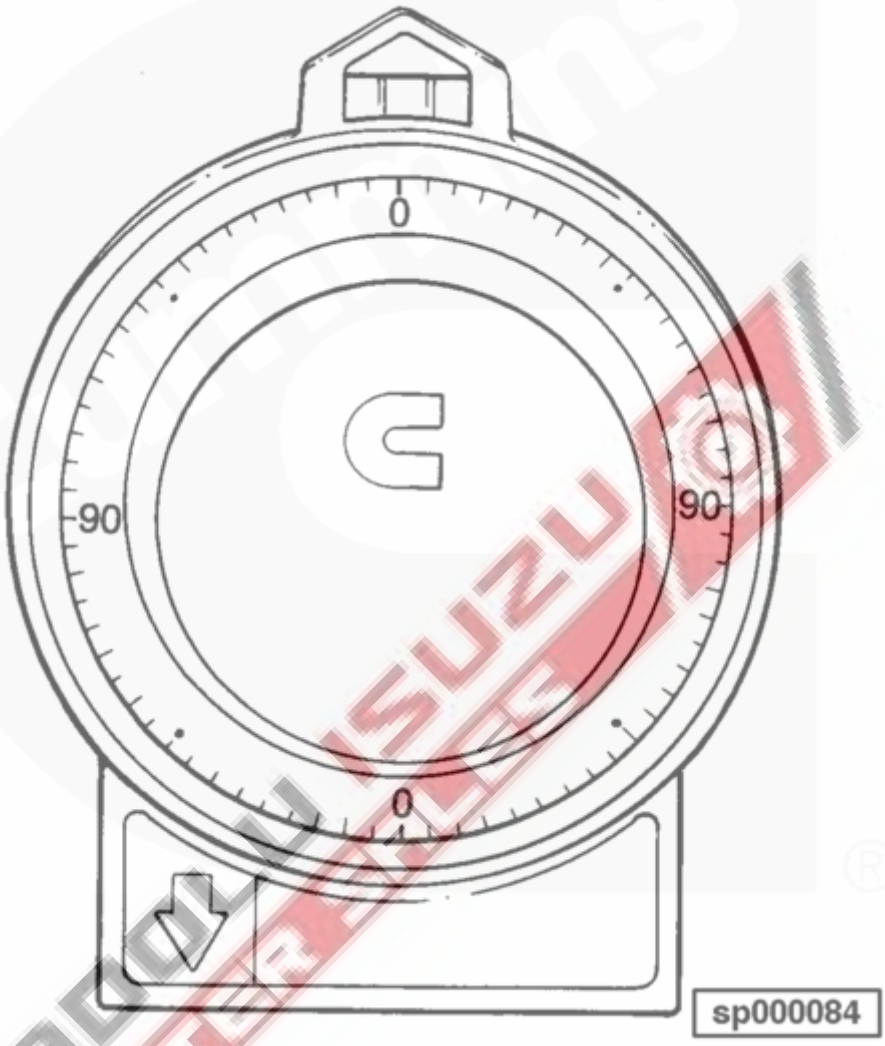
3375855

Angle Level Indicator

This angle indicator is used to set and/or adjust the fuel pump throttle lever angle. It can also be used to set a remote governor throttle lever angle or check drive line angles etc.

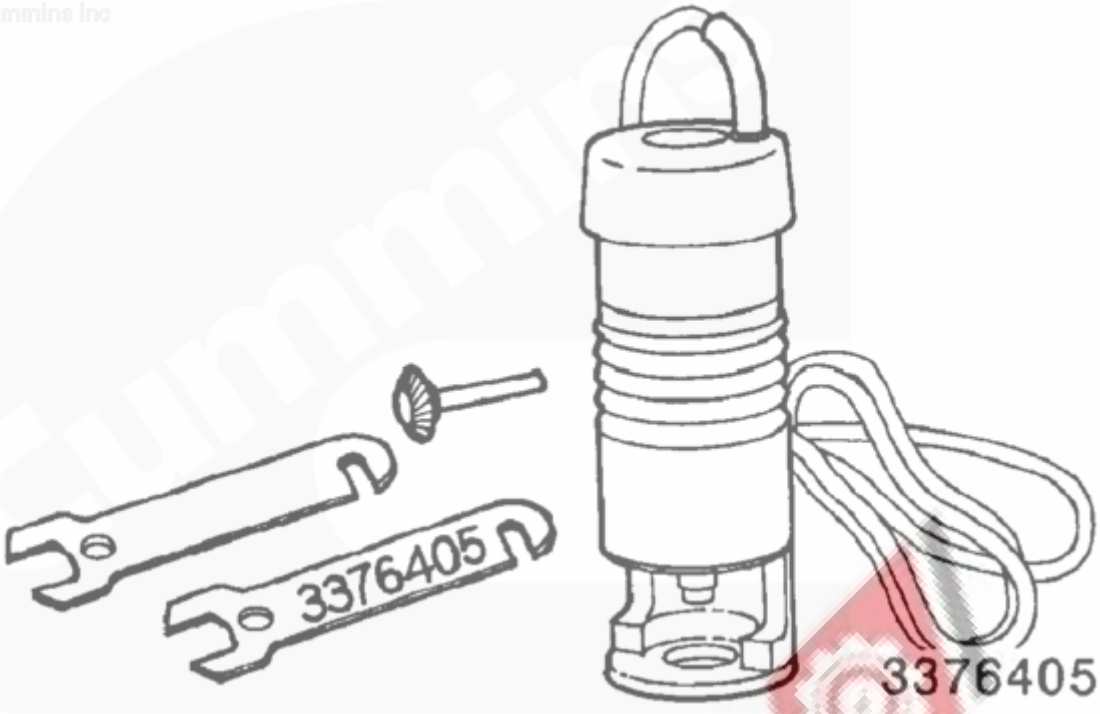


Tool Number

3376405

Valve Seat Grooving Tool

Used to cut a groove in the valve seat. This is often required prior to use of the valve seat extractor. It requires cutter bit, Part Number 3376407. The cutter bit is sold separately.

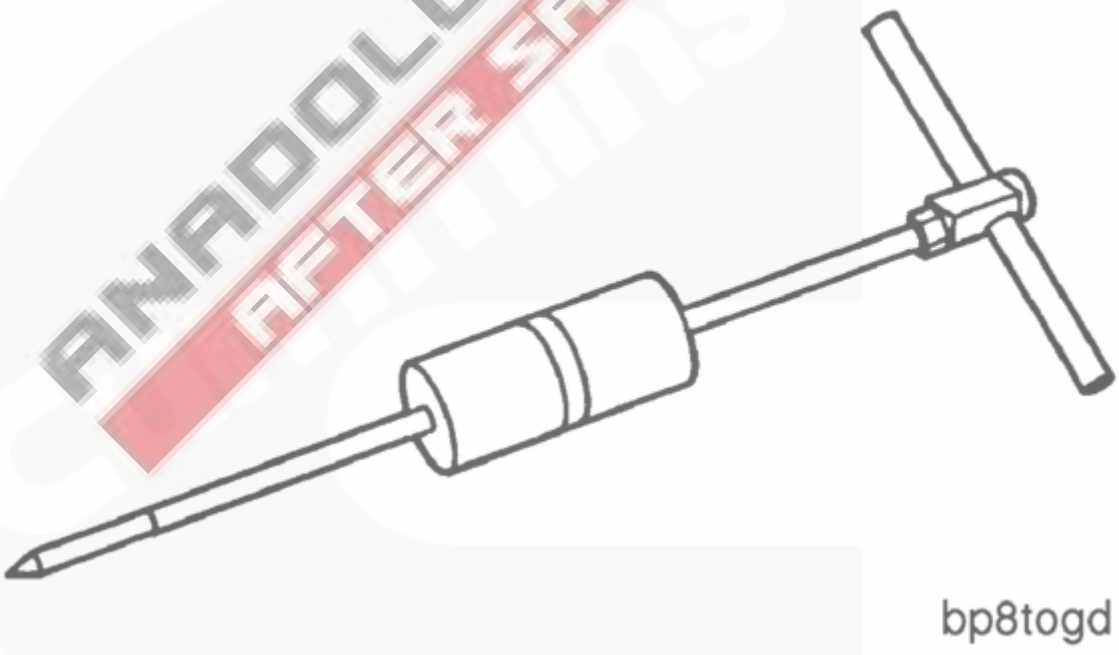


Tool Number

3376617

Slide Hammer Assembly

Used with the valve seat extractor to remove the valve seat inserts from the cylinder head.

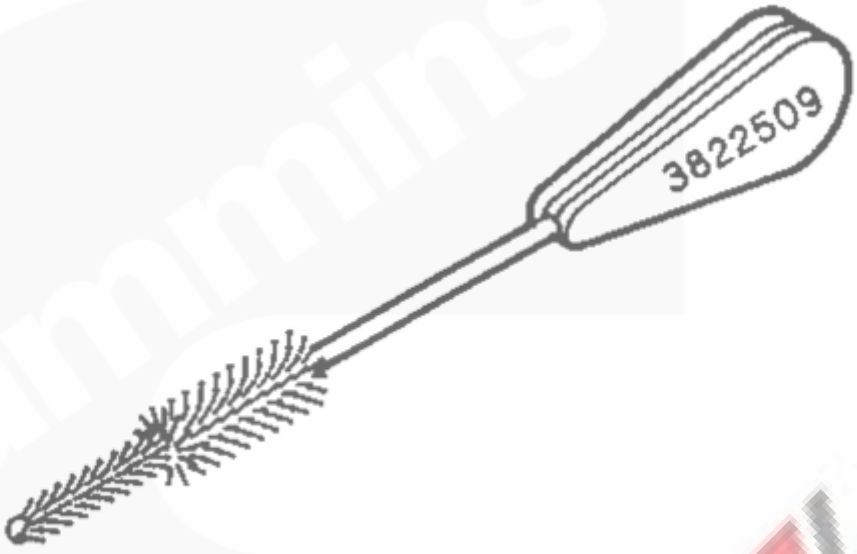


Tool Number

3822509

Injector Bore Brush

Used to clean carbon from injector bores.



3822509

Tool Number

3823258

Abrasive Pad

Used to clean carbon from the upper liner bores, remove rust and corrosion, and scuff surfaces.



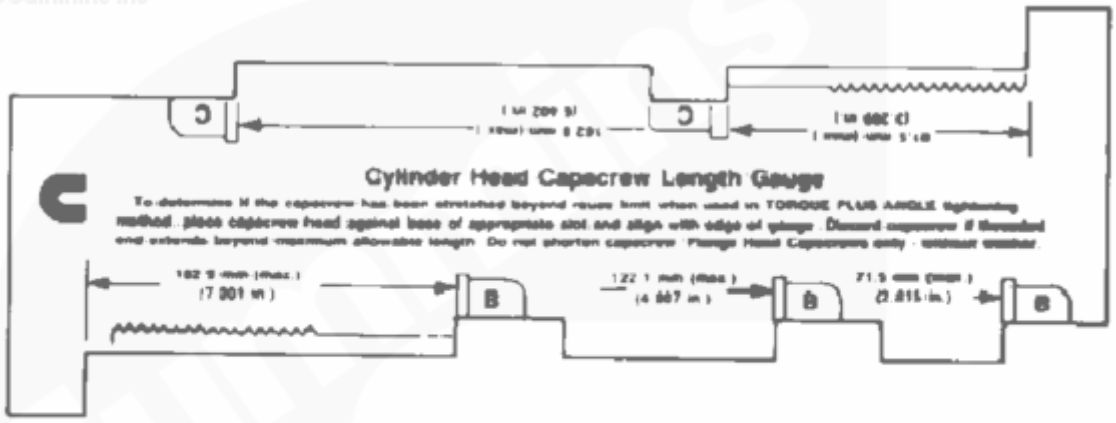
22900039

Tool Number

3823921

Capscrew Length Gauge

Used to measure capscrew free length.

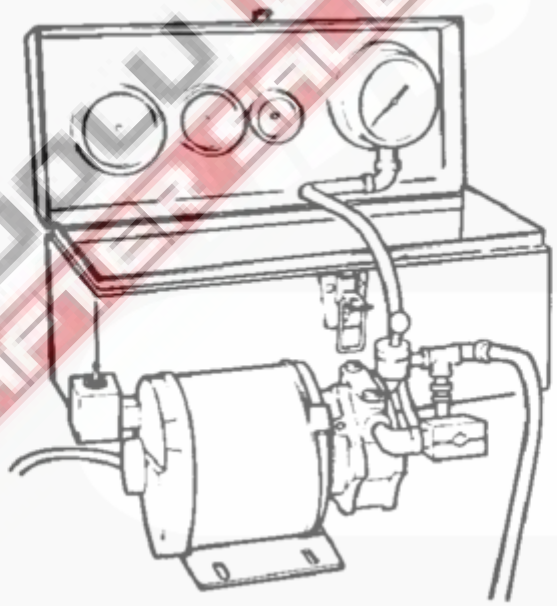


Tool Number

3824277

Valve Vacuum Tester (115 VAC 50/60 Hz)

Used with vacuum cup, Part Number ST 1257 6, to vacuum test the cylinder head, to determine if the valves are properly seated.



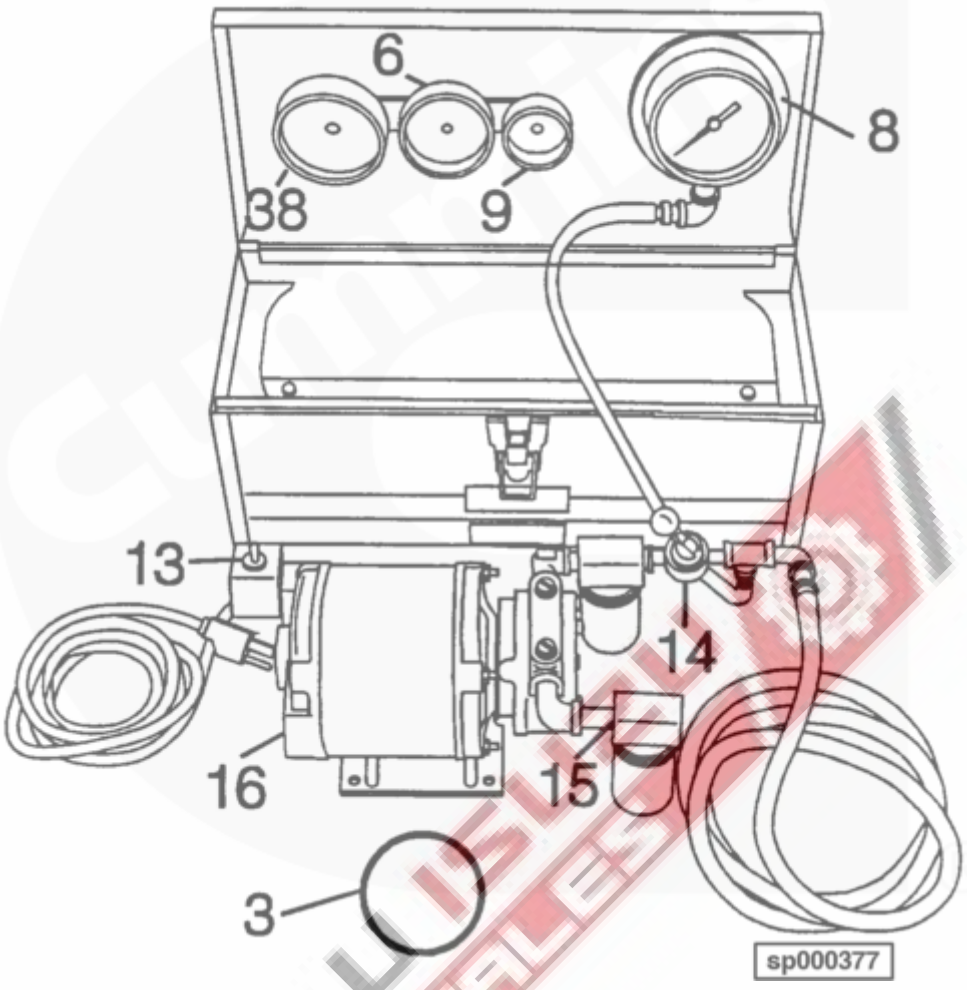
Tool Number

3824278

Valve Vacuum Tester (230 VAC 50/60 Hz)

This valve vacuum tester provides all the necessary vacuum cups and seals to determine if

valves are properly seated in the cylinder head using vacuum to provide a positive test. Above kits do not include cups and seals for B and C Series.



Tool Number

3824510

Contact Cleaner

This is an alcohol based precision cleaner 100% free of CFC's. This product is ideal for application where lower flash-point solvents can be used. It evaporates rapidly and completely and is harmless to most plastics. Use this when cleaning electrical/electronics connections. (Flammable).



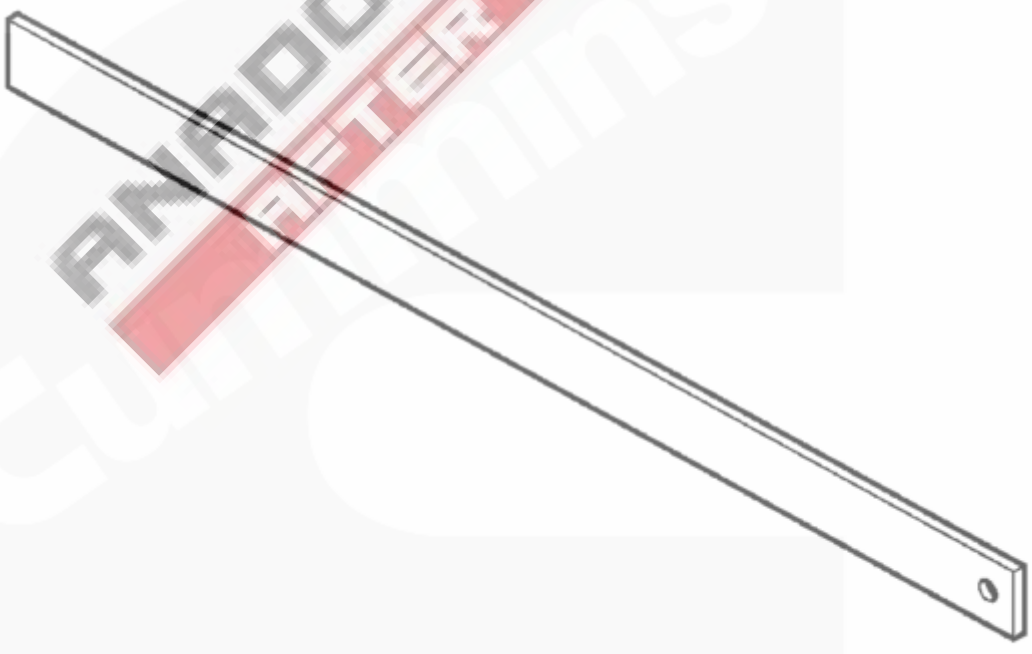
SP000784

Tool Number

4918219

Precision Straightedge

Used to check cylinder head combustion decks for flatness.



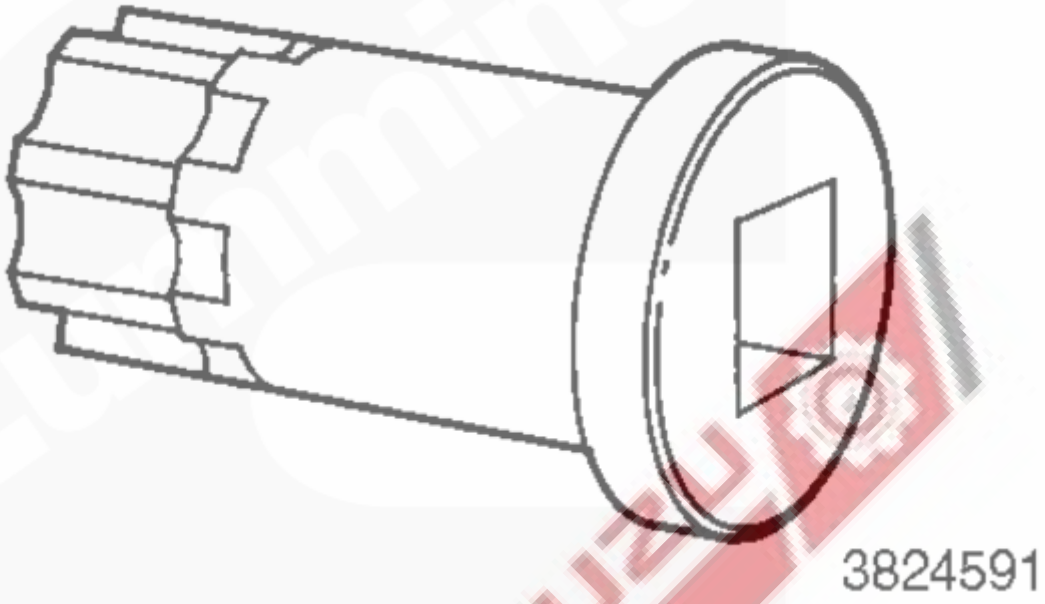
22d00222

Tool Number

5299073

Engine Barring Gear

Used to engage the flywheel ring gear to rotate the crankshaft.

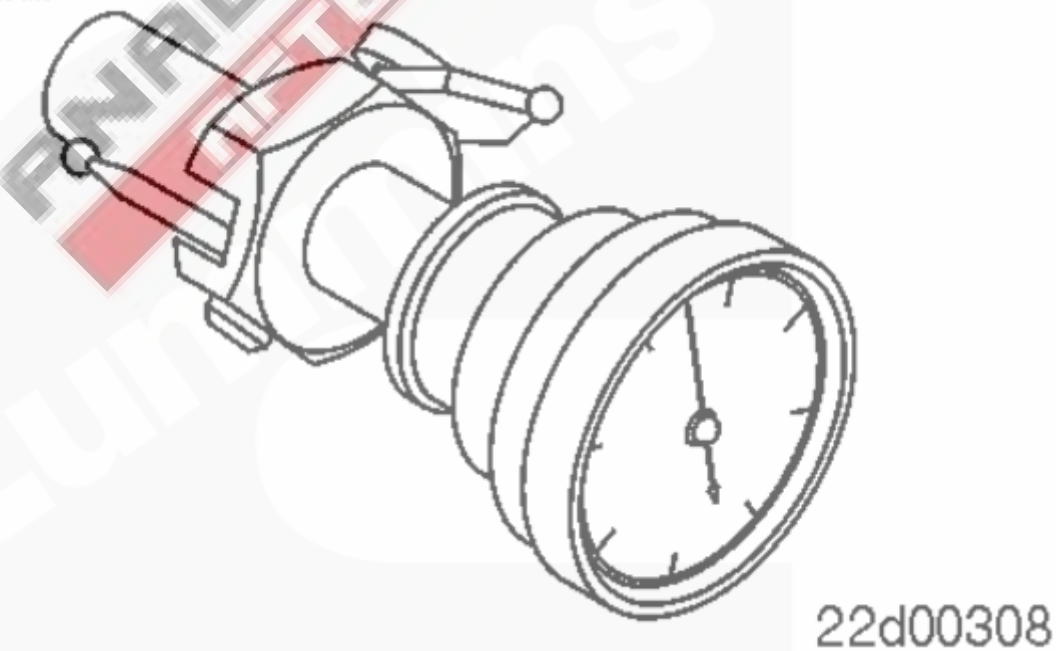


Tool Number

ST 685 4

Eccentrimeter Gauge

Used to measure the valve seat to valve guide runout.

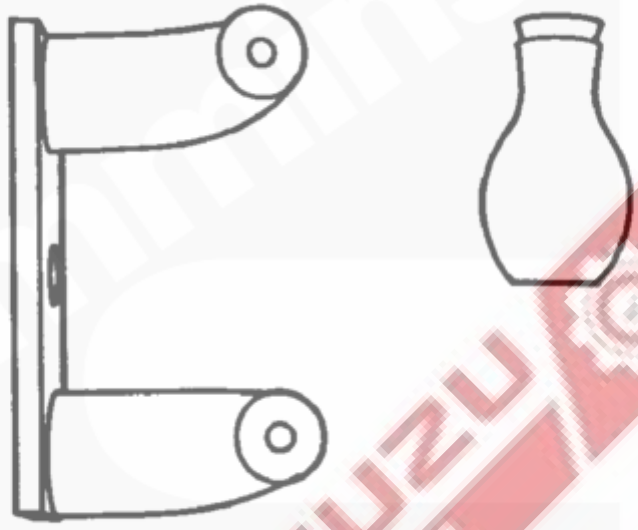


Tool Number

ST 1166

Magnetic Crack Detector

Used to inspect the cylinder head combustion face for cracks in the injector bore and valve seat areas. The kit includes powder spray bulb, Part Number ST 1166 7, used for spraying metal powder, Part Number ST 1166 8.



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Last Modified: 25-Jul-2016

Select Service Tools

Recommended Cummins® Service Tools

- No Cummins® Service Tools required.

Additional Service Items

- No additional service items required.

Preparatory Steps

⚠ WARNING ⚠

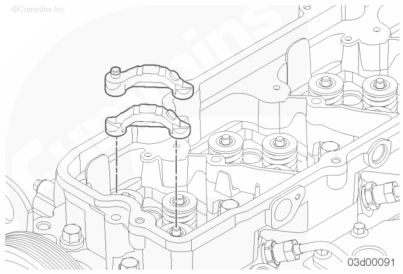
Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

- Disconnect the batteries. See equipment manufacturer service information.
- Remove the crankcase breather tube and drain tube. Refer to Procedure 003-018 in Section 3. (/qs3/pubsys2/xml/en/procedures/425/425-003-018.html)
- Remove the exhaust gas recirculation (EGR) connection tube. Refer to Procedure 011-025 in Section 11. (/qs3/pubsys2/xml/en/procedures/425/425-011-025.html)
- Remove the rocker lever cover. Refer to Procedure 003-011 in Section 3. (/qs3/pubsys2/xml/en/procedures/425/425-003-011.html)
- Remove the engine brake assembly, if equipped. Refer to Procedure 020-004 in Section 20. (/qs3/pubsys2/xml/en/procedures/425/425-020-004-tr.html)
- Remove the rocker lever assembly. Refer to Refer to Procedure 003-008 in Section 3. (/qs3/pubsys2/xml/en/procedures/425/425-003-008.html)

Remove

Note : Make note of the crosshead location and orientation. If the crossheads are reused, they **must** be installed in their original location and orientation.

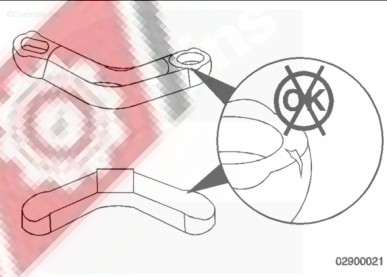
Remove the crossheads.



Clean and Inspect for Reuse

⚠ WARNING ⚠

When using solvents, acids, or alkaline materials for cleaning, follow the manufacturer's recommendations for use. Wear goggles and protective clothing to reduce the possibility of personal injury.



⚠ WARNING ⚠

Some solvents are flammable and toxic. Read the manufacturer's instructions before using.

⚠ WARNING ⚠

Wear appropriate eye and face protection when using compressed air. Flying debris and dirt can cause personal injury.

Clean the crossheads. Use solvent. Dry with compressed air.

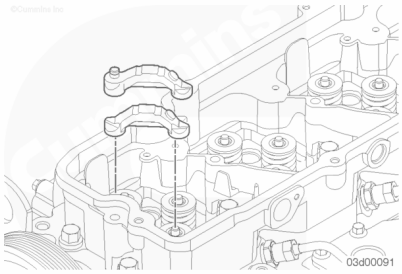
Inspect the crossheads for cracks and/or excessive wear on the rocker lever and valve tip mating surfaces.

Inspect the contact pads for cracks and other damage.

Install

Note : The crosshead has a round hole and an oval hole. If installing new crossheads, it is **not** required to place the holes in a particular position.

Note : When reusing the crossheads, make sure to install them in their original location and orientation.



Install the crossheads on the valve stems.

When installing the crossheads on engines equipped with engine brakes, the pin on the crosshead **must** be facing the exhaust manifold.

Finishing Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

- Install the rocker lever assembly. Refer to Procedure 003-008 in Section 3. (/qs3/pubsys2/xml/en/procedures/425/425-003-008.html)
- Adjust the overhead. Refer to Procedure 003-004 in Section 3. (/qs3/pubsys2/xml/en/procedures/425/425-003-004-tr.html)
- Install the engine brake assembly, if equipped. Refer to Procedure 020-004 in Section 20. (/qs3/pubsys2/xml/en/procedures/425/425-020-004-tr.html)
- Install the rocker lever cover. Refer to Procedure 003-011 in Section 3. (/qs3/pubsys2/xml/en/procedures/425/425-003-011.html)
- Install the crankcase breather tube and drain tube. Refer to Procedure 003-018 in Section 3. (/qs3/pubsys2/xml/en/procedures/425/425-003-018.html)
- Install the EGR connection tube. Refer to Procedure 011-025 in Section 11. (/qs3/pubsys2/xml/en/procedures/425/425-011-025.html).
- Connect the batteries. See equipment manufacturer service information.
- Operate the engine. Check for leaks.

ANADOLU ISUZU

Last Modified: 03-Aug-2016

Select Service Tools

Recommended Cummins® Service Tools

- Valve vacuum tester, Part Number 4918803
- Cup, Part Number 3376100
- Cylinder head holding fixture, Part Number ST 583, or equivalent
- Gauge block, Part Number 3164438
- Valve spring compressor, Part Number 3164329
- Valve guide driver, Part Number 3163101, or equivalent
- Valve Seat Insert Cutting Kit, Part Number 3376405, or equivalent
- Slide hammer remover, Part Number 3376617
- Intake valve seat insert extractor, Part Number 3165113
- Exhaust valve seat insert extractor, Part Number 3165114
- Injector bore brush, Part Number 3822509, or equivalent
- Abrasive pad, Part Number 3823258, or equivalent
- Straightedge, Part Number 4918219, or equivalent
- Crack Detection Kit, Part Number 3375432, or equivalent
- Spring compressor tool, Part Number 3375182
- Capscrew length gauge, Part Number 3823921
- Valve seat installer, Part Number 3165115
- Arbor set, Part Number 3823186
- Eccentrimeter, Part Number ST 685 4, or equivalent
- Fine lapping compound, Part Number 3375805, or equivalent

Additional Service Items

- Lead pencil or Dykem™ marking pen
- Feeler gauge
- Depth micrometer
- Dead blow hammer

ANADOLU ISUZU AFTER SALES

Preparatory Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

⚠ WARNING ⚠

Do not remove the pressure cap from a hot engine. Wait until the coolant temperature is below 50°C [120°F] before removing the pressure cap. Heated coolant spray or steam can cause personal injury.

⚠ WARNING ⚠

Coolant is toxic. Keep away from children and pets. If not reused, dispose of in accordance with local environmental regulations.

⚠ CAUTION ⚠

If removing the cylinder head with the injectors installed, be careful not to damage the tips of the injector. Do not set the cylinder head down on the combustion face with the injectors installed. Damage to the injector tips will result.

- Disconnect the batteries. See equipment manufacturer service information.
- Drain the coolant. Refer to Procedure 008-018 in Section 8. (/qs3/pubsys2/xml/en/procedures/425/425-008-018-tr.html)
- Remove the air crossover tube. Refer to Procedure 010-019 in Section 10. (/qs3/pubsys2/xml/en/procedures/425/425-010-019.html)
- Remove the air intake connection adapter. Refer to Procedure 010-131 in Section 10. (/qs3/pubsys2/xml/en/procedures/425/425-010-131.html)
- Remove the injector supply lines. Refer to Procedure 006-051 in Section 6. (/qs3/pubsys2/xml/en/procedures/425/425-006-051.html)
- Remove the air intake manifold. Refer to Procedure 010-023 in Section 10. (/qs3/pubsys2/xml/en/procedures/425/425-010-023.html)
- Remove the fuel rail. Refer to Procedure 006-060 in Section 6. (/qs3/pubsys2/xml/en/procedures/425/425-006-060.html)
- Remove the fuel connection tubes. Refer to Procedure 006-052 in Section 6. (/qs3/pubsys2/xml/en/procedures/425/425-006-052.html)
- Remove the crankcase breather tube and drain tube. Refer to Procedure 003-018 in Section 3. (/qs3/pubsys2/xml/en/procedures/425/425-003-018.html)
- Remove the heat shield. Refer to Procedure 011-032 in Section 11. (/qs3/pubsys2/xml/en/procedures/425/425-011-032.html)
- Remove the rocker lever cover. Refer to Procedure 003-011 in Section 3. (/qs3/pubsys2/xml/en/procedures/425/425-003-011.html)
- Remove the engine brake assembly, if equipped. Refer to Procedure 020-004 in Section 20. (/qs3/pubsys2/xml/en/procedures/425/425-020-004-tr.html)
- Remove the rocker lever housing. Refer to Procedure 003-013 in Section 3. (/qs3/pubsys2/xml/en/procedures/425/425-003-013.html)
- Remove the rocker lever. Refer to Procedure 003-008 in Section 3. (/qs3/pubsys2/xml/en/procedures/425/425-003-008.html)
- Remove the crossheads. Refer to Procedure 002-001 in Section 2. (/qs3/pubsys2/xml/en/procedures/425/425-002-001.html)

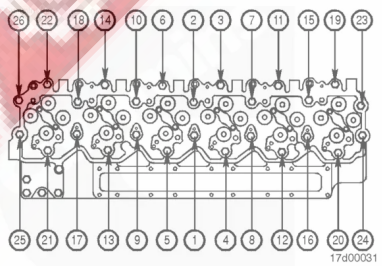
- Remove the push rods or tubes. Refer to Procedure 004-014 in Section 4. (/qs3/pubsys2/xml/en/procedures/425/425-004-014.html)
- Remove the fuel drain lines. Refer to Procedure 006-013 in Section 6. (/qs3/pubsys2/xml/en/procedures/425/425-006-013.html)
- Remove the turbocharger. Refer to Procedure 010-033 in Section 10. (/qs3/pubsys2/xml/en/procedures/425/425-010-033.html)
- Remove the exhaust manifold. Refer to Procedure 011-007 in Section 11. (/qs3/pubsys2/xml/en/procedures/425/425-011-007.html)

Note : Do **not** remove the injectors at this time. Remove the cylinder head with the injectors installed so the injector protrusion can be checked.

Remove

⚠ WARNING ⚠

This component or assembly weighs greater than 23 kg [50 lb]. To prevent serious personal injury, be sure to have assistance or use appropriate lifting equipment to lift this component or assembly.

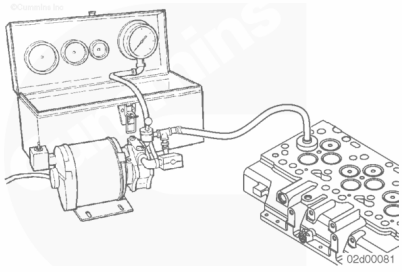


Remove the cylinder head capscrews.

Remove the cylinder head and gasket from the cylinder block.

Vacuum Test

Note : If a leaking valve is suspected, use valve vacuum tester, Part Number 4918803, and cup, Part Number 3376100, to vacuum test the valves and valve seats. The vacuum **must not** drop more than 254 mm-hg [10 in-hg] in 10 seconds.



Valve to Valve Seat Vacuum		
457 mm-hg	Used	18 in-hg
635 mm-hg	New	25 in-hg

Note : If a vacuum tester is **not** available, use a lead pencil or Dykem™ marking pen with the valve removed to mark across the valve face. Install the valve in the valve guide. Hold the valve against the valve seat. Rotate the valve backward and forward

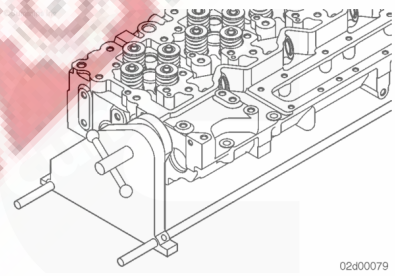
three or four times. Correct contact against the valve seat will break the marks on the valve face.

If out of specification, disassemble the cylinder head. Inspect for damaged valves and/or valve seat inserts. Repair as necessary:

1. Clean the valve, valve seat inserts, and lap the valves.
2. Replace the damaged valve/valve seat inserts, if available.
3. Replace the cylinder head.

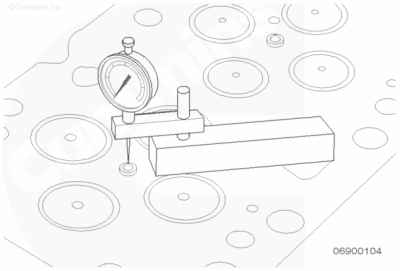
Disassemble

Install the cylinder head in cylinder head holding fixture, Part Number ST 583, or equivalent.



Before removing the injectors, use gauge block, Part Number 3164438, to measure the injector protrusion.

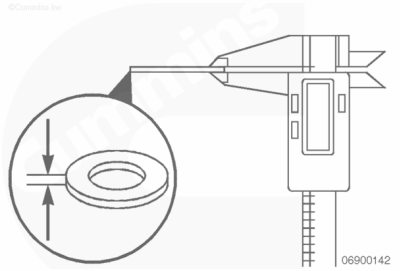
Place the injector protrusion tool on the flat surface of the head. Measure the injector protrusion to the highest point on the injector. The protrusion **must** be within the following specifications:



Injector Protrusion		
mm		in
2.25	MIN	0.088
2.80	MAX	0.110

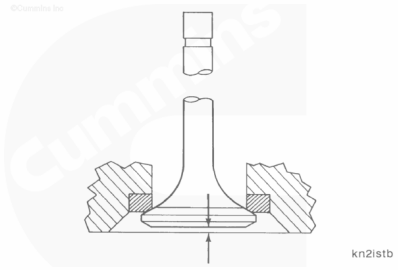
Remove the injector. Refer to Procedure 006-026 in Section 6. (/qs3/pubsys2/xml/en/procedures/425/425-006-026.html)

If the injector protrusion is out of specification, check the thickness of the injector sealing washer. Refer to Procedure 006-026 in Section 6. (/qs3/pubsys2/xml/en/procedures/425/425-006-026.html)



If the sealing washer is the correct thickness, check to make sure the injector bore is clean and free of debris. Also make sure sealing washers are **not** "stacked" in the injector bore.

Standard Cylinder Head

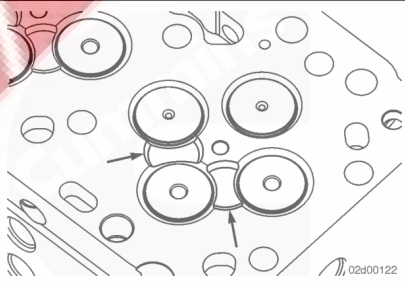


Measure the valve recess.

Standard Head Valve Recess in Cylinder Head		
mm		in
0.84	MIN	0.033
1.32	MAX	0.052

If the valve recess is outside the specifications, replace the valve. If the valve recess is still outside the specifications, the valve seat insert or cylinder head **must** be replaced.

Scallop Cylinder Head

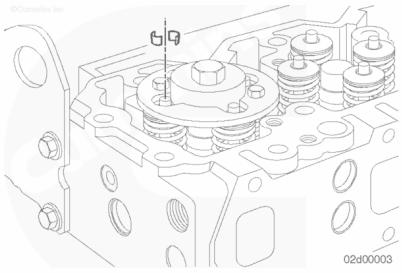


Measure the valve recess.

Scallop Head Valve Recess in Cylinder Head		
mm		in
0.69	MIN	0.027
1.17	MAX	0.046

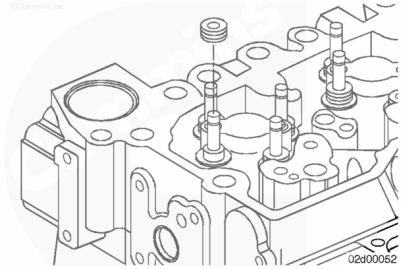
If the valve recess is outside of the specifications, replace the valve. If the valve recess is still outside the specifications, the valve seat insert or cylinder head **must** be replaced.

Compress the valve springs. Remove the valve stem collets. Use valve spring compressor, Part Number 3164329.



Release the valve springs. Remove the spring retainers and springs.

Use boot pliers, Part Number 3163293, or equivalent, to remove the valve stem seal.

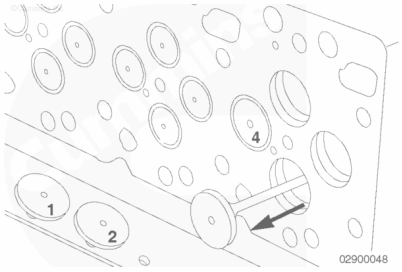


Remove and discard the valve stem seals.

Keep the valves in a labeled rack for a correct match with companion seats while making measurements.

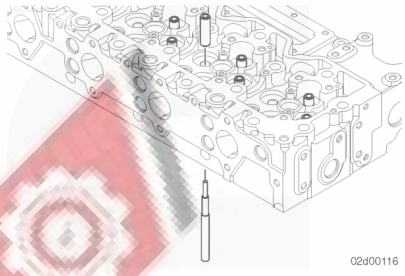
Mark the valves to identify their location. Any numbering system can be used as long as the valves are put back in their original location if they are to be reused.

Remove the valves.



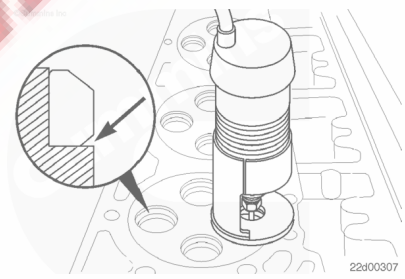
Note : Prior to removing the valve guide, see the Inspect for Reuse section in this procedure. The condition of the valve guide will help to determine if it needs to be replaced.

Use valve guide driver, Part Number 3163101, or equivalent, to remove the old valve guides.



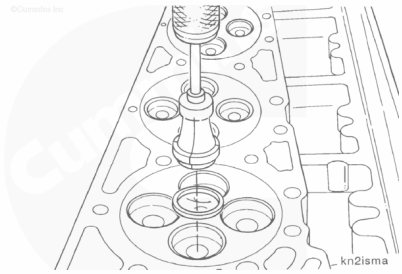
Note : Prior to the removal of the valve seat inserts, see the Clean and Inspect for Reuse section in this procedure. The condition of the valve, the amount of recess, and the sealing of the valve on the seat insert all help to determine if a valve seat insert needs to be replaced.

1. If required, remove the valve seat inserts.
2. Inspect the valve insert-to-cylinder head contact area. A sufficient groove for the remover **must** exist.
3. If there is sufficient valve seat insert groove area, proceed to the next step.
4. If the valve seat insert groove area is **not** sufficient, use Valve Seat Insert Cutting Kit, Part Number 3376405, or equivalent, to create a sufficient groove.



Use slide hammer remover, Part Number 3376617, with intake valve seat insert extractor, Part Number 3165113, and exhaust valve seat insert extractor, Part Number 3165114, to remove the valve seat inserts.

Note : Make certain the valve seat insert remover assembly is perpendicular to the cylinder head when installed. Place the valve seat insert remover assembly into the valve seat insert. Rotate the T-handle **clockwise** until the remover loosely grips the valve seat insert.



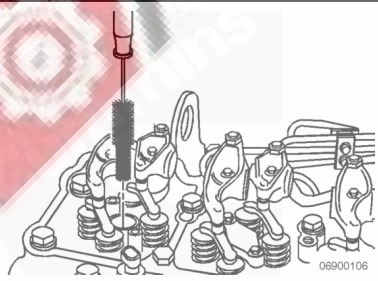
Position the valve seat insert remover assembly into the valve seat insert groove area. Tighten the T-handle firmly, allowing the remover to expand under the valve seat insert or into the cut groove.

Strike the slide hammer remover against the top nut until the valve seat insert is removed. Turn the T-handle **counterclockwise** to release the valve seat insert from the remover.

Clean and Inspect for Reuse

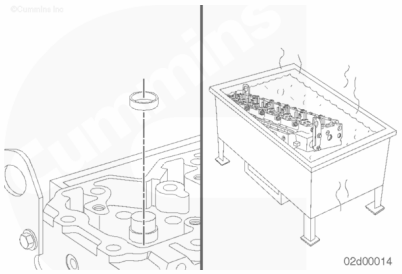
Use injector bore brush, Part Number 3822509, or equivalent, to clean the carbon from the injector nozzle seat.

Scrape the gasket material from all gasket surfaces on the block and head.



⚠ WARNING ⚠

When using solvents, acids, or alkaline materials for cleaning, follow the manufacturer's recommendations for use. Wear goggles and protective clothing to reduce the possibility of personal injury.



⚠ WARNING ⚠

Some solvents are flammable and toxic. Read the manufacturer's instructions before using.

⚠ WARNING ⚠

Wear appropriate eye and face protection when using compressed air. Flying debris and dirt can cause personal injury.

⚠ WARNING ⚠

To reduce the possibility of personal injury, wear goggles and protective clothing.

Clean the buildup of deposits from the coolant passages. Excessive deposits can be cleaned in an acid tank, but the expansion plugs **must** first be removed.

Clean the cylinder head combustion deck. Use abrasive pad, Part Number 3823258, or equivalent, and diesel fuel or solvent. The surface finish (RA - roughness average) maximum is 3.2 µm [0.0001 in].

Inspect the area within 1/8 inch of the firing ring diameter. Any wear that can be felt with a fingernail within the 1/8 inch area is unacceptable, making the cylinder head **not** reusable.

Wear beyond this 1/8 inch area will have no effect on future combustion sealing and the usability of the cylinder head.

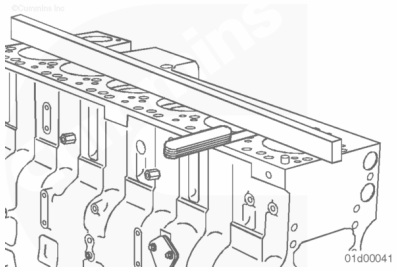
Clean carbon deposits from the valve pockets with a high quality steel wire wheel installed in a drill or a die grinder.

Note : An inferior quality wire wheel will lose steel bristles during operation, causing additional contamination.

Wash the cylinder head in a hot, soapy water solution.

Dry with compressed air.

Use straightedge, Part Number 4918219, or equivalent, and a feeler gauge to measure the overall flatness of the cylinder block.

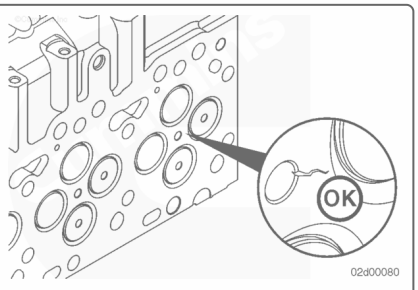


The overall flatness, end-to-end and side-to-side, **must not** exceed 0.075 mm [0.003 in].

Use a 2 foot straightedge and a 0.0254 mm [0.001 in] feeler gauge to measure local cylinder block combustion surfaces flatness. Check between the cylinder bores and also between the coolant passages. If the 0.0254 mm [0.001 in] feeler gauge fits under the 2 foot straightedge, or if the cylinder block is pitted, has grooves or other damage, the cylinder block **must** be replaced.

Cylinder Head Cracks - Reuse Guidelines

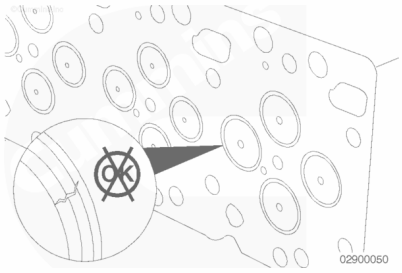
The reuse guidelines for a cylinder head with a crack extending from the injector bore to the intake valve seat are as follows:



- If a crack does **not** extend into the valve seat, the cylinder head is reusable.

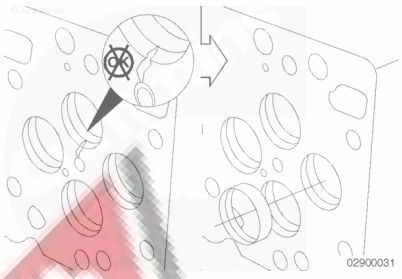
Inspect the valve seats for cracks or burn spots.

- If the valve seats are cracked or burned, the valve seat **must** be replaced.
- If the valve seat has dropped out and caused damage to the cylinder head combustion face, the cylinder head **must** be replaced.



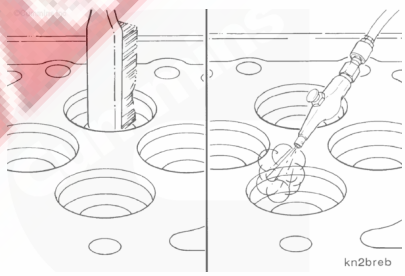
If a crack extends into or through the valve seat bore, the cylinder head **must** be replaced.

Use Crack Detection Kit, Part Number 3375432, or equivalent, to help identify cylinder head cracks.



⚠ WARNING ⚠

When using solvents, acids, or alkaline materials for cleaning, follow the manufacturer's recommendations for use. Wear goggles and protective clothing to reduce the possibility of personal injury.



⚠ WARNING ⚠

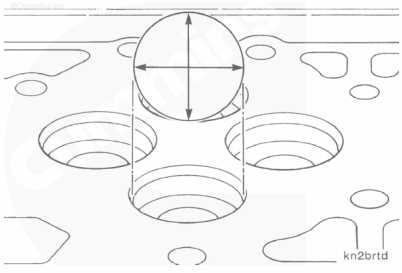
Wear appropriate eye and face protection when cleaning the valves. Flying debris and dirt can cause personal injury.

Use a wire brush and solvent to clean the deposits from the valve seat insert bores, if it was necessary to remove the valve seat inserts.

Dry with compressed air.

If the valve seat insert was removed in the Disassemble section, measure the inside diameter of the valve seat insert bore in the cylinder head.

Cylinder Head Insert Bore Inside Diameter (ID)		
mm		in
39.371	MIN	1.550
39.401	MAX	1.551



ANADOLU ISUZU PARTS

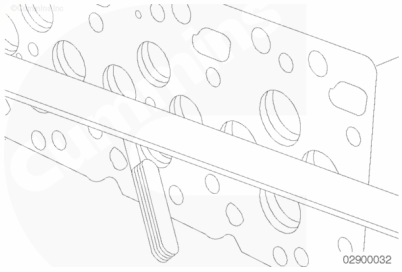
Note : Before cutting the cylinder head, verify the valve seat inserts are available for the engine being serviced. If none are available, the cylinder head **must** be replaced.

If out of specification, the valve seat insert bore can be oversized 0.254 mm [0.010 in].

Cylinder Head Insert Bore Inside Diameter (ID) for Oversized Seats		
mm		in
39.625	MIN	1.560
39.655	MAX	1.561

Note : It is very important to take precise measurements of the valve seat pocket diameter. A 4 point contact gauge is recommended for this measurement process. Failure to take proper diameter measurements will lead to a poor press fit of the valve seat, which can lead to a dropped valve seat and damage to the cylinder head combustion face.

Use straightedge, Part Number 4918219, and a feeler gauge to inspect the cylinder head combustion surface for flatness.



Cylinder Head Flatness				
	mm		in	
End-to-End		0.203	MAX	0.008
Side-to-Side		0.075	MAX	0.003

Use a 2 foot straightedge and a 0.0254 mm [0.001 in] feeler gauge to measure local cylinder head combustion surface flatness. Check between the cylinder bores and also between the coolant passages. If the 0.0254 mm [0.001 in] feeler gauge fits under the 2 foot straightedge or if the cylinder head is pitted, has grooves or other damage, the cylinder head **must** be replaced.

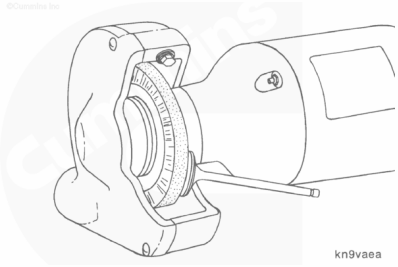
⚠ WARNING ⚠

When using solvents, acids, or alkaline materials for cleaning, follow the manufacturer's recommendations for use. Wear goggles and protective clothing to reduce the possibility of personal injury.

ANADOLU ISUZU

⚠ WARNING ⚠

Some solvents are flammable and toxic. Read the manufacturer's instructions before using.



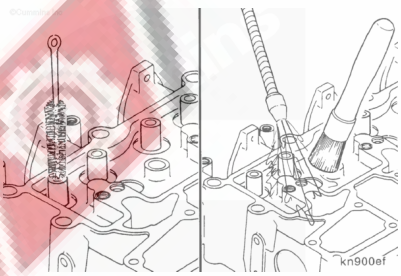
Clean the valve heads. Use a soft wire wheel.

Note : Keep the valves in a labeled rack to prevent mixing prior to making measurements.

Polish the valve stems. Use abrasive pad, Part Number 3823258, or equivalent, and diesel fuel or solvent.

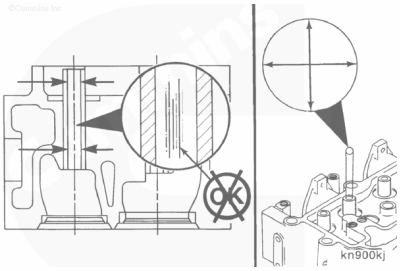
⚠ WARNING ⚠

Wear appropriate eye and face protection when using compressed air. Flying debris and dirt can cause personal injury.



Use a bristle brush to clean the inside diameter of the valve guide bore and blow out with compressed air.

Inspect the valve guides for scuffing, scoring, chips, or cracks.

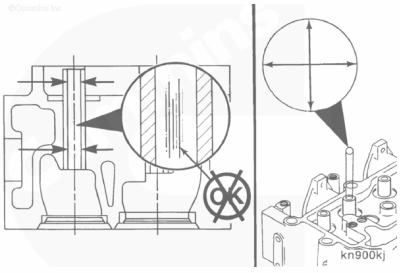


Measure the valve guide inside diameter.

Valve Guide Inside Diameter		
mm		in
8.019	MIN	0.3157
8.071	MAX	0.3178

If the valve guide inside diameter is worn larger than the maximum specified, the cylinder head **must** be replaced.

Inspect the valve guides for scuffing, scoring, chips, or cracks.



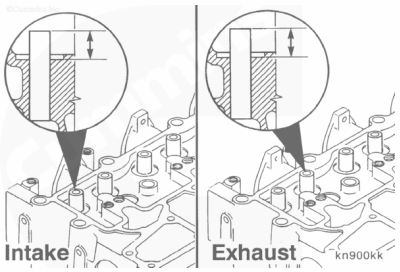
Measure the valve guide inside diameter.

Valve Guide Inside Diameter		
mm		in
8.019	MIN	0.316
8.081	MAX	0.318

ANADOLU ISUZU AFTER SALES

If the valve guide inside diameter is worn larger than the maximum specified, the cylinder head **must** be replaced.

Use a depth micrometer to measure the valve guide installed height. Measure from the top of the valve guide to the bottom of the recessed area.

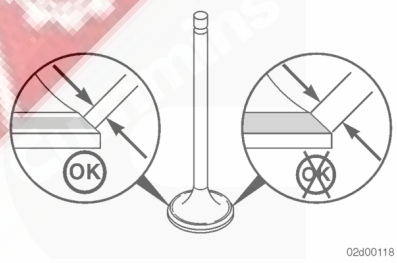


Valve Guide Height (Installed)		
mm		in
13.15	MIN	0.518
13.65	MAX	0.537

If the valve guide height is outside the specification, the cylinder head **must** be replaced.

Verify the valve sealing area is in the center of the valve. If the sealing area extends to the top or bottom of the valve, the valve **must** be replaced.

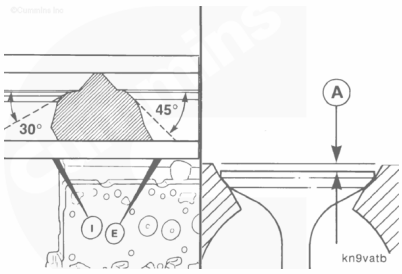
After replacing the valve, recheck the valve sealing area. If the sealing area still extends to the top or bottom of the valve, the valve seat **must** be replaced.



Use a lead pencil or Dykem™ marking pen to mark across the valve face. Install the valve in the valve guide. Hold the valve against the valve seat. Rotate the valve backward and forward three or four times. Correct contact against the valve seat will break the marks on the valve face.

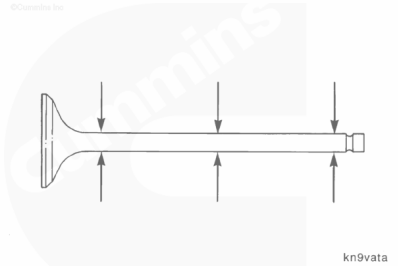
Valve seat angle:

- Intake is 30 degrees.
- Exhaust is 45 degrees.



Inspect for abnormal wear or scuffing on the heads and stems.

Measure the valve stem diameter.



Valve Stem Diameter		
mm		in
7.96	MIN	0.313
7.98	MAX	0.314

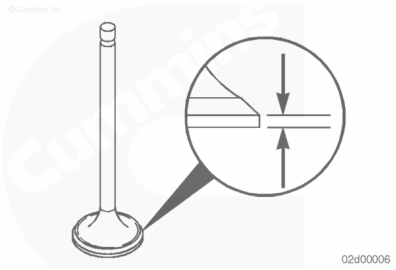
Replace any valve found outside these dimensions.

Check the valve stem tip for flatness.

Inspect for bent valves.

Measure the rim thickness.

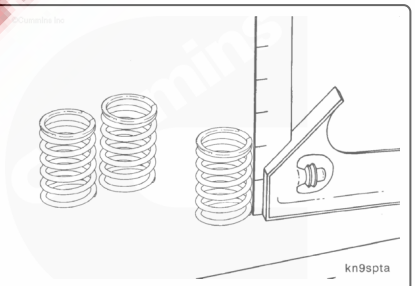
Note : Measure 90 degrees apart to verify uniformity of lap.



If the valve thickness is **not** within the limits, a new valve **must** be used.

Valve Rim Thickness			
	mm		in
Exhaust	1.83	MIN	0.072
Intake	2.20	MIN	0.087

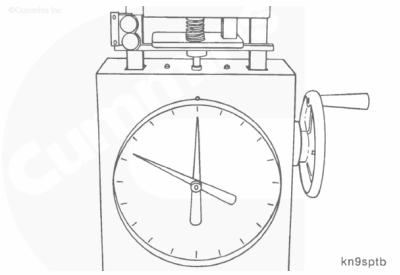
Inspect the valve springs.



A load of 906 to 1007 N [204 to 226 lbf] is required to compress the spring to a height of 30.6 mm [1.20 in]. Use spring compressor tool, Part Number 3375182, to measure spring force.

Replace the valve spring if the load required to compress the spring is outside the specification.

Note : Valve springs **must** be replaced in pairs under the same cross head. If one spring does **not** meet the specification, replace both valve springs under the same cross head.



⚠ WARNING ⚠

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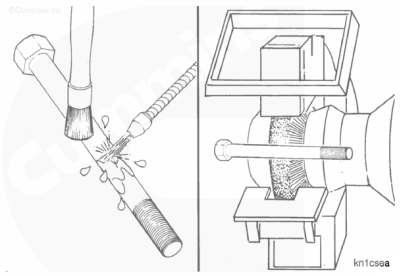


ANADOLU ISUZU AFTER SALES

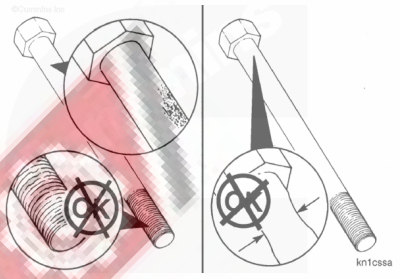
⚠ WARNING ⚠

Some solvents are flammable and toxic. Read the manufacturer's instructions before using.

Use a petroleum-based solvent to clean the capscrews.

Clean the capscrews thoroughly. Use a wire brush or a soft wire wheel. A non-abrasive bead blaster can be used to remove deposits from the shank and the threads.

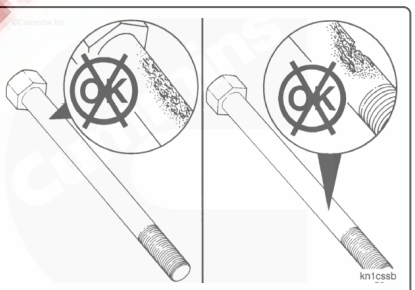
Inspect the cylinder head capscrews for damaged threads, corroded surfaces, or a reduced diameter (due to capscrew stretching).



Do **not** reuse cylinder head capscrews under the following conditions:

Visible corrosion or pitting exceeds 1 sq cm [0.155 sq in] in area. Example:

- Acceptable is 9.525 x 9.525 mm [3/8 x 3/8 in].
- Unacceptable is 12.700 x 12.700 mm [1/2 x 1/2 in].



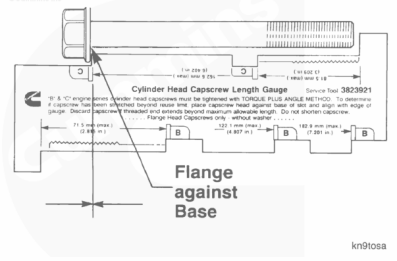
- Visible corrosion or pitting exceeds 0.12 mm [0.005 in] in depth.
- Visible corrosion or pitting is located within 3.2 mm [1/8 in] of the fillet or threads.
- Stretched beyond "free length" maximum. Reference the measurement procedure below.

Capscrew Length Gauge, Part Number 3823921

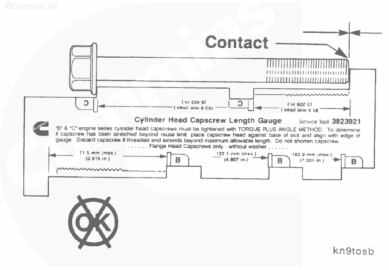
Free Length Measurement

Note : If the capscrews are **not** damaged, they can be reused throughout the life of the engine, unless the specified "free length" is exceeded.

To check the capscrew free length, place the head of the capscrew in the appropriate slot with the flange against the base of the slot.



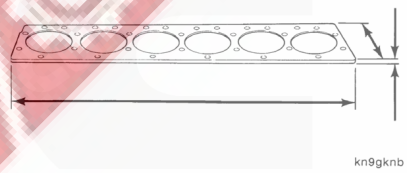
If the end of the capscrew touches the foot of the gauge, the capscrew is too long and **must** be discarded. The maximum capscrew free length is 162.6 mm [6.4 in].



Cylinder Head Capscrew Free Length		
mm		in
162.6	MAX	6.4

Pressure Test

A cylinder head test fixture can be fabricated from a flat piece of steel or aluminum. See the following table for test fixture dimensions.

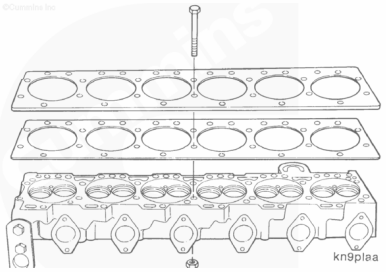


Test Fixture Dimensions		
16 mm	Thickness	0.630 in
851 mm	Length	33.5 in
203 mm	Width	8.0 in

Use a cylinder head gasket as a pattern for drilling the capscrew holes.

Install the cylinder head water test fixture.

- Install a new head gasket.
- Install the test plate.



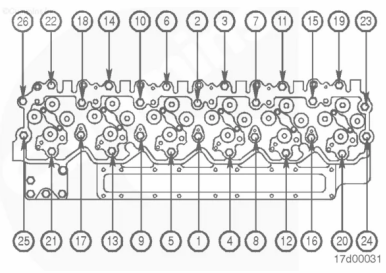
Install the following:

- 26 - Reuse existing cylinder head capscrews.
- 26 - M14 x 2 hexagon flange nuts.
- 52 - 14 mm washers, Part Number 4096383.

Place a washer between each capscrew and the head, and between each nut and test plate. This will prevent mutilation on the surface of the cylinder head.

Tighten the 26 nuts in the sequence shown in the illustration.

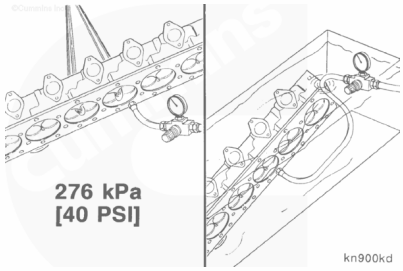
Torque Value: 110 n•m [81 ft-lb]



ANADOLU ISUZU PARTS SALES

⚠ WARNING ⚠

This component or assembly weighs greater than 23 kg [50 lb]. To prevent serious personal injury, be sure to have assistance or use appropriate lifting equipment to lift this component or assembly.



Connect a regulated air supply hose to the test fixture plate.

Apply air pressure.

Measurements		
	kpa	psi
Air Pressure	276	40

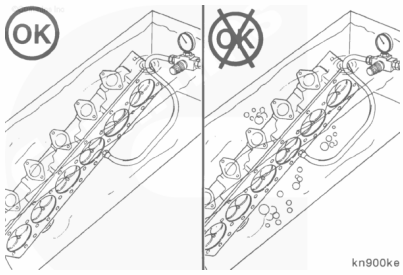
Use a nylon lifting strap and hoist to place the cylinder head in a tank of heated water.

Measurements		
	celsius	fahrenheit
Water Temperature	60	140

The cylinder head **must** be completely submerged in the water.

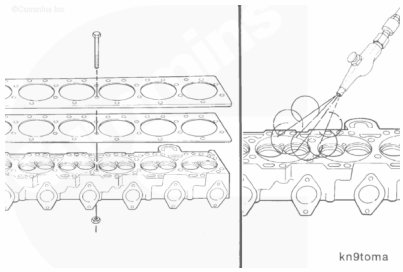
Inspect the cylinder head. Bubbles indicate an air leak.

If the cylinder head leaks, it **must** be replaced.



⚠ WARNING ⚠

Wear appropriate eye and face protection when using compressed air. Flying debris and dirt can cause personal injury.



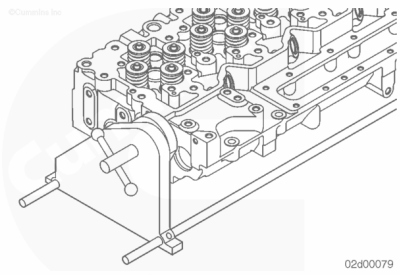
Remove the test fixture.

Use compressed air to dry the cylinder head.

ANADOLU ISUZU PARTS

Assemble

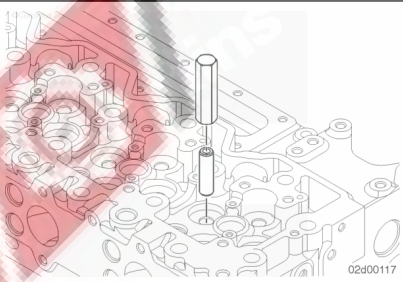
Install the cylinder head in cylinder head holding fixture, Part Number ST 583.



Use valve guide driver, Part Number 3163100, or equivalent, to install the new valve guides.

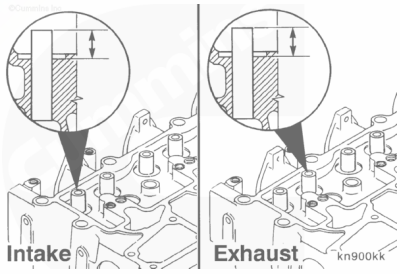
Verify the valve slides freely in the valve guide. If **not**, it can be necessary to ream the guide bore.

See the Clean and Inspect for Reuse step for valve guide inside diameter specifications.



Use a depth micrometer to measure the valve guide installed height. Measure from the top of the valve guide to the bottom of the recessed area.

Valve Guide Height (Installed)		
mm		in
13.15	MIN	0.518
13.65	MAX	0.537

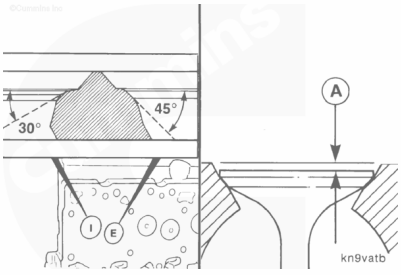


If the valve guide height is **not** within specifications, seat the guide with the installation tool.

When installing the valve seat inserts, the exhaust and intake valve seat inserts are **not** the same.

Valve seat angle:

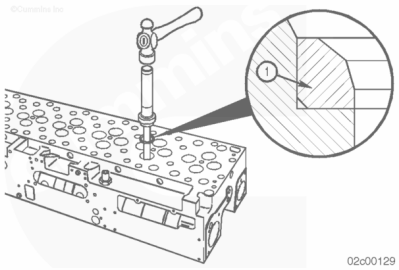
- Intake is 30 degrees.
- Exhaust is 45 degrees.



If the valve seat inserts were removed in the Disassemble section, new inserts **must** be installed.

Note : The valve guide **must** be installed prior to installing the valve seats.

Make sure the valve seat pocket and valve seat is clean before installing.



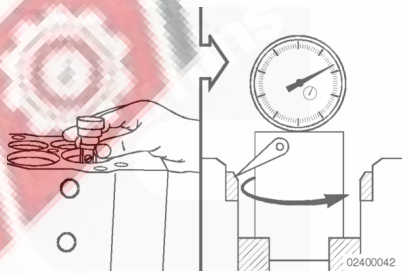
The insert chamfer (1) **must** be installed toward the bottom of the counterbore.

Use valve seat installer, Part Number 3165115, to drive the intake and exhaust valve seat inserts into the counterbore.

Use a dead blow hammer with the seat drivers to install the new valve seat inserts.

The seats **must** be fully seated into the valve seat pocket. There should **not** be a gap between the seat and the bottom of the pocket.

Measure the valve seat-to-valve guide runout. Use arbor set, Part Number 3823186, and eccentrimeter, Part Number ST 685 4, or equivalent.

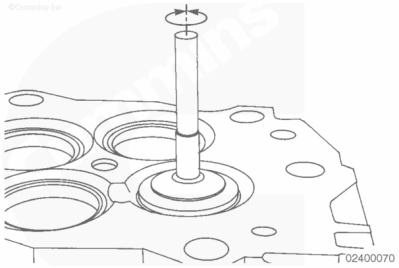


Valve-Seat-to-Valve-Guide Runout		
mm		in
0.2	MAX	0.008

If the valve seat-to-valve guide runout is **not** within specifications, one of the following actions can be taken:

- Apply Dykem™ marking pen to the valve seat and valve seating surfaces. Allow to dry. Install the valve in the valve guide. Hold the valve against the valve seat. Rotate the valve backward and forward three to four times. Verify the contact against the valve seat forms a uniform band on the valve sealing surface. If a uniform band is formed, the assembly is within specifications.
- Clean the valve/valve seat and lap the valves.
- Remove the valve seat. Make sure no debris is causing an issue under the seat. Reinstall the valve seat if debris is found.
- Remove the valve seat. Machine the valve seat pocket oversize so an oversize valve seat can be installed. See the Clean and Inspect for Reuse section above for valve seat pocket diameter specifications. Use the valve guide ID during machining to help position the valve seat pocket to valve guide ID, to make sure of a proper runout measurement after the oversize valve seat is installed.
- Replace the cylinder head.

If new valve seat inserts were installed and/or the valve leakage was above specification, the valve seat/valve can be lapped.



Lubricate the stems with Society of Automotive Engineers (SAE) engine oil before installing the valves.

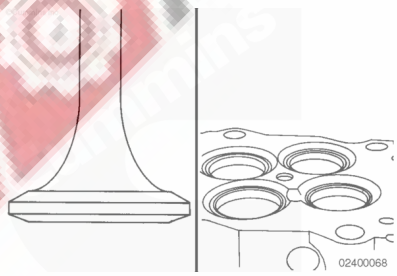
Use fine lapping compound, Part Number 3375805, or equivalent. Apply a thin and even coating on the valve.

Use a power or a hand suction lapping tool to provide pressure in the center of the valve.

Turn the valve backward and forward. Continue lapping until the compound shows a continuous contact pattern on both the valve seat insert and valve.

⚠ CAUTION ⚠

Lapping compound is an abrasive material. Damage will result if the cylinder head, valves, and valve seats are not cleaned thoroughly.



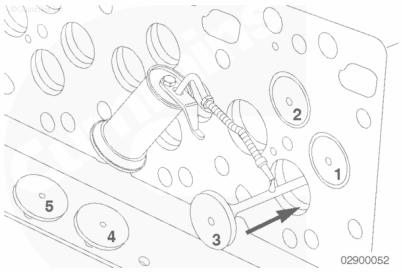
Clean the lapping compound from the parts.

Measure the valve rim thickness. See the Clean and Inspect for Reuse section.

Valves being reused **must** be installed in the same location from which they were removed.

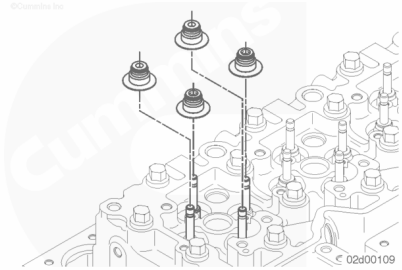
Lubricate the stems with clean engine oil before installing the valves.

Install the valves.



Install the valve seals over the exhaust valve guides.

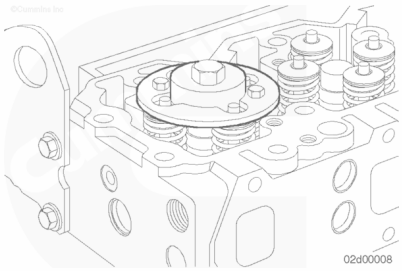
Install the valve seals over the intake valve guides.



⚠ WARNING ⚠

ANADOLU ISUZU AFTERSALES

Valve springs are under tension and can act as projectiles if released. To reduce the possibility of eye injury, wear safety glasses with side shields.

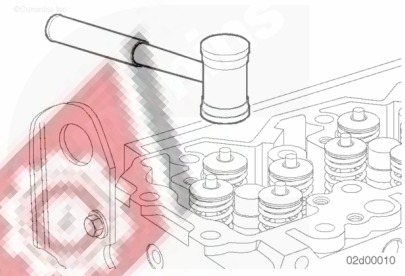


Install the valve spring retainers and valve springs.

Use valve spring compressor, Part Number 3164329, to compress the valve springs.

Install the valve collets. Release the spring tension.

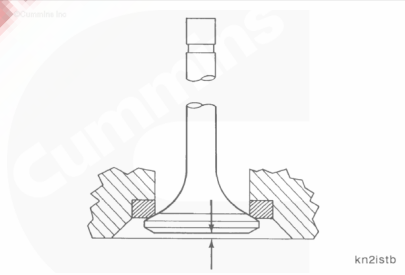
After assembly, hit the valve stems with a plastic hammer to make sure the collets are seated.



Standard Cylinder Head

Measure the valve recess.

Standard Head Valve Recess in Cylinder Head		
mm		in
0.84	MIN	0.033
1.32	MAX	0.052

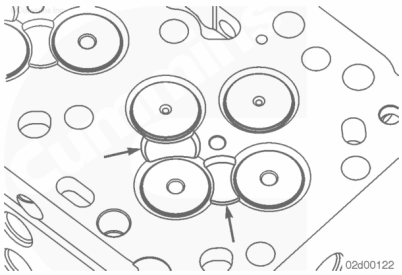


If the valve recess is outside the specifications, replace the valve. If the valve recess is still outside the specifications, the valve seat insert or cylinder head **must** be replaced.

Scallop Cylinder Head

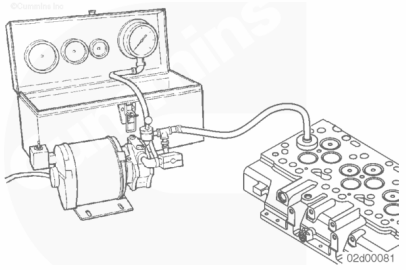
Measure the valve recess.

Scallop Head Valve Recess in Cylinder Head		
mm		in
0.69	MIN	0.027
1.17	MAX	0.046

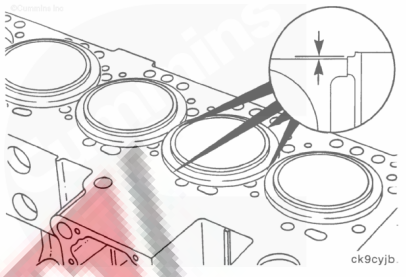


If the valve recess is outside of the specifications, replace the valve. If the valve recess is still outside the specifications, the valve seat insert or cylinder head **must** be replaced.

Before installing the cylinder head, vacuum test the cylinder head again. See the information above in the Vacuum Test section of this procedure.



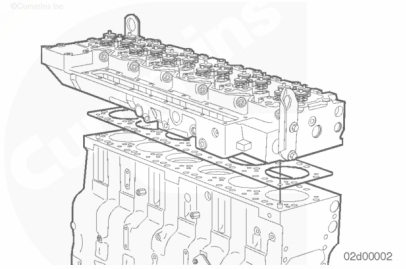
Before installing the cylinder head, check the cylinder liner protrusion. Refer to Procedure 001-028 in Section 1. (/qs3/pubsys2/xml/en/procedures/425/425-001-028.html)



Install

⚠ CAUTION ⚠

Make sure the cylinder head gasket is correctly aligned with holes in the cylinder block. If not aligned properly, it can cause engine damage.

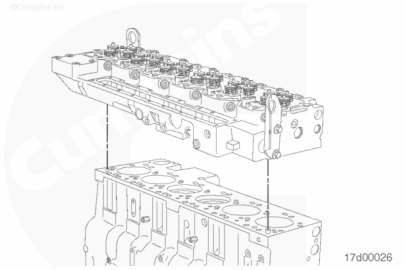


Do **not** attempt to reuse the cylinder head gasket.

Position the new cylinder head gasket over the dowels.

⚠ WARNING ⚠

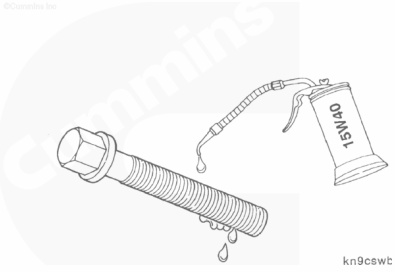
This component or assembly weighs greater than 23 kg [50 lb]. To prevent serious personal injury, be sure to have assistance or use appropriate lifting equipment to lift this component or assembly.



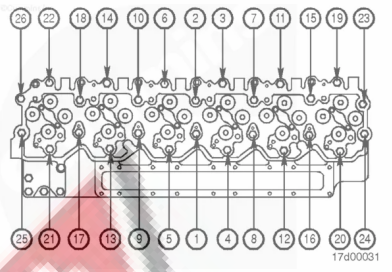
Carefully put the cylinder head straight down onto the cylinder block. Seat it onto the dowels.

If new capscrews are used, capscrew threads are to be burnished. To burnish new capscrews, tighten the capscrews as described below. Loosen the capscrews. Repeat the tightening sequence.

Lubricate the threads and under the heads on the cylinder head capscrews. Use clean engine lubricating oil.



Tighten the cylinder head capscrews in the sequence shown in the illustration.



Torque Value:

1. 50 n•m [37 ft-lb]
2. 150 n•m [111 ft-lb]
3. Loosen all capscrews.
4. 115 n•m [85 ft-lb]
5. 115 n•m [85 ft-lb]
6. Advance 120 degrees.

Finishing Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

Note : If the cylinder head is being replaced due to damaged exhaust valves, intake valves, pistons, or other debris-generating malfunction, refer to Service Bulletin, Prevention of Turbocharger Damage After Engine Mechanical Issue, Bulletin 4326040. (/qs3/pubsys2/xml/en/bulletin/4326040.html)

- Install the exhaust manifold. Refer to Procedure 011-007 in Section 11. (/qs3/pubsys2/xml/en/procedures/425/425-011-007.html)
- Install the turbocharger. Refer to Procedure 010-033 in Section 10. (/qs3/pubsys2/xml/en/procedures/425/425-010-033.html)
- Install the fuel drain lines. Refer to Procedure 006-013 in Section 6. (/qs3/pubsys2/xml/en/procedures/425/425-006-013.html)
- Install the push rods or tubes. Refer to Procedure 004-014 in Section 4. (/qs3/pubsys2/xml/en/procedures/425/425-004-014.html)
- Install the crossheads. Refer to Procedure 002-001 in Section 2. (/qs3/pubsys2/xml/en/procedures/425/425-002-001.html)

- Install the rocker lever. Refer to Procedure 003-008 in Section 3. (/qs3/pubsys2/xml/en/procedures/425/425-003-008.html)
- Adjust the overhead. Refer to Procedure 003-004 in Section 3. (/qs3/pubsys2/xml/en/procedures/425/425-003-004-tr.html)
- Install the rocker lever housing. Refer to Procedure 003-013 in Section 3. (/qs3/pubsys2/xml/en/procedures/425/425-003-013.html)
- Install the engine brake assembly, if equipped. Refer to Procedure 020-004 in Section 20. (/qs3/pubsys2/xml/en/procedures/425/425-020-004-tr.html)
- Install the heat shield. Refer to Procedure 011-032 in Section 11. (/qs3/pubsys2/xml/en/procedures/425/425-011-032.html)
- Install the rocker lever cover. Refer to Procedure 003-011 in Section 3. (/qs3/pubsys2/xml/en/procedures/425/425-003-011.html)

Note : If the cylinder head or the cylinder head gasket is being replaced due to a malfunction that caused an internal coolant leak, the crankcase breather element **must** be replaced.

- Install the crankcase breather tube and drain tube. Refer to Procedure 003-018 in Section 3. (/qs3/pubsys2/xml/en/procedures/425/425-003-018.html)
- Install the fuel connection tubes. Refer to Procedure 006-052 in Section 6. (/qs3/pubsys2/xml/en/procedures/425/425-006-052.html)
- Install the fuel rail. Refer to Procedure 006-060 in Section 6. (/qs3/pubsys2/xml/en/procedures/425/425-006-060.html)
- Install the air intake manifold. Refer to Procedure 010-023 in Section 10. (/qs3/pubsys2/xml/en/procedures/425/425-010-023.html)
- Install the injector supply lines. Refer to Procedure 006-051 in Section 6. (/qs3/pubsys2/xml/en/procedures/425/425-006-051.html)
- Install the air intake connection. Refer to Procedure 010-080 in Section 10. (/qs3/pubsys2/xml/en/procedures/425/425-010-080.html)
- Fill the coolant. Refer to Procedure 008-018 in Section 8. (/qs3/pubsys2/xml/en/procedures/425/425-008-018-tr.html)
- If the malfunction resulted in coolant, oil, excessive fuel, or excessive black smoke entering the exhaust system, the aftertreatment system **must** be inspected. Refer to Procedure 014-017 in Section 14. (/qs3/pubsys2/xml/en/procedures/425/425-014-017.html)
- Connect the batteries. See equipment manufacturer service information.
- Operate the engine. Check for leaks.

Last Modified: 17-Mar-2021

Select Service Tools

Recommended Cummins® Service Tools

- Barring tool, Part Number 5299073
- Angle/level indicator, Part Number 3375855
- Valve spring compressor, Part Number 3164329
- Boot pliers, Part Number 3163293
- Contact cleaner, Part Number 3824510
- Assembly lubricant, Part Number 3163087, or equivalent

Additional Service Items

- Marker or masking tape
- Anti-seize compound
- Plastic hammer

General Information

Note : This procedure can also be used for removing the valve springs, valve spring retainers, and valve collets with the cylinder head installed.

The following procedure is for removing the valve stem seals with the cylinder head installed.

For removing the valve stem seals with the cylinder head removed, Refer to Procedure 002-004 in Section 2. (/qs3/pubsys2/xml/en/procedures/425/425-002-004.html)

Preparatory Steps

⚠ WARNING ⚠

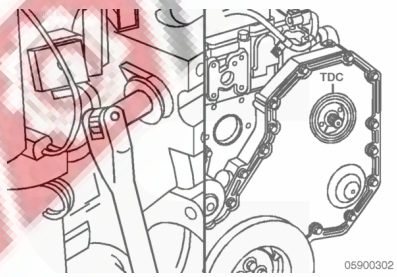
Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

- Disconnect the batteries. See equipment manufacturer service information.
- Remove the rocker lever cover. Refer to Procedure 003-011 in Section 3. (/qs3/pubsys2/xml/en/procedures/425/425-003-011.html)

- If necessary, remove the engine brake assemblies. Refer to Procedure 020-004 in Section 2. (/qs3/pubsys2/xml/en/procedures/425/425-020-004-tr.html)
- Remove the rocker lever assemblies. Refer to Procedure 003-008 in Section 3. (/qs3/pubsys2/xml/en/procedures/425/425-003-008.html)
- Remove the crossheads. Refer to Procedure 002-001 in Section 2. (/qs3/pubsys2/xml/en/procedures/425/425-002-001.html)
- Remove all injectors. Refer to Procedure 006-026 in Section 6. (/qs3/pubsys2/xml/en/procedures/425/425-006-026.html)

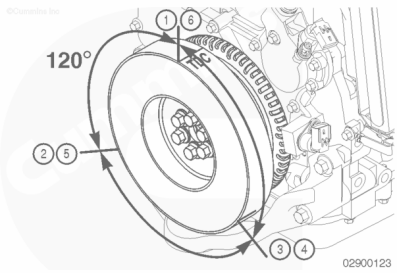
Remove

Note : In order to remove the valve springs with the cylinder head installed, the piston of the cylinder being worked on **must** be brought to top dead center (TDC) to support the valves.



Use barring tool, Part Number 5299073, to rotate the crankshaft to align the TDC marks on the gear cover and fuel pump gear.

With the TDC marks for the number 1 cylinder aligned, mark the vibration damper for the location of TDC for the other cylinders.

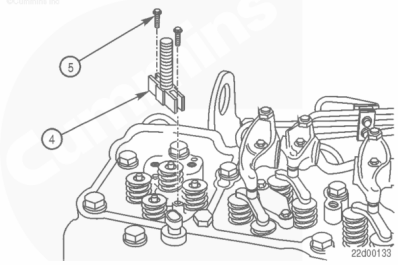


- Mark the vibration damper every 120 degrees with a marker directly on the damper or to a piece of masking tape applied to the outside diameter of the damper.

Service Tip: A protractor, camshaft degree wheel, or angle/level indicator, Part Number 3375855, can be used to locate 120 degree increments around the vibration damper.

- Mark the damper with the TDC indicator for each cylinder as shown. Two cylinders correspond to each 120 degree line.

Compress the valve springs. Use valve spring compressor, Part Number 3164329.

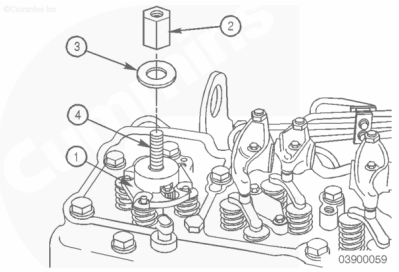


Position the replacer screw (4) above the injector bore. Install the two capscrews (5) in the cylinder head where the hold-down clamp capscrews were removed.

Tighten the capscrews.

Torque Value: 5 n•m [44 in-lb]

Note : The valves are **not** evenly spaced from the injector bore. It is important to align the slots in the valve spring compressor plate with the valve springs.



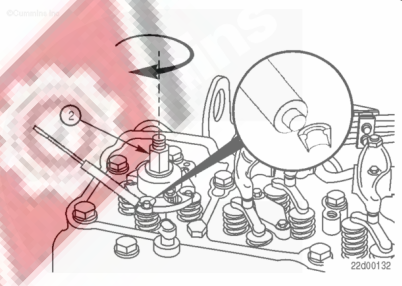
Apply anti-seize compound to the replacer screw (4) threads. **Always** read and follow label precautions.

Position the valve spring compressor plate (1) on the replacer screw (4). Align the slots in the valve spring compressor plate with the valve springs.

Install the washer (3) and nut (2) on the replacer screw (4).

⚠ WARNING ⚠

Wear appropriate eye and face protection when performing this procedure. Springs are under tension and can act as a projectile if released, causing personal injury.



Turn the nut (2) **clockwise** to compress the valve springs.

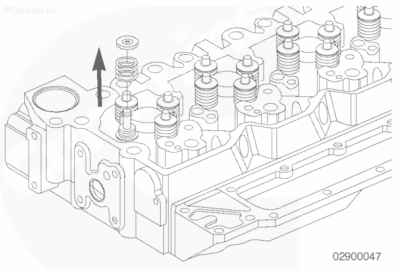
Continue turning the nut (2) **clockwise** until the valve collets can be removed using a magnetic tool, such as the end of a magnetic screwdriver.

Note : Because there is a gap between the top of the piston and valve face, it can be necessary to use a second magnet to hold the valve stem up to remove the valve collets.

Remove the valve collets and valve spring compressor service tool.

⚠ CAUTION ⚠

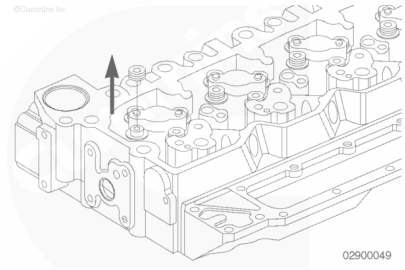
With the valve collets, valve springs, and valve spring retainers removed, do not rotate the engine. Rotating the engine will allow the valves to drop into the cylinder requiring the cylinder head to be removed or possible engine damage.



Remove the four valve spring retainers and valve springs.

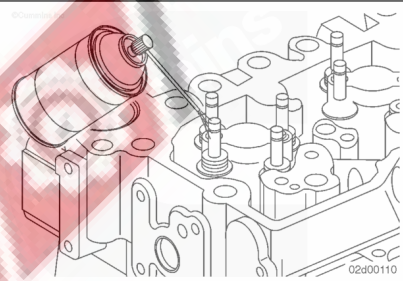
Remove the valve stem seals. Use boot pliers, Part Number 3163293.

ANADOLU ISUZU PARTS



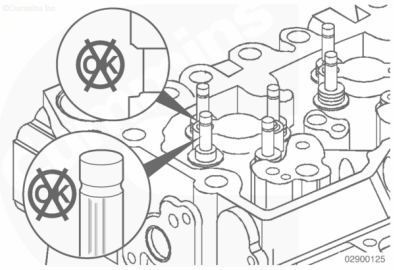
Clean and Inspect for Reuse

Clean the seal tower and valve stem. Use electrical contact cleaner, Part Number 3824510.



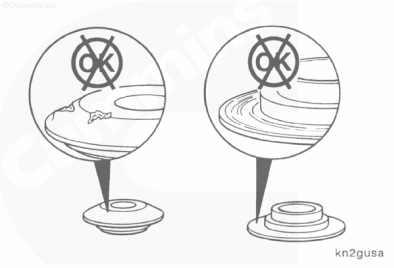
Inspect the exposed valve stem for scoring or heavy polishing. Inspect the valve collet grooves for wear.

If the valve stem is damaged, the cylinder head **must** be removed and the valve replaced. Refer to Procedure 002-004 in Section 2. (/qs3/pubsys2/xml/en/procedures/425/425-002-004.html)



Inspect the valve spring retainers and valve collets for damage or worn areas.

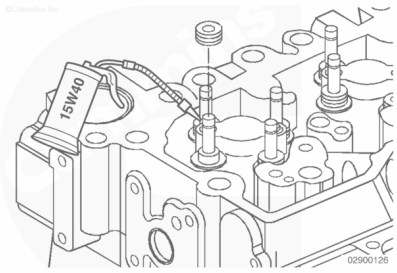
Discard and replace damaged and worn parts.



Install

⚠ CAUTION ⚠

The same color valve stem seal must be installed in the same location as removed. Incorrect valve stem seals will result in excessive oil consumption and internal engine damage.



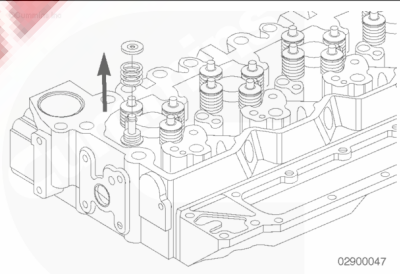
⚠ CAUTION ⚠

Lubricate all the valve guide bores and valve stems with Society of Automotive Engineers (SAE) engine oil. Failure to lubricate the valve guides and valve stems can result in premature valve guide wear.

Install new valve stem seals. The intake and exhaust valve guide seals are the same color.

Lubricate the stems with SAE engine oil before installing the valve stem seals.

Install the valve spring retainer and valve springs.

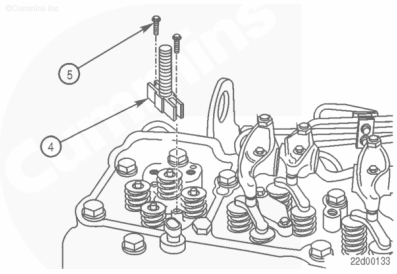


Compress the valve springs using valve spring compressor, Part Number 3164329.

Position the replacer screw (4) above the injector bore. Install the two capscrews (5) in the cylinder head where the hold-down clamp screws were removed.

Tighten the capscrews.

Torque Value: 5 n•m [44 in-lb]

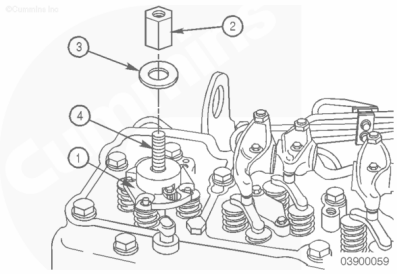


Note : The valves are **not** evenly spaced from the injector bore. It is important to align the slots in the valve spring compressor plate with the valve springs.

Apply anti-seize compound to the replacer screw (4) threads. **Always** read and follow label precautions.

Position the valve spring compressor plate (1) on the replacer screw (4). Align the slots in the valve spring compressor plate with the valve springs.

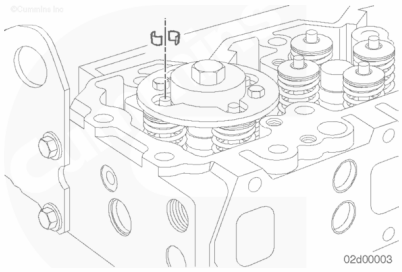
Install the washer (3) and nut (2) on the replacer screw (4).



ANADOLU ISUZU PARTS SALES

⚠ WARNING ⚠

Wear appropriate eye and face protection when performing this procedure. Springs are under tension and can act as a projectile if released, causing personal injury.



Note : Because there is a gap between the top of the piston and the valve face, it can be necessary to use a second magnet to pull the valve stem up to remove the valve collets.

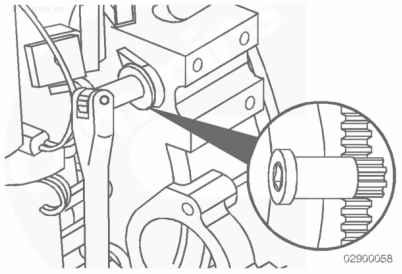
Compress the valve springs until the valve collets can be installed.

Install the valve collets.

Service Tip: Use assembly lubricant, Part Number 3163087, or equivalent, on the valve collets to help hold them in place until the valve spring compressor is released.

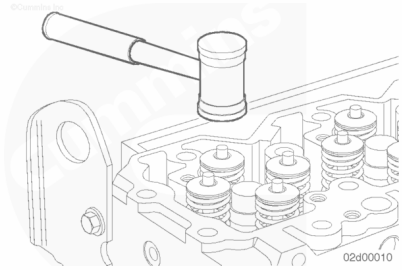
Remove the valve spring compressor service tool.

Use the marks made previously on the vibration damper. Rotate the engine to the next mark to replace the valve guide seals on the next pair of cylinders.



⚠ WARNING ⚠

To reduce the possibility of personal injury, wear eye protection. If the collets are not correctly installed, they can fly out when the stems are hit with a hammer.



⚠ CAUTION ⚠

Rotate the engine to the next cylinder in the firing order before hitting the valve stem of the cylinder previously worked on. This will ensure the valve does not contact the piston, resulting in a bent valve and internal engine damage.

ANADOLU ISUZU AFTER SALES

After rotating the engine to the next cylinder in the firing order, hit the valve stems of the cylinder previously worked on with a plastic hammer to make sure the collets are seated.

Repeat the previous steps until all of the valve stem seals have been replaced.

Finishing Steps

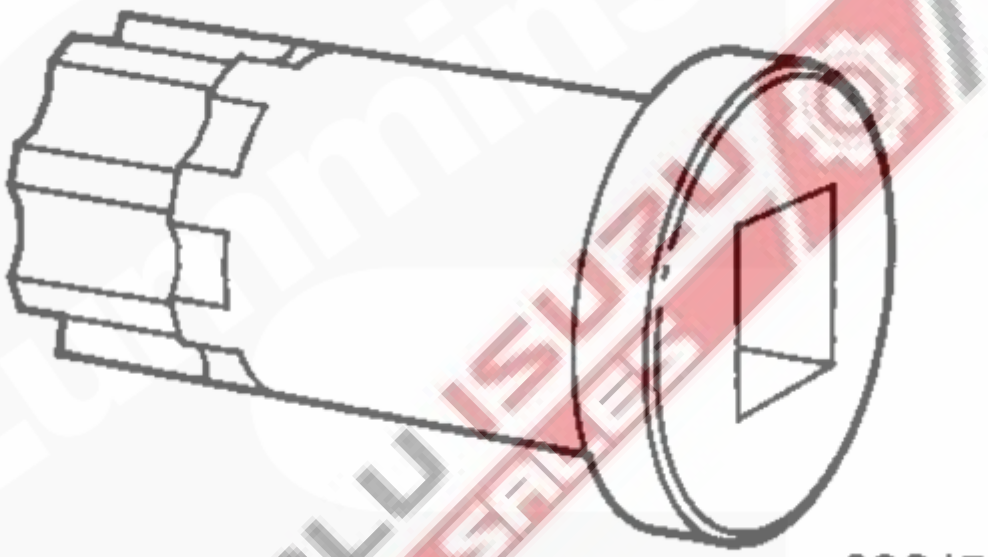
⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

- Install the injectors. Refer to Procedure 006-026 in Section 6. (/qs3/pubsys2/xml/en/procedures/425/425-006-026.html)
- Install the crossheads. Refer to Procedure 002-001 in Section 2. (/qs3/pubsys2/xml/en/procedures/425/425-002-001.html)
- Install the rocker lever assemblies. Refer to Procedure 003-008 in Section 3. (/qs3/pubsys2/xml/en/procedures/425/425-003-008.html)
- Adjust the overhead. Refer to Procedure 003-004 in Section 3. (/qs3/pubsys2/xml/en/procedures/425/425-003-004-tr.html)
- Install the engine brake assemblies, if removed. Refer to Procedure 020-004 in Section 20. (/qs3/pubsys2/xml/en/procedures/425/425-020-004-tr.html)
- Install the rocker lever cover. Refer to Procedure 003-011 in Section 3. (/qs3/pubsys2/xml/en/procedures/425/425-003-011.html)
- Connect the batteries. See equipment manufacturer service information.
- Operate the engine. Check for leaks.

ANADOLU ISUZU

Rocker Levers

Tool Number
5299073
Engine Barring Gear Used to engage the flywheel ring gear to rotate the crankshaft.


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ANADOLU ISUZU AFTER SALES

Last Modified: 25-Jul-2016

Select Service Tools

Recommended Cummins® Service Tools

- No Cummins® Service Tools required.

Additional Service Items

- No additional service items required.

Preparatory Steps

⚠ WARNING ⚠

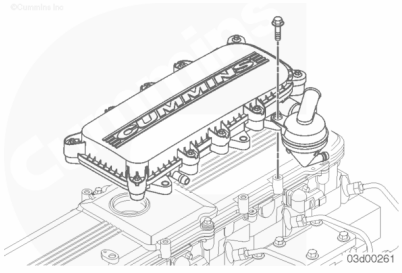
Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

- Disconnect the batteries. See equipment manufacturer service information.
- Remove the crankcase breather tube and drain tubes. Refer to Procedure 003-018 in Section 3. (/qs3/pubsys2/xml/en/procedures/425/425-003-018.html)

Remove

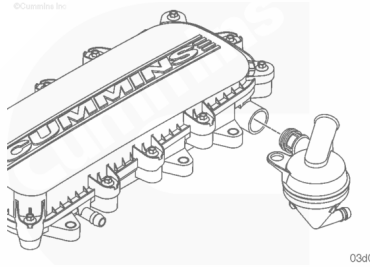
Remove the six mounting capscrews.

Remove the breather from the rocker lever cover by pulling straight up on the breather assembly.



Remove the oil separator from the breather housing.

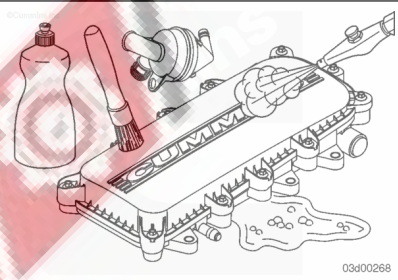
ANADOLU ISUZU



Clean and Inspect for Reuse

⚠ WARNING ⚠

Wear appropriate eye and face protection when using compressed air. Flying debris and dirt can cause personal injury.



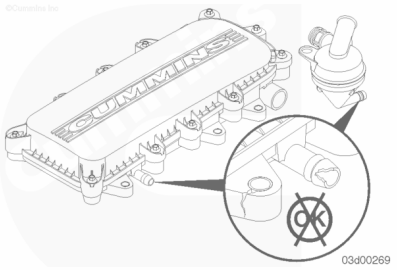
Cover the oil inlet, oil drain, and draft line connections to prevent debris from entering the crankcase breather element. Use hot, soapy water and a soft brush to clean the crankcase breather and separator.

Dry with compressed air.

Note : If necessary, disassemble the crankcase breather and remove the crankcase breather element in order to clean the housing. Refer to Procedure 003-019 in Section 3. (/qs3/pubsys2/xml/en/procedures/425/425-003-019.html)

Inspect the crankcase breather and separator for cracks or other damage.

Replace parts as necessary.

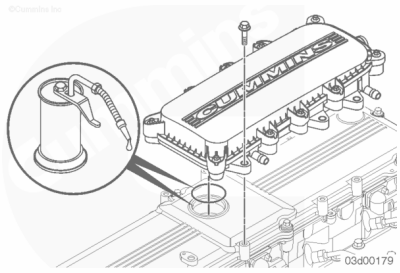


Install

Install a new o-ring on the breather.

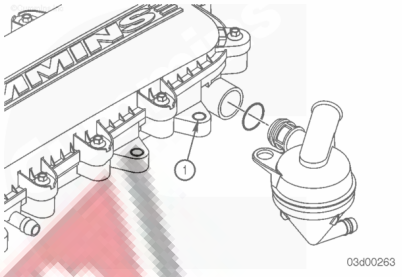
Lubricate the o-ring and the valve cover o-ring seat. Use lubricating oil.

Install the breather into the rocker lever cover.



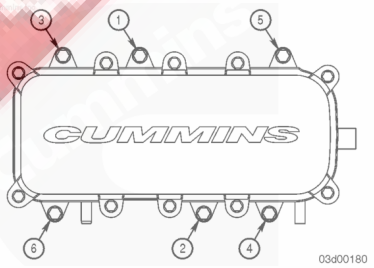
Install a new o-ring on the oil separator. Attach it to the breather housing.

Make sure the mounting location for the oil separator is aligned with a rear breather housing mounting location (1).



Tighten the capscrews in the sequence shown.

Torque Value: 18 n•m [159 in-lb]



Finishing Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

- Install the crankcase breather tube and drain tube. Refer to Procedure 003-018 in Section 3. (/qs3/pubsys2/xml/en/procedures/425/425-003-018.html)
- Connect the batteries. See equipment manufacturer service information.
- Operate the engine. Check for leaks.

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ANADOLU ISUZU
AFTER SALES

Select Service Tools

Recommended Cummins® Service Tools

- Barring tool, Part Number 5299073, or equivalent

Additional Service Items

- Feeler gauge

Preparatory Steps

⚠ WARNING ⚠

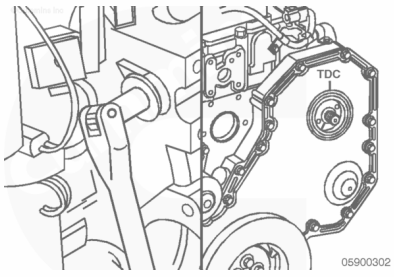
Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

- Disconnect the batteries. See equipment manufacturer service information.
- Remove the exhaust gas exhaust gas recirculation (EGR) connection tube. Refer to Procedure 011-025 in Section 11. (/qs3/pubsys2/xml/en/procedures/425/425-011-025-tr.html)
- Remove the plastic fuel pump drive cover located on the front of the engine.
- Remove the rocker lever cover. Refer to Procedure 003-011 in Section 3. (/qs3/pubsys2/xml/en/procedures/425/425-003-011-tr.html)

Adjust

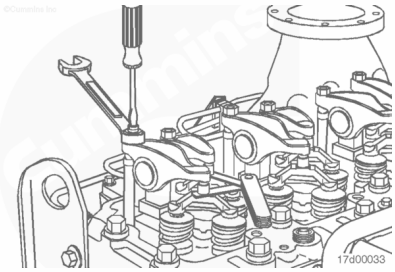
⚠ CAUTION ⚠

Engine coolant temperature should be less than 60°C [140°F].



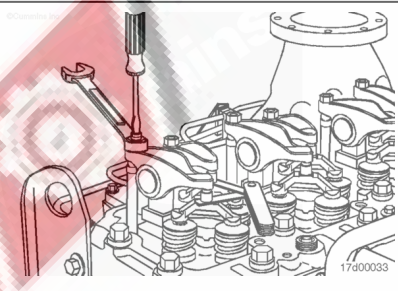
Use barring tool, Part Number 5299073, or equivalent. Rotate the crankshaft to align the top dead center marks on the gear cover and fuel pump gear.

With the engine in this position, lash can be checked on the following rocker arms: 1I, 1E, 2I, 3E, 4I, and 5E.



Lash Check Limits			
	mm		in
Intake	0.152	MIN	0.006
	0.559	MAX	0.022
Exhaust	0.381	MIN	0.015
	0.813	MAX	0.032

Measure lash by inserting a feeler gauge between the crosshead and rocker lever ball insert and socket while lifting up on the end of the rocker arm. If the lash measurement is out of specification, loosen the locknut and adjust the lash to the nominal specification.



Lash Reset Specifications			
	mm		in
Intake	0.305	NOM	0.012
Exhaust	0.559	NOM	0.022

Note : Lash resets are **only** required at the interval specified in the appropriate owner's or operation and maintenance manual when lash is measured and found out of specification, or when engine repairs cause removal of the rocker arms and/or loosening of the adjusting screws.

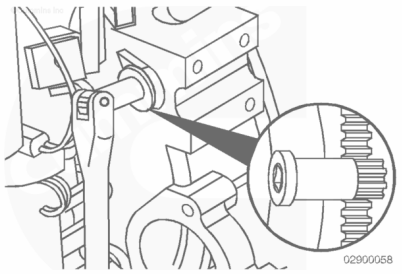
Tighten the locknut. Measure again.

Torque Value: 24 n•m [212 in-lb]

Install the nut cap on the exhaust adjusting screws for engine brakes, if applicable.

Torque Value: 24 n•m [212 in-lb]

Use barring tool, Part Number 5299073, or equivalent. Rotate the crankshaft 360 degrees. Measure lash for rocker arms 2E, 3I, 4E, 5I, 6I, and 6E. Reset the lash, if out of specification.



Finishing Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

- Install the rocker lever cover. Refer to Procedure 003-011 in Section 3. (/qs3/pubsys2/xml/en/procedures/425/425-003-011.html)
- Install the EGR connection tube. Refer to Procedure 011-025 in Section 11. (/qs3/pubsys2/xml/en/procedures/425/425-011-025.html)
- Install the plastic fuel pump drive cover located on the front of the engine.
- Connect the batteries. See equipment manufacturer service information.
- Operate the engine. Check for leaks.

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Last Modified: 17-Nov-2016

Select Service Tools

Recommended Cummins® Service Tools

- No Cummins® Service Tools required.

Additional Service Items

- No additional service items required.

Preparatory Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

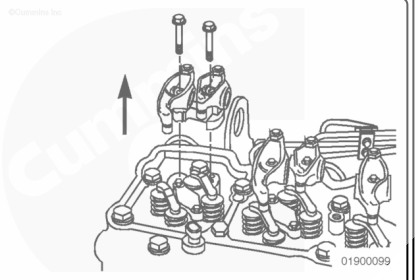
- Disconnect the batteries. See equipment manufacturer service information.
- Remove the crankcase breather tube. Refer to Procedure 003-018 in Section 3. (/qs3/pubsys2/xml/en/procedures/425/425-003-018.html)
- Remove the exhaust gas recirculation (EGR) connection tube. Refer to Procedure 011-025 in Section 11. (/qs3/pubsys2/xml/en/procedures/425/425-011-025.html)
- Remove the rocker lever cover. Refer to Procedure 003-011 in Section 3. (/qs3/pubsys2/xml/en/procedures/425/425-003-011.html)
- Remove the engine brake assembly, if equipped. Refer to Procedure 020-004 in Section 20. (/qs3/pubsys2/xml/en/procedures/425/425-020-004-tr.html)

Remove

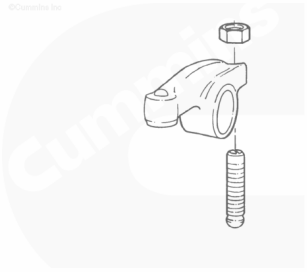
Remove the capscrews from the rocker lever pedestals.

Remove and mark the pedestals and rocker lever assemblies one at a time as to their location and position.

The rocker assemblies **must** be installed in their original location and position.

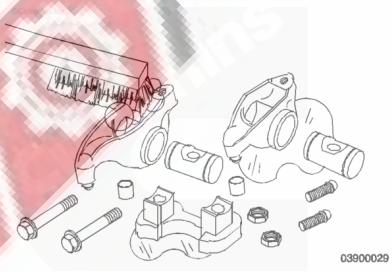


Remove the locknut and adjusting screw.



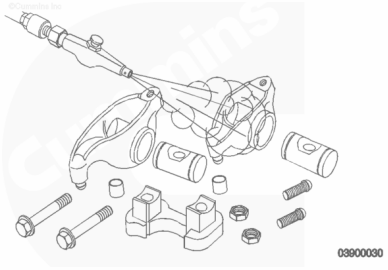
Clean and Inspect for Reuse

Clean all parts in a strong solution of laundry detergent in hot water.



⚠ WARNING ⚠

Wear appropriate eye and face protection when using compressed air. Flying debris and dirt can cause personal injury.



Use compressed air to dry the parts after rinsing in clean hot water.

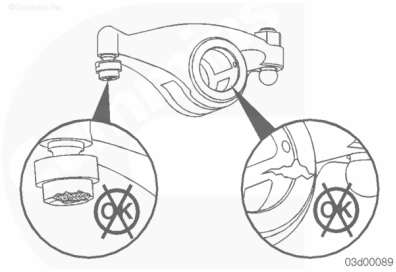
The pedestals are made from powdered metal and will continue to show wetness after they have been cleaned and dried.

Make sure the oil drillings in the rocker arms and shafts are unobstructed.

Inspect for cracks and excessive wear in the bore.

The socket should move freely on the rocker lever. The plastic socket retainer should be in place and **not** cracked.

Inspect for wear on the nose of the socket.



AYRDOU ISUZU PARTS

Measure the rocker lever bore.

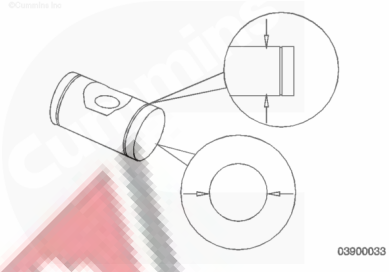
Rocker Lever Bore		
mm		in
24.987	MIN	0.984
25.013	MAX	0.985



Inspect the rocker lever pedestal and rocker lever shaft for cracks.

Measure the rocker lever shaft diameter.

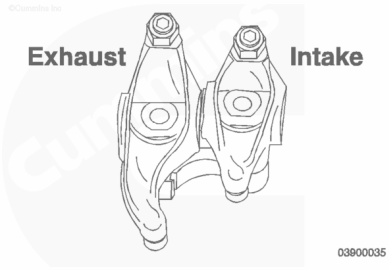
Rocker Lever Shaft		
mm		in
24.950	MIN	0.982
24.962	MAX	0.983



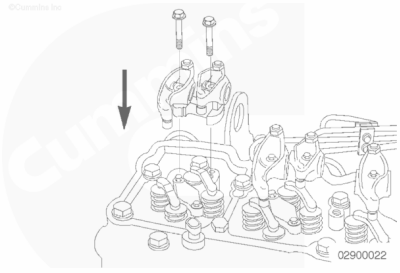
Install

Without Engine Brakes

Position the rocker levers on the rocker pedestal.



Install the rocker lever assemblies and pedestals in their original locations.

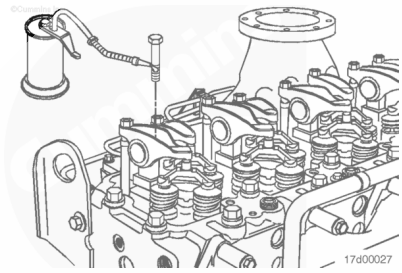


Lubricate the capscrew threads. Use clean engine oil.

Install and tighten the pedestal capscrews.

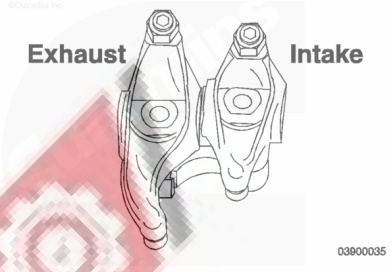
Torque Value: 65 n•m [48 ft-lb]

ANADOLU ISUZU AFTER SALES



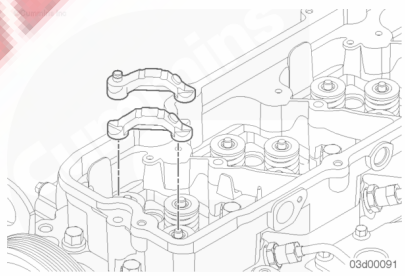
With Engine Brakes

Position the rocker levers on the rocker pedestal.



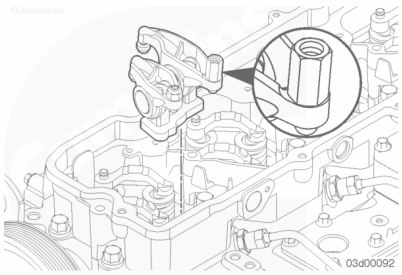
Install the crossheads in their original location and position.

Install the engine brake compatible exhaust crossheads with the pin facing the exhaust manifold.



Install the rocker lever assemblies and pedestals in their original location.

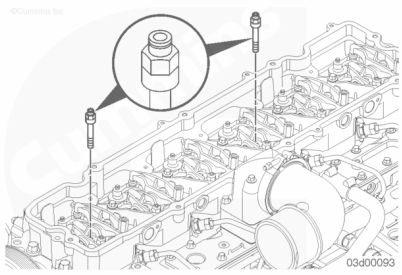
Make sure the exhaust rocker levers have the longer adjusting screw locknut installed.



Lubricate the capscrew threads. Use clean engine oil.

Install the engine brake oil supply capscrews on intake rocker levers 1 and 4.

Torque Value: 65 n•m [48 ft-lb]

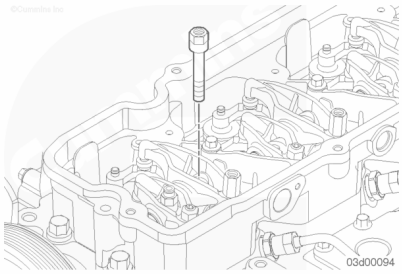


Lubricate the capscrew threads. Use clean engine oil.

ANADOLU ISUZU AFTER SALES

Install the exhaust rocker lever capscrews into all exhaust levers.

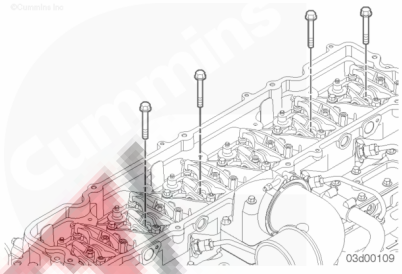
Torque Value: 65 n•m [48 ft-lb]



Lubricate the capscrew threads. Use clean engine oil.

Install the pedestal capscrews in cylinders 2, 3, 5, and 6 intake rocker pedestals.

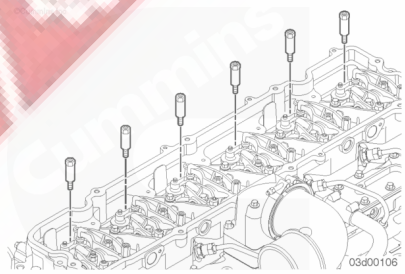
Torque Value: 65 n•m [48 ft-lb]



Lubricate the capscrew threads. Use clean engine oil.

Install the six threaded spacers into the cylinder head.

Torque Value: 24 n•m [212 in-lb]



Finishing Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

- Adjust the overhead. Refer to Procedure 003-004 in Section 3. (/qs3/pubsys2/xml/en/procedures/425/425-003-004-tr.html)
- Install the engine brake assemblies, if equipped. Refer to Procedure 020-004 in Section 20. (/qs3/pubsys2/xml/en/procedures/425/425-020-004-tr.html)
- Install the rocker lever cover. Refer to Procedure 003-011 in Section 3. (/qs3/pubsys2/xml/en/procedures/425/425-003-011.html)
- Install the crankcase breather tube. Refer to Procedure 003-018 in Section 3. (/qs3/pubsys2/xml/en/procedures/425/425-003-018.html)
- Install the EGR connection tube. Refer to Procedure 011-025 in Section 11. (/qs3/pubsys2/xml/en/procedures/425/425-011-025.html)

ANADOLU ISUZU AFTER SALES

- Connect the batteries. See equipment manufacturer service information.
- Operate the engine. Check for leaks.

Last Modified: 03-Aug-2016

ANADOLU ISUZU AFTER SALES

Select Service Tools

Recommended Cummins® Service Tools

- No Cummins® service tools required.

Additional Service Items

- No additional service items required.

Preparatory Steps

⚠ WARNING ⚠

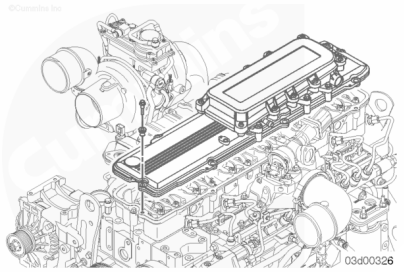
Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

- Disconnect the batteries. See equipment manufacturer service information.
- Remove the exhaust gas recirculation (EGR) connection tube. Refer to Procedure 011-025 in Section 11. (/qs3/pubsys2/xml/en/procedures/425/425-011-025-tr.html)
- Disconnect and remove the aftertreatment intake NOx sensor. Refer to Procedure 019-463 in Section 19. (/qs3/pubsys2/xml/en/procedures/425/425-019-463.html)
- Disconnect the crankcase pressure sensor. Refer to Procedure 019-445 in Section 19. (/qs3/pubsys2/xml/en/procedures/425/425-019-445.html)
- Remove the crankcase breather tube and drain tube. Refer to Procedure 003-018 in Section 3. (/qs3/pubsys2/xml/en/procedures/425/425-003-018.html)

Remove

Remove the capscrews.

Remove the rocker lever cover and gasket.



Note : The rocker lever cover can be taller if the engine is equipped with engine brakes.

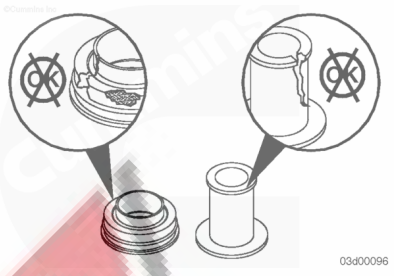
Note : It is **not** necessary to remove the crankcase breather in order to remove the rocker lever cover.

Note : It is **not** necessary to remove the heat shield in order to remove the rocker lever cover.

Clean and Inspect for Reuse

Check the isolators for cracks, tears, or brittleness.

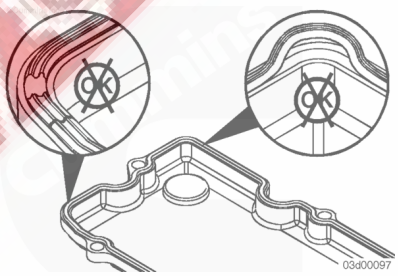
Replace the isolators if any damage is found.



Check the gasket for cracks on the sealing surface.

Replace the gasket if damage is present.

Replace the gasket if it is removed from the groove in the rocker lever cover.

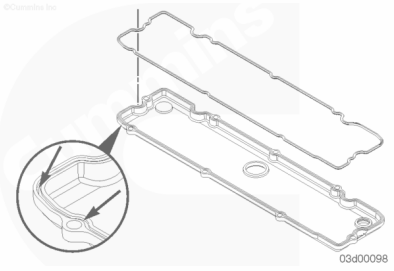


Install

Note : If the gasket has been removed from the rocker lever cover, a new gasket **must** be installed.

The following installation procedure **must** be used when installing the press in gasket.

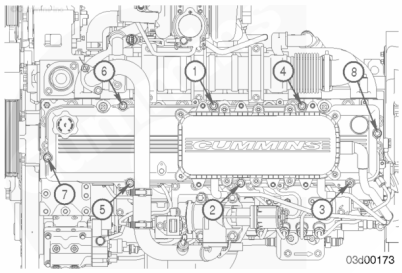
1. Press the molded gasket into the corners of the rocker lever cover.
2. Press the gasket around the capscrew mounting holes.
3. Press the remaining gasket into the rocker lever cover.



Install the rocker lever cover and capscrews.

Torque Value: 12 n•m [106 in-lb]

Tighten the capscrews in the sequence shown.



ANADOLU ISUZU DEALER SALES

Finishing Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

- Install the crankcase breather tube and drain tube. Refer to Procedure 003-018 in Section 3. (/qs3/pubsys2/xml/en/procedures/425/425-003-018.html)
- Connect the crankcase pressure sensor. Refer to Procedure 019-445 in Section 19. (/qs3/pubsys2/xml/en/procedures/425/425-019-445.html)
- Install and connect the aftertreatment intake NOx sensor. Refer to Procedure 019-463 in Section 19. (/qs3/pubsys2/xml/en/procedures/425/425-019-463.html)
- Install the EGR connection tube. Refer to Procedure 011-025 in Section 11. (/qs3/pubsys2/xml/en/procedures/425/425-011-025-tr.html)
- Connect the batteries. See equipment manufacturer service information.
- Operate the engine. Check for leaks.

ANADOLU ISUZU AFTER SALES

Last Modified: 17-Nov-2016

Select Service Tools

Recommended Cummins® Service Tools

- No Cummins® service tools required.

Additional Service Items

- Permatex® sealant, or equivalent

Preparatory Steps

⚠ WARNING ⚠

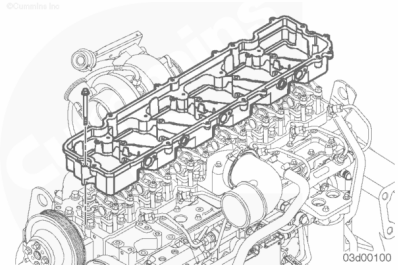
Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

- Disconnect the batteries. See equipment manufacturer service information.
- Remove the exhaust gas recirculation (EGR) connection tube. Refer to Procedure 011-025 in Section 11. (/qs3/pubsys2/xml/en/procedures/425/425-011-025.html)
- Remove the crankcase breather tube and drain tube. Refer to Procedure 003-018 in Section 3. (/qs3/pubsys2/xml/en/procedures/425/425-003-018.html)
- Remove the rocker lever cover. Refer to Procedure 003-011 in Section 3. (/qs3/pubsys2/xml/en/procedures/425/425-003-011.html)
- Remove the heat shield. Refer to Procedure 011-032 in Section 11. (/qs3/pubsys2/xml/en/procedures/425/425-011-032.html)
- Disconnect the injector harness pass-through connectors.
- Remove the engine brake assembly, if equipped. Refer to Procedure 020-004 in Section 20. (/qs3/pubsys2/xml/en/procedures/425/425-020-004-tr.html)
- Disconnect the injector wiring harness from the injector. Refer to Procedure 006-026 in Section 6. (/qs3/pubsys2/xml/en/procedures/425/425-006-026.html)

Remove

Remove the rocker lever housing mounting capscrews.

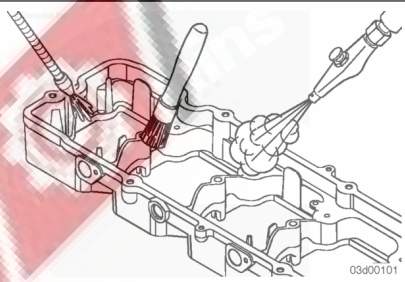
Remove the rocker lever housing and gasket from the cylinder head.



Clean and Inspect for Reuse

⚠ WARNING ⚠

When using solvents, acids, or alkaline materials for cleaning, follow the manufacturer's recommendations for use. Wear goggles and protective clothing to reduce the possibility of personal injury.



⚠ WARNING ⚠

Some solvents are flammable and toxic. Read the manufacturer's instructions before using.

⚠ WARNING ⚠

Wear appropriate eye and face protection when using compressed air. Flying debris and dirt can cause personal injury.

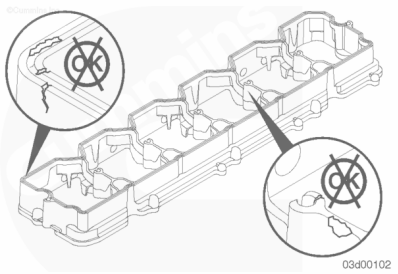
Remove the rocker lever housing gasket.

Make sure the work surface is clean and free from any oil, dirt, or debris.

Clean the rocker lever housing. Use solvent. Dry with compressed air.

Inspect the rocker lever housing for cracks or any other damage, especially on the cylinder head mounting surface.

Inspect the bridge area in the center of the rocker lever housing for cracks.

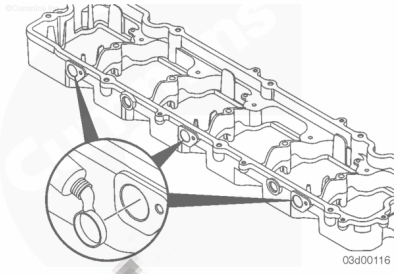


Install

Install the 22 mm cup plugs into the rocker lever housing.

Coat the contact surface of cup plug. Use Permatex® sealant, or equivalent.

Install the cup plugs flush with the outer surface of the rocker lever housing.



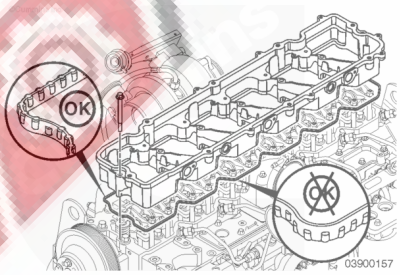
Note : A new rocker lever housing gasket **must** be used when the rocker lever housing is removed. Do **not** reuse the old gasket.

Note : Unpack the gasket. Lay it out in front of the grooved section of the rocker lever housing. Align the gasket in the position in which it will be installed. Confirm the gasket is not twisted.

Note : Make sure the orientation of the gasket matches the corresponding features in the rocker lever housing and the beaded side of the gasket is installed into the housing.

Install the new rocker lever housing gasket. Start by pressing the beaded side of the gasket into the corresponding features of the rocker lever housing. Press the remaining gasket into the housing.

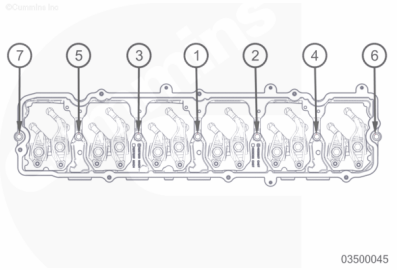
Install the rocker lever housing on the cylinder head.



Install the capscrews. Tighten. Start with the center capscrew and work outward in a spiral pattern.

Capscrews are not installed in the perimeter holes of the rocker lever housing. These holes are used to install another component onto the rocker lever housing.

Torque Value: 24 n•m [212 in-lb]



Finishing Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

- Connect the injector wiring harness to the injectors. Refer to Procedure 006-026 in Section 6. (/qs3/pubsys2/xml/en/procedures/425/425-006-026.html)
- Connect the injector harness pass-through connectors.
- Install the engine brake assembly, if equipped. Refer to Procedure 020-004 in Section 20. (/qs3/pubsys2/xml/en/procedures/425/425-020-004-tr.html)
- Install the heat shield. Refer to Procedure 011-032 in Section 11. (/qs3/pubsys2/xml/en/procedures/425/425-011-032.html)
- Install the rocker lever cover. Refer to Procedure 003-011 in Section 3. (/qs3/pubsys2/xml/en/procedures/425/425-003-011.html)
- Install the crankcase breather tube and drain tube. Refer to Procedure 003-018 in Section 3. (/qs3/pubsys2/xml/en/procedures/425/425-003-018.html)
- Install the EGR connection tube. Refer to Procedure 011-025 in Section 11. (/qs3/pubsys2/xml/en/procedures/425/425-011-025.html)
- Connect the batteries. See equipment manufacturer service information.
- Operate the engine. Check for leaks.

ANADOLU ISUZU AFTER SALES

Last Modified: 27-Apr-2018

Select Service Tools

Recommended Cummins® Service Tools

- No Cummins® service tools required.

Additional Service Items

- Soft brush

Preparatory Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

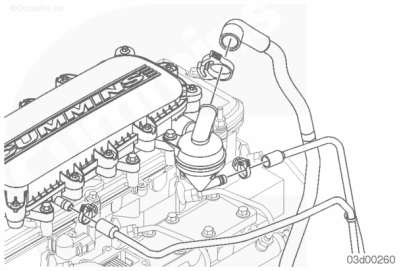
- Disconnect the batteries. See equipment manufacturer service information.

Remove

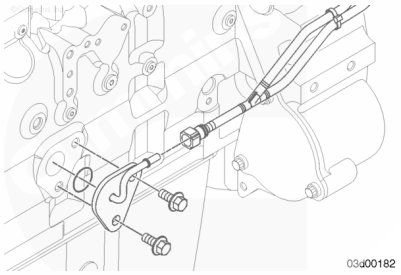
Remove the crankcase breather tube from the crankcase breather assembly.

Remove the crankcase drain lines from the crankcase breather assembly.

Remove the snapper hose clamps from the drain tube and lines.



Remove the breather drain lines, breather drain line cover, and gasket from the cylinder block.



ANADOLU ISUZU AFTER SALES

Clean and Inspect for Reuse

⚠ WARNING ⚠

Wear appropriate eye and face protection when using compressed air. Flying debris and dirt can cause personal injury.

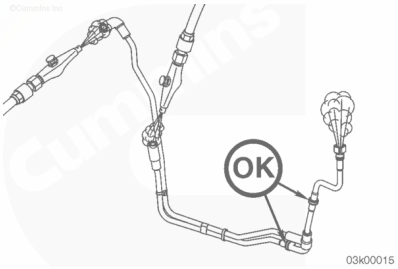


Check the tube and lines internally for obstructions or sludge buildup.

Clean the tube and lines. Use hot, soapy water and a soft brush.

Use compressed air to dry the tube and lines after rinsing in clean water.

Inspect the breather drain line check valve for correct operation. A small amount of air can be blown through the line (less than 34 kPa [5 psi]) to check the check valve operation.

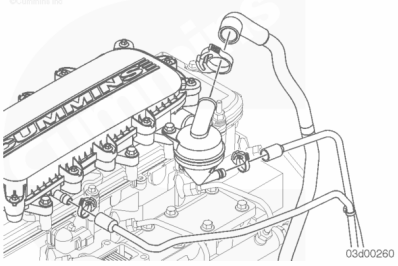


Note : To properly test each check valve, the inlet of the breather drain line **not** being tested **must** be covered to force air down the correct path.

Note : An obstructed drain tube or line will lead to excessive crankcase pressure.

Install

Note : Make sure the crankcase breather tube or drain lines do **not** contact any high pressure fuel lines.

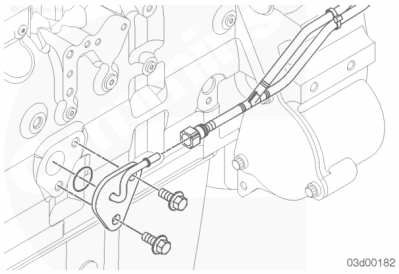


Install the crankcase breather tube to the crankcase breather assembly.

Install the crankcase drain lines to the crankcase breather assembly.

Install the breather drain line cover, gasket, and tube to the cylinder block.

Torque Value: 45 n•m [33 ft-lb]



Finishing Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

- Connect the batteries. See equipment manufacturer service information.
- Operate the engine. Check for leaks.

ANADOLU ISUZU AFTER SALES

Last Modified: 08-Nov-2016

Select Service Tools

Recommended Cummins® Service Tools

- No Cummins® Service Tools required.

Additional Service Items

- No additional service items required.

Preparatory Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

⚠ WARNING ⚠

When using a steam cleaner, wear safety glasses or a face shield, as well as protective clothing. Hot steam can cause serious personal injury.

⚠ WARNING ⚠

Wear appropriate eye and face protection when using compressed air. Flying debris and dirt can cause personal injury.

- Disconnect the batteries. See equipment manufacturer service information.
- Clean the crankcase breather cover area. Use steam. Dry with compressed air.

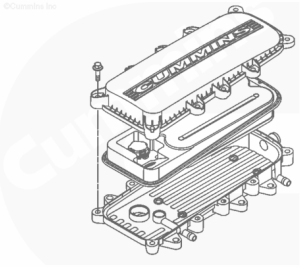
Remove

Remove the eleven crankcase breather cover capscrews.

Note : The six capscrews attaching the crankcase breather base to the valve cover do **not** need to be removed.

Remove the crankcase breather cover.

Remove the crankcase breather element.

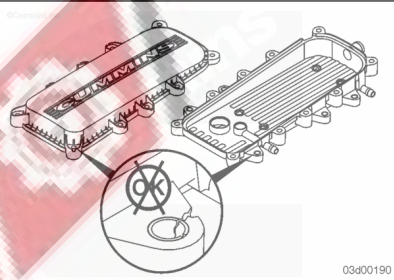


03d00189

Clean and Inspect for Reuse

⚠ WARNING ⚠

Wear appropriate eye and face protection when using compressed air. Flying debris and dirt can cause personal injury.



03d00190

Inspect the breather cover and base for cracks or other damage.

Check for internal obstructions or sludge buildup.

Clean the crankcase breather cover. Use hot, soapy water and a soft brush.

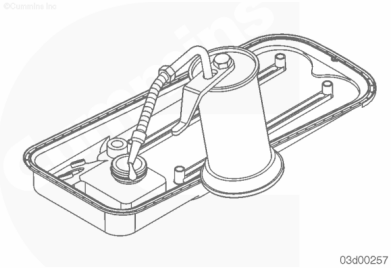
Rinse the cover with clean water. Dry with compressed air.

Note : Do **not** use soapy water to clean or rinse the breather base. Clean the base with a wet rag to prevent water from entering the crankcase.

Install

Lubricate the breather element o-ring seal. Use clean lubricating oil.

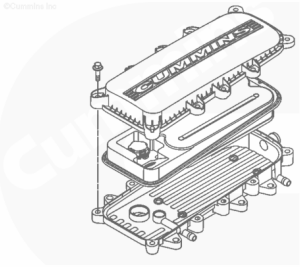
Use the following procedure for breather element recommendations. Refer to Procedure 018-024 in Section V. (/qs3/pubsys2/xml/en/procedures/425/425-018-024.html)


03d00257

Install the new breather element onto the breather base.

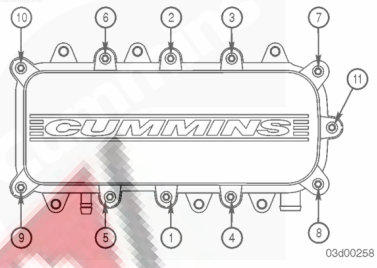
Install the crankcase breather cover.

Install the eleven crankcase breather cover capscrews.



Tighten the capscrews in the sequence shown.

Torque Value: 5 n•m [44 in-lb]



Finishing Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

- Connect the batteries. See equipment manufacturer service information.
- Operate the engine. Check for leaks.

ANADOLU ISUZU

Last Modified: 03-Aug-2016

Cam Followers/Tappets

Tool Number

3165086

Tappet Removal Tool

Tappet trough for engines using the larger bore tappets. Used to update Tappet Removal Tool Kit, Part Number 3163468.

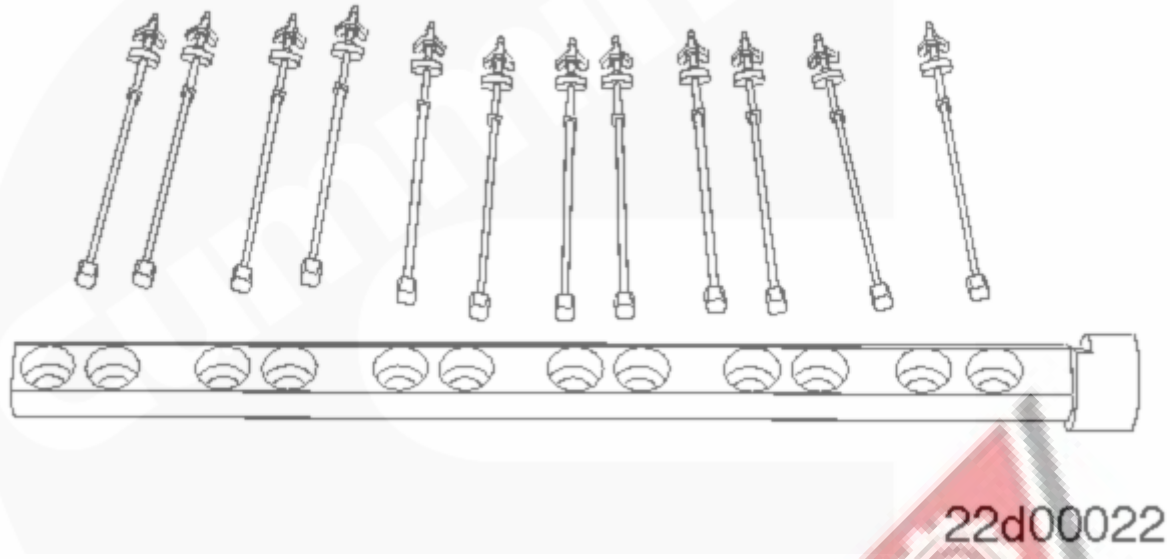


Tool Number

3165088

Tappet Removal Tool Kit

Used to remove and install roller tappets.

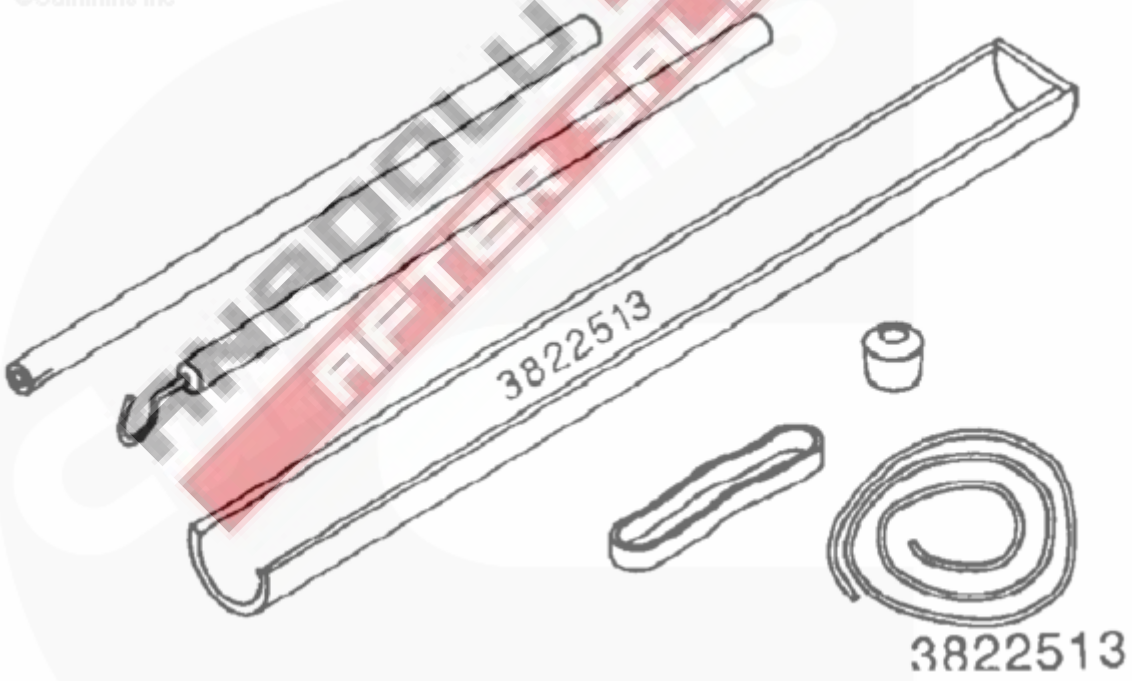


Tool Number

3822513

Tappet Removal Tool Kit

Used to remove and install sliding valve tappets.



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ANADOLU ISUZU
AFTER SALES

Select Service Tools

Recommended Cummins® Service Tools

- No Cummins® Service Tools required.

Additional Service Items

- No additional service items required.

Preparatory Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

- Disconnect the batteries. See equipment manufacturer service information.
- Remove the exhaust gas recirculation (EGR) connection tube. Refer to Procedure 011-025 in Section 11. (/qs3/pubsys2/xml/en/procedures/425/425-011-025.html)
- Remove the crankcase breather tube. Refer to Procedure 003-018 in Section 3. (/qs3/pubsys2/xml/en/procedures/425/425-003-018.html)
- Remove the rocker lever cover. Refer to Procedure 003-011 in Section 3. (/qs3/pubsys2/xml/en/procedures/425/425-003-011.html)
- Remove the engine brake assembly, if equipped. Refer to Procedure 020-004 in Section 20. (/qs3/pubsys2/xml/en/procedures/425/425-020-004-tr.html)
- Remove the rocker levers. Refer to Procedure 003-008 in Section 3. (/qs3/pubsys2/xml/en/procedures/425/425-003-008.html)

Remove

Mark the push tubes to identify their location.

Remove the push tubes.

Clean and Inspect for Reuse

⚠ WARNING ⚠

Wear appropriate eye and face protection when using compressed air. Flying debris and dirt can cause personal injury.

Clean the push tubes in hot soapy water. Dry with compressed air.

Inspect the push tube ball and socket for signs of scoring. Check for cracks where the ball and socket are welded into the tube.

Check the push tubes for straightness.

Install

Install the push tubes in their original location.

Install the push tubes into the sockets of the valve tappets.

Lubricate the push tube sockets. Use clean engine oil.

Finishing Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

- Install the rocker levers. Refer to Procedure 003-008 in Section 3. (/qs3/pubsys2/xml/en/procedures/425/425-003-008.html)

ANADOLU ISUZU AFTER SALES

- Adjust the valve lash. Refer to Procedure 003-004 in Section 3. (/qs3/pubsys2/xml/en/procedures/425/425-003-004-tr.html)
- Install the engine brake assembly, if equipped. Refer to Procedure 020-004 in Section 20. (/qs3/pubsys2/xml/en/procedures/425/425-020-004-tr.html)
- Install the rocker lever cover. Refer to Procedure 003-011 in Section 3. (/qs3/pubsys2/xml/en/procedures/425/425-003-011.html)
- Install the crankcase breather tube. Refer to Procedure 003-018 in Section 3. (/qs3/pubsys2/xml/en/procedures/425/425-003-018.html)
- Install the EGR connection tube. Refer to Procedure 011-025 in Section 11. (/qs3/pubsys2/xml/en/procedures/425/425-011-025.html)
- Connect the batteries. See equipment manufacturer service information.
- Operate the engine. Check for leaks.

Last Modified: 14-Sep-2016

ANADOLU ISUZU AFTER SALES

Select Service Tools

Recommended Cummins® Service Tools

- Tappet Removal Tool Kit, Part Number 3165088
- Assembly lubricant, Part Number 3163087, or equivalent

Additional Service Items

- No additional service items required.

Preparatory Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

- Disconnect the batteries. See equipment manufacturer service information.
- Remove the exhaust gas recirculation (EGR) connection tube. Refer to Procedure 011-025 in Section 11. (/qs3/pubsys2/xml/en/procedures/425/425-011-025.html)
- Remove the crankcase breather tube and drain tube. Refer to Procedure 003-018 in Section 3. (/qs3/pubsys2/xml/en/procedures/425/425-003-018.html)
- Remove the rocker lever cover. Refer to Procedure 003-011 in Section 3. (/qs3/pubsys2/xml/en/procedures/425/425-003-011.html)
- Remove the engine brake assembly, if equipped. Refer to Procedure 020-004 in Section 20. (/qs3/pubsys2/xml/en/procedures/425/425-020-004-tr.html)
- Remove the rocker levers. Refer to Procedure 003-008 in Section 3. (/qs3/pubsys2/xml/en/procedures/425/425-003-008.html)
- Remove the push rods or tubes. Refer to Procedure 004-014 in Section 4. (/qs3/pubsys2/xml/en/procedures/425/425-004-014.html)
- Remove the drive belt. Refer to Procedure 008-002 in Section 8. (/qs3/pubsys2/xml/en/procedures/425/425-008-002-tr.html)
- Remove the rubber vibration damper, if installed. Refer to Procedure 001-051 in Section 1. (/qs3/pubsys2/xml/en/procedures/425/425-001-051.html)
- Remove the viscous vibration damper, if installed. Refer to Procedure 001-052 in Section 1. (/qs3/pubsys2/xml/en/procedures/425/425-001-052.html)
- Remove the gear cover. Refer to Procedure 001-031 in Section 1. (/qs3/pubsys2/xml/en/procedures/425/425-001-031.html)

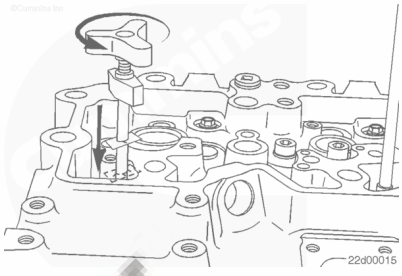
Remove

Use Tappet Removal Tool Kit, Part Number 3165088, to remove the tappets.

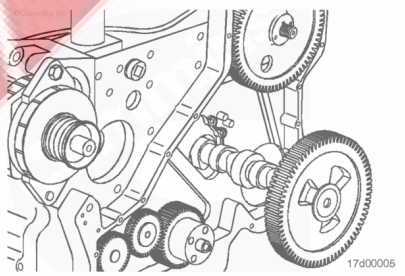
Insert the tappet extractor tool (2) into the tappet bore. Turn the top knob **counterclockwise** while holding the bottom knob to expand and secure the tool into the tappet.

Raise the tappet extractor (2) until it stops. Push the metal tab down against the head surface to secure the tool and captured tappet in the up position.

Repeat for the remaining tappets.

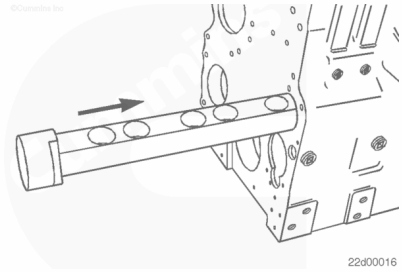


Remove the camshaft. Refer to Procedure 001-008 in Section 1. (/qs3/pubsys2/xml/en/procedures/425/425-001-008.html)

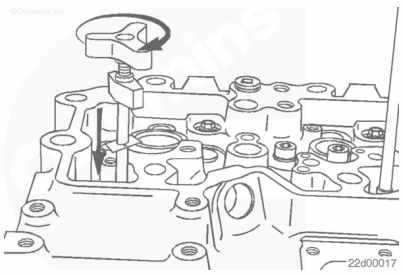


Make sure the holes are in the up position.

Insert the tappet holder to the full length of the camshaft bore.

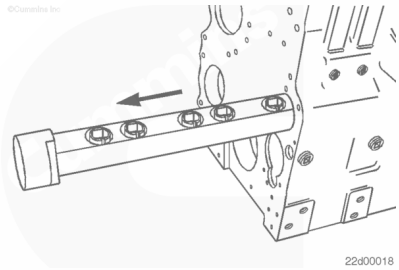


Lower the tappet extractor. Seat the tappet into the tappet holder. Turn the top knob **clockwise** while holding the bottom knob to disengage the extractor from the tappet. Repeat the step for the remaining tappets.



Carefully pull the tappet holder and tappets from the camshaft bore. If the tappets will be reused, be sure to note their position. Do **not** install a tappet in a different position.

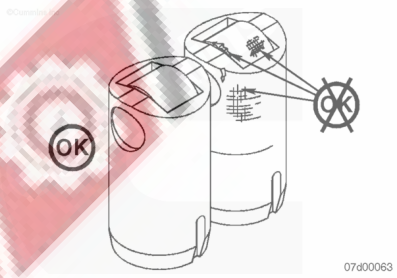
ANADOLU ISUZU AFTERSALES



Clean and Inspect for Reuse

Inspect the tappet body for cracks or other damage.

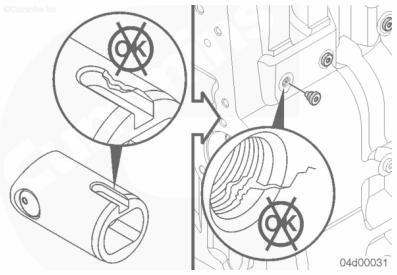
Inspect the roller for flat spots or pitting. See Service Bulletin, Camshaft Reuse Guidelines for Cummins® Engines with Roller Followers or Roller Tappets, Bulletin 3666052. (/qs3/pubsys2/xml/en/bulletin/3666052.html) If excessive wear is found, replace the tappet. Inspect the camshaft.



The roller **must** rotate freely. If it does **not**, replace the tappet.

Inspect the tappet body guide screw groove for damage.

If damage to the groove is found, remove the guide screw from the cylinder block.



Inspect the guide screw and guide screw hole for thread condition and cracks.

Note : Damage to the tappet body guide screw is **not** common.

Install the tappet guide screw. Tighten.

Torque Value: 10 n•m [89 in-lb]

Install

Lubricate the tappets with assembly lubricant, Part Number 3163087, or equivalent.



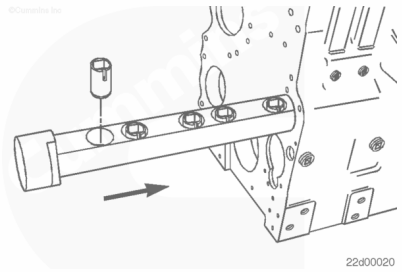
ANADOLU ISUZU AFTER SALES

Make sure the tappets are installed with the pin slots toward the outside of the block.

Insert the tappets into the tappet holder.

Note : If the tappets are being reused, be sure to install them in their original position.

Insert the tappet holder the full length of the camshaft bore.

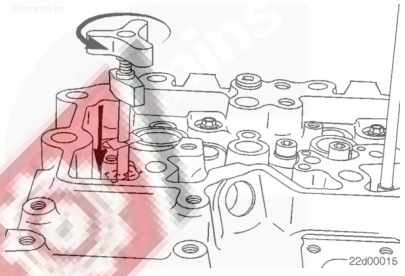


Insert the tappet extractor tool into the tappet bore. Turn the top **counterclockwise** to expand and secure the tool into the tappet.

Raise the tappet extractor until it stops. Push the metal tab down against the head surface to secure the tool in the up position.

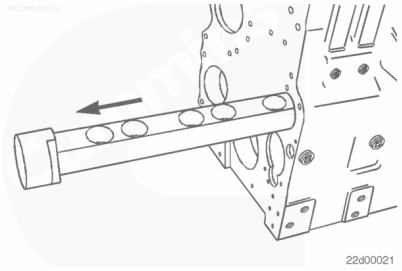
Note : Some manipulation can be necessary to get the tappet to enter the bore. When the tappet enters the bore, attempt to rotate the extractor while applying light upward pressure. If the tool will **not** rotate, the tappet has engaged the guide pin. If the tool does rotate, continue until the tappet engages the guide pin.

Repeat for the remaining tappets.

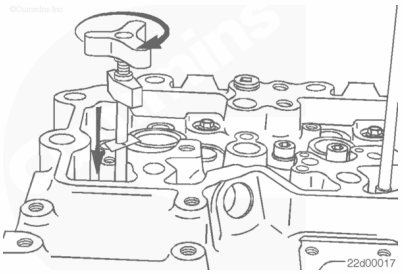


Remove the tappet holder.

Install the camshaft. Refer to Procedure 001-008 in Section 1. (/qs3/pubsys2/xml/en/procedures/425/425-001-008.html)



Lower the tappet extractor. Seat the tappet into the camshaft. Turn the top knob **clockwise** while holding the bottom knob to disengage the extractor from the tappet. Repeat the step for the remaining tappets.



ANADOLU ISUZU AFTER SALES

Finishing Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

- Install the gear cover. Refer to Procedure 001-031 in Section 1. (/qs3/pubsys2/xml/en/procedures/425/425-001-031.html)
- Install the rubber vibration damper, if required. Refer to Procedure 001-051 in Section 1. (/qs3/pubsys2/xml/en/procedures/425/425-001-051.html)
- Install the viscous vibration damper, if required. Refer to Procedure 001-052 in Section 1. (/qs3/pubsys2/xml/en/procedures/425/425-001-052.html)
- Install the drive belt. Refer to Procedure 008-002 in Section 8. (/qs3/pubsys2/xml/en/procedures/425/425-008-002-tr.html)
- Install the push rods or tubes. Refer to Procedure 004-014 in Section 4. (/qs3/pubsys2/xml/en/procedures/425/425-004-014.html)
- Install the rocker levers. Refer to Procedure 003-008 in Section 3. (/qs3/pubsys2/xml/en/procedures/425/425-003-008.html)
- Adjust the valves. Refer to Procedure 003-004 in Section 3. (/qs3/pubsys2/xml/en/procedures/425/425-003-004-tr.html)
- Install the engine brake assembly, if equipped. Refer to Procedure 020-004 in Section 20. (/qs3/pubsys2/xml/en/procedures/425/425-020-004-tr.html)
- Install the rocker lever cover. Refer to Procedure 003-011 in Section 3. (/qs3/pubsys2/xml/en/procedures/425/425-003-011.html)
- Install the crankcase breather tube and drain tube. Refer to Procedure 003-018 in Section 3. (/qs3/pubsys2/xml/en/procedures/425/425-003-018.html)
- Connect the batteries. See equipment manufacturer service information.
- Operate the engine. Check for leaks.

ANADOLU ISUZU

Last Modified: 01-Nov-2016

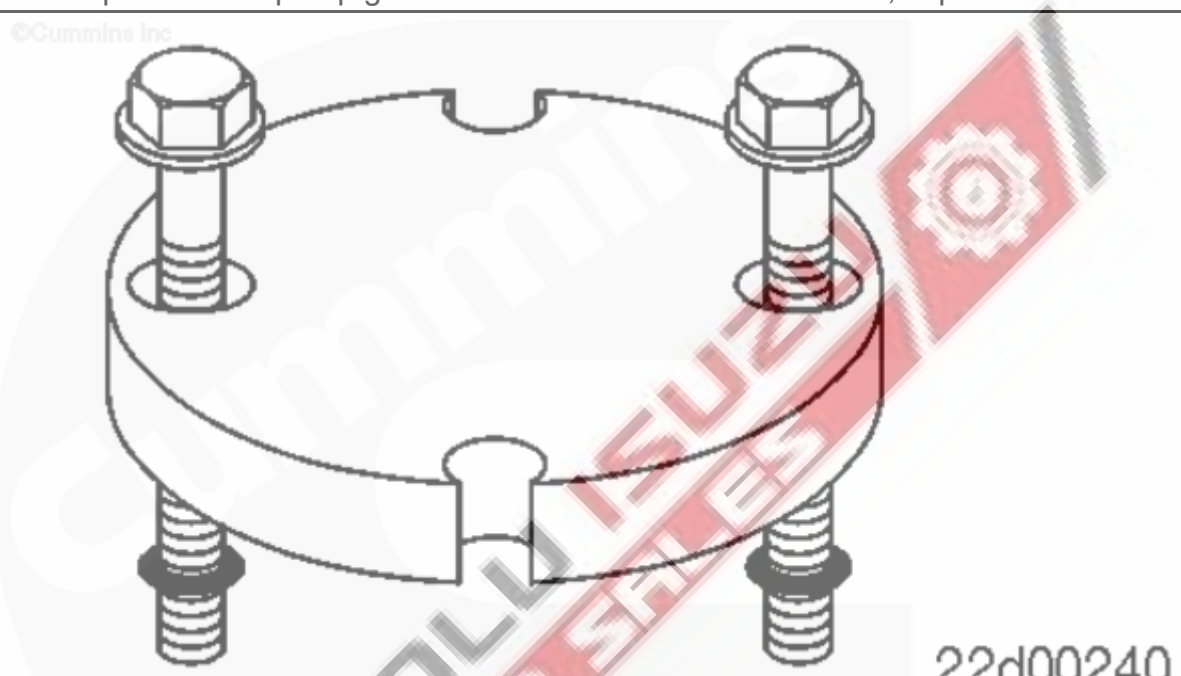
Fuel System

Tool Number

3163381

Fuel Pump Gear Puller

Used to pull the fuel pump gear. Includes Part Number 3900633, capscrews.

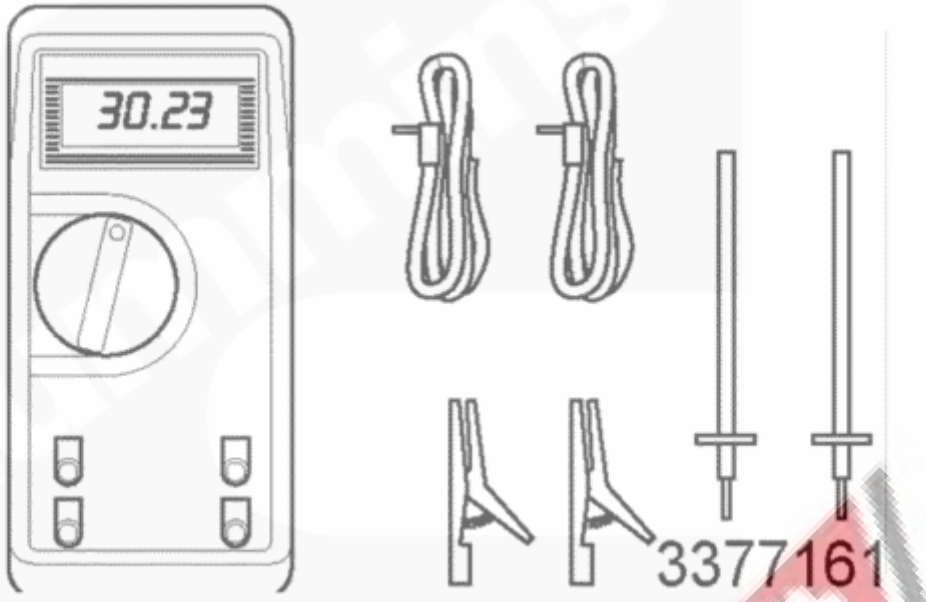


Tool Number

3164488

Multimeter

Used to measure voltage, resistance, and current in electrical circuits.

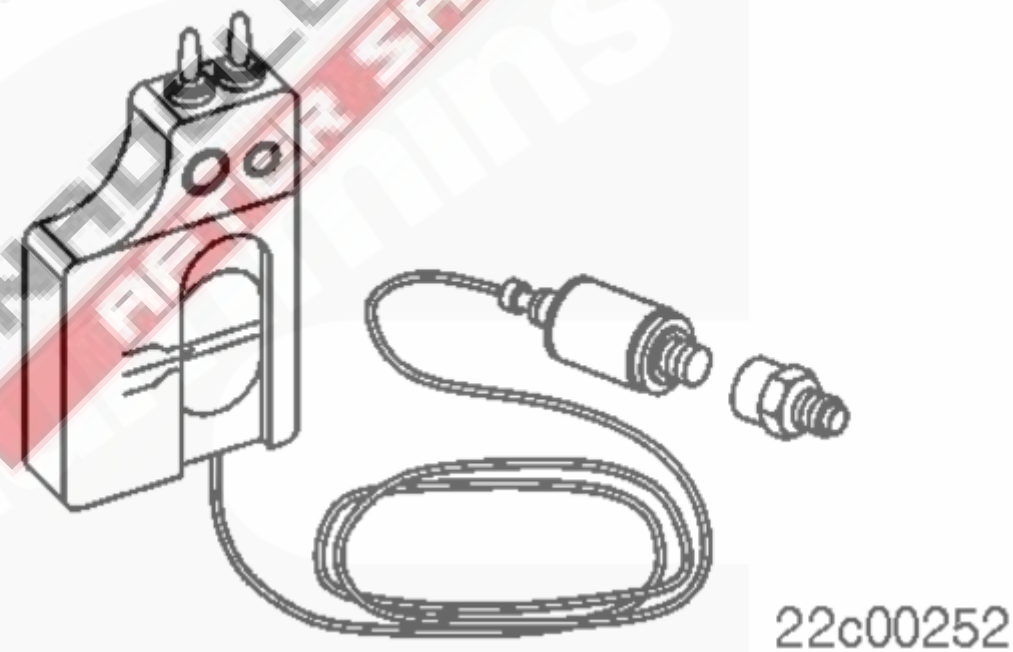


Tool Number

3164499

Pressure and Vacuum Module

Used with multimeter, Part Number 3164488, to measure pressures and restrictions in the fuel system.

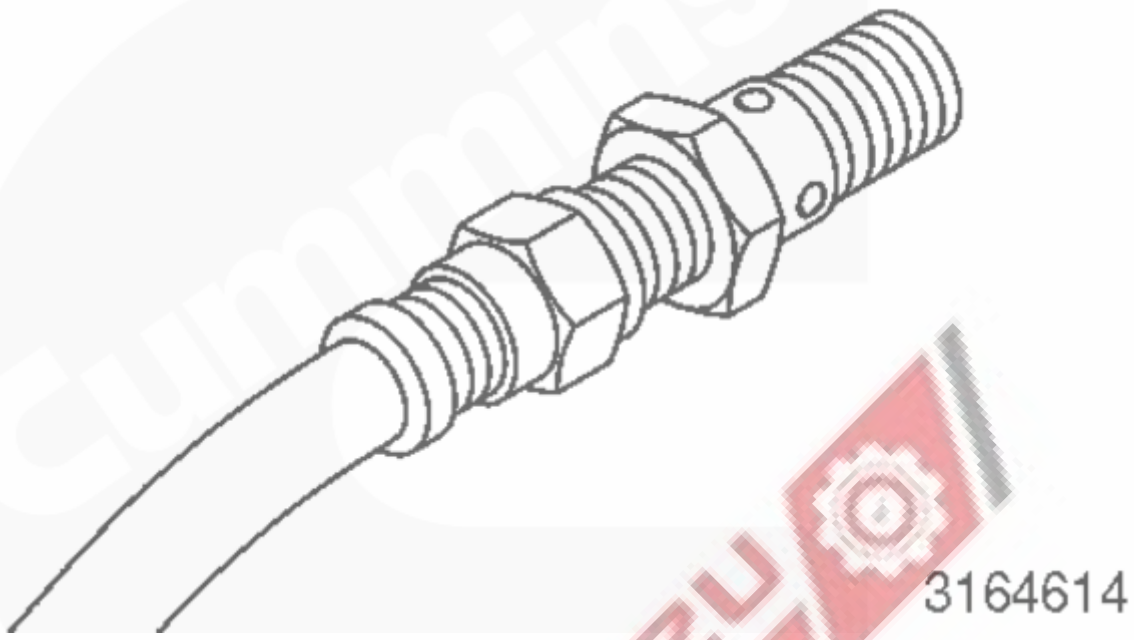


Tool Number

3164618

12 mm Banjo Adapter Fitting (Leakage Flow Adapter)

Used to isolate drain flow from the fuel drain lines where they connect to the fuel drain manifold. Allows fuel leakage measurement from the fuel pump, injector, or fuel rail pressure relief valve drain lines.

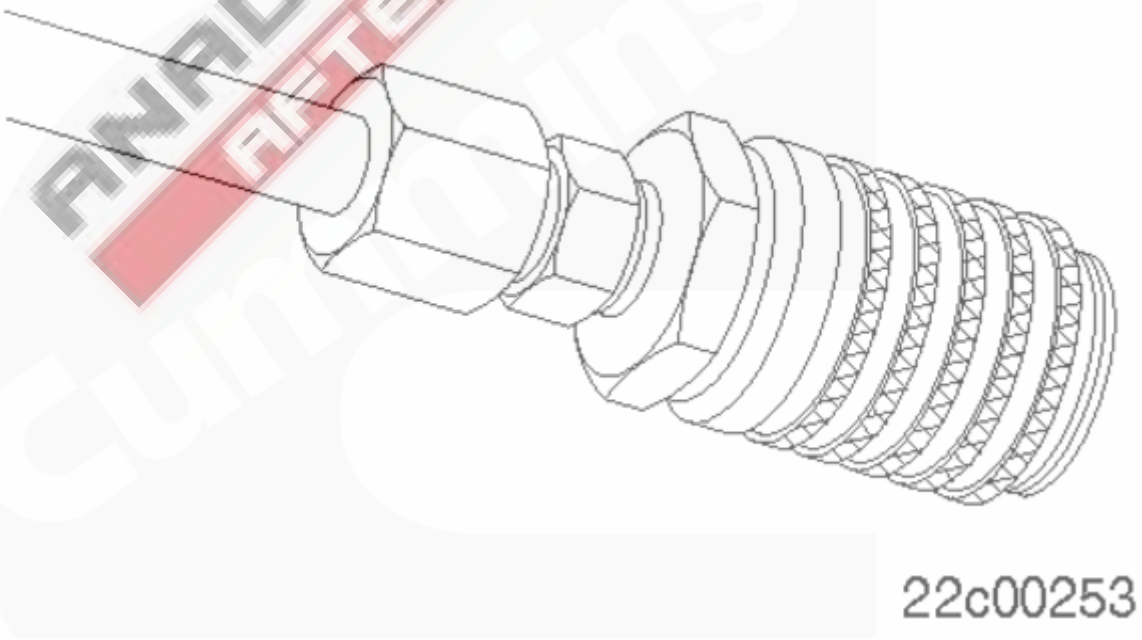


Tool Number

3164621

0.043-Inch Diagnostic Fuel Line

Used to create rated fuel flows through the low-pressure fuel system without loading the engine.

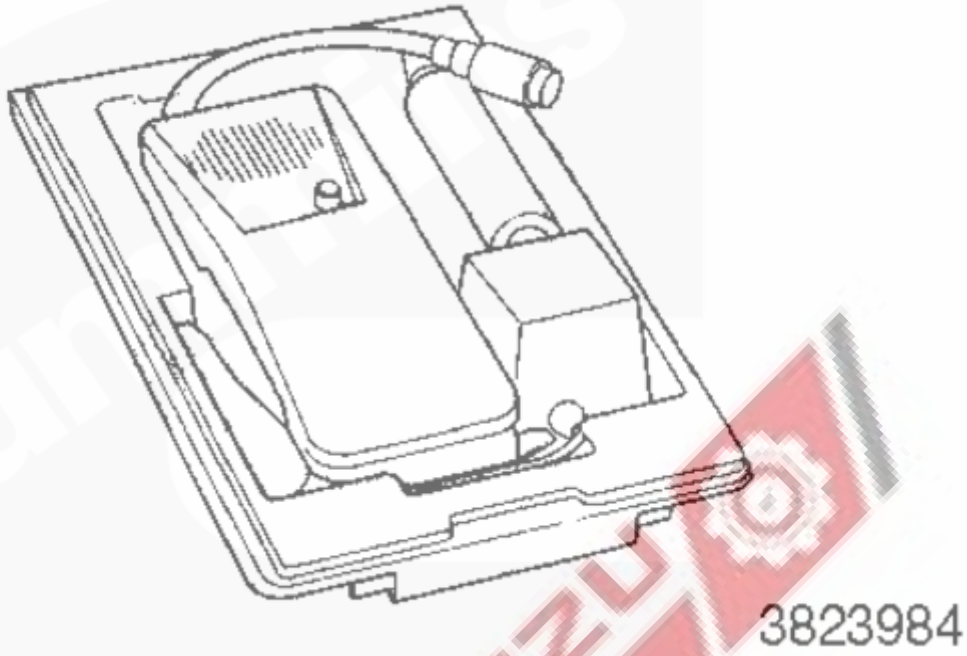


Tool Number

3823984

Combustible Gas Detector

Used to check for gas leaks at connections.



Tool Number

3824510

Electrical Contact Cleaner

Non-petroleum cleaner used to clean electrical connections and fuel pump internal parts.

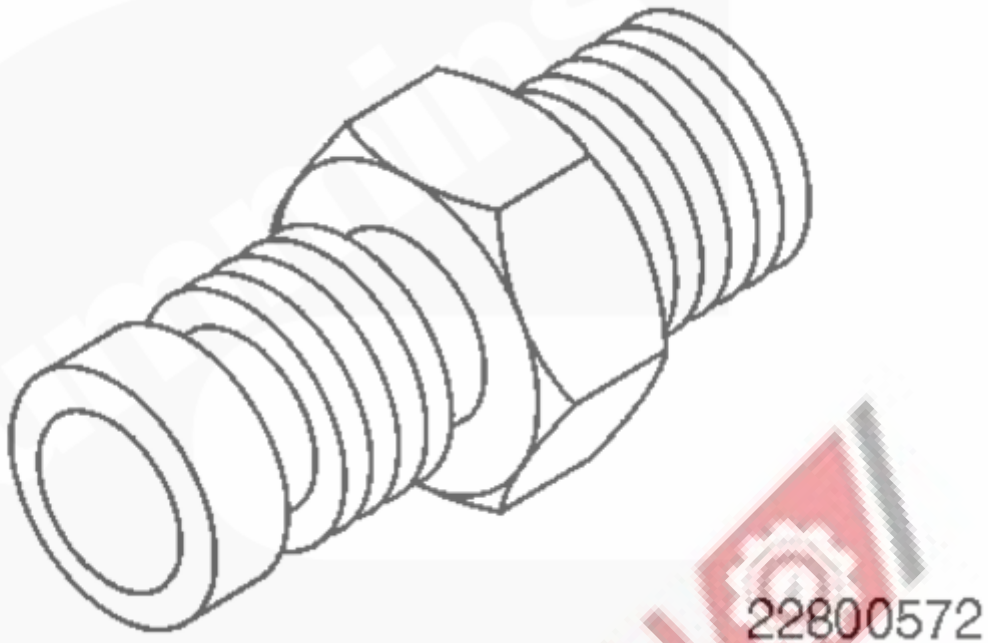


Tool Number

3824842

M10 Compucheck® Fitting

Used to measure fuel system pressure at the fuel filter head.

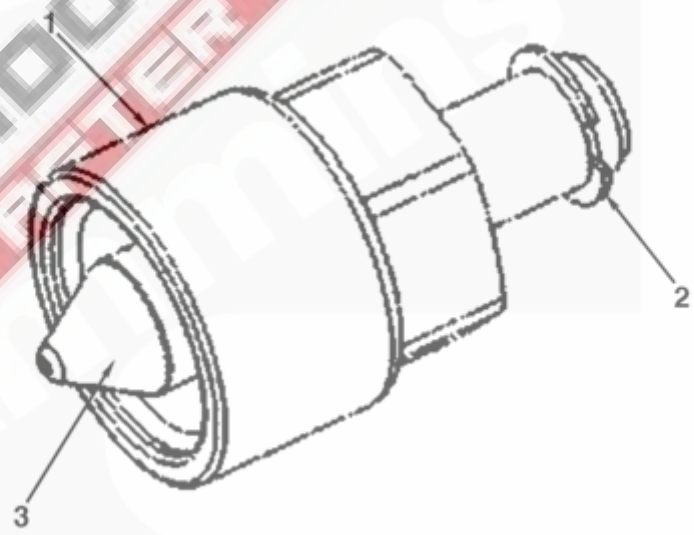


Tool Number

4918563

Fuel System Leak Tester

The tester is used to block off the high pressure fuel rail connections to detect faulty or leaking injectors and fuel connectors.

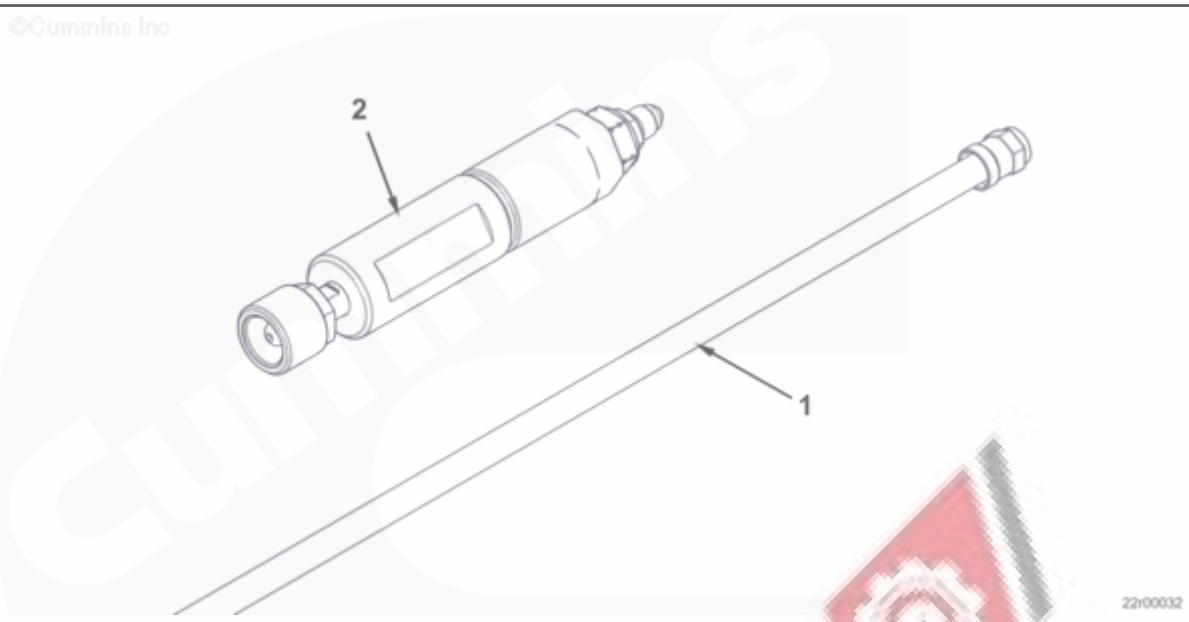


Tool Number

5299726

Fuel Pump Test Kit

Used to measure high pressure fuel pump pressure and volume output. Includes Part Number 3164673, Leak Test Hose (1) and Part Number 5299754, Fuel Pump Tester (2).



Tool Number

Not Applicable

1000 cc Graduated Cylinder

Used to measure high-pressure pump drain flow (leakage).



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AFTER SALES

Select Service Tools

Recommended Cummins® Service Tools

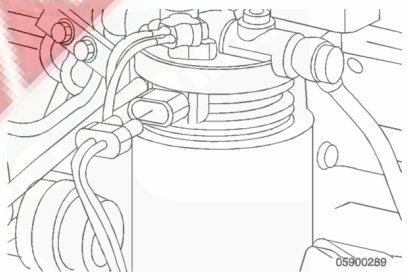
- Thread locker, Part Number 3375068, or equivalent

Additional Service Items

- No additional service items required.

Initial Check

The fuel heater is an optional device installed on the suction-side original equipment manufacturer (OEM)-supplied fuel filter head. It is held on the filter head by the threaded filter spud.

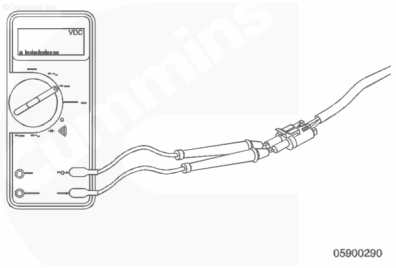


Note : The fuel heater is **not** controlled by the engine control module (ECM). A bimetallic switch on the filter head acts as a thermostat. The fuel heater will turn on at approximately 1°C [34°F] and turn off at approximately 18°C [65°F].

The switch should register as an open circuit above 18°C [65°F] and register as a closed circuit below 1°C [34°F].

Remove the 2 pin connector from the fuel heater.

Check for proper voltage to the fuel heater.



Note : Minimum voltage is 12 VDC with keyswitch ON (separate 24 volt heaters are used on vehicles with a 24 volt charging system).

If the voltage is **not** within specifications, see equipment manufacturer service information.

Preparatory Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

⚠ WARNING ⚠

Fuel is flammable. Keep all cigarettes, flames, pilot lights, arcing equipment, and switches out of the work area and areas sharing ventilation to reduce the possibility of severe personal injury or death when working on the fuel system.

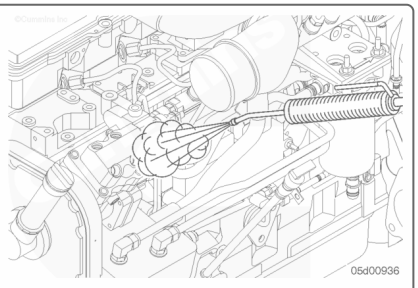
⚠ CAUTION ⚠

Drain the fuel-water separator into a container, and dispose of contents in accordance with local environmental regulations.

- Disconnect the batteries. See equipment manufacturer service information.
- Disconnect the OEM power supply connector from the fuel heater.
- Disconnect the engine harness connector from the water in fuel sensor. Refer to Procedure 019-127 in Section 19. (/qs3/pubsys2/xml/en/procedures/425/425-019-127.html)
- Drain a small quantity of fuel from the filter water drain to reduce fuel spillage during filter removal.
- Remove the spin-on fuel filter. Refer to Procedure 006-015 in Section 6. (/qs3/pubsys2/xml/en/procedures/425/425-006-015-tr.html)

⚠ WARNING ⚠

Wear appropriate eye and face protection when using compressed air. Flying debris and dirt can cause personal injury.



⚠ WARNING ⚠

When using a steam cleaner, wear safety glasses or a face shield, as well as protective clothing. Hot steam can cause serious personal injury.

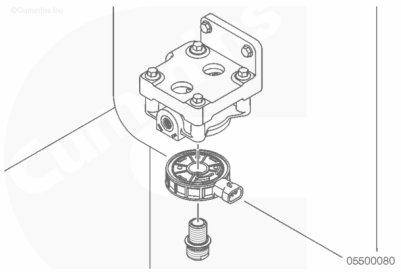
⚠ CAUTION ⚠

Clean all fittings before disassembly. Dirt or contaminants can damage the fuel system.

Before servicing **any** fuel system components, (such as fuel lines, fuel pump, injectors, etc.) which would expose the fuel system or internal engine component to potential contaminants prior to disassembly, clean the fittings, mounting hardware, and the area around the component to be removed. Dirt or contaminants can be introduced into the fuel system and engine if the surrounding areas are **not** cleaned, resulting in damage to the fuel system and engine. Refer to Procedure 000-009 in Section 0. (/qs3/pubsys2/xml/en/procedures/99/99-000-009.html)

Remove

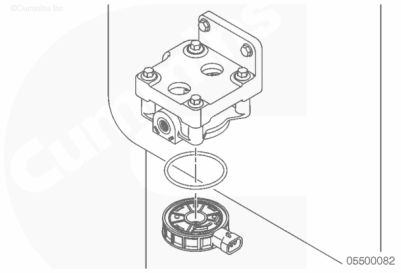
Remove the threaded filter spud and fuel heater.



Install

Install a new gasket onto the fuel heater.

Place the fuel heater, gasket side facing up, against the filter head with the electrical connector facing away from the engine block.

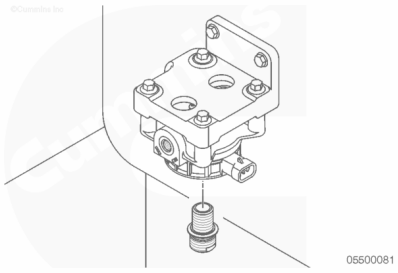


Apply thread locker, Part Number 3375068, or equivalent, to the filter spud threads where they will engage the filter head.

ANADOLU ISUZU AFTER SALES

Install the fuel filter spud.

Torque Value: 30 n•m [22 ft-lb]



Finishing Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

- Install the fuel filter. Refer to Procedure 006-015 in Section 6. (/qs3/pubsys2/xml/en/procedures/425/425-006-015-tr.html)
- Connect the fuel heater.
- Connect the water in fuel sensor. Refer to Procedure 019-127 in Section 19. (/qs3/pubsys2/xml/en/procedures/425/425-019-127.html)
- Connect the batteries. See equipment manufacturer service information.
- Operate the engine. Check for leaks.

ANADOLU ISUZU

Last Modified: 12-Aug-2019

Select Service Tools

Recommended Cummins® Service Tools

- Contact cleaner, Part Number 3824510, or equivalent
- Fuel pump gear puller, Part Number 3824469

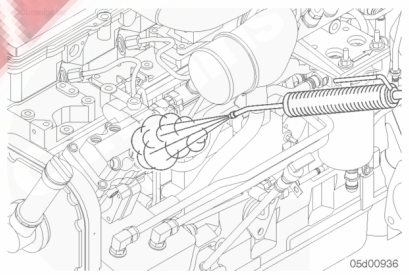
Additional Service Items

- Strap style filter wrench

Preparatory Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.



⚠ WARNING ⚠

Wear appropriate eye and face protection when using compressed air. Flying debris and dirt can cause personal injury.

⚠ WARNING ⚠

When using a steam cleaner, wear safety glasses or a face shield, as well as protective clothing. Hot steam can cause serious personal injury.

⚠ CAUTION ⚠

Clean all fittings before disassembly. Dirt or contaminants can damage the fuel system.

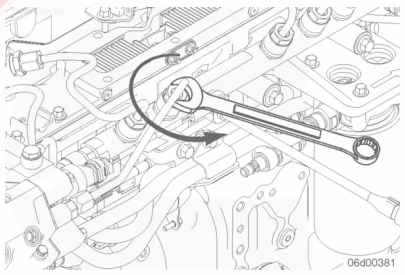
Before servicing **any** fuel system components, (such as fuel lines, fuel pump, injectors, etc.) which would expose the fuel system or internal engine component to potential

contaminants prior to disassembly, clean the fittings, mounting hardware, and the area around the component to be removed. Dirt or contaminants can be introduced into the fuel system and engine if the surrounding areas are **not** cleaned, resulting in damage to the fuel system and engine.

- Clean the engine. Refer to Procedure 000-009 in Section 0. (/qs3/pubsys2/xml/en/procedures/99/99-000-009.html)
- Use electrical contact cleaner, Part Number 3824510, or equivalent, to thoroughly clean all fuel lines before removal from the engine. Clean the connector fittings to remove as much debris as possible. It is very important extra care is taken to keep the fuel connections clean during removal and installation. Refer to Procedure 204-008 in Section i. (/qs3/pubsys2/xml/en/procedures/99/99-204-008.html)
- Make sure debris, water, steam, or cleaning solution does **not** get inside the fuel system.

⚠ WARNING ⚠

Normal engine operation creates highly pressurized fuel in the fuel line which will remain in the fuel line after engine shutdown. Never open the fuel system when the engine is operating. Before servicing the fuel system, always loosen the pump to rail fuel line at the rail to vent the pressure. Keep hands clear of the line when loosening. High-pressure fuel spray can penetrate the skin, resulting in serious personal injury or death.



Before servicing the fuel system, loosen the pump to rail line at the rail to vent the pressure.

Keep hands clear of the line when loosening.

Tighten the fuel rail nut.

Torque Value: 65 n•m [48 ft-lb]

Note : A machined slot in this fitting directs the fuel spray towards the engine block.

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce

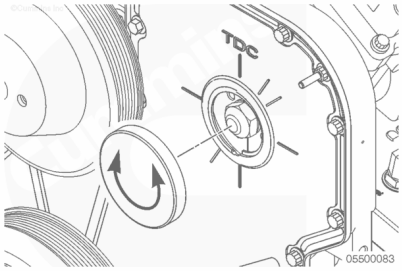
the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

- Disconnect the batteries. See equipment manufacturer service information.
- Remove the fuel supply lines from the fuel pump. Refer to Procedure 006-024 in Section 6. (/qs3/pubsys2/xml/en/procedures/425/425-006-024.html)
- Remove the fuel drain line from the fuel pump. Refer to Procedure 006-013 in Section 6. (/qs3/pubsys2/xml/en/procedures/425/425-006-013.html)
- Disconnect the engine harness from the fuel pump actuator. Refer to Procedure 019-117 in Section 19. (/qs3/pubsys2/xml/en/procedures/425/425-019-117.html)

Remove

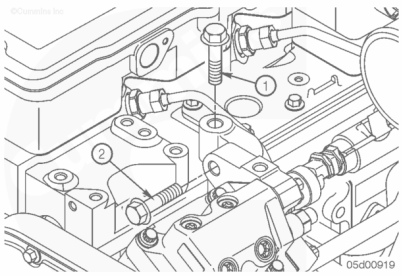
Note : The access cover is threaded and screws on and off. Use of a strap style filter wrench is recommended for removal to avoid damaging the cover.

- Remove the fuel pump gear access cover.

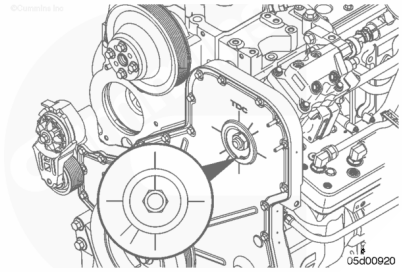


Remove the fuel pump upper support bracket by removing the two bolts (1) and (2).

The upper support bracket is located on the fuel pump actuator housing. Refer to Procedure 005-228 in Section 5. (/qs3/pubsys2/xml/en/procedures/425/425-005-228.html)

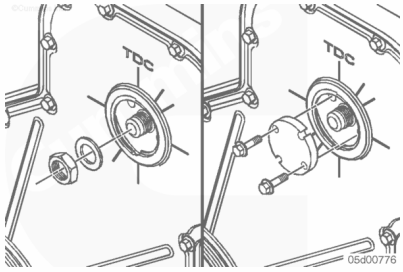


Locate top dead center (TDC) for cylinder Number 1 by barring the engine until the line on the fuel pump gear aligns with the front cover mark for TDC.



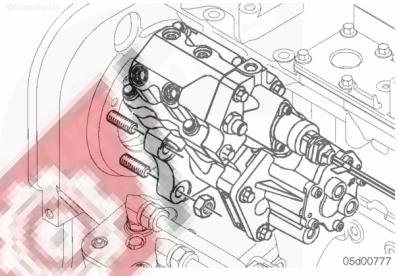
Remove the fuel pump gear nut and washer.

Use fuel pump gear puller, Part Number 3163381, to pull the fuel injection pump drive gear loose from the fuel pump drive shaft.



Remove the four mounting nuts that hold the fuel pump to the gear housing.

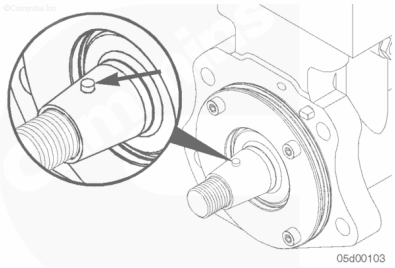
Remove the fuel pump.



Inspect for Reuse

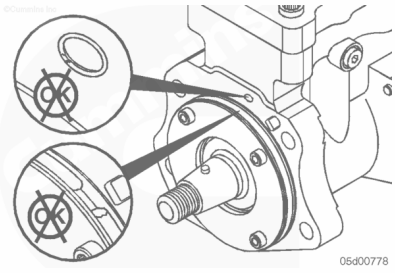
The dowel pin in the fuel pump drive shaft **must not** be sheared.

If the dowel is sheared, the camshaft housing or fuel pump **must** be replaced, and the drive gear **must** be replaced.



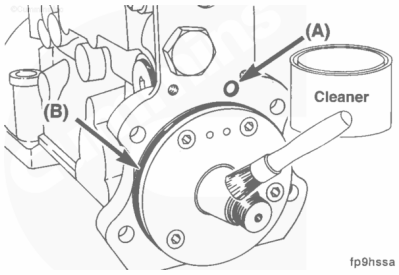
Make sure the pilot o-ring is **not** cut or otherwise damaged.

The pump oil supply o-ring **must** be replaced. Make sure it is **not** damaged.



Install

Make sure the engine is at Number 1 cylinder, TDC. The fuel pump gear timing mark **must** align with the TDC mark on the front cover.



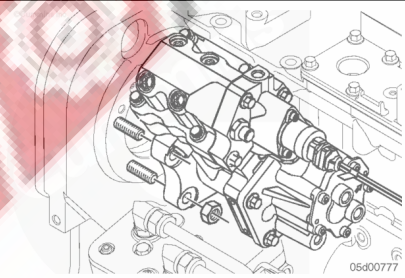
Make sure the o-ring seals for the oil feed orifice (A) and pilot (B) are installed correctly.

Lubricate the pilot o-ring (B). Use clean engine oil.

Clean the nose of the drive shaft and the fuel pump gear inside diameter. Use electrical contact cleaner, Part Number 3824510, or equivalent.

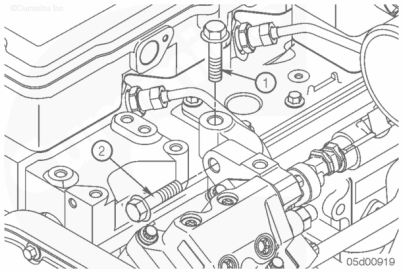
The fuel pump drive gear inside diameter and drive shaft outside diameter **must** be clean and dry before installing the gear.

Slide the fuel injection pump shaft through the drive gear/ Position the fuel injection pump flange onto the mounting studs.



Make sure the dowel pin in the drive shaft lines up with the keyway in the fuel injection pump gear.

Installation sequence for fuel pump actuator housing mounted support bracket:



1. Install the pump mounting nuts (leave loose).

2. Install the bolt to the cylinder head (1) and the bolt through the pump flange (2) into the support bracket (leave loose).

3. Tighten the pump mounting nuts.

Torque Value: 44 n•m [32 ft-lb]

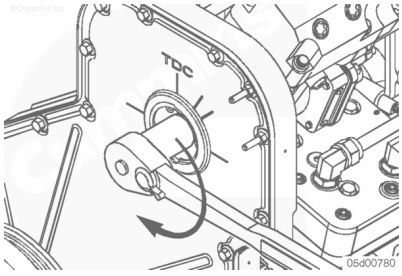
4. Tighten the bolt into the cylinder head (1).

Torque Value: 65 n•m [48 ft-lb]

5. Tighten the bolt into the pump flange (2).

Torque Value: 80 n•m [59 ft-lb]

Tighten the fuel injection pump drive gear nut.



Torque Value: 180 n•m [133 ft-lb]

Install the threaded access cover.

Torque Value: 10 n•m [89 in-lb]

Note : To avoid damage, Cummins Inc. recommends the use of a strap style filter wrench to install the

access cover.

Finishing Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

- Install the fuel supply lines to the fuel pump. Refer to Procedure 006-024 in Section 6. (/qs3/pubsys2/xml/en/procedures/425/425-006-024.html)
- Install the fuel drain line to the fuel pump. Refer to Procedure 006-013 in Section 6. (/qs3/pubsys2/xml/en/procedures/425/425-006-013.html)
- Connect the wire harness to the fuel pump actuator. Refer to Procedure 019-117 in Section 19. (/qs3/pubsys2/xml/en/procedures/425/425-019-117.html)
- Connect the batteries. See equipment manufacturer service information.
- Operate the engine. Check for leaks.

ANADOLU ISUZU AFTER SALES

Last Modified: 12-Aug-2019

Select Service Tools

Recommended Cummins® Service Tools

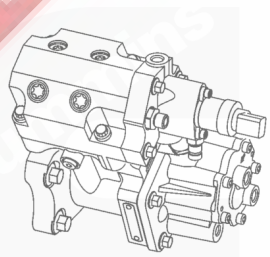
- Electrical contact cleaner, Part Number 3824510, or equivalent

Additional Service Items

- No additional service items required.

General Information

This procedure references the Cummins® Common Rail fuel system.



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Preparatory Steps

⚠ WARNING ⚠

Wear appropriate eye and face protection when using compressed air. Flying debris and dirt can cause personal injury.

⚠ WARNING ⚠

When using a steam cleaner, wear safety glasses or a face shield, as well as protective clothing. Hot steam can cause serious personal injury.

⚠ CAUTION ⚠

Clean all fittings before disassembly. Dirt or contaminants can damage the fuel system.

ANADOLU ISUZU AFTER SALES

Note : All fuel system diagnostics procedures and component specifications have been moved. Refer to Procedure 005-236 in Section 5. (/qs3/pubsys2/xml/en/procedures/425/425-005-236.html)

Before servicing **any** fuel system components, (such as fuel lines, fuel pump, injectors, etc.) which would expose the fuel system or internal engine component to potential contaminants prior to disassembly, clean the fittings, mounting hardware, and the area around the component to be removed. Dirt or contaminants can be introduced into the fuel system and engine if the surrounding areas are **not** cleaned, resulting in damage to the fuel system and engine.

- Clean the engine. Refer to Procedure 000-009 in Section 0. (/qs3/pubsys2/xml/en/procedures/99/99-000-009.html)
- Use electrical contact cleaner, Part Number 3824510, or equivalent, to thoroughly clean all fuel lines before removal from the engine. Clean the connector fittings to remove as much debris as possible. It is very important extra care is taken to keep the fuel connections clean during removal and installation. Refer to Procedure 204-008 in Section i. (/qs3/pubsys2/xml/en/procedures/99/99-204-008.html)
- Make sure debris, water, steam, or cleaning solution does **not** get inside the fuel system.

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

⚠ WARNING ⚠

Depending on the circumstance, diesel fuel is flammable. Keep all cigarettes, flames, pilot lights, arcing equipment, and switches out of the work area and areas sharing ventilation to reduce the possibility of severe personal injury or death when working on the fuel system.

⚠ WARNING ⚠

Do not vent the fuel system on a hot engine; this can cause fuel to spill onto a hot exhaust manifold, which can cause a fire.

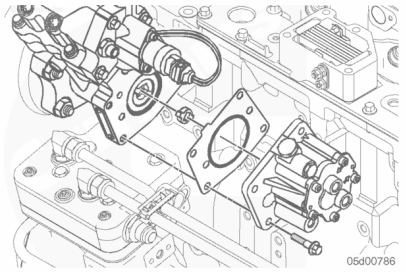
- Disconnect the batteries. See equipment manual service information.
- Clean any fuel, oil, and debris from the gear pump.
- Remove the fuel supply lines from the gear pump. Refer to Procedure 006-024 in Section 6. (/qs3/pubsys2/xml/en/procedures/425/425-006-024.html)

Remove

Remove the four bolts that hold the gear pump to the fuel pump.

Remove the drive coupling if it remains attached to the rear of the fuel pump camshaft.

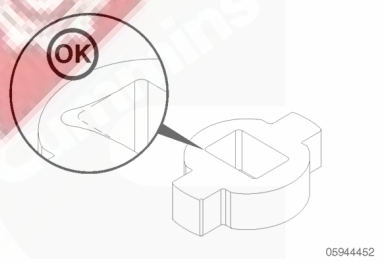
Remove the gear pump gasket.



Clean and Inspect for Reuse

Note : Gear pump coupling wear is normal. The gear pump should **not** be replaced due to coupling or shaft wear.

Inspect the gear pump for damage.



Install

Install the drive coupling into the back of the high-pressure pump camshaft.

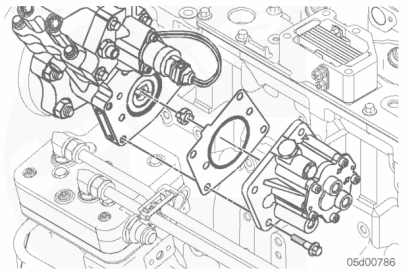
Insert the mounting bolts through the gear pump flange.

Install a new gasket onto the bolts.

Index the gear pump input shaft to engage the drive coupling and install the gear pump.

Install the four gear pump bolts. Tighten.

Torque Value: 34 n•m [25 ft-lb]



Finishing Steps

⚠ WARNING ⚠

ANADOLU ISUZU AFTER SALES

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

- Install the fuel supply lines. Refer to Procedure 006-024 in Section 6. (/qs3/pubsys2/xml/en/procedures/425/425-006-024.html)
- Connect the batteries. See equipment manufacturer service information.
- Operate the engine. Check for leaks.

Last Modified: 27-Jul-2016

ANADOLU ISUZU AFTER SALES

Select Service Tools

Recommended Cummins® Service Tools

- No Cummins® Service Tools required.

Additional Service Items

- No additional service items required.

Preparatory Steps

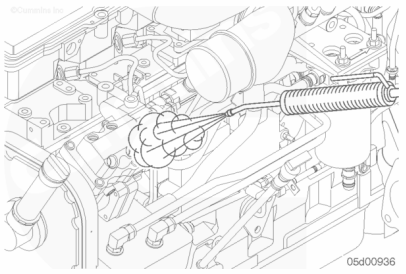
⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

- Disconnect the batteries. See equipment manufacturer service information.
- Remove the gear cover. Refer to Procedure 001-031 in Section 1. (/qs3/pubsys2/xml/en/procedures/425/425-001-031.html)
- Remove the fuel pump camshaft nut. Refer to Procedure 005-016 in Section 5. (/qs3/pubsys2/xml/en/procedures/425/425-005-016.html)

⚠ WARNING ⚠

Wear appropriate eye and face protection when using compressed air. Flying debris and dirt can cause personal injury.



⚠ WARNING ⚠

When using a steam cleaner, wear safety glasses or a face shield, as well as protective clothing. Hot steam can cause serious personal injury.

⚠ CAUTION ⚠

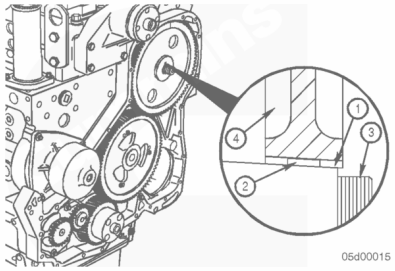
Clean all fittings before disassembly. Dirt or contaminants can damage the fuel system.

Before servicing any fuel system components, (such as fuel lines, fuel pump, injectors, etc.) which would expose the fuel system or internal engine component to potential contaminants prior to disassembly, clean the fittings, mounting hardware, and the area around the component to be removed. Dirt or contaminants can be introduced into the fuel system and engine if the surrounding areas are **not** cleaned, resulting in damage to the fuel system and engine. Refer to Procedure 000-009 in Section 0. (/qs3/pubsys2/xml/en/procedures/99/99-000-009.html)

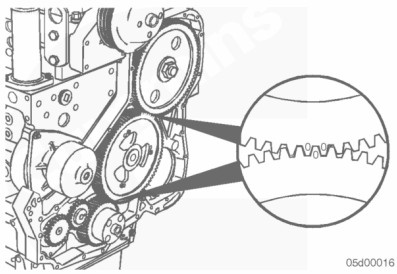
Inspect for Reuse

Check that the fuel pump camshaft alignment dowel is present in the fuel pump drive gear keyway. If the alignment dowel is **not** visible, remove the injection pump, determine the cause of misalignment, and repair or replace any damaged components.

1. Fuel pump gear keyway
2. Fuel pump timing dowel pin
3. Fuel pump camshaft
4. Fuel pump gear.



If this inspection is being performed due to a performance complaint, and the problem first occurred after gear train removal and replacement, then check the timing of the camshaft gear to the crankshaft gear and the camshaft gear to the fuel pump drive gear. Refer to Procedure 001-012 in Section 1. (/qs3/pubsys2/xml/en/procedures/425/425-001-012.html)



Finishing Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

- Install and tighten the injection pump camshaft nut. Refer to Procedure 005-016 in Section 5. (/qs3/pubsys2/xml/en/procedures/425/425-005-016.html)
- Install the front gear cover. Refer to Procedure 001-031 in Section 1. (/qs3/pubsys2/xml/en/procedures/425/425-001-031.html)
- Connect the batteries. See equipment manufacturer service information.
- Operate the engine. Check for leaks.

ANADOLU ISUZU AFTER SALES

Last Modified: 27-Jul-2016

Select Service Tools

Recommended Cummins® Service Tools

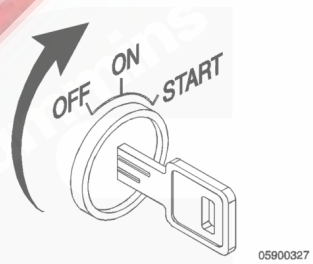
- Electrical contact cleaner, Part Number 3824510, or equivalent

Additional Service Items

- No additional service items required.

Initial Check

A malfunctioning electric fuel lift pump can cause slow engine starts or can result in an engine failing to start. The fuel lift pump can be cleaned and repaired to a limited extent.

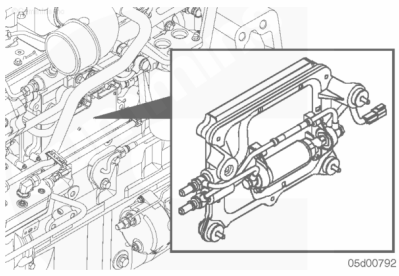


The lift pump will operate for 30 seconds when the key is switched ON. The lift pump will also operate while the engine is cranking.

Refer to Procedure 019-397 in Section 19 (/qs3/pubsys2/xml/en/procedures/425/425-019-397.html) for information on checking the fuel lift pump circuit.

General Information

A lift pump is mounted to the back of the engine control module (ECM) mounting plate.



A bypass check valve in the ECM mounting plate makes sure the system is primed by the lift pump. This check valve opens under vacuum created by the gear pump, once the engine is started. High vacuum measured between the electric lift pump and the gear pump can indicate this check valve has become plugged.

The ECM mounting plate check valve is integral with the lower (outlet) fitting of the ECM mounting plate.

Preparatory Steps

⚠ WARNING ⚠

Wear appropriate eye and face protection when using compressed air. Flying debris and dirt can cause personal injury.

⚠ WARNING ⚠

When using a steam cleaner, wear safety glasses or a face shield, as well as protective clothing. Hot steam can cause serious personal injury.

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

⚠ WARNING ⚠

The fuel pump, high-pressure fuel lines, and fuel rail contain very high-pressure fuel. Do not loosen any fittings while the engine is running. Wait at least 10 minutes after shutting down the engine before loosening any fittings in the high-pressure fuel system to allow pressure to decrease to a lower level.

⚠ CAUTION ⚠

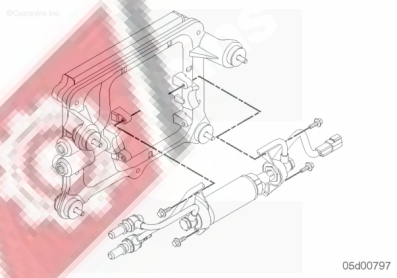
Clean all fittings before disassembly. Dirt or contaminants can damage the fuel system.

- Before servicing **any** fuel system components, (such as fuel lines, fuel pump, injectors, etc.) which can expose the fuel system or internal engine component to potential contaminants prior to disassembly, clean the fittings, mounting hardware, and the area around the component to be removed. Dirt or contaminants can be introduced into the fuel system and engine if the surrounding areas are **not** cleaned, resulting in damage to the fuel system and engine. Refer to Procedure 000-009 in Section 0. (/qs3/pubsys2/xml/en/procedures/99/99-000-009.html)
- Use contact cleaner, Part Number 3824510, or equivalent, to thoroughly clean all fuel lines before removal from the engine. Clean the connector fittings to remove as much debris as possible. It is very important extra care is taken to keep the fuel connections clean during removal and installation. Refer to Procedure 204-008 in Section i. (/qs3/pubsys2/xml/en/procedures/99/99-204-008.html)
- Make sure debris, water, steam, or cleaning solution does **not** get inside the fuel system.

- Disconnect the batteries. See equipment manufacturer service information.
- Disconnect the electric fuel priming pump from the engine wiring harness.
- Remove the fuel supply lines. Refer to Procedure 006-024 in Section 6. (/qs3/pubsys2/xml/en/procedures/425/425-006-024.html)
- Remove the ECM mounting plate. Refer to Procedure 001-103 in Section 1. (/qs3/pubsys2/xml/en/procedures/425/425-001-103.html)

Remove

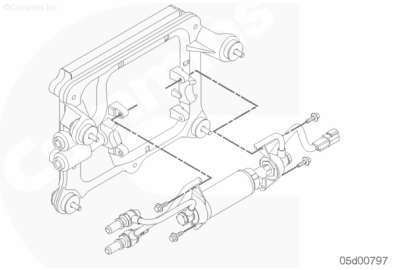
Remove the electric lift pump from the ECM mounting plate.



Install

Note : The ECM mounting plate check valve **must** be free of debris and installed into the lower ECM mounting plate port (outlet port).

Note : Hold the fuel lines, as illustrated, so they can **not** come into contact with each other or the engine block.



Install the electric lift pump to the ECM mounting plate.

Tighten the mounting capscrews.

Torque Value: 10 n•m [89 in-lb]

Finishing Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery

cable last.

- Install the ECM mounting plate to the engine block. Refer to Procedure 001-103 in Section 1. (/qs3/pubsys2/xml/en/procedures/425/425-001-103.html)
- Install all fuel supply lines. Refer to Procedure 006-024 in Section 6. (/qs3/pubsys2/xml/en/procedures/425/425-006-024.html)
- Connect the batteries. See equipment manufacturer service information.
- Operate the engine. Check for leaks.

Last Modified: 08-Jul-2019

ANADOLU ISUZU AFTER SALES

Select Service Tools

Recommended Cummins® Service Tools

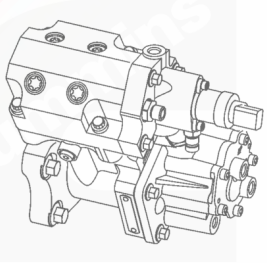
- Electrical contact cleaner, Part Number 38224510, or equivalent

Additional Service Items

- Allen wrench
- Assembly lubricant, or equivalent

General Information

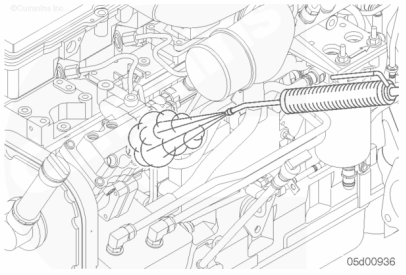
This procedure references the Cummins® Common Rail fuel system.



Preparatory Steps

⚠ WARNING ⚠

Wear appropriate eye and face protection when using compressed air. Flying debris and dirt can cause personal injury.



⚠ WARNING ⚠

When using a steam cleaner, wear safety glasses or a face shield, as well as protective clothing. Hot steam can cause serious personal injury.

⚠ CAUTION ⚠

ANADOLU ISUZU AFTER SALES

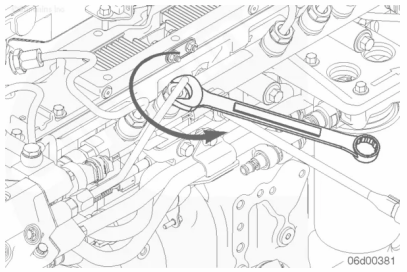
Clean all fittings before disassembly. Dirt or contaminants can damage the fuel system.

Before servicing **any** fuel system components, (such as fuel lines, fuel pump, injectors, etc.) which would expose the fuel system or internal engine component to potential contaminants prior to disassembly, clean the fittings, mounting hardware, and the area around the component to be removed. Dirt or contaminants can be introduced into the fuel system and engine if the surrounding areas are **not** cleaned, resulting in damage to the fuel system and engine.

- Clean the engine. Refer to Procedure 000-009 in Section 0. (/qs3/pubsys2/xml/en/procedures/99/99-000-009.html)
- Use electrical contact cleaner, Part Number 3824510, or equivalent, to thoroughly clean all fuel lines before removal from the engine. Clean the connector fittings to remove as much debris as possible. It is very important extra care is taken to keep the fuel connections clean during removal and installation. Refer to Procedure 204-008 in Section i. (/qs3/pubsys2/xml/en/procedures/99/99-204-008.html)
- Make sure debris, water, steam, or cleaning solution does **not** get inside the fuel system.

⚠ WARNING ⚠

Normal engine operation creates highly pressurized fuel in the fuel line which will remain in the fuel line after engine shutdown. Never open the fuel system when the engine is operating. Before servicing the fuel system, always loosen the pump to rail fuel line at the rail to vent the pressure. Keep hands clear of the line when loosening. High pressure fuel spray can penetrate the skin, resulting in serious personal injury or death.



Note : A machined slot in this fitting directs the fuel spray towards the engine block.

Before servicing the fuel system, loosen the pump-to-rail line at the rail to vent the pressure.

Keep hands clear of the line when loosening.

Tighten the fuel rail nut.

Torque Value: 65 n•m [48 ft-lb]

⚠ WARNING ⚠

The fuel pump, high-pressure fuel lines, and fuel rail contain very high-pressure fuel. Do not loosen any fittings while the engine is running. Wait at least 10 minutes after shutting down the engine before loosening any fittings in the high-pressure fuel system to allow pressure to decrease to a lower level.

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

⚠ WARNING ⚠

Wear appropriate eye and face protection when using compressed air. Flying debris or dirt can cause personal injury.

⚠ WARNING ⚠

Fuel is flammable. Keep all cigarettes, flames, pilot lights, arcing equipment, and switches out of the work area and areas sharing ventilation to reduce the possibility of severe personal injury or death when working on the fuel system.

⚠ WARNING ⚠

Do not vent the fuel system on a hot engine; this can cause fuel to spill onto a hot exhaust manifold, which can cause a fire.

- Disconnect the batteries. See equipment manufacturer service information.
- Thoroughly clean the entire fuel pump. Dry the fuel pump with compressed air.
- Close the fuel supply valve. See equipment manufacturer service information.
- Remove the high-pressure fuel line from the fuel pump actuator housing. Refer to Procedure 006-051 in

Section 6. (/qs3/pubsys2/xml/en/procedures/425/425-006-051.html)
- Remove the fuel drain line from the actuator housing. Refer to Procedure 006-013 in Section 6. (/qs3/pubsys2/xml/en/procedures/425/425-006-013.html)
- Remove the fuel supply line from the fuel pump actuator housing. Refer to Procedure 006-024 in Section 6. (/qs3/pubsys2/xml/en/procedures/425/425-006-024.html)
- Remove the fuel pump actuator housing from the high-pressure fuel pump. Refer to Procedure 005-228 in Section 5. (/qs3/pubsys2/xml/en/procedures/425/425-005-228.html)

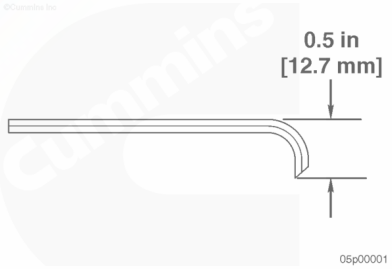
Remove

Removal of a “flat washer”

The flat sealing washer is swaged into the inlet fitting bore duing installation.

A special tool can be created to aid in its removal by grinding a 45 degree angle on the short leg of a 1/8 inch or 3/16 inch Allen wrench, so the wrench is no longer than 13 mm [1/2 in] long (measured from the outside of the long leg).

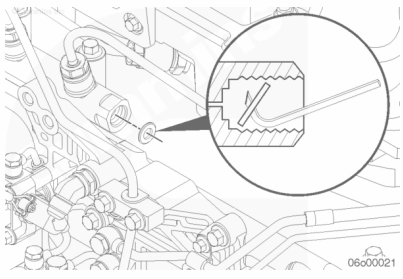
This tool acts as a mini heel bar to pry out the sealing washer without damaging the back of the hole.



Remove the fuel pump head outlet fitting.

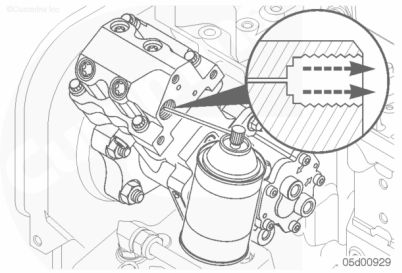
Pry out the old sealing washer from the threaded hole in the back of the high-pressure pump head using the modified Allen wrench.

Note : Considerable force is required to remove the sealing washer.



Clean and Inspect for Reuse

Clean the threaded hole in the high-pressure pump head. Use electrical contact cleaner, Part Number 3824510, or equivalent.



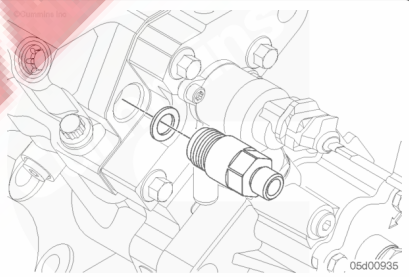
Inspect the threads and cavity in the high-pressure pump head for burrs or debris.

Inspect the seal washer end of the outlet fitting. There should be a polished crown free of nicks or inclusions. If the crown is damaged or severely flattened, the male union **must** be replaced.

Clean any burrs with a wire brush, then flush the bore clean.

Install

Note : This joint is designed to seal in excess of 179,264 kPa [26,000 psi]. Seal washers **must not** be reused.



Install a new seal washer onto the outlet fitting. The seal washer should pilot into the outlet fitting. A small amount of clean grease, such as assembly lubricant, will help in keeping the seal attached to the outlet fitting during installation.

Torque Value:

1. 13.6 n•m [120 in-lb]
2. Rotate 90 degrees.

Finishing Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

- Install the fuel pump actuator housing to the high-pressure fuel pump. Refer to Procedure 005-228 in Section 5. (/qs3/pubsys2/xml/en/procedures/425/425-005-228.html)
- Install the high-pressure fuel line to the fuel pump actuator housing. Refer to Procedure 006-051 in Section 6. (/qs3/pubsys2/xml/en/procedures/425/425-006-051.html)

- Install the fuel drain line to the actuator housing. Refer to Procedure 006-013 in Section 6. (/qs3/pubsys2/xml/en/procedures/425/425-006-013.html)
- Install the fuel supply line to the fuel pump actuator housing. Refer to Procedure 006-024 in Section 6. (/qs3/pubsys2/xml/en/procedures/425/425-006-024.html)
- Open the fuel supply valve. See equipment manufacturer service information.
- Connect the batteries. See equipment manufacturer service information.
- Operate the engine. Check for leaks.
- Perform several throttle snaps so increased fuel rail pressure will be developed.

Last Modified: 27-Jul-2016

ANADOLU ISUZU AFTER SALES

Select Service Tools

Recommended Cummins® Service Tools

- Contact cleaner, Part Number 3824510, or equivalent

Additional Service Items

- No additional service items required.

Preparatory Steps

⚠ WARNING ⚠

Wear appropriate eye and face protection when using compressed air. Flying debris and dirt can cause personal injury.

⚠ WARNING ⚠

Depending on the circumstances, diesel fuel is flammable. When inspecting or performing service or repairs on the fuel system, to reduce the possibility of fire and resulting severe personal injury, death or property damage, never smoke or allow sparks or flames (such as pilot lights, electrical switches, or welding equipment) in the work area.

⚠ WARNING ⚠

When using a steam cleaner, wear safety glasses or a face shield, as well as protective clothing. Hot steam can cause serious personal injury.

⚠ WARNING ⚠

Normal engine operation creates highly pressurized fuel in the fuel line which will remain in the fuel line after engine shutdown. Never open the fuel system when the engine is operating. Before servicing the fuel system, always loosen the pump to rail fuel line at the rail to vent the pressure. Keep hands clear of the line when loosening. High-pressure fuel spray can penetrate the skin, resulting in serious personal injury or death.

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

⚠ CAUTION ⚠

Clean all fittings before disassembly. Dirt or contaminants can damage the fuel system.

Note : Use the following procedure for all fuel system diagnostic procedures and component specifications. Refer to Procedure 005-236 in Section 5. (/qs3/pubsys2/xml/en/procedures/425/425-005-236.html)

- Before servicing **any** fuel system components, (such as fuel lines, fuel pump, injectors, etc.) which would expose the fuel system or internal engine component to potential contaminants prior to disassembly, clean the fittings, mounting hardware, and the area around the component to be removed. Dirt or contaminants can be introduced into the fuel system and engine if the surrounding areas are **not** cleaned, resulting in damage to the fuel system and engine.
- Clean the engine. Refer to Procedure 000-009 in Section 0. (/qs3/pubsys2/xml/en/procedures/99/99-000-009.html) Refer to Procedure 204-008 in Section i. (/qs3/pubsys2/xml/en/procedures/99/99-204-008.html)
- Use contact cleaner, Part Number 3824510, or equivalent, to thoroughly clean all fuel lines before removal from the engine. Clean the connector fittings to remove as much debris as possible. It is very important extra care is taken to keep the fuel connections clean during removal and installation. Refer to Procedure 204-008 in Section i. (/qs3/pubsys2/xml/en/procedures/99/99-204-008.html)
- Make sure debris, water, steam, or cleaning solution does **not** get inside the fuel system.

Note : A machined slot in this fitting directs the fuel spray toward the engine block.

- Before servicing the fuel system, loosen the pump to rail line at the rail to vent the pressure.
- Keep hands clear of the line when loosening.
- Tighten the fuel rail nut.

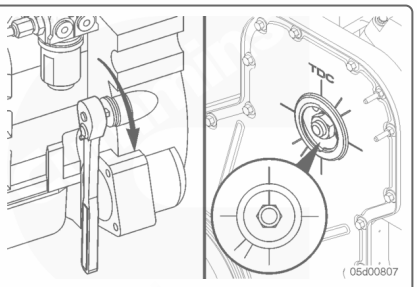
- Disconnect the batteries. See equipment manufacturer service information.
- Remove the high-pressure fuel line from the high-pressure pump. Refer to Procedure 006-051 in Section 6. (/qs3/pubsys2/xml/en/procedures/425/425-006-051.html)
- Remove the fuel drain line from the fuel pump actuator housing. Refer to Procedure 006-013 in Section 6. (/qs3/pubsys2/xml/en/procedures/425/425-006-013.html)
- Remove the fuel supply line from the fuel pump actuator housing. Refer to Procedure 006-024 in Section 6. (/qs3/pubsys2/xml/en/procedures/425/425-006-024.html)
- Disconnect the wiring harness from the fuel pump actuator.
- Remove the fuel pump actuator housing. Refer to Procedure 005-228 in Section 5. (/qs3/pubsys2/xml/en/procedures/425/425-005-228.html)

Remove

Note : The drive gear cover is threaded.

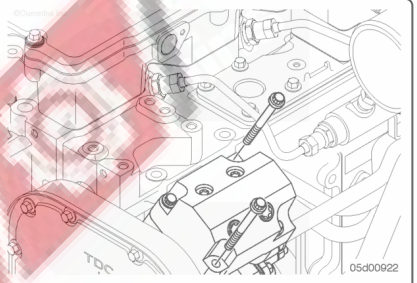
Remove the fuel pump drive gear cover.

Locate top dead center (TDC) for cylinder number 1 by barring the engine slowly until the line on the pump gear lines up with the line on the gear cover.



⚠ CAUTION ⚠

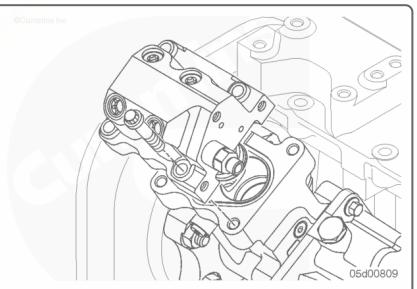
Do not use air tools. The use of air tools will possibly damage the fuel pump.



Remove two of the four capscrews located diagonally from one another.

Remove the last two capscrews. Alternately loosen the capscrews to avoid binding. Loosen each capscrew one turn at a time.

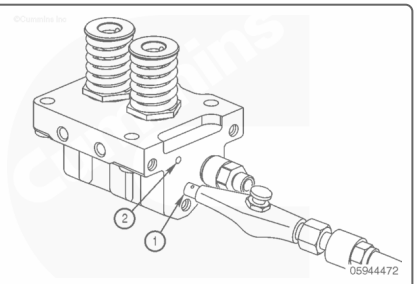
Carefully lift the fuel pump head from the camshaft housing, being careful to keep the tappet springs attached to the pump head. Place the head on a clean surface.



Clean and Inspect for Reuse

⚠ WARNING ⚠

Wear appropriate eye and face protection when using compressed air. Flying debris and dirt can cause personal injury.



Special care **must** be taken to make sure these parts are kept extremely clean, if removed. Cover the camshaft housing with a clean shop towel while the head is removed.

Do **not** use cleaning agents, other than contact cleaner, on pump components.

Note : Do **not** perform the following test without the springs and spring retainers installed.

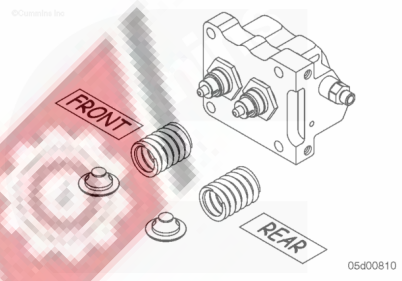
1. Drain
2. Inlet.

With the springs and spring retainers installed, blow compressed air (at least 276 kPa [40 psi]) into the inlet (2).

The plungers should extend to the tappet spring retainers. If the pumping plungers are stuck and do **not** extend to the tappet spring retainers, replace the fuel pump head.

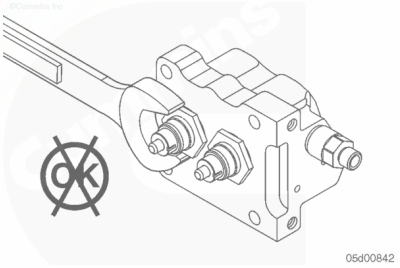
Remove the springs and spring retainers from the barrel retainers.

Make certain to keep track of which spring came from the front and rear. It is recommended these parts be installed in the same location, even if a new high-pressure pump head is installed.



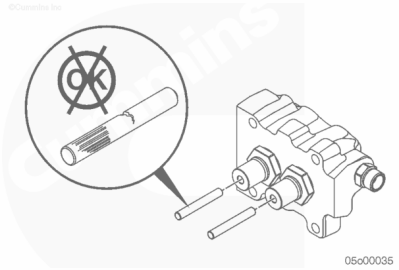
⚠ CAUTION ⚠

Do not remove the barrel retainers. Damage to the pump head and barrel retainers will result.



⚠ CAUTION ⚠

Each plunger must be installed in the same orientation and in the same barrel, or engine damage can result. Marking the bottoms of the plungers with a felt tip marker will help to make sure correct orientation is maintained.

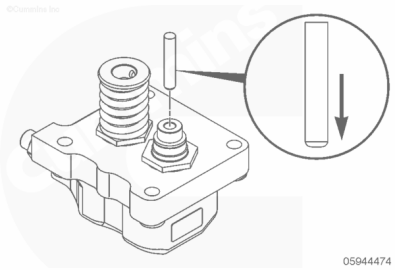


Remove and inspect the plungers. Slight discoloration can be evident. Deep scoring **must not** be present. If scoring or scratches exist that can be felt, the fuel pump head **must** be replaced.

Install the plungers into the barrel retainers.

Note : Some fuel pump heads are built with non-symmetric pumping plungers. The crowned end of the pumping plunger must be installed into the barrel. If

the plunger is installed in the wrong orientation, fuel pump head damage will result.



Use finger pressure to test the plunger action.

- Press the plunger halfway into the barrel quickly, with a pumping motion.
- Release it quickly.

If the check valves in the fuel pump head are good, the trapped air will cause the plunger to bounce or rebound. If the plunger falls to the bottom, one of the check valves in the fuel pump head may be damaged.

While the fuel pump head is removed, inspect the camshaft housing. The tappets can be removed. Use an o-ring pick as the removal tool.

Inspect the tappet guide pins and tappet guide pin grooves for excessive wear. If more than 25 percent guide pin or groove wear is observed, the fuel pump **must** be replaced.

Normal operation creates vertical grooves in the cylinder bores of the fuel pump camshaft housing. These grooves are **not** an indication of a malfunction.

Camshaft housings with grooves are acceptable for reuse.

With the camshaft housing tappets removed, inspect the camshaft for wear.

Inspect the tappet rollers for wear.

Normal operation creates bands around the circumference of the tappet roller. These bands are **not** an indicator of a malfunction. Tappet rollers with bands are acceptable for reuse.

If damage to the camshaft, tappets, or camshaft housing is observed, it is possible the fuel pump is **not** receiving adequate lubricating oil. When replacing the fuel pump, inspect the gear housing to make sure no blockages exist in the oil supply to the fuel pump.

Install

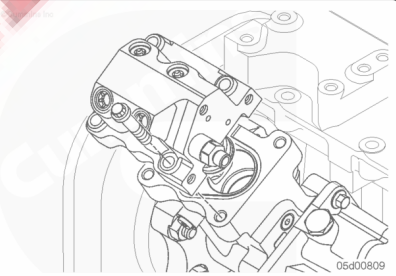
Install the tappets in the original tappet bores.

Make certain the tappets are installed in the original locations.

Make certain the tappet guide pins engage the guide pin grooves.

Install new fuel pump head o-rings onto the camshaft housing.

If installing a new or rebuilt pump head, install the new tappet springs and retainers provided with the pump head.



Place the high-pressure pump head onto the high-pressure pump camshaft housing.

Draw the high-pressure pump head down by alternately tightening the four high-pressure pump head capscrews until the head just contacts the camshaft housing.

Tighten the four high-pressure pump head capscrews to the final torque.

Torque Value: 68 n•m [50 ft-lb]

Finishing Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

- Install the fuel pump actuator housing. Refer to Procedure 005-228 in Section 5. (/qs3/pubsys2/xml/en/procedures/425/425-005-228.html)
- Connect the high-pressure fuel supply line. Refer to Procedure 006-051 in Section 6. (/qs3/pubsys2/xml/en/procedures/425/425-006-051.html)
- Connect the fuel drain line to the fuel pump actuator housing. Refer to Procedure 006-013 in Section 6. (/qs3/pubsys2/xml/en/procedures/425/425-006-013.html)
- Connect the fuel supply line to the fuel pump actuator housing. Refer to Procedure 006-024 in Section 6. (/qs3/pubsys2/xml/en/procedures/425/425-006-024.html)
- Connect the engine harness to the fuel pump actuator.
- Connect the batteries. See equipment manufacturer service information.
- Operate the engine. Check for leaks.

Last Modified: 27-Jul-2016

ANADOLU ISUZU AFTER SALES

Select Service Tools

Recommended Cummins® Service Tools

- Contact cleaner, Part Number 3824510, or equivalent

Additional Service Items

- No additional service items required.

Preparatory Steps

⚠ WARNING ⚠

Wear appropriate eye and face protection when using compressed air. Flying debris and dirt can cause personal injury.

⚠ WARNING ⚠

Depending on the circumstance, diesel fuel is flammable. When inspecting or performing service or repairs on the fuel system, to reduce the possibility of fire and resulting severe personal injury, death, or property damage, never smoke or allow sparks or flames (such as pilot lights, electrical switches, or welding equipment) in the work area.

⚠ WARNING ⚠

When using a steam cleaner, wear safety glasses or a face shield, as well as protective clothing. Hot steam can cause serious personal injury.

⚠ WARNING ⚠

Normal engine operation creates highly pressurized fuel in the fuel line which will remain in the fuel line after engine shutdown. Never open the fuel system when the engine is operating. Before servicing the fuel system, always loosen the pump to rail fuel line at the rail to vent the pressure. Keep hands clear of the line when loosening. High-pressure fuel spray can penetrate the skin, resulting in serious personal injury or death.

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

⚠ CAUTION ⚠

Clean all fittings before disassembly. Dirt or contaminants can damage the fuel system.

Note : Use the following procedure for all fuel system diagnostic procedures and component specifications. Refer to Procedure 005-236 in Section 5. (/qs3/pubsys2/xml/en/procedures/425/425-005-236.html)

- Before servicing **any** fuel system components, (such as fuel lines, fuel pump, injectors, etc.) which would expose the fuel system or internal engine component to potential contaminants prior to disassembly, clean the fittings, mounting hardware, and the area around the component to be removed. Dirt or contaminants can be introduced into the fuel system and engine if the surrounding areas are **not** cleaned, resulting in damage to the fuel system and engine.
- Clean the engine. Refer to Procedure 000-009 in Section 0. (/qs3/pubsys2/xml/en/procedures/99/99-000-009.html) Refer to Procedure 204-008 in Section i. (/qs3/pubsys2/xml/en/procedures/99/99-204-008.html)
- Use contact cleaner, Part Number 3824510, or equivalent, to thoroughly clean all fuel lines before removal from the engine. Clean the connector fittings to remove as much debris as possible. It is very important extra care is taken to keep the fuel connections clean during removal and installation. Refer to Procedure 204-008 in Section i. (/qs3/pubsys2/xml/en/procedures/99/99-204-008.html)
- Make sure debris, water, steam, or cleaning solution does **not** get inside the fuel system.

Note : A machined slot in this fitting directs the fuel spray toward the engine block.

- Before servicing the fuel system, loosen the pump to rail line at the rail to vent the pressure.
- Keep hands clear of the line when loosening.
- Tighten the fuel rail nut.

Torque Value: 65 n.m [48 ft-lb]

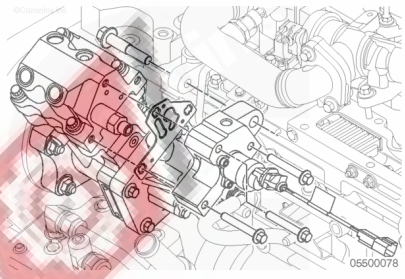
- Disconnect the batteries. See equipment manufacturer service information.
- Disconnect the wire harness from the fuel pump actuator.
- Disconnect the fuel supply line from the fuel pump actuator housing. Refer to Procedure 006-024 in Section 6. (/qs3/pubsys2/xml/en/procedures/425/425-006-024.html)
- Remove the high-pressure fuel line from the high-pressure pump actuator housing. Refer to Procedure 006-051 in Section 6. (/qs3/pubsys2/xml/en/procedures/425/425-006-051.html)
- Remove the fuel drain line from the fuel pump actuator housing. Refer to Procedure 006-013 in Section 6. (/qs3/pubsys2/xml/en/procedures/425/425-006-013.html)

- Disconnect the wiring harness from the fuel pump actuator. Refer to Procedure 019-117 in Section 19. (/qs3/pubsys2/xml/en/procedures/425/425-019-117.html)
- Remove the upper support bracket from the fuel pump actuator bracket. Refer to Procedure 005-016 in Section 5. (/qs3/pubsys2/xml/en/procedures/425/425-005-016.html)

Remove

Remove the three bolts that hold the fuel pump actuator housing to the high-pressure fuel pump head.

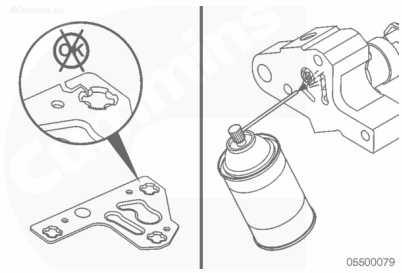
Remove the fuel pump actuator housing and the gasket.



Clean and Inspect for Reuse

Inspect the fuel pump actuator housing gasket. Do **not** reuse the gasket if the material is cracked, torn, or otherwise damaged.

Make sure the mounting surfaces of the high-pressure pump head and fuel control valve adapter block are clean. Use contact cleaner to clean these surfaces.



Install

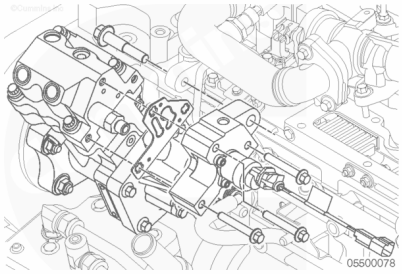
Insert the three mounting bolts through the fuel pump actuator housing.

Install the gasket over the bolts. The gasket **must** be installed dry.

Install the actuator housing.

Tighten the mounting bolts.

Torque Value: 34 n•m [25 ft-lb]



ANADOLU ISUZU
PARTS

Finishing Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

- Install the upper support bracket. Refer to Procedure 005-016 in Section 5. (/qs3/pubsys2/xml/en/procedures/425/425-005-016.html)
- Connect the high-pressure fuel line to the fuel pump. Refer to Procedure 006-051 in Section 6. (/qs3/pubsys2/xml/en/procedures/425/425-006-051.html)
- Connect the fuel supply line to the fuel pump. Refer to Procedure 006-024 in Section 6. (/qs3/pubsys2/xml/en/procedures/425/425-006-024.html)
- Connect the fuel drain line to the fuel pump. Refer to Procedure 006-013 in Section 6. (/qs3/pubsys2/xml/en/procedures/425/425-006-013.html)
- Connect the wire harness to the fuel pump actuator. Refer to Procedure 019-117 in Section 19. (/qs3/pubsys2/xml/en/procedures/425/425-019-117.html)
- Connect the batteries. See equipment manufacturer service information.
- Operate the engine. Check for leaks.

ANADOLU FUEL AFTER SALES

Last Modified: 12-Aug-2019

Select Service Tools

Recommended Cummins® Service Tools

- M10 male Comuchek™ fitting, Part Number 3824842
- Orificed diagnostic fuel line, Part Number 3164621
- Adapter fitting, Part Number 3932302
- 1/8 NPT male Compuchek™ fitting, Part Number 3377244

Additional Service Items

- No additional service items required.

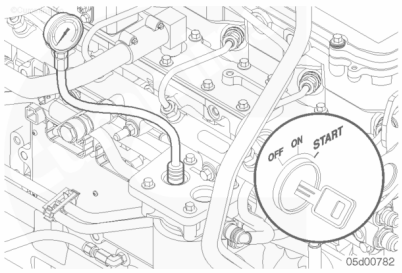
General Information

If the engine has been allowed to run out of fuel or the fuel system has been serviced or repaired, it will be necessary to prime the fuel system.

Prime

⚠ WARNING ⚠

High pressure fuel spray can cause serious injury or death.



Install M10 male Compuchek™ fitting, Part Number 3824842, on the engine fuel filter head inlet port.

To assist in fuel system priming and removing air from the fuel system, orificed diagnostic fuel line, Part Number 3164621, can be used to bleed air from the low-pressure fuel system.

Install the orificed diagnostic fuel line to the Compuchek™ fitting at the inlet to the pressure-side fuel filter.

Note : If there is **not** enough clearance to install the 1.0922 mm [0.043 in] orificed diagnostic fuel line, Part Number 3164621, adapter fitting, Part Number 3932302, and 1/8 NPT male Compuchek™ fitting,

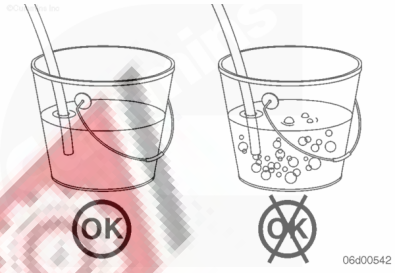
ANADOLU ISUZU PARTS SALES

Part Number 3377244, can be used to aid accessibility.

Turn the keyswitch to the ON position. Do **not** start the engine. Allow the priming pump to run. Observe the orificed diagnostic fuel line. When a solid stream of fuel exits the line, the initial priming process is complete. It can be necessary to repeat this process two or three times.

Remove the diagnostic fuel line

Note : The engine can possibly run rough for several minutes until the air is out of the system.



Note : If the air is **not** properly purged from the fuel system, the engine will be difficult to start, but will run smoothly once it starts. If the engine is shut OFF, it will be difficult to restart.

Start the engine. Allow it to stabilize.

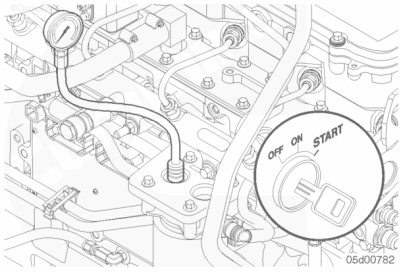
Attach diagnostic fuel line, Part Number 3164621, to the Compuchek™ fitting at the inlet to the pressure-side fuel filter.

Shut the engine OFF. bserve the orificed diagnostic fuel line. Allow the entrapped air to expand and exit through the diagnostic fuel line. Repeat this process up to four times, or until air no longer exits the diagnostic fuel line.

Note : Remove the orificed diagnostic fuel line prior to starting the engine. The engine will be difficult to start if the orificed diagnostic fuel line is installed during starting.

If air continues to exit the diagnostic fuel line after four or more repetitions, check the suction-side of the fuel system for leaks. Refer to Procedure 006-003 in Section 6. (/qs3/pubsys2/xml/en/procedures/425/425-006-003.html)

Note : If the air is **not** properly purged from the fuel system, the engine will be difficult to start, but will run smoothly once it starts. If the engine is shut OFF, it will be difficult to restart.



If the engine will **not** start, attach diagnostic fuel line, Part Number 3164621, to the Compuchek™ fitting at the inlet to the pressure-side fuel filter. Crank the engine for 15 seconds.

Note : Crank the engine in 15 second intervals with a 15 second break between cranking. This reduces the possibility of overheating the starter motor.

Stop cranking the engine. Observe the orificed diagnostic fuel line. Allow the entrapped air to expand and exit through the diagnostic fuel line. Repeat this process up to four times or until the engine starts.

If air continues to exit the diagnostic fuel line after four or more repetitions, check the suction-side of the fuel system for leaks. Refer to Procedure 006-003 in Section 6. (/qs3/pubsys2/xml/en/procedures/425/425-006-003.html)

Last Modified: 01-Nov-2016

ANADOLU ISUZU AFTER SALES

Select Service Tools

Recommended Cummins® Service Tools

- Removal tool, Part Number 4918878
- Adapter fitting, Part Number 39323022
- 1/8 inch NTP Compuchek™ fitting, Part Number 30422618
- Diagnostic fuel line, Part Number 4918895
- 0.043 inch orificed diagnostic fuel line, Part Number 3164621
- Electrical contact cleaner, Part Number 3824510, or equivalent
- High-pressure fuel pump service tool, Part Number 5299754
- Fuel return flow hose, Part Number 3164618
- Fuel return flow hose, Part Number 3164617
- Graduated beaker, Part Number 4919139, or equivalent
- Leak test isolation tool, Part Number 4918563, or equivalent
- Banjo screw and cap, Part Number 4918295.

Additional Service Items

- 1/8 inch NTP "T" fitting
- 1/8 inch NTP pipe.

General Information

⚠ WARNING ⚠

Normal engine operation creates highly pressurized fuel in the fuel line which will remain in the fuel line after engine shutdown. Never open the fuel system when the engine is operating. Before servicing the fuel system, always loosen the pump to rail fuel line at the rail to vent the pressure. Keep hands clear of the line when loosening. High-pressure fuel spray can penetrate the skin, resulting in serious personal injury or death.

⚠ CAUTION ⚠

Do not engage the starter motor for more than 30 seconds at a time. Allow 2 minutes between cranking intervals.

⚠ CAUTION ⚠

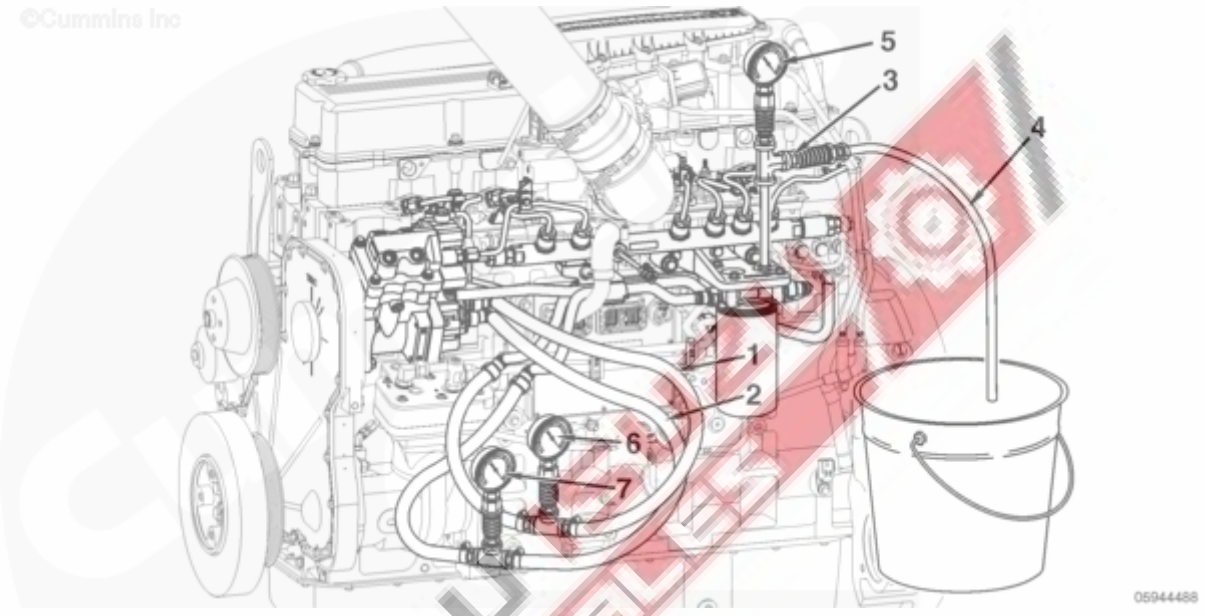
Clean all fittings before disassembly. Dirt or contaminants can damage the fuel system.

PHABOLU ISUZU DEALER SALES

The following procedure contains measurement steps and specifications for the engine fuel system components.

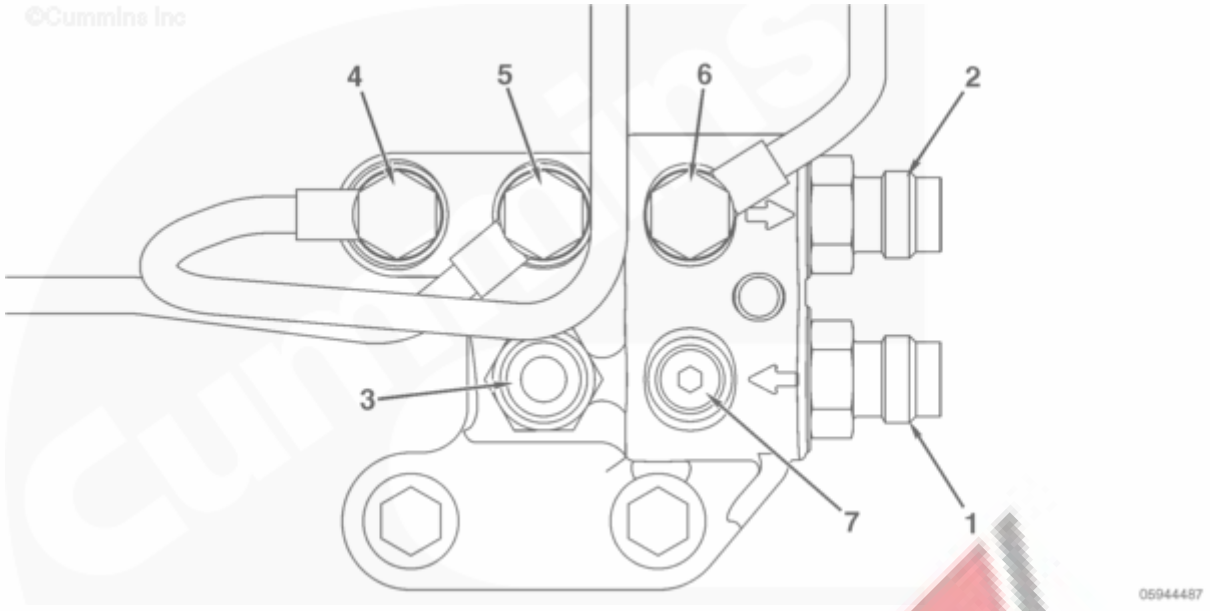
Note : This procedure is **not** intended to take the place of the troubleshooting tree repair directions. Use the appropriate troubleshooting tree for repair directions.

The diagrams below are intended to supplement the setup instructions in this procedure. See the appropriate setup section for step by step instructions.



Engine Will Start - Engine Mounted Filter

1. Diagnostic fuel line, Part Number 4918895
2. Diagnostic fuel line, Part Number 4918895
3. "T" adapter fitting
4. Diagnostic fuel line 0.043 inch orificed, Part Number 3164621
5. Pressure gauge 0 to 1034 kPa [0 to 150 psi]
6. Vacuum gauge 0 to 762 mm-hg [0 to 30 in-hg]
7. Pressure gauge 0 to 1034 kPa [0 to 150 psi].



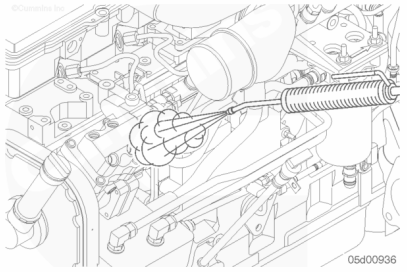
Fuel Return Manifold

1. Original equipment manufacturer (OEM) inlet
2. OEM return
3. To transfer pump
4. Pressure relief valve return flow
5. Pump head return flow
6. Injector return flow (can also check drain line restriction here)
7. Unused port (can also check OEM inlet restriction here).

Preparatory Steps

⚠ WARNING ⚠

Wear appropriate eye and face protection when using compressed air. Flying debris and dirt can cause personal injury.



⚠ WARNING ⚠

When using a steam cleaner, wear safety glasses or a face shield, as well as protective clothing. Hot steam can cause serious personal injury.

⚠ WARNING ⚠

Depending on the circumstance, diesel fuel is flammable. When inspecting or performing service or repairs on the fuel system, to reduce the possibility of

fire and resulting severe personal injury, death, or property damage, never smoke or allow sparks or flames (such as pilot lights, electrical switches, or welding equipment) in the work area.

⚠ WARNING ⚠

Do not bleed the fuel system of a hot engine; this can result in fuel spilling onto a hot exhaust manifold, which can cause a fire.

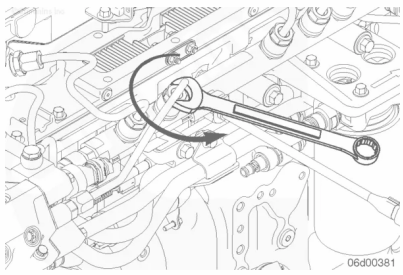
⚠ CAUTION ⚠

Clean the connector fittings to remove as much debris as possible. It is very important that extra care is taken to keep the fuel system connections clean during removal and installation. Dirt or contaminants can be introduced into the fuel system and engine if the surrounding areas are not cleaned, resulting in damage to the fuel system and engine.

- Clean the engine. Refer to Procedure 000-009 in Section 0. (/qs3/pubsys2/xml/en/procedures/99/99-000-009.html)
- Use contact cleaner, Part Number 3824510, or equivalent, to thoroughly clean all fuel lines before removal from the engine. Refer to Procedure 204-008 in Section i. (/qs3/pubsys2/xml/en/procedures/99/99-204-008.html)
- Make sure debris, water, steam, or cleaning solution does **not** enter the fuel system.

⚠ WARNING ⚠

Normal engine operation creates highly pressurized fuel in the fuel line which will remain in the fuel line after engine shutdown. Never open the fuel system when the engine is operating. Before servicing the fuel system, always loosen the pump to rail fuel line at the rail to vent the pressure. Keep hands clear of the line when loosening. High-pressure fuel spray can penetrate the skin, resulting in serious personal injury or death.



- Before servicing the fuel system, loosen the pump-to-rail line at the rail to vent the pressure. Keep hands clear of

the line when loosening. Tighten the fuel rail nut once pressure has been released.

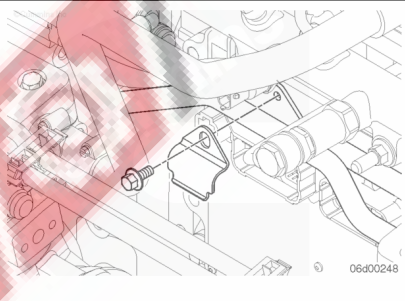
Torque Value: 65 n•m [48 ft-lb]

Note : A machined slot in this fitting directs the fuel spray toward the engine block.

Low-Pressure System Check

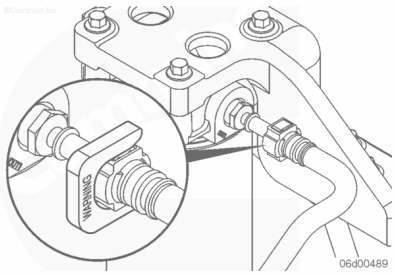
Initial Setup

The low-pressure system check is designed to help troubleshoot the low-pressure side fuel system using one setup to take multiple fuel system checks. This procedure is optimized for engines with engine-mounted pressure side filter. See supplementary diagrams in the general section of this procedure to view setup differences.



- Remove the clasp from the fuel line brace. This will allow the fuel lines to move so test equipment can be installed properly.

- Disconnect the quick disconnect style fuel lines from the gear pump inlet and outlet by pressing in the locking tangs on both sides of the quick disconnect fitting OR slide the removal tool, Part Number 4918878, over the locking tangs.

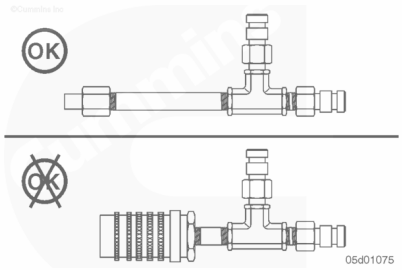


Note : Make sure the tool is removed from the fuel line as soon as possible after the line has been disconnected. Inadvertently leaving the tool in place can result in fuel leaks.

- To aid in removal, a screwdriver can be inserted between the fuel line end and the quick disconnect male union. After pressing the opposing locking tangs, twisting the flat blade of the screwdriver helps to remove the fuel line.

- Construct a "T" adapter fitting using one adapter fitting, Part Number 3932302 (M10 to 1/8-inch NPT adapter), a 1/8 inch NTP pipe (of appropriate length for application), a 1/8 inch NPT “T” fitting, and two 1/8 inch NPT Compuchek™ fittings, Part Number 3042618

Note : Do **not** use female Compuchek™ fitting, Part Number 3376859, when constructing the “T” adapter. If female Compuchek™ fitting, Part Number 3376859, is used, pressure readings will be inaccurate.



For Engine Will Start

1. Install one diagnostic fuel line (1), Part Number 4918895, between the gear pump fuel supply line and the gear pump inlet (upper fuel line fitting).
2. Install the second diagnostic fuel line (2), Part Number 4918895, between the gear pump outlet and the pressure side fuel filter fuel supply line (lower fuel line fitting).
3. Install the “T” adapter fitting (3) at the outlet port of the pressure side fuel filter.
4. Install a 0.043 inch orificed diagnostic fuel line (4), Part Number 3164621. Insert the fuel hose into the fuel tank or into a fuel collection device. This diagnostic line is used to simulate operating the engine at rated fuel system flow rate.
5. Install a 0 to 1034 kPa [0 to 150 psi] pressure gauge (5) at the "T" adapter fitting at the outlet of the fuel filter head.
6. Attach a 0 to 762 mm-hg [0 to 30 in-hg] vacuum gauge (6) on the diagnostic fuel line, Part Number 4918895, connected at the gear pump inlet.
7. Install a 0 to 1034 kPa [0 to 150 psi] pressure gauge (7) at the Compuchek™ fitting on diagnostic fuel line, Part Number 4918895, connected at the gear pump outlet.

Start the engine and allow it to operate at high idle for 3 minutes, or until the air is purged from the newly installed diagnostic fuel lines.

Note : If the engine is difficult to start after installing the diagnostic fuel lines, it may be necessary to cycle the fuel lift pump three or four times in order to purge the air out of the fuel system prior to starting. Refer to Procedure 005-234 in Section 5. (/qs3/pubsys2/xml/en/procedures/425/425-005-234-tr.html)

Note : If the engine is **not** equipped with an engine-mounted pressure side fuel filter, diagnostic fuel line, Part Number 4918895, can **not** be installed at the gear pump outlet. To measure the pressure drop

across a remote-mounted pressure side fuel filter, install a second pressure gauge at the inlet port of the fuel filter head instead. See supplementary diagrams in the general section of this procedure to view setup differences.

For Engine Will Not Start

1. Fully prime the system. Refer to Procedure 005-234 (/qs3/pubsys2/xml/en/procedures/425/425-005-234-tr.html) in Section 5.
2. Install a Compuchek™ fitting (to the outlet port of the filter head. The “T” adapter fitting can also be used).
3. Install a 0 to 1034 kPa [0 to 150 psi] pressure gauge at the outlet of the fuel filter head.

Measurement - Engine Will Start

Air in Fuel

- Refer to Procedure 006-003 in Section 6. (/qs3/pubsys2/xml/en/procedures/425/425-006-003.html)

Inlet Restriction

- Refer to Procedure 006-020 in Section 6. (/qs3/pubsys2/xml/en/procedures/425/425-006-020.html)

Fuel Gear Pump Pressure and Fuel Filter Restriction

- Operate the engine until it is at operating temperature.
- Operate the engine at high idle for 5 minutes.
- Record the fuel pressure at the inlet and outlet of the fuel filter.
- Subtract the outlet reading from the inlet reading to determine the restriction.
- Observe the gear pump pressure at the filter outlet.

Fuel Filter Restriction		
kpa		psi
69	MAX	10

Fuel Pump Gear Pump Pressure Engine Operating at High Idle 1800 rpm (Fuel Filter Inlet)		
kpa		psi
552	MIN	80

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Fuel Pump Gear Pump Pressure Engine Operating at High Idle 1800 rpm (Fuel Filter Outlet)		
kpa		psi
483	MIN	70

Measurement - Engine Will Not Start

Air in Fuel

- Refer to Procedure 006-003 in Section 6. (/qs3/pubsys2/xml/en/procedures/425/425-006-003.html)

Fuel Lift Pump Pressure

- Install a 0 to 345 kPa [0 to 50 psi] pressure gauge at the Compuchek™ fitting on the diagnostic fuel line, Part Number 4918895.
- Activate the fuel lift pump by turning the keyswitch ON. The fuel lift pump will run for 30 seconds and then stop. Repeat if necessary.
- Measure the fuel lift pump pressure. See graphic for the convoluted tube's (1) location on the fuel lift pump.

Fuel Lift Pump Pressure Requirements		
Fuel Lift Pump Convoluted Tube Color	**kPa (min)**	**Psi (min)**
Red or Blue	138	20
Yellow or Black	55	8

If the fuel lift pump pressure is greater than specified, the fuel lift pump is functional.

If the fuel lift pump pressure is less than specified, the fuel lift pump is malfunctioning. Replace the fuel lift pump.

Fuel Gear Pump Pressure

- Verify lift pump is working and there is flow to the gear pump. Refer to fuel lift pump pressure check.
- Remove the 0.043 inch orificed diagnostic fuel line, Part Number 3164621.
- Crank engine. Make sure engine cranking speed is at least 150 rpm.

- Monitor the gear pump pressure at the outlet port of the filter head, while the engine is cranking.

Gear Pump Pressure at Cranking (with Fuel Lift Pump assist)		
kpa		psi
173	MIN	25

Gear Pump Pressure at Cranking (without Fuel Lift Pump Assist)		
kpa		psi
105	MIN	15

Note : Crank the engine in 15 second intervals with a 15 second break between intervals. This reduces the possibility of overheating the starter motor.

Note : Some vehicles are equipped with an Engine Starting Motor Protection feature. If the starting motor is engaged for 30 or more seconds, without the engine starting, the starting motor will be locked out from operating, allowing for proper cooling of the starting motor. During this time the Wait to Start lamp, if equipped, will flash for 2 minutes. Once the lamp discontinues flashing, the starting motor will be allowed to function again.

High-Pressure System Leak Down Test

Note : This test can **not** be performed if the engine will **not** start.

The high-pressure system check is designed to troubleshoot the high-pressure side of the fuel system by determining if there is a leak in the system.

- Operate the engine to operating temperature.
- Begin INSITE™ electronic service tool Fuel System Leakage Test.
- Allow pressure to stabilize.
- Select “Data Monitor/Logger” > ”All Parameters” > “Fuel Rail Pressure Measured” and monitor the fuel rail pressure.
- Turn the keyswitch to the OFF position. Wait for the engine to stop, and turn the keyswitch ON quickly,

without starting the engine.

- Monitor the fuel rail pressure decay rate for 1 minute.
- A change in fuel pressure greater than 1500 bar [21756 psi] in 1 minute is an indication of a high-pressure fuel system leak.

High-Pressure Fuel Pump Performance Test

Initial Setup

⚠ WARNING ⚠

Normal engine operation creates highly pressurized fuel in the fuel line which will remain in the fuel line after engine shutdown. Never open the fuel system when the engine is operating. Before servicing the fuel system, always loosen the pump-to-rail fuel line at the rail to vent the pressure. Keep hands clear of the line when loosening. High-pressure fuel spray can penetrate the skin, resulting in serious personal injury or death.

⚠ WARNING ⚠

High pressure fuel spray can cause serious injury or death.

⚠ WARNING ⚠

Depending on the circumstance, diesel fuel is flammable. When inspecting or performing service or repairs on the fuel system, to reduce the possibility of fire and resulting severe personal injury, death, or property damage, never smoke or allow sparks or flames (such as pilot lights, electrical switches, or welding equipment) in the work area.

Note : If the low-pressure fuel system is degraded or the fuel pressure relief valve leakage is out of specification, this test will **not** provide accurate results.

Note : Troubleshoot the low-pressure system and any high-pressure fuel system leakage before performing this test.

Before servicing the high-pressure fuel system, loosen the pump-to-rail line at the rail to vent the pressure.

When loosening the nut, keep hands clear of the line.

Tighten the fuel rail nut.

Torque Value: 65 n•m [48 ft-lb]

Note : A machine slot in this fitting directs the fuel spray toward the engine.

⚠ WARNING ⚠

When servicing the engine, do not use a remote starter switch or other means that would engage the starting motor to rotate the engine on a high-pressure common rail engine. Using the starter motor can create highly pressurized fuel in the fuel system. High-pressure fuel spray can penetrate the skin, resulting in serious personal injury or death. Use a hand barring tool to rotate the engine for servicing the engine. Always loosen the pump-to-rail fuel line at the rail to vent the pressure after rotating the engine. Keep hands clear of the line when loosening and wear appropriate eye protection.

⚠ CAUTION ⚠

Do not install the isolation tool at the high-pressure pump outlet fitting. Severe engine damage will result. This tool must only be installed at the fuel rail for the purpose of isolating the high-pressure fuel supply from individual injectors.

This test requires five leak test isolation tools, Part Number 4918563.

Block off five injectors at the fuel rail in place of the high-pressure fuel line. Keep the injector line supply port that is most accessible unblocked.

Torque Value: 65 n•m [48 ft-lb]

Before installation, use electrical contact cleaner, Part Number 3824510, or equivalent, to thoroughly flush any residual fuel and/or debris from the high-pressure fuel pump service tool, Part Number 5299754.

Install the high-pressure fuel pump service tool, Part Number 5299754, from Fuel Pump Performance Test Kit, Part Number 5299726, at the unblocked fuel rail connection.

Note : Cranking speed **must** be above 130 rpm. If necessary, use a battery charger to maintain proper cranking speed.

Note : Units equipped with starter lockout features may require additional cranking aids.

Measurement

Note : Do **not** crank the engine for 30 seconds continuously. Crank the engine in intervals with a 15 second pause between intervals. This reduces the possibility of overheating the starting motor.

- With the following conditions met:
  - Connect fuel drain line, Part Number 3164673, to high-pressure fuel pump service tool, Part Number 5299754.
  - Disconnect the fuel pump actuator from the electrical harness.
  - Disconnect the injector pass-through harness from the engine wiring harness.
  - Route the hose, Part Number 3164673, into a graduated beaker, Part Number 4919139, for measurement.
  - Connect INSITE™ electronic service tool.Log engine speed and fuel rail pressure with INSITE™ electronic service tool.
- Perform initial air purge - no measurements required.
- Crank until fuel flow exits the hose making sure air has been purged or for a maximum of 15 seconds.
- If no fuel flow exists after three 15 second crank cycles, measure the fuel pressure relief valve return flow while performing the High-Pressure Fuel Pump Performance Test. Follow the Fuel Pump Pressure Relief Performance Test in this procedure.
  - Remove the service tool and use electrical contact cleaner, Part Number 3824510, or equivalent, to thoroughly flush any residual fuel and/or debris from the high-pressure fuel pump service tool.
  - Install the high-pressure fuel pump service tool and crank until the fuel exits the hose or for maximum of 15 seconds.
  - If no fuel exits the hose after three 15 seconds crank cycles, high-pressure service tool, Part Number 5299754, is **not** working properly and **must** be replaced.
  - If the fuel pressure relief valve return flow is in specification, inspect the fuel pump head. Refer to Procedure 005-227 in Section 5. (/qs3/pubsys2/xml/en/procedures/425/425-005-227.html)

Note : After completing the test, fuel may still be contained in the drain line. Make sure to empty the line into the measuring container to obtain a proper measurement.

Flow from the service tool is directly related to engine speed.

Use the graph to determine the minimum flow from the service tool.

- Engine speed can be found on the horizontal axis.
- Service tool flow in milliliters can be found on the vertical axis.

If the measured fuel flow from the high-pressure fuel pump service tool at the recorded engine speed is in the upper region of the graph, the fuel pump is functioning properly.

If the measured fuel flow from the high-pressure fuel pump service tool at the recorded engine speed is in the lower region of the graph, the fuel pump is **not** functioning properly and **must** be replaced.

If the measured flow is in the gray area of the graph:

- Check to make sure the correct specifications are being used.
- Verify proper high-pressure fuel pump service tool installation.
- Make sure there are no external leaks.
- Verify all low-pressure system checks were made. Perform the High-Pressure Fuel Pump Performance Test again.

If the test readings are still in the gray area, the fuel pump head **must** be removed and the fuel pump camshaft and fuel pump camshaft tappet rollers **must** be inspected. If the fuel pump passes the inspection, contact technical support.

- Remove the test equipment.
- Use electrical contact cleaner, Part Number 3824510, or equivalent, to thoroughly flush any residual fuel from the high-pressure fuel pump service tool, Part Number 5299754.
- Install the fuel injector supply lines. Refer to Procedure 006-060 in Section 6.
- Connect the fuel pump actuator to the electrical harness.
- Connect the injector pass-through harness to the engine wiring harness.

Note : Do **not** disassemble the high-pressure fuel pump service tool, Part Number 5299754.

High-Pressure Fuel Rail Return Flow Test

Initial Setup

⚠ CAUTION ⚠

Installation of the banjo flow adapter at any place other than the recommended locations can cause damage to high-pressure fuel system components.

Return fuel is routed from the injectors, the fuel rail pressure relief valve, and the fuel pump head through three different drain lines. The measurement of fuel pressure relief valve leakage requires use of fuel return flow hose, Part Number 3164618. This tool is used to isolate the leakage from just the fuel pressure relief valve, so leakage can be measured in a graduated cylinder.

⚠ WARNING ⚠

The fuel pump, high-pressure fuel lines, and fuel rail contain very high-pressure fuel. To reduce the possibility of personal injury, never loosen any fittings while the engine is running.

- Remove the M12 banjo bolt that connects the fuel pressure relief valve drain line to the fuel drain manifold.
- Install fuel return flow hose, Part Number 3164618, at the fuel drain manifold.
- Insert the fuel return flow hose into a collection device.

- Alternatively, fuel return flow hose (fuel pressure relief valve), Part Number 3164617, can be installed at the fuel pressure relief valve.

Torque Value: : 16.8 n•m [148 in-lb]

Measurement - Engine Will Start

⚠ CAUTION ⚠

Fuel is at high-pressure during this test. After connecting the test fitting, close the engine cover and stand clear of high-pressure fuel lines.

- Operate the engine until it is at operating temperature.
- Begin INSITE™ Fuel System Leakage Test.
- Count the number of drops from the fuel return hose within 60 seconds.

Maximum High-Pressure Fuel Rail Return Flow (Engine Operating)	
Drops	Seconds
30	60

Measurement - Engine Will Not Start

⚠ CAUTION ⚠

Fuel is at high-pressure during this test. After connecting the test fitting, close the engine cover and stand clear of high-pressure fuel lines.

- Crank the engine for 30 seconds.
- Count the number of drops from the fuel return hose within 30 seconds.

Maximum High-Pressure Fuel Rail Return Flow (Engine Cranking)	
Drops	Seconds
5	30

Note : Do **not** crank the engine for 30 seconds continuously. Crank the engine in 15 second intervals with a 15 second break between cranking. This reduces the possibility of overheating the starter motor.

Note : Some vehicles are equipped with an Engine Starting Motor Protection feature. If the starting motor is engaged for 30 or more seconds, without the engine starting, the starting motor will be locked out from operating, allowing for proper cooling of the starting motor. During this time the Wait to Start lamp, if equipped, will flash for 2 minutes. Once the lamp discontinues flashing, the starting motor will be allowed to function again.

Cutout Test

Perform a manual cutout test that will **not** start.

- With the engine **not** operating, disconnect the fuel line routed from the fuel rail to cylinder number 1. Refer to Procedure 006-051 in Section 6. (/qs3/pubsys2/xml/en/procedures/425/425-006-051.html)
- Install the injector leakage isolation tool.

Torque Value: 65 n•m [48 ft-lb]

Attempt to start the engine or operate the engine at idle.

Repeat the above test, as necessary, with each cylinder blocked off.

High-Pressure Injector Return Flow Test

Initial Setup

⚠ CAUTION ⚠

Installation of the banjo flow adapter at any place other than the recommended locations can cause damage to high-pressure fuel system components.

Return fuel is routed from the injectors, the fuel rail pressure relief valve, and the fuel pump head through three different drain lines. The measurement of fuel injector leakage requires use of fuel return flow hose, Part Number 3164618. This tool is used to isolate the leakage from the injectors, so leakage can be measured in a graduated beaker.

Obtain a graduated beaker marked in cubic centimeters or milliliters, Part Number 4919139, or equivalent.

⚠ WARNING ⚠

Depending on the circumstance, diesel fuel is flammable. When inspecting or performing service or repairs on the fuel system, to reduce the possibility of fire and resulting severe personal injury, death, or property damage, never smoke or allow sparks or flames (such as pilot lights, electrical switches, or welding equipment) in the work area.

- Remove the M12 banjo bolt that connects the fuel injector drain line to the fuel drain manifold.
- Install M12 fuel return hose, Part Number 3164618, at the fuel drain manifold.
- Route the fuel return hose into a collection device.

Measurement - Engine Will Start

⚠ CAUTION ⚠

Fuel is at high-pressure during this test. After connecting the test fitting, close the engine cover and stand clear of high-pressure fuel lines.

- Connect INSITE™ electronic service tool.
- Operate the engine until it is at operating temperature.

- Allow the engine to idle with fuel flowing into a collection container.
- Begin the INSITE™ Fuel System Leakage Test and allow the engine to operate at high-pressure for AT LEAST 1 minute.
- Use a graduated cylinder to collect fuel flow from the injector drain for EXACTLY 1 minute.
- IMMEDIATELY return the injector drain hose into collection container.
- After recording the fuel leakage quantity, stop INSITE™ High-Pressure Leakage Test and turn the keyswitch to OFF.

High-Pressure Fuel Injector Return Flow Specification (Engine operating)	
Maximum leakage in 1 minute	120 ml/cc

Note : Fuel temperature and fuel type will influence this measurement. For example; as the engine is warmed up and the injectors become hot, the leakage rate will increase. Also, low viscosity fuels, such as kerosene, will cause the leakage rate to increase. The above specification is correct for on-highway diesel fuels where fuel inlet temperature is less than 49°C [120°F].

Note : Make sure a steady flow of fuel is present at the drain line before beginning the measurement. Air in the line and movement of the hose during measurement can result in inaccurate measurements.

Measurement - Engine Will Not Start

- If the engine will **not** start, the injector return flow **must** be measured while engaging the starter for 30 seconds at a time.
- The leakage should **only** be a few drops. If leakage is greater than a few drops, an injector or a high-pressure connector is leaking.

Note : Do **not** crank the engine for 30 seconds continuously. Crank the engine in 15 second intervals with a 15 second break between cranking. This reduces the possibility of overheating the starter motor.

Note : Some vehicles are equipped with an Engine Starting Motor Protection feature. If the starting motor is engaged for 30 or more seconds, without the

engine starting, the starting motor will be locked out from operating, allowing for proper cooling of the starting motor. During this time the Wait to Start lamp, if equipped, will flash for 2 minutes. Once the lamp discontinues flashing, the starting motor will be allowed to function again.

Initial Setup - Injector Isolation

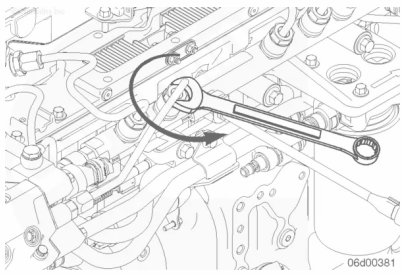
⚠ WARNING ⚠

Normal engine operation creates highly pressurized fuel in the fuel line which will remain in the fuel line after engine shutdown. Never open the fuel system when the engine is operating. Before servicing the fuel system, always loosen the pump to rail fuel line at the rail to vent the pressure. Keep hands clear of the line when loosening. High-pressure fuel spray can penetrate the skin, resulting in serious personal injury or death.

If injector drain flow is excessive, it will be necessary to isolate the injector(s) or fuel connector(s) that are damaged or worn. A loose fuel connector retaining nut results in a poor seal at the interface between the fuel connector and the injector. This loose condition will result in a leak of high-pressure fuel to the injector drain.

- Verify first that the fuel connectors are properly tightened. Refer to Procedure 006-052 in Section 6. (/qs3/pubsys2/xml/en/procedures/425/425-006-052.html)
- If loose retaining nut(s) are found, test for leakage after tightening the retaining nut(s).

- Before servicing the fuel system, loosen the pump to rail line at the rail to vent the pressure. Keep hands clear of the line when loosening. Tighten the fuel rail nut, once pressure has been released.



Torque Value: 65 n•m [48 ft-lb]

Note : A machined slot in this fitting directs the fuel spray toward the engine block.

⚠ CAUTION ⚠

Do not install the isolation tool at the high-pressure pump outlet fitting. Severe engine damage will result. This tool must only be installed at the fuel rail for the purpose of isolating the high-pressure fuel supply from individual injectors.

⚠ CAUTION ⚠

Make certain the keyswitch is in the OFF position (Engine will Not Start) when loosening or tightening high-pressure fuel lines.

- Use leak test isolation tool, Part Number 4918563, or equivalent, to isolate excessive fuel drain from injectors or fuel connectors.

- Isolate the injector and fuel connector for each cylinder by installing the isolation tool at the fuel rail in place of the high-pressure fuel line that supplies the fuel connector.
- Tighten the isolation tool.

Torque Value: 65 n•m [48 ft-lb]

Measurement - Injector Isolation

- Record the amount of fuel flow from the injector drain line in 1 minute while the engine is operating. Use INSITE™ electronic service tool High-Pressure Leakage Test. If the engine will **not** start, drain flow **must** be measured while engaging the starter for 30 seconds.
- Do this up to six times, once while each line is isolated.
- If isolating a single injector and the high-pressure fuel connector causes the leakage to decrease significantly compared to the rest of the set, that injector and fuel connector **must** be inspected.

Injector Inspection: Refer to Procedure 006-026 in Section 6. (/qs3/pubsys2/xml/en/procedures/425/425-006-026.html)

Fuel Connector Inspection: Refer to Procedure 006-052 in Section 6. (/qs3/pubsys2/xml/en/procedures/425/425-006-052.html)

Note : Do **not** crank the engine for 30 seconds continuously. Crank the engine in 15 second intervals with a 15 second break between cranking. This

reduces the possibility of overheating the starter motor.

Note : Some vehicles are equipped with an Engine Starting Motor Protection feature. If the starting motor is engaged for 30 or more seconds, without the engine starting, the starting motor will be locked out from operating, allowing for proper cooling of the starting motor. During this time the Wait to Start lamp, if equipped, will flash for 2 minutes. Once the lamp discontinues flashing, the starting motor will be allowed to function again.

Note : Make sure a steady flow of fuel is present at the drain line before beginning the measurement. Air in the line and movement of the hose during measurement can result in inaccurate measurements.

High-Pressure Fuel Pump Return Flow Test

Initial Setup

⚠ WARNING ⚠

Depending on the circumstance, diesel fuel is flammable. When inspecting or performing service or repairs on the fuel system, to reduce the possibility of fire and resulting severe personal injury, death, or property damage, never smoke or allow sparks or flames (such as pilot lights, electrical switches, or welding equipment) in the work area.

⚠ CAUTION ⚠

Installation of the banjo flow adapter at any place other than the recommended locations can cause damage to high-pressure fuel system components.

This fuel pump head leakage test uses a flow adapter fitting. The purpose of the flow adapter fitting is to route the drain flow of the fuel pump **only** into a collection device so that leakage may be measured.

Obtain a graduated cylinder marked in cubic centimeters or milliliters, graduated beaker Part Number, 4919139, or equivalent.

Note : The pump drain line connects at the center connection point on the fuel drain manifold.

- Remove the banjo bolt from the fuel pump drain line at the fuel drain manifold.
- Install banjo flow adapter, Part Number 3164618, at the fuel drain manifold and insert the hose into a bucket or the vehicle fuel tanks.

Alternate Test Setup

- If the drain manifold is **not** easily accessed, a M14 banjo can be attached at the pump head drain port with a fuel hose that is routed to the collection container.
- In this setup, a 12 x 1.5 banjo screw and cap, Part Number 4918295, is required to prevent fuel from flowing backward and leaking from the unused drain line. This kit also includes fuel hose to be routed into collection container.

⚠ CAUTION ⚠

The high-pressure leakage test in INSITE™ electronic service tool will cause the engine to operate at elevated pressures while the engine idles. The engine noise will change when this test is being performed due to the higher fuel injection pressures. Safety glasses should be worn while working near the operating engine. Fuel lines should not be adjusted while performing this test.

Close the engine cover(s) while performing these tests.

Measurement - Engine Will Start

- Connect INSITE™ electronic service tool.
- Operate the engine until operating temperature is reached.
- Allow the engine to idle with fuel flowing into a collection container.
- Begin the INSITE™ Fuel System Leakage Test and allow the engine to operate at high-pressure for AT LEAST 1 minute.
- Use a graduated cylinder to collect the fuel pump return flow for EXACTLY 30 seconds.

- IMMEDIATELY return the injector drain hose into collection container.
- After recording the fuel leakage quantity, stop INSITE™ High-Pressure Leakage Test and turn the keyswitch to OFF.

Minimum High-Pressure Fuel Pump Return Flow (Engine Operating)	
ml/cc	Seconds
50	30

Note : This specification is valid for engines operating on diesel fuels. Low fuel viscosity will increase the leakage rate; for example, kerosene or aviation fuels will result in excessive leakage. Verify the fuel type before replacing a fuel pump head for excessive leakage.

Measurement - Engine Will Not Start

- Turn the keyswitch ON. Allow the fuel lift pump to complete the cycle. After the cycle is completed, begin cranking the engine until fuel exits the drain line.
- When fuel begins to exit the drain line, route the drain flow to a graduated cylinder and continue cranking for 30 seconds.

Maximum High-Pressure Fuel Pump Return Flow (Engine Cranking)	
ml/cc	Seconds
320	30

Note : Do **not** crank the engine for 30 seconds continuously. Crank the engine in 15 second intervals with a 15 second break between cranking. This reduces the possibility of overheating the starter motor.

Note : Some vehicles are equipped with an Engine Starting Motor Protection feature. If the starting motor is engaged for 30 or more seconds, without the engine starting, the starting motor will be locked out from operating, allowing for proper cooling of the starting motor. During this time the Wait to Start lamp, if equipped, will flash for 2 minutes. Once the lamp discontinues flashing, the starting motor will be allowed to function again.

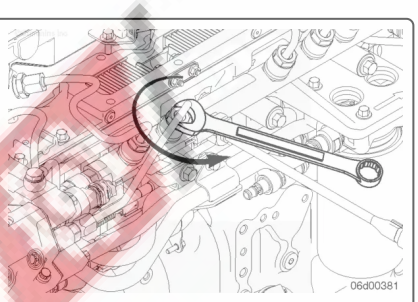
High-Pressure Fuel Pump Supply Flow Test

Initial Setup

Obtain a graduated cylinder marked in cubic centimeters or milliliters, graduated beaker, Part Number 4919139, or equivalent.

⚠ WARNING ⚠

Normal engine operation creates highly pressurized fuel in the fuel line which will remain in the fuel line after engine shutdown. Never open the fuel system when the engine is operating. Before servicing the fuel system, always loosen the pump to rail fuel line at the rail to vent the pressure. Keep hands clear of the line when loosening. High-pressure fuel spray can penetrate the skin, resulting in serious personal injury or death.



- Before servicing the fuel system, loosen the pump-to-rail line at the rail to vent the pressure. Keep hands clear of the line when loosening. Tighten the fuel rail nut, once pressure has been released.

Torque Value: 65 n•m [48 ft-lb]

Note : A machined slot in this fitting directs the fuel spray toward the engine block.

- Disconnect the high-pressure fuel line from the rail.
- Clamp a hose to the end of the fuel line.
- Route a hose from the test fitting into a clean graduated cylinder.

Measurement

- Crank the engine for 30 seconds. Make sure engine cranking speed is at least 150 rpm.
- If there is no flow, verify that the vehicle has been fully primed.

Minimum High-Pressure Fuel Pump Supply Flow

Minimum High-Pressure Fuel Pump Supply Flow	
ml/cc	Seconds
75	30

Note : Do **not** crank the engine for 30 seconds continuously. Crank the engine in 15 second intervals with a 15 second break between cranking. This reduces the possibility of overheating the starter motor.

Note : Some vehicles are equipped with an Engine Starting Motor Protection feature. If the starting motor is engaged for 30 or more seconds, without the engine starting, the starting motor will be locked out from operating, allowing for proper cooling of the starting motor. During this time the Wait to Start lamp, if equipped, will flash for 2 minutes. Once the lamp discontinues flashing, the starting motor will be allowed to function again.

Finishing Steps

- Start the engine. Check for proper operation.

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Last Modified: 23-Oct-2020

Injectors and Fuel Lines

Tool Number
3163067
Assembly Lubricant This is a multi purpose anti-seize lubricant. This is an all purpose anti-seize lubricant that speeds assembly and disassembly of studs, bolts, capscrews, flanges and fittings.
 SP000786

Tool Number
3164025
Fuel Connector Remover Used to pull the fuel connector.

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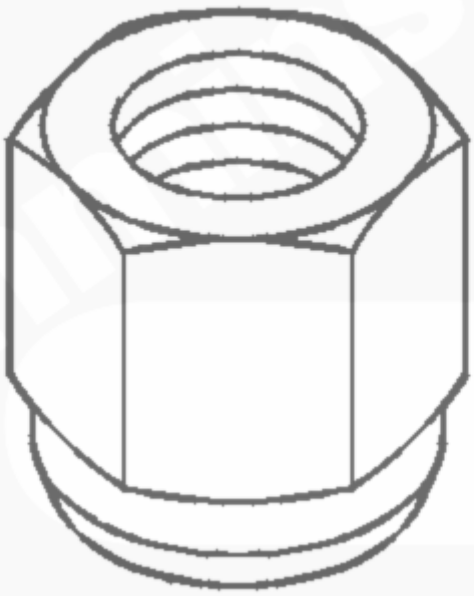

22d00081

Tool Number

3164489

Digital Multimeter

This digital multimeter includes the functions of frequency, capacitance and temperature (with a built-in temperature module). Also included are these functions: RPM, Dwell, Duty Cycle and Pulse Width and comes with test leads, protective boot, inductive pick-up, bead-type temperature probe. Nylon carrying case available separately (3164497).

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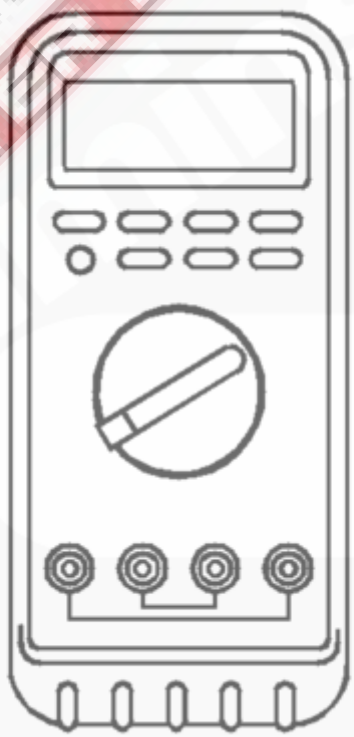


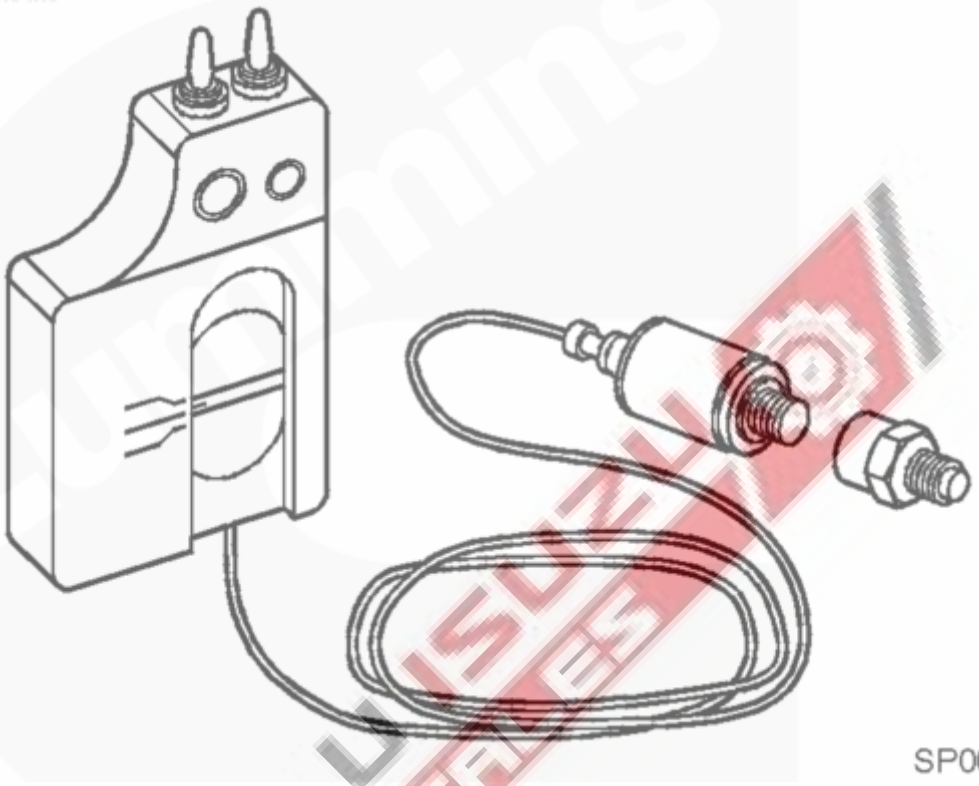
SP000709

Tool Number

3164491

Pressure Adapter/Vacuum

This pressure/vacuum adapter is used with digital multimeter, Part Number, 3164488, or digital multimeter, Part Number 3164489, to measure up to 500 psi pressure and vacuum to -30 in-hg.

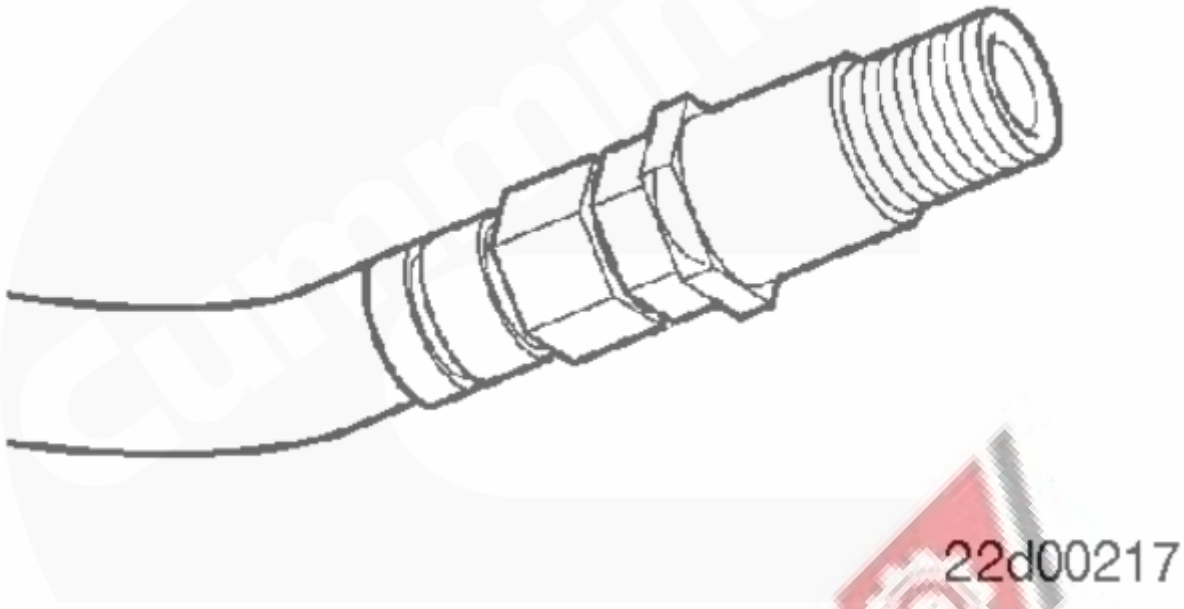


Tool Number

3164617

Fuel Return Flow Hose (fuel pressure relief valve)

This tool uses a special banjo fitting to connect to the fuel return circuit to measure the return flow from the fuel pressure relief valve.

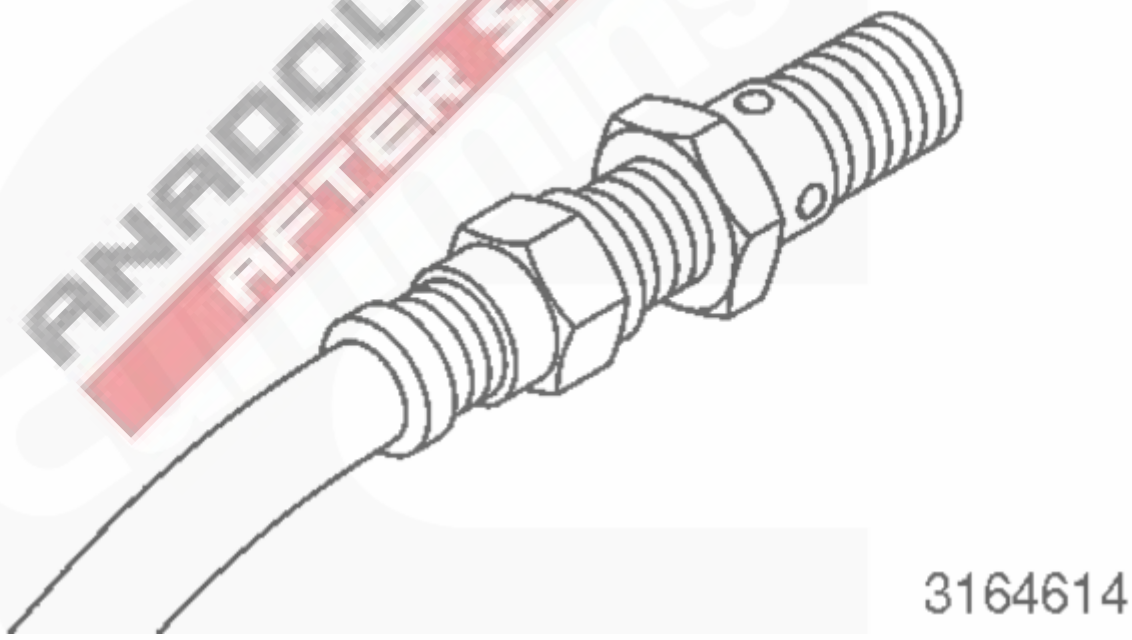


Tool Number

3164618

Fuel Return Flow Hose

This tool uses a special fitting to connect to the fuel return circuits to measure return flow from the injectors and fuel pump.

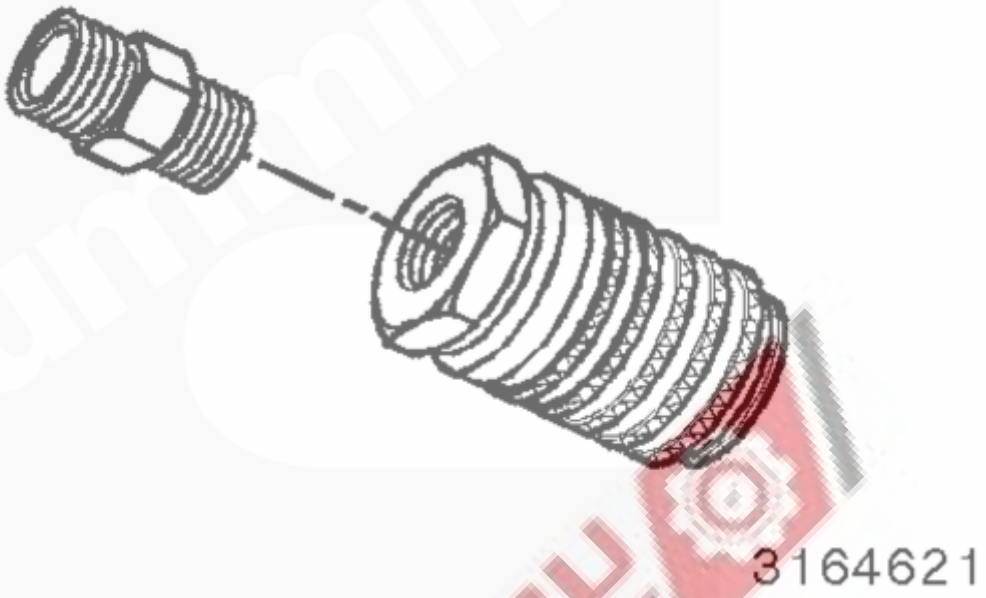


Tool Number

3164621

Fuel line with 1.09 mm [0.043 in] orifice.

Used in procedures to create rated flow through the low pressure fuel system, without the need to operate the engine under load.

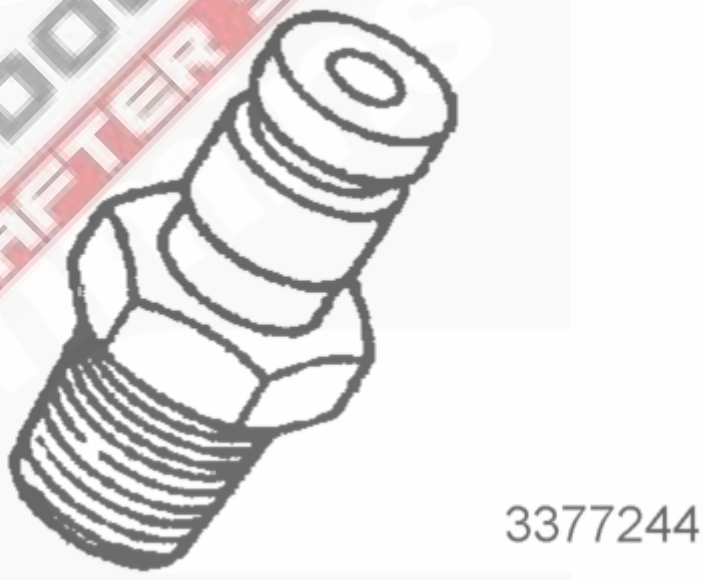


Tool Number

3377244

Fitting, Quick-Disconnect Male

Used to perform a pressure-side air in fuel test.



Tool Number

3824510

QD Contact Cleaner

This is an alcohol based precision cleaner that is 100% free of CFC's. This product is ideal

for application where lower flash-point solvents can be used. It evaporates rapidly and completely and is harmless to most plastics. Use this when cleaning electrical/electronics connections. (Flammable).



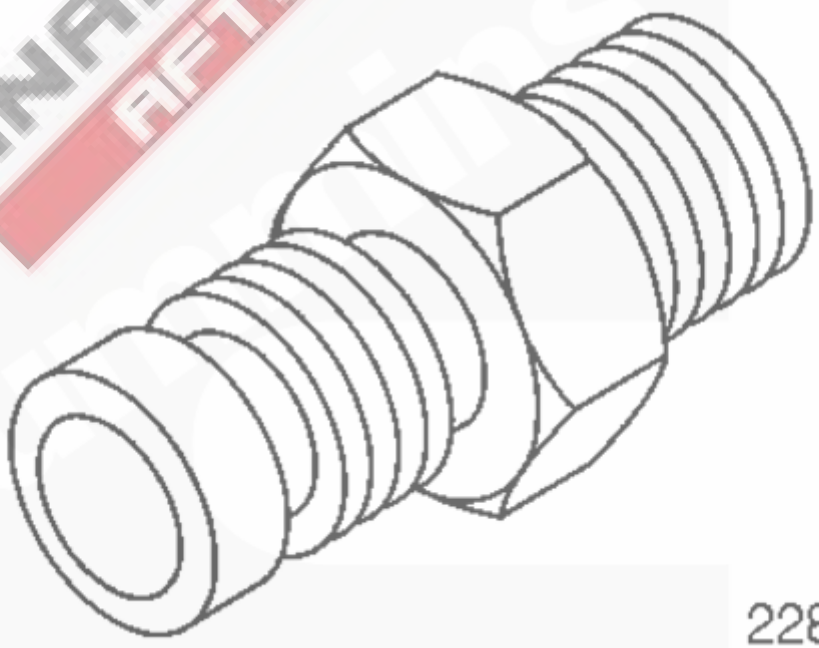
SP000784

Tool Number

3824842

M10 STORM Compuchek™ Diagnostic Fitting

Used to measure fuel pressure or vacuum wherever STORM M10 diagnostic ports exist.



22800572

Tool Number

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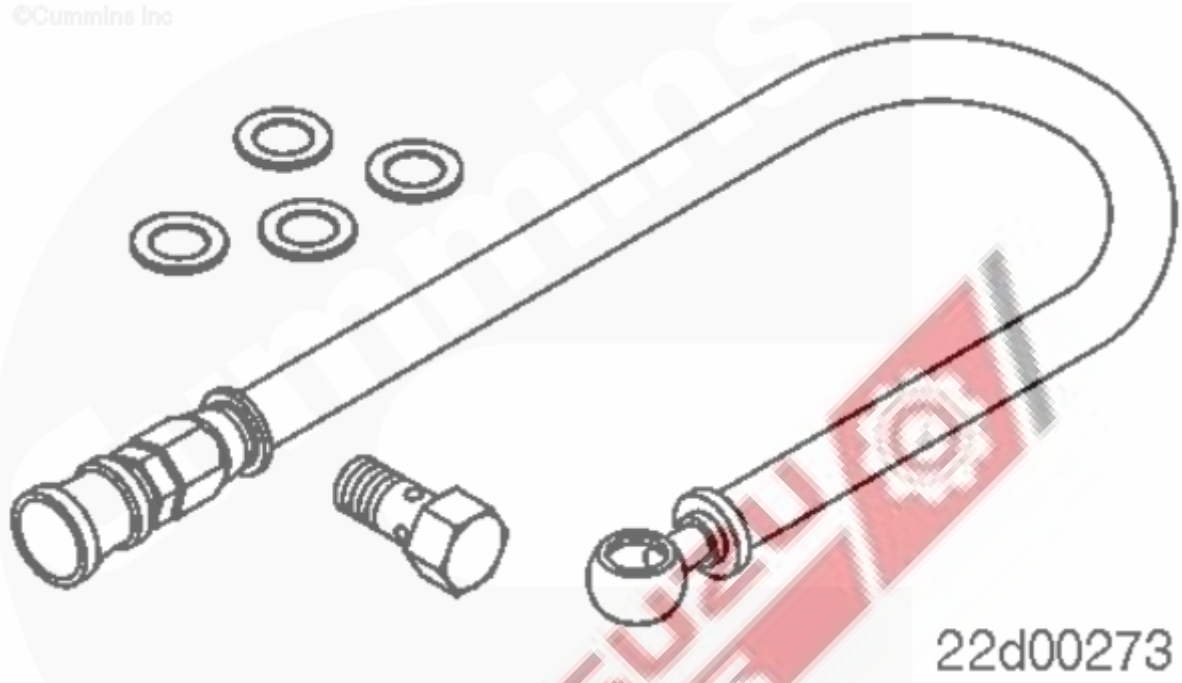
4918324

Fuel Pressure Test Kit

Used with a vacuum gauge, Part Number ST 434, or equivalent, along with quick-disconnect fitting, Part Number 3972088, to check the fuel inlet restriction.



Tool Number

4918413

Banjo Fitting

A banjo-style pressure gauge adapter may be used to measure pressure or vacuum at any point in the low-pressure fuel system where a banjo bolt exists at a fuel line.

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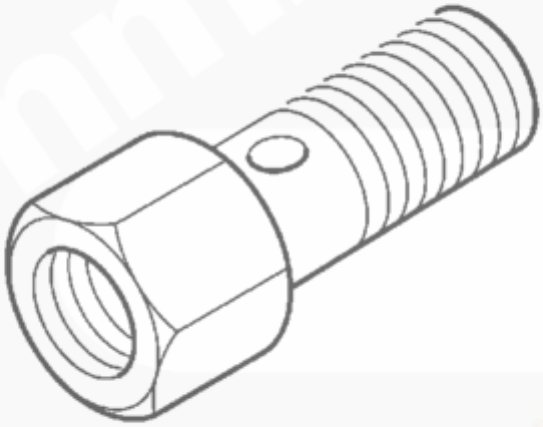


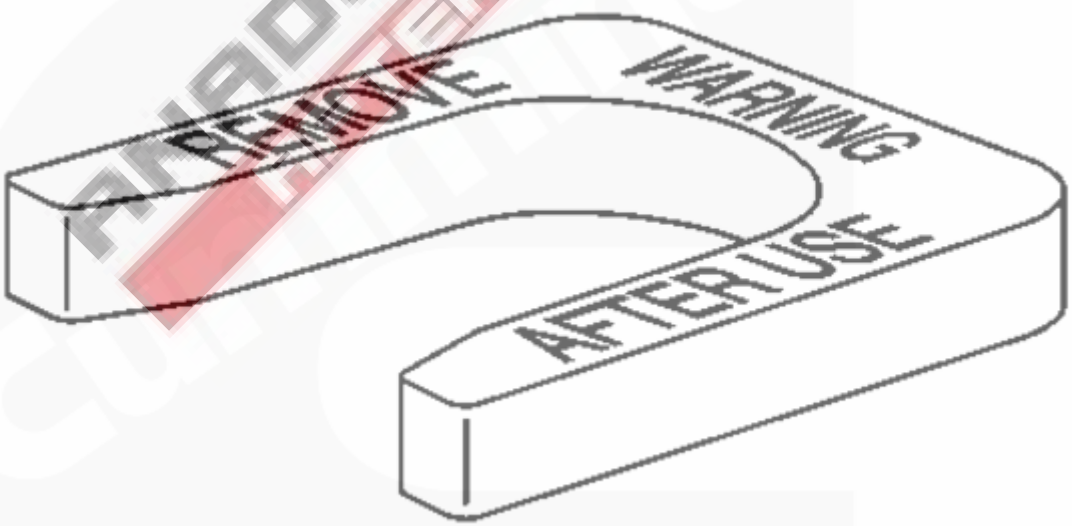
22d00230

Tool Number

4918878

Fuel Line Quick Disconnect Tool

Used to remove 3/8 quick disconnect fittings female connectors.



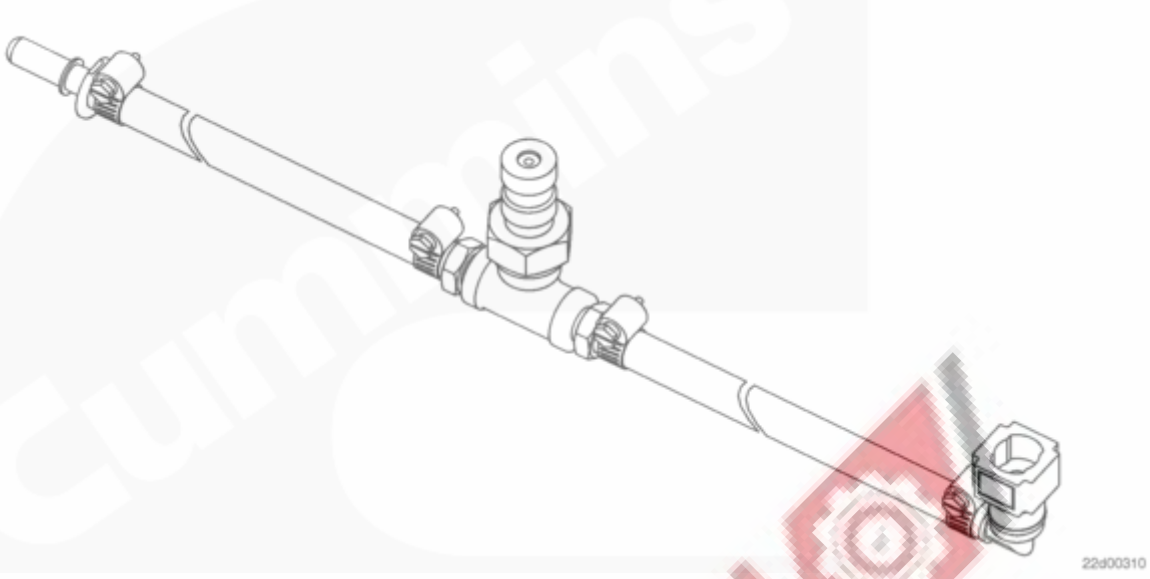
22d00299

Tool Number

4918895

Pressure Gauge Adapter

The adapter is used to check the fuel inlet restriction and the drain line pressure on engines equipped with a 11.8 mm [.46 inch] quick disconnect fuel line fitting.



Tool Number

ST 434

Vacuum Gauge (0 to 762 mm-hg [0 to 30 in-hg])

Used to measure lift pump inlet restriction. Hose adaptor, Part Number ST 434 2 and vacuum gauge, Part Number ST 434 12 are used to perform the test.

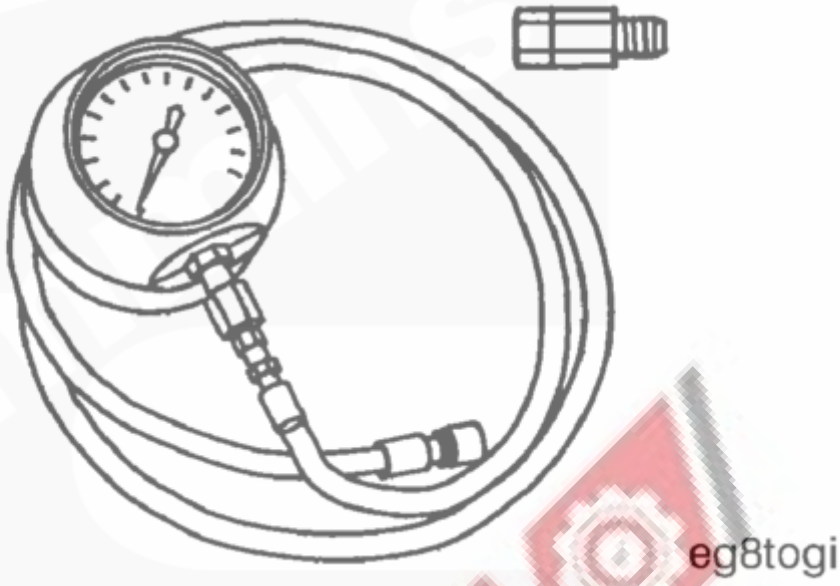


Tool Number

ST 1273

Pressure Gauge (0 to 1905 mm-hg [0 to 75 in-hg])

Used to measure engine intake manifold pressure, exhaust restriction, lift pump output pressure, and pressure drop across fuel filters.



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Last Modified: 10-Aug-2016

ANADOLU ISUZU AFTER SALES

Select Service Tools

Recommended Cummins® Service Tools

- Compuchek™ fitting, Part Number 3824842
- Adapter fitting, Part Number 3932302
- 1/8 inch NTP male Compuchek™ fitting, Part Number 33772244
- Diagnostic fuel line Part Number 4918895
- Diagnostic fuel line, Part Number 3164621

Additional Service Items

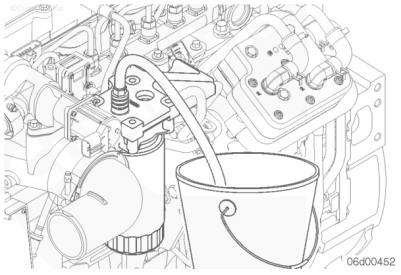
- Container suitable for fuel

General Information

Perform the steps in the Priming procedure before beginning this procedure to make sure all entrapped air is removed from the system. Refer to Procedure 005-234 in Section 5. (/qs3/pubsys2/xml/en/procedures/425/425-005-234-tr.html)

Setup

Note : A symptom of air in fuel for the engines equipped with a common rail fuel system is an audible surge associated with fuel system pressure fluctuations, due to air in the fuel supply.



The following test method will simulate rated fuel flow through the system, so air in fuel problems can be diagnosed.

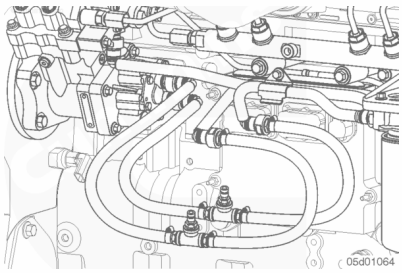
Install Compuchek™ fitting, Part Number 3824842, at the inlet to the 5 micron fuel filter and attach the 1.09 mm [0.043 in] diagnostic fuel line.

Route the outlet of the 1.09 mm [0.043 in] diagnostic fuel line into a collection device of suitable size (a 19 liter [5 gal] bucket is recommended).

Note : If there is **not** enough clearance to install female Compuchek™ fitting, Part Number 3824842,

an adapter fitting, Part Number 3932302, and 1/8 NPT male Compuchek™ fitting, Part Number 3377244, can be used to aid accessibility.

Obtain two diagnostic fuel lines, Part Number 4918895.



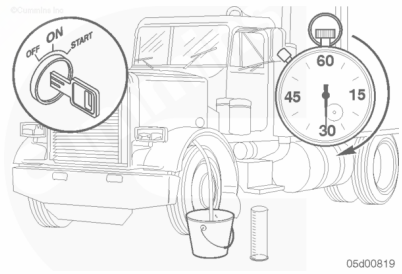
Install one diagnostic fuel line between the gear pump fuel supply line and the gear pump inlet (upper fuel line fitting).

Install the second diagnostic fuel line between the gear pump outlet and the pressure side fuel filter fuel supply line (lower fuel line fitting).

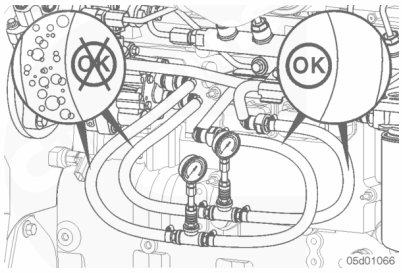
Note : If the engine is **not** equipped with an engine mounted pressure side fuel filter, diagnostic fuel line, Part Number 4918895, can **not** be installed at the gear pump outlet.

Measure

Start the engine. Operate the engine speed from idle to high idle several times to purge the air introduced while installing the diagnostic fuel line.



Observe the clarity of the fuel in the clear diagnostic fuel lines installed at the gear pump inlet and outlet. Air should **not** be present in the fuel.



Note : Make sure 0.043 inch orificed diagnostic fuel line, Part Number 3164621, is installed at the inlet of the fuel filter head. Make certain the test lines are **not** kinked or leaking after installation.

Bubbles at the inlet to the gear pump are an indication of a leak that allows air to enter, a severe inlet restriction that causes cavitation, or a system **not** yet primed. Refer to Procedure 006-020 Section 6. (/qs3/pubsys2/xml/en/procedures/425/425-006-020.html)

- Suction fuel lines
- Engine control module (ECM) mounting plate assembly
- Original equipment manufacturer (OEM) fuel lines
- Suction-side fuel filter assemblies

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- Standpipe(s) in the fuel tank(s).

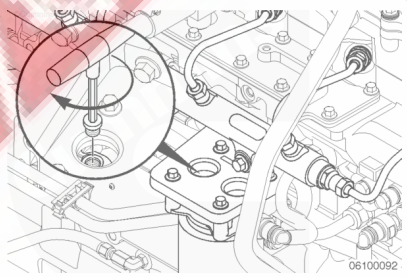
Note : Inspect clear diagnostic fuel lines to make sure air is **not** entering the diagnostic fuel line at the Compuchek™ fitting.

Clear fuel at the inlet of the gear pump and bubbles at the outlet of the gear pump are an indication the fuel pump gear pump is allowing air to enter the fuel system and the gear pump **must** be replaced. Refer to Procedure 005-025 in Section 5. (/qs3/pubsys2/xml/en/procedures/425/425-005-025.html)

Test

⚠ WARNING ⚠

To reduce the possibility of fire and resulting severe personal injury, death or property damage, care must be taken when installing diagnostic equipment on the fuel system. Always allow a short period of time after shutting down the engine before loosening any fittings in the fuel system to allow residual fuel pressure to decrease.

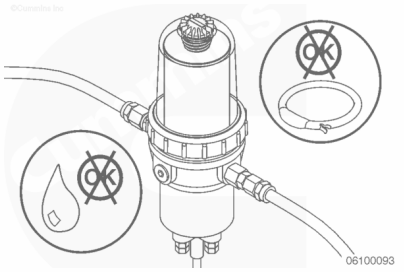


If the engine is hard to start or will **not** start, perform the following test to check for trapped air.

Check For Trapped Air:

- Crank the engine for 5 seconds.
- Turn the keyswitch OFF.
- Loosen the diagnostic port plug at the top of the fuel filter head while shielding the area with a shop towel.
- Trapped air will retain pressure in the system causing a spray of air/fuel mixture from the diagnostic port fitting.

If air is found to be trapped in the system, inspect the OEM-supplied suction-side fuel filter for leaks, loose fittings, damaged o-rings, etc.



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Finishing Steps

- Remove all test fuel lines. Refer to Procedure 006-024 in Section 6. (/qs3/pubsys2/xml/en/procedures/425/425-006-024.html)
- Operate the engine. Check for leaks.

Last Modified: 12-Aug-2019

ANADOLU ISUZU AFTER SALES

Select Service Tools

Recommended Cummins® Service Tools

- Electrical contact cleaner, Part Number 3824510, or equivalent.

Additional Service Items

- Steam cleaner.

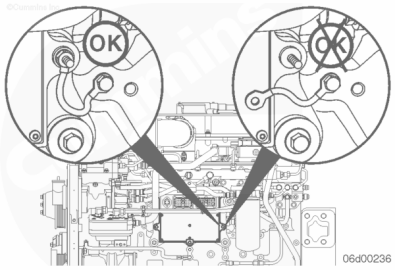
Initial Check

The engine control module (ECM) cooling plate assembly provides a vibration isolated mounting location for the ECM. The cooling plate also provides ECM cooling and incorporates the fuel lift pump. A check valve at the outlet port in the ECM cooling plate makes sure that the fuel system is primed while the fuel lift pump is running. Check the ECM cooling plate for damaged vibration isolators, loose capscrews, or fuel leaks.

Make sure that the ground strap is properly installed. A missing or poorly connected ground strap may cause intermittent engine performance problems.

The ground strap **must** be connected between the head of the ECM mounting bolt and the ECM.

The ground strap **must** be connected to an unpainted block surface that is free of corrosion.



Preparatory Steps

⚠ WARNING ⚠

Fuel is flammable. Keep all cigarettes, flames, pilot lights, arcing equipment, and switches out of the work area and areas sharing ventilation to reduce the possibility of severe personal injury or death when working on the fuel system.



⚠ WARNING ⚠

Wear appropriate eye and face protection when using compressed air. Flying debris and dirt can cause personal injury.

⚠ WARNING ⚠

When using a steam cleaner, wear safety glasses or a face shield, as well as protective clothing. Hot steam can cause serious personal injury.

⚠ WARNING ⚠

Clean all fittings before disassembly. Dirt or contaminants can damage the fuel system.

Before servicing **any** fuel system components, (such as fuel lines, fuel pump, injectors, etc.) which would expose the fuel system or internal engine component to potential contaminants prior to disassembly, clean the fittings, mounting hardware, and the area around the component to be removed. Dirt or contaminants can be introduced into the fuel system and engine if the surrounding areas are **not** cleaned, resulting in damage to the fuel system and engine.

- Clean the engine. Refer to Procedure 000-009 in Section 0. (/qs3/pubsys2/xml/en/procedures/99/99-000-009.html) Refer to Procedure 204-008 in Section i. (/qs3/pubsys2/xml/en/procedures/99/99-204-008.html)
- Make sure that debris, water, steam, or cleaning solution does **not** get inside the fuel system.

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.



⚠ WARNING ⚠

Fuel is flammable. Keep all cigarettes, flames, pilot lights, arcing equipment, and switches out of the work area and areas sharing ventilation to reduce the

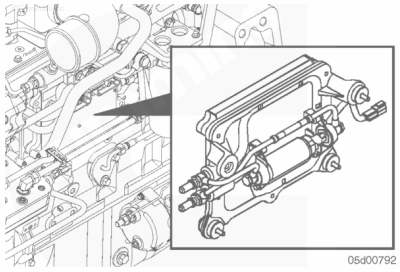
possibility of severe personal injury or death when working on the fuel system.

- Disconnect the batteries. See equipment manufacturer service information.
- Shut off the fuel supply and drain valves. See equipment manufacturer service information.
- Disconnect the rail fuel pressure sensor from the engine wiring harness. Refer to Procedure 019-115 in Section 19. (/qs3/pubsys2/xml/en/procedures/425/425-019-115.html)
- Remove the high-pressure fuel lines from the fuel rail. Refer to Procedure 006-051 in Section 6. (/qs3/pubsys2/xml/en/procedures/425/425-006-051.html)
- Remove the fuel drain line from the fuel pressure relief valve. Refer to Procedure 006-013 in Section 6. (/qs3/pubsys2/xml/en/procedures/425/425-006-013.html)

Remove

Note : The electric fuel priming pump and priming pump fuel lines will be attached to the ECM cooling plate while the cooling plate is being removed.

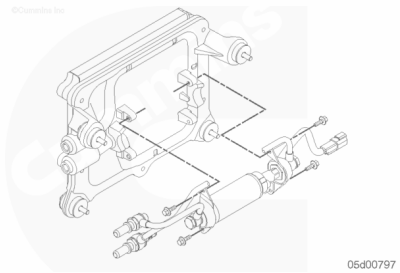
Remove the ECM cooling plate capscrews and ECM cooling plate from the engine block.



Disassemble

Remove the following components from the ECM cooling plate:

- Male banjo quick disconnect fitting
- Male banjo check valve fitting
- Fuel lift pump supply lines
- Fuel lift pump brackets
- Fuel lift pump.



ANADOLU ISUZU AFTER SALES

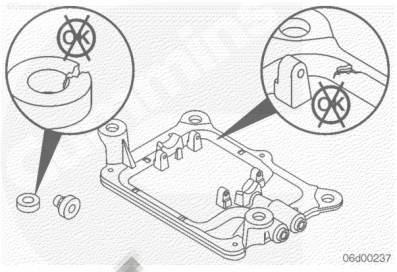
Inspect for Reuse

Inspect the ECM cooling plate for leaks (note that the fuel passages are contained in a tube that is cast into the cooling plate).

Replace any damaged vibration isolators.

Inspect for leaks in the electric fuel supply pump priming circuit. Look for cracked fuel tubes, damaged o-rings, or damaged seal washers.

Inspect the check valve for debris or damage.

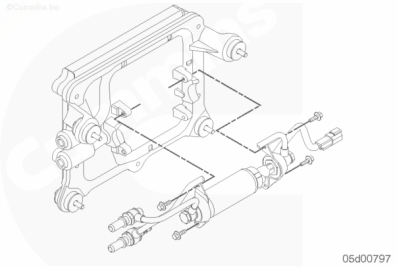


Assemble

Install the electric fuel priming pump and the priming circuit fuel lines. Refer to Procedure 005-045 in Section 5. (/qs3/pubsys2/xml/en/procedures/425/425-005-045.html)

Make sure the lines are supported while tightening the banjo screws. The lines **must not** be permitted to bind.

Make sure the ECM check valve is installed into the bottom (outlet) fitting of the ECM cooling plate.

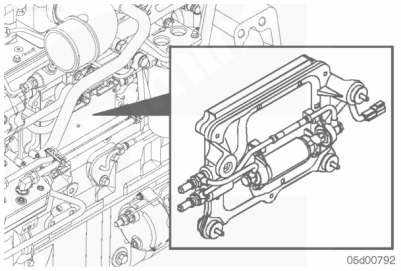


Install

Install the ECM cooling plate assembly on the engine block.

Tighten the capscrews.

Torque Value: 24 n•m [212 ft-lb]



Finishing Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.



⚠ WARNING ⚠

Failure to properly install the ECM ground strap may cause intermittent engine symptoms including intermittent engine stalls. One end of the ground strap must be installed between the ECM housing and the head of the bottom most ECM mounting capscrew. The other end of the ground strap must be tightly bolted to an unpainted block surface that is free from corrosion.

Note : Make sure the vibrations isolators are installed correctly. The isolators fit in a single direction into the chamfered locators.

- Install the ECM on the ECM cooling plate. Refer to Procedure 019-031 in Section 19. (/qs3/pubsys2/xml/en/procedures/425/425-019-031.html)
- Install the suction fuel lines, if removed.
- Connect the fuel supply lines. Refer to Procedure 006-024 in Section 6. (/qs3/pubsys2/xml/en/procedures/425/425-006-024.html)
- Connect the engine harness to the electric fuel priming pump.
- Connect the ECM ground strap.
- Connect the harness connections to the ECM.
- Connect the batteries. See equipment manufacturer service information.
- Open the fuel supply valves, if equipped.
- Cycle the keyswitch and allow lift pump to operate for 30 seconds. Afterward, turn the keyswitch OFF and back ON again allowing the lift pump to operate again.
- Allow the lift pump to operate for three or four 30-second cycles before attempting to start the engine.
- Operate the engine. Check for leaks.

Last Modified: 19-Feb-2019



Select Service Tools

Recommended Cummins® Service Tools

- M12 banjo pressure gauge tool, Part Number 4918413
- Compuchek™ fitting, Part Number 3377244

Additional Service Items

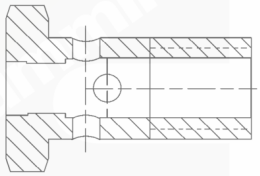
- No additional service items required.

Preparatory Steps

Obtain an M12 banjo pressure gauge tool, Part Number 4918413.

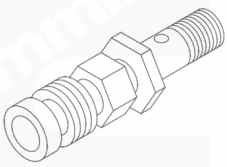
A banjo-style pressure gauge adapter can be used to measure pressure or vacuum at any point in the low-pressure fuel system where a banjo bolt exists at a fuel line.

The engine use M12 x 1.5 banjo bolt connections. Part Number 4918413 can be used for measurement of drain line restriction (pressure) at the fuel drain manifold.



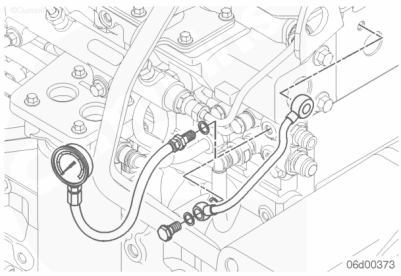
Assemble the banjo pressure gauge adapter.

1. Install Compuchek™ fitting, Part Number 3377244, or other type fitting in the hex face of the banjo bolt.
2. Attach a hose or pressure gauge to the banjo pressure adapter.



Install the M12 banjo pressure gauge adapter in place of the injector drain line banjo at the fuel drain manifold.

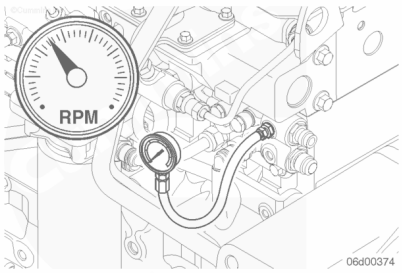
Install a 0 to 762 mm-hg [0 to 30 in-hg] pressure gauge at the M12 banjo pressure gauge adapter.



Measure

Operate the engine at rated speed and no load.

Observe the reading on the gauge.



Fuel Drain Line Pressure		
mm-hg		in-hg
254.0	MAX	10.0

If the drain line pressure is out of specification, check for bends or kinks in the drain lines. Look for places where the original equipment manufacturer (OEM) fuel lines can be pinched by wire ties or P-clips. Check for blocked fuel tank vents.

Finishing Steps

- Remove all test fittings. Install the drain lines.
- Operate the engine. Check for leaks. Refer to Procedure 006-013 in Section 6. (/qs3/pubsys2/xml/en/procedures/425/425-006-013.html)

Last Modified: 27-Jul-2016

ANADOLU ISUZU PARTS

Select Service Tools

Recommended Cummins® Service Tools

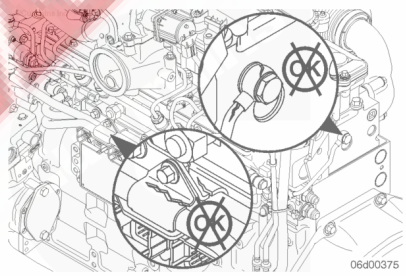
- Contact cleaner, Part Number 3824510, or equivalent

Additional Service Items

- No additional service items required.

Initial Check

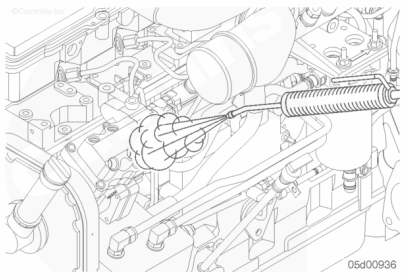
Inspect the drain lines for any signs of leaks, cracks, chafing, or loose or broken brackets.



Preparatory Steps

⚠ WARNING ⚠

Fuel is flammable. Keep all cigarettes, flames, pilot lights, arcing equipment, and switches out of the work area and areas sharing ventilation to reduce the possibility of severe personal injury or death when working on the fuel system.



⚠ WARNING ⚠

Wear appropriate eye and face protection when using compressed air. Flying debris and dirt can cause personal injury.

⚠ WARNING ⚠

When using a steam cleaner, wear safety glasses or a face shield, as well as protective clothing. Hot steam can cause serious personal injury.

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

⚠ CAUTION ⚠

Clean all fittings before disassembly. Dirt or contaminants can damage the fuel system.

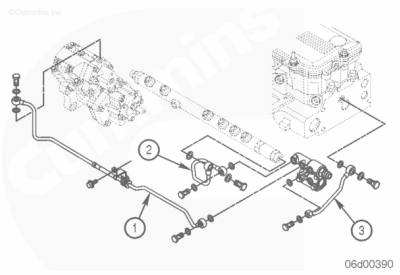
Before servicing **any** fuel system components, (such as fuel lines, fuel pump, injectors, etc.) which would expose the fuel system or internal engine component to potential contaminants prior to disassembly, clean the fittings, mounting hardware, and the area around the component to be removed. Dirt or contaminants can be introduced into the fuel system and engine if the surrounding areas are **not** cleaned, resulting in damage to the fuel system and engine.

- Clean the engine. Refer to Procedure 000-009 in Section 0. (/qs3/pubsys2/xml/en/procedures/99/99-000-009.html) Refer to Procedure 204-008 in Section i. (/qs3/pubsys2/xml/en/procedures/99/99-204-008.html)
- Use contact cleaner, Part Number 3824510, or equivalent, to thoroughly clean all fuel lines before removal from the engine. Clean the connector fittings to remove as much debris as possible. It is very important extra care is taken to keep the fuel connections clean during removal and installation. Refer to Procedure 204-008 in Section i. (/qs3/pubsys2/xml/en/procedures/99/99-204-008.html)
- Make sure debris, water, steam, or cleaning solution does **not** get inside the fuel system.
- Disconnect the batteries. See equipment manufacturer service information.

Remove

⚠ WARNING ⚠

Fuel is flammable. Keep all cigarettes, flames, pilot lights, arcing equipment, and switches out of the work area and areas sharing ventilation to reduce the possibility of severe personal injury or death when working on the fuel system.



⚠ WARNING ⚠

Do not vent the fuel system on a hot engine; this can cause fuel to spill onto a hot exhaust manifold, which can cause a fire.

There are three drain lines on the engine:

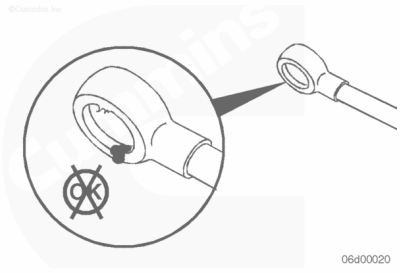
1. The fuel pump drain line connects the fuel pump to the fuel drain manifold.
2. The fuel rail pressure relief valve drain line connects the fuel rail pressure relief valve to the fuel drain manifold.
3. The injector drain line connects the back of the cylinder head to the fuel drain manifold.

These lines are removed by removing the banjo bolts and sealing washers.

Inspect for Reuse

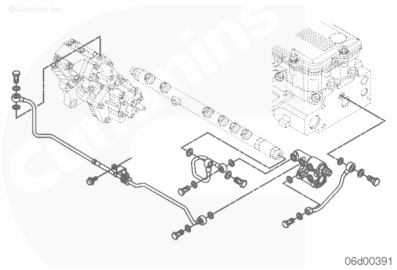
Inspect the lines for damage.

Inspect the banjo seal washers for damage.



Install

Install the three drain lines on the engine.



High-pressure fuel pump drain:

- Install the P-clip bracket.
- Install the banjo bolt at the fuel drain manifold.
- Install the banjo bolt at the fuel pump.

Pressure relief valve drain line:

- Install the banjo bolt at the fuel drain manifold.
- Install the banjo bolt at the pressure relief valve. Hold the line so it will **not** twist and wear against the bottom of the cylinder head.

Injector drain line.

Torque Value:
M12 Banjo Bolts 24 n•m [212 in-lb]

Torque Value:
M16 Banjo Bolts 43 n•m [32 ft-lb]

Torque Value:
P-Clip Capscrew 24 n•m [212 in-lb]

Finishing Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

- Connect the batteries. See equipment manufacturer service information.
- Operate the engine. Check for leaks.

ANADOLU ISUZU PARTS

Last Modified: 01-Nov-2016

Select Service Tools

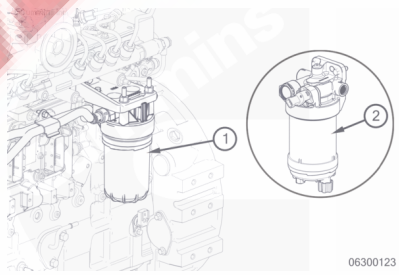
Recommended Cummins® Service Tools

- No Cummins® service tools required.

Additional Service Items

- Steam cleaner
- O-ring pick

General Information



The pressure-side fuel filter (1) is used for filtration **only** and is pressurized by the gear pump mounted on the engine's fuel pump.

Note : Some application utilize a chassis-mounted pressure-side filter.

The suction-side fuel filter (2) is a fuel-water separator and is located between the gear pump, mounted on the engine's fuel pump, and the original equipment manufacturer (OEM) fuel supply tank. This filter is not pressurized, but operates under a vacuum. Use the following procedure for maximum inlet restriction at the inlet and to test the suction-side fuel filter condition. Refer to Procedure 006-020 in Section 6. (/qs3/pubsys2/xml/en/procedures/425/425-006-020.html)

Note : Some applications utilize an engine-mounted suction-side filter.

Note : This procedure applies to both suction- and pressure-side fuel filters (if supplied by Cummins Inc.). The vehicle/equipment OEM can be equipped with a non-Cummins Inc. supplied filter. See equipment manufacturer service information for further instruction.

Preparatory Steps

⚠ WARNING ⚠

Fuel is flammable. Keep all cigarettes, flames, pilot lights, arcing equipment, and switches out of the work area and areas sharing ventilation to reduce the possibility of severe personal injury or death when working on the fuel system.

⚠ WARNING ⚠

Do not vent the fuel system on a hot engine; this can cause fuel to spill onto a hot exhaust manifold, which can cause a fire.

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative(-) battery cable last.

⚠ WARNING ⚠

Wear appropriate eye and face protection when using compressed air. Flying debris and dirt can cause personal injury.

⚠ WARNING ⚠

When using a steam cleaner, wear safety glasses or a face shield, as well as protective clothing. Hot steam can cause serious personal injury.

⚠ CAUTION ⚠

Clean all fittings before disassembly. Dirt or contaminants can damage the fuel system.

- Disconnect the batteries. See equipment manufacturer service information.
- Clean the area around the fuel filter. Use steam. Dry with compressed air.
- If required, disconnect the wiring harness from the water in fuel sensor.

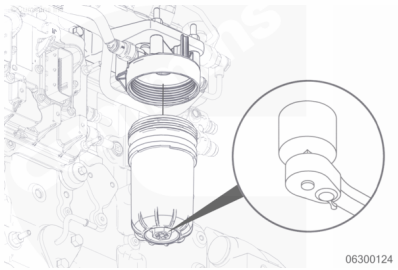
Remove

Loosen and remove the fuel filter.

Make sure the o-ring does **not** stick to the fuel filter head.
Remove the o-ring with an o-ring pick, if necessary.

ANADOLU ISUZU AFTER SALES

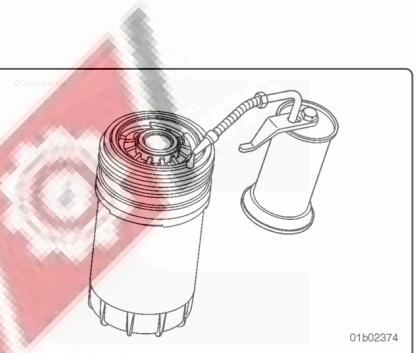
Remove the filter carefully. Remove the canister. Use the hex drive feature on the bottom of the filter.



Install

⚠ CAUTION ⚠

Do not pre-fill the pressure-side fuel filter with fuel unless a clean side block-off plug is used. The system must be primed after the fuel filter is installed. Pre-filling the pressure-side fuel filter can result in debris entering the fuel system and damaging fuel system components.



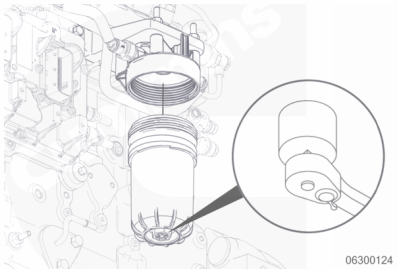
Note : If available, pre-fill new filters, both pressure-side and suction-side, with clean fuel prior to assembly. Use the clean side block-off plug packed with the filter. Do not pour fuel directly into the center of the filter. This will allow unfiltered fuel to enter the system and cause damage to fuel system components.

Use the correct fuel filter. Refer to Procedure 018-024 in Section V. (/qs3/pubsys2/xml/en/procedures/459/459-018-024.html)

Lubricate the fuel filter o-ring. Use clean lubricating oil.

⚠ CAUTION ⚠

Mechanical overtightening can distort the threads as well as damage the filter element seal or filter can.



Install the filter on the filter head:

- Install to the point of first contact for the filter and head.
- Tighten the canister. Use the hex drive feature on the bottom.

Torque Value: 38 n•m [28 ft-lb]

Finishing Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

- If required, connect the wiring harness to the water in fuel sensor.
- Connect the batteries. See equipment manufacturer service information.
- Prime the fuel system. Refer to Procedure 005-234 in Section 5. (/qs3/pubsys2/xml/en/procedures/425/425-005-234-tr.html)

ANADOLU ISUZU AFTER SALES

Last Modified: 07-Nov-2016

Select Service Tools

Recommended Cummins® Service Tools

- Contact cleaner, Part Number 3824510, or equivalent

Additional Service Items

- No additional service items required.

Preparatory Steps

⚠ WARNING ⚠

Fuel is flammable. Keep all cigarettes, flames, pilot lights, arcing equipment, and switches out of the work area and areas sharing ventilation to reduce the possibility of severe personal injury or death when working on the fuel system.

⚠ WARNING ⚠

Wear appropriate eye and face protection when using compressed air. Flying debris and dirt can cause personal injury.

⚠ WARNING ⚠

When using a steam cleaner, wear safety glasses or a face shield, as well as protective clothing. Hot steam can cause serious personal injury.

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

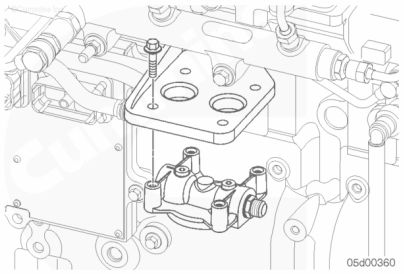
⚠ CAUTION ⚠

Clean all fittings before disassembly. Dirt or contaminants can damage the fuel system.

- Before servicing **any** fuel system components, (such as fuel lines, fuel pump, injectors, etc.) which would expose the fuel system or internal engine component to potential contaminants prior to disassembly, clean the fittings, mounting hardware, and the area around the component to be removed. Dirt or contaminants can be introduced into the fuel system and engine if the surrounding areas are **not** cleaned, resulting in damage to the fuel system and engine.
- Clean the engine. Refer to Procedure 000-009 in Section 0. (/qs3/pubsys2/xml/en/procedures/99/99-000-009.html) Refer to Procedure 204-008 in Section i. (/qs3/pubsys2/xml/en/procedures/99/99-204-008.html)
- Use contact cleaner, Part Number 3824510, or equivalent, to thoroughly clean all fuel lines before removal from the engine. Clean the connector fittings to remove as much debris as possible. It is very important extra care is taken to keep the fuel connections clean during removal and installation. Refer to Procedure 204-008 in Section i. (/qs3/pubsys2/xml/en/procedures/99/99-204-008.html)
- Make sure debris, water, steam, or cleaning solution does **not** get inside the fuel system.
- Disconnect the batteries. See equipment manufacturer service information.
- Shut off the fuel supply, if equipped. See equipment manufacturer service information.
- Remove the fuel filter. Refer to Procedure 006-015 in Section 6. (/qs3/pubsys2/xml/en/procedures/425/425-006-015-tr.html)
- Disconnect the fuel line supply and return line connections. Refer to Procedure 006-024 in Section 6. (/qs3/pubsys2/xml/en/procedures/425/425-006-024.html)

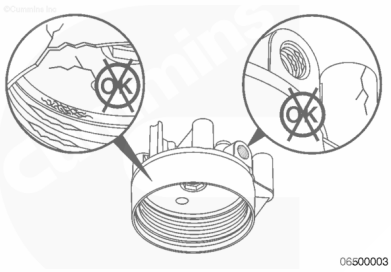
Remove

Remove the fuel filter head mounting capscrews.



Inspect for Reuse

Inspect the fuel filter head for cracks, passage blockage, and material or debris on the sealing surfaces.



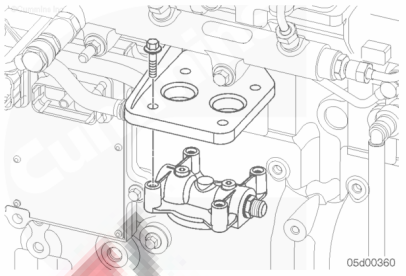
ANADOLU ISUZU AFTER SALES

Install

Install the fuel filter head.

Tighten the retaining capscrews.

Torque Value: 24 n•m [212 in-lb]



Finishing Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

- Connect the fuel return and supply lines. Refer to Procedure 006-024 in Section 6. (/qs3/pubsys2/xml/en/procedures/425/425-006-024.html)
- Install the fuel filter. Refer to Procedure 006-015 in Section 6. (/qs3/pubsys2/xml/en/procedures/425/425-006-015-tr.html)
- Open the fuel supply valve, if equipped. See equipment manufacturer service information.
- Connect the batteries. See equipment manufacturer service information.
- Operate the engine. Check for leaks.

ANADOLU ISUZU PARTS

Last Modified: 27-Jul-2016

Select Service Tools

Recommended Cummins® Service Tools

- No Cummins® service tools required.

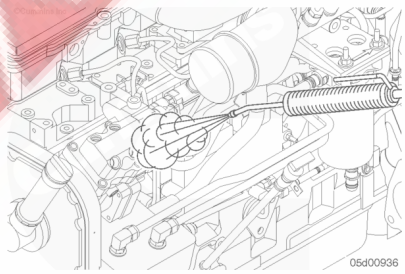
Additional Service Items

- No additional service items required.

Preparatory Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.



⚠ WARNING ⚠

Fuel is flammable. Keep all cigarettes, flames, pilot lights, arcing equipment, and switches out of the work area and areas sharing ventilation to reduce the possibility of severe personal injury or death when working on the fuel system.

⚠ WARNING ⚠

Wear appropriate eye and face protection when using compressed air. Flying debris and dirt can cause personal injury.

⚠ WARNING ⚠

When using a steam cleaner, wear safety glasses or a face shield, as well as protective clothing. Hot steam can cause serious personal injury.

⚠ CAUTION ⚠

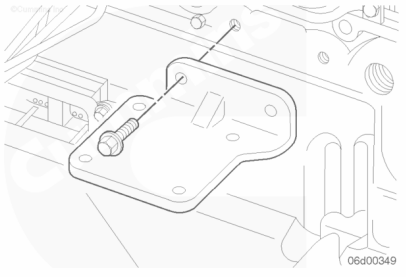
Clean all fittings before disassembly. Dirt or contaminants can damage the fuel system.

Before servicing **any** fuel system components, (such as fuel lines, fuel pump, injectors, etc.) which can expose the fuel system or internal engine component to potential contaminants prior to disassembly, clean the fittings, mounting hardware, and the area around the component to be removed. Dirt or contaminants can be introduced into the fuel system and engine if the surrounding areas are **not** cleaned, resulting in damage to the fuel system and engine. Refer to Procedure 000-009 in Section 0. (/qs3/pubsys2/xml/en/procedures/99/99-000-009.html)

- Disconnect the batteries. See equipment manufacturer service information.
- Remove the fuel filter. Refer to Procedure 006-015 in Section 6. (/qs3/pubsys2/xml/en/procedures/425/425-006-015-tr.html)
- Remove the fuel supply lines from the filter head. Refer to Procedure 006-024 in Section 6. (/qs3/pubsys2/xml/en/procedures/425/425-006-024.html)
- Remove the fuel filter head. Refer to Procedure 006-017 in Section 6. (/qs3/pubsys2/xml/en/procedures/425/425-006-017.html)

Remove

Remove the filter head bracket from the engine.

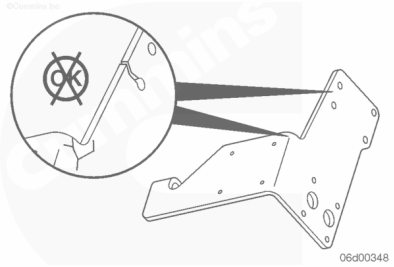


Inspect for Reuse

ANADOLU ISUZU AFTER SALES

Inspect the filter head for bracket mounting for cracks and signs of fretting on the mounting holes.

Replace the bracket if it is cracked or has signs of fretting.

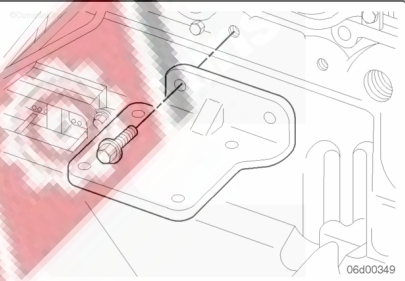


Install

Install the fuel filter head bracket and filter head.

Tighten the retaining capscrews.

Torque Value: 43 n•m [32 ft-lb]



Finishing Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

- Install the fuel filter head. Refer to Procedure 006-017 in Section 6. (/qs3/pubsys2/xml/en/procedures/425/425-006-017.html)
- Install the fuel filter. Refer to Procedure 006-015 in Section 6. (/qs3/pubsys2/xml/en/procedures/425/425-006-015-tr.html)
- Install the fuel supply lines. Refer to Procedure 006-024 in Section 6. (/qs3/pubsys2/xml/en/procedures/425/425-006-024.html)
- Connect the batteries. See equipment manufacturer service information.
- Operate the engine. Check for leaks.

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ANADOLU ISUZU
AFTER SALES

Select Service Tools

Recommended Cummins® Service Tools

- Diagnostic fuel line, Part Number 3164621
- Pressure gauge adapter, Part Number 4918324
- Fuel line connector fitting, Part Number 3972088
- M10 Compuchek™ fitting, Part Number 3824842
- Adapter fitting, Part Number 3932302
- 1/8 NPT male Compuchek™ fitting, Part Number 3377244
- Diagnostic fuel line, Part Number 4918895
- Slide removal tool, Part Number 4918878

Additional Service Items

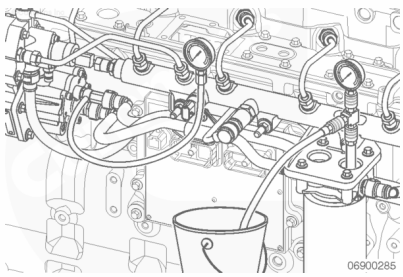
- Container suitable for fuel
- Vacuum gauge

Preparatory Steps

Obtain a 1.09 mm [0.043 in] orificed diagnostic fuel line, Part Number 3164621.

Obtain a container suitable for collection of fuel that exits the diagnostic fuel line. A 19 liter [5 gal] bucket is recommended.

Install pressure gauge adapter, Part Number 4918324. Use fuel line connector fitting, Part Number 3972088, at the inlet to the gear pump.



Note : The quick-disconnect fitting threaded into the inlet of the fuel pump **must** be substituted for fuel line connector fitting, Part Number 3972088, in order to use pressure gauge adapter, Part Number 4918324.

Install M10 Compuchek™ fitting, Part Number 3824842, at the fuel filter head.

Note : If there is **not** enough clearance to install female Compuchek™ fitting, Part Number 3824842, adapter fitting, Part Number 3932302, and 1/8 NPT

male Compuchek™ fitting, Part Number 3377244, can be used to aid accessibility.

Attach the 1.09 mm [0.043 in] orificed diagnostic fuel line at the fuel filter head Compuchek™ fitting. Route this hose into a collection container or into the vehicle fuel tank.

Note : It is necessary to attach the 1.09 mm [0.043 in] orificed diagnostic fuel line so the fuel pump can reach rated flow. Failure to reach rated flow may result in an incorrect test result.

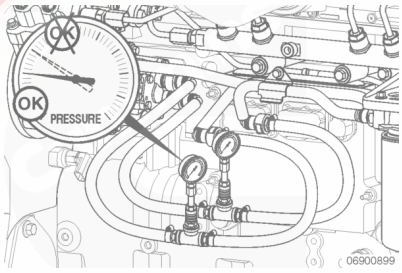
Attach a 0 to 762 mm-hg [0 to 30 in-hg] vacuum gauge to pressure gauge adapter, Part Number 4918324, at the gear pump inlet.

Install M10 Compuchek™ fitting, Part Number 3824842, at the original equipment manufacturer (OEM) fuel inlet connection.

Attach a 0 to 762 mm-hg [0 to 30 in-hg] vacuum gauge at the OEM fuel inlet connection.

⚠ CAUTION ⚠

Make sure the slide removal tool is removed from the fuel line as soon as possible after the line has been disconnected. Inadvertently leaving the tool in place can result in fuel leaks.



Alternative Set-up

Install diagnostic fuel line, Part Number 4918895, between the gear pump fuel supply line and gear pump inlet (upper fuel line fitting).

To aid in the removal of quick-disconnect style fuel lines, slide removal tool, Part Number 4918878, over the locking tangs.

Attach a 0 to 762 mm-hg [0 to 30 in-hg] vacuum gauge to pressure gauge adapter, Part Number 4918895, connected at the gear pump inlet.

Install M10 Compuchek™ fitting, Part Number 3824842, at the fuel filter head.

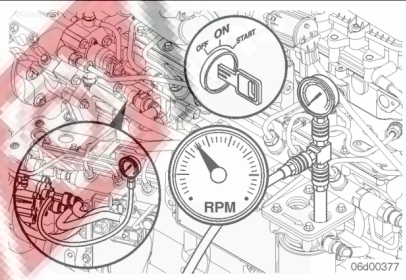
Note : If there is **not** enough clearance to install female Compuchek™ fitting, Part Number 3824842, adapter fitting, Part Number 3932302, and 1/8 NPT male Compuchek™ fitting, Part Number 3377244, can be used to aid accessibility.

Attach the 1.09 mm [0.043 in] orificed diagnostic fuel line at the fuel filter head Compuchek™ fitting. Route this hose into a collection container or into the vehicle fuel tank.

Note : It is necessary to attach the 1.09 mm [0.043 in] orificed diagnostic fuel line so the fuel pump can reach rated flow. Failure to reach rated flow can result in an incorrect test result.

Measure

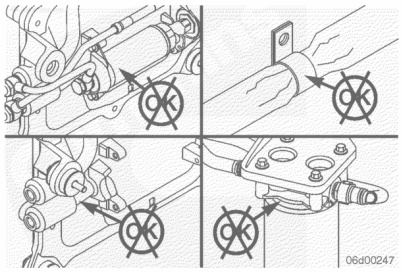
Operate the engine at high idle. Measure the inlet vacuum.



Allow the engine to operate for at least 30 seconds before measuring. Measurements **must** be taken after the fuel lift pump has turned OFF.

Maximum Fuel Inlet Restriction		
mm-hg		**in-hg**
203.2	At OEM connection (dirty filter) loaded condition	8.0
254	At inlet to fuel gear pump (dirty filter) loaded condition	10.0

If the inlet restriction is excessive, look for the root cause:



- Suction-side fuel filters plugged
- Fuel heater valves restricted
- Engine control module (ECM) mounting plate plugged
- ECM cooling plate check valve restricted
- OEM fuel lines pinched or restricted
- Fuel tank stand pipes restricted.

Finishing Steps

- Disconnect all diagnostic test fittings. Install all components removed during testing.

BARDOLU ISUZU PARTS SALES

Last Modified: 27-Jul-2016



Select Service Tools

Recommended Cummins® Service Tools

- Contact cleaner, Part Number 3824510, or equivalent
- Slide removal tool, Part Number 4918878

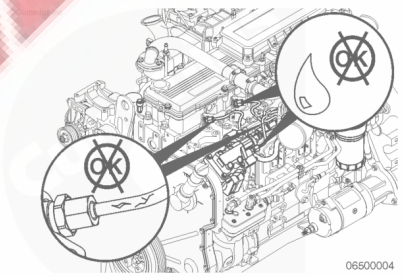
Additional Service Items

- Screwdriver

Initial Check

Inspect all fuel supply lines and fittings. Look for cracks in the lines or leaking fittings.

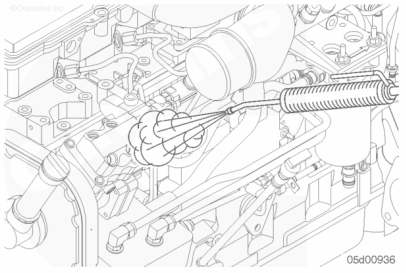
Inspect the quick-disconnect style fittings for damaged o-ring connections or broken locking tangs.



Preparatory Steps

⚠ WARNING ⚠

Fuel is flammable. Keep all cigarettes, flames, pilot lights, arcing equipment, and switches out of the work area and areas sharing ventilation to reduce the possibility of severe personal injury or death when working on the fuel system.



⚠ WARNING ⚠

Wear appropriate eye and face protection when using compressed air. Flying debris and dirt can cause personal injury.

⚠ WARNING ⚠

ANADOLU ISUZU AFTERSALES

When using a steam cleaner, wear safety glasses or a face shield, as well as protective clothing. Hot steam can cause serious personal injury.

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

⚠ CAUTION ⚠

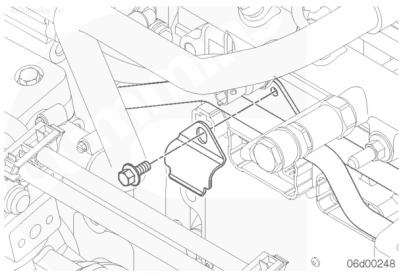
Clean all fittings before disassembly. Dirt or contaminants can damage the fuel system.

- Before servicing **any** fuel system components, (such as fuel lines, fuel pump, injectors, etc.) which would expose the fuel system or internal engine component to potential contaminants prior to disassembly, clean the fittings, mounting hardware, and the area around the component to be removed. Dirt or contaminants can be introduced into the fuel system and engine if the surrounding areas are **not** cleaned, resulting in damage to the fuel system and engine.
- Clean the engine. Refer to Procedure 000-009 in Section 0. (/qs3/pubsys2/xml/en/procedures/99/99-000-009.html) Refer to Procedure 204-008 in Section i. (/qs3/pubsys2/xml/en/procedures/99/99-204-008.html)
- Use electrical contact cleaner, Part Number 3824510, or equivalent, to thoroughly clean all fuel lines before removal from the engine. Clean the connector fittings to remove as much debris as possible. It is very important extra care is taken to keep the fuel connections clean during removal and installation. Refer to Procedure 204-008 in Section i. (/qs3/pubsys2/xml/en/procedures/99/99-204-008.html)
- Make sure debris, water, steam, or cleaning solution does **not** get inside the fuel system.
- Disconnect the batteries. See equipment manufacturer service information.
- Close the fuel supply and return valves. See equipment manufacturer service information.

Remove

⚠ WARNING ⚠

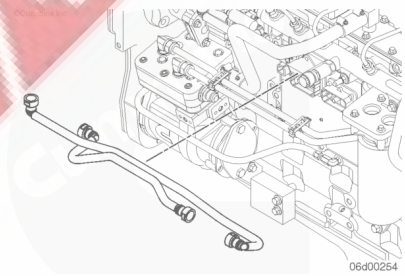
Fuel is flammable. Keep all cigarettes, flames, pilot lights, arcing equipment, and switches out of the work area and areas sharing ventilation to reduce the possibility of severe personal injury or death when working on the fuel system.



For quick-disconnect style fuel lines, remove the clasp from the fuel line brace. This will allow the lines to move so they can be disconnected.

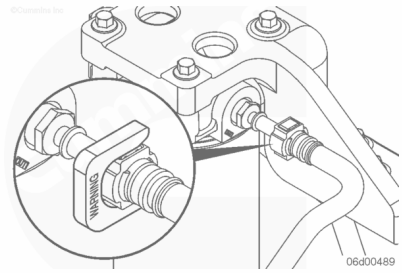
Loosen all quick-disconnect lines from the brace.

To remove the gear pump outlet line, the gear pump inlet line **must** be removed first.

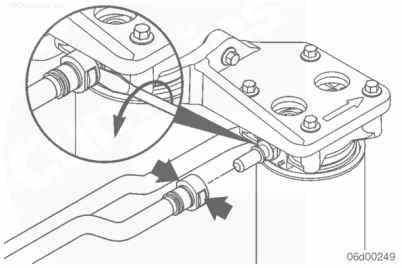


Remove the quick-disconnect style fuel lines by pressing in the locking tangs on both sides of the quick-disconnect fitting.

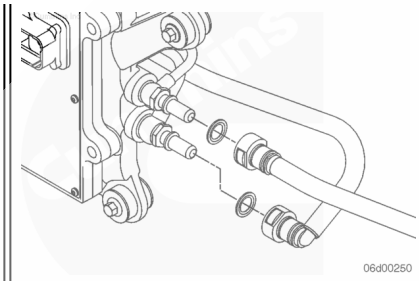
To aid in the removal of quick-disconnect style fuel lines, slide removal tool, Part Number 4918878, over the locking tangs. Make sure the tool is removed from the fuel line as soon as possible after the line has been disconnected. Inadvertently leaving the tool in place can result in fuel leaks.



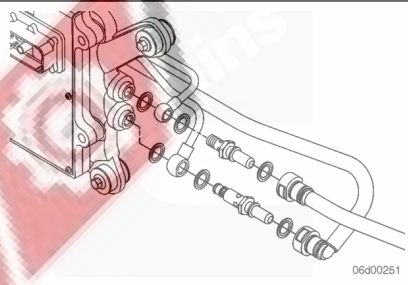
To aid removal, a screwdriver can be inserted between the fuel line end and quick-disconnect male union. After pressing the opposing locking tangs, twisting the flat blade of the screwdriver helps to remove the fuel line.



If fuel leaks or suction-side air entry is suspected, remove the fuel hoses or quick-disconnect fittings.



Inspect for Reuse



Inspect for burrs or debris on metal connectors that can cause leaks.

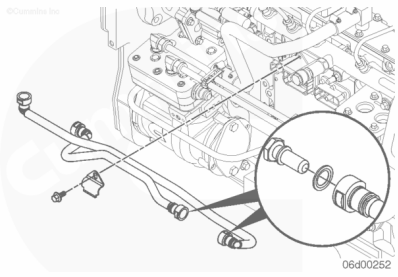
On straight thread o-ring metric connectors, be certain the o-rings are **not** frayed or cut.

On quick-disconnect style fittings, be certain the o-rings are **not** frayed or cut, and the lock tangs are **not** damaged.

The lower quick-disconnect fitting on the mounting plate has a check valve built in to it.

- Inspect the anti-drain back valve for damage or improper sealing. Replace, if necessary.
- Verify the anti-drain back valve seats properly and is free of damage or debris. If damage is found, replace the valve.

Install



Install the quick-disconnect fuel lines.

Install the quick-disconnect fittings.

Torque Value: 24 n•m [212 in-lb]

Make sure the quick-disconnect style fuel lines clasp onto the quick-disconnect fittings.

Make sure the lines are routed and connected correctly. If the lines are connected incorrectly, the engine will **not** operate.

Fuel lines are routed in the following order:

1. Original equipment manufacturer (OEM) connection to the upper fitting at the engine control module (ECM) mounting plate.
2. Lower ECM mounting plate fitting to the upper gear pump fitting.
3. Lower gear pump fitting to the pressure side fuel filter inlet.
4. Pressure-side fuel filter outlet to the fuel pump fuel control actuator housing.

The fuel supply line brace holds the fuel lines in the following order:

1. The inside line connects the upper gear pump fitting to the lower ECM mounting plate fitting.
2. The middle line connects the pressure side fuel filter outlet to the fuel pump fuel control actuator housing.
3. The outside line connects the lower gear pump fitting to the pressure side fuel filter inlet.

Install the fuel line brace clasp (quick-disconnect style fuel lines **only**) and the brace, if necessary.

Torque Value:
Fuel Line Brace 24 n•m [212 in-lb]

Torque Value:
Fuel Line Brace Clasp 24 n•m [212 in-lb]

Finishing Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

- Open the fuel supply and return valves, if equipped. See equipment manufacturer service information.
- Connect the batteries. See equipment manufacturer service information.
- Prime the fuel system. Refer to Procedure 005-234 in Section 5. (/qs3/pubsys2/xml/en/procedures/425/425-005-234-tr.html)
- Operate the engine. Check for leaks.

ANADOLU ISUZU AFTER SALES

Last Modified: 03-Aug-2016



Select Service Tools

Recommended Cummins® Service Tools

- Contact cleaner, Part Number 3824510, or equivalent

Additional Service Items

- Heel-bar
- Torque wrench

Preparatory Steps

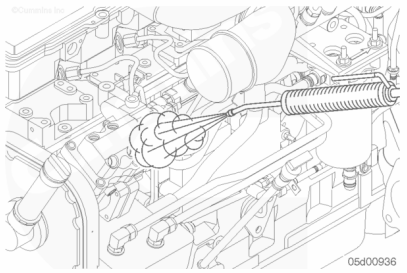
⚠ CAUTION ⚠

Attempting to remove the injector without first removing the fuel connector will cause damage to the injector body and/or fuel connector.

Note : All fuel system diagnostics procedures and component specifications have been moved. Refer to Procedure 005-236 in Section 5. (/qs3/pubsys2/xml/en/procedures/425/425-005-236.html)

⚠ WARNING ⚠

Wear appropriate eye and face protection when using compressed air. Flying debris and dirt can cause personal injury.



⚠ WARNING ⚠

When using a steam cleaner, wear safety glasses or a face shield, as well as protective clothing. Hot steam can cause serious personal injury.

⚠ CAUTION ⚠

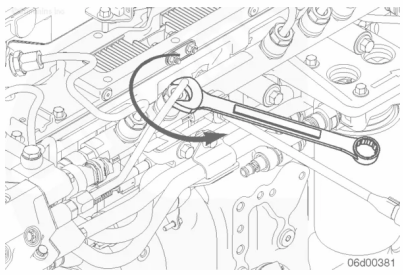
Clean all fittings before disassembly. Dirt or contaminants can damage the fuel system.

Before servicing **any** fuel system components, (such as fuel lines, fuel pump, injectors, etc.) which would expose the fuel system or internal engine component to potential contaminants prior to disassembly, clean the fittings, mounting hardware, and the area around the component to be removed. Dirt or contaminants can be introduced into the fuel system and engine if the surrounding areas are **not** cleaned, resulting in damage to the fuel system and engine.

- Clean the engine. Refer to Procedure 000-009 in Section 0. (/qs3/pubsys2/xml/en/procedures/99/99-000-009.html) Refer to Procedure 204-008 in Section i. (/qs3/pubsys2/xml/en/procedures/99/99-204-008.html)
- Use electrical contact cleaner, Part Number 3824510, or equivalent, to thoroughly clean all fuel lines before removal from the engine. Clean the connector fittings to remove as much debris as possible. It is very important extra care is taken to keep the fuel connections clean during removal and installation. Refer to Procedure 204-008 in Section i. (/qs3/pubsys2/xml/en/procedures/99/99-204-008.html)
- Make sure debris, water, steam, or cleaning solution does **not** get inside the fuel system.

⚠ WARNING ⚠

Normal engine operation creates highly pressurized fuel in the fuel line which will remain in the fuel line after engine shutdown. Never open the fuel system when the engine is operating. Before servicing the fuel system, always loosen the pump-to-rail fuel line at the rail to vent the pressure. Keep hands clear of the line when loosening. High pressure fuel spray can penetrate the skin, resulting in serious personal injury or death.



⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

⚠ WARNING ⚠

Fuel is flammable. Keep all cigarettes, flames, pilot lights, arcing equipment, and switches out of the work area and areas sharing ventilation to reduce the possibility of severe personal injury or death when working on the fuel system.

⚠ CAUTION ⚠

Attempting to remove the injector without first removing the fuel connector will cause damage to the injector body and/or fuel connector.

- Before servicing the fuel system, loosen the pump-to-rail line at the rail to vent the pressure.
- Keep hands clear of the line when loosening.
- Tighten the pump-to-rail line nut.

Torque Value: 65 n•m [48 ft-lb]

Note : A machined slot in this fitting directs the fuel spray toward the cylinder block.

- Disconnect the batteries. See equipment manufacturer service information.
- Close the fuel supply and drain valves. See equipment manufacturer service information.
- Remove the rocker lever cover. Refer to Procedure 003-011 in Section 3. (/qs3/pubsys2/xml/en/procedures/425/425-003-011.html)
- Remove the high-pressure fuel lines from the fuel rail. Refer to Procedure 006-051 in Section 6. (/qs3/pubsys2/xml/en/procedures/425/425-006-051.html)
- Remove the engine brake, if equipped. Refer to Procedure 020-004 in Section 20. (/qs3/pubsys2/xml/en/procedures/425/425-020-004-tr.html)
- Remove the fuel connector. Refer to Procedure 006-052 in Section 6. (/qs3/pubsys2/xml/en/procedures/425/425-006-052.html)
- Remove the exhaust rocker lever assembly. Refer to Procedure 003-008 in Section 3. (/qs3/pubsys2/xml/en/procedures/425/425-003-008.html)

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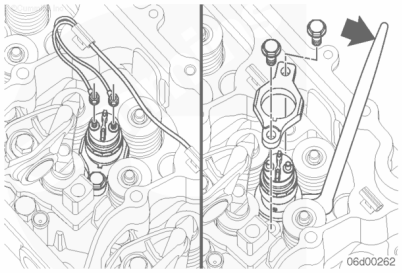
Remove

Disconnect the injector wire harness from the injector.

Remove the two injector hold-down clamp capscrews. Remove the injector hold-down clamp.

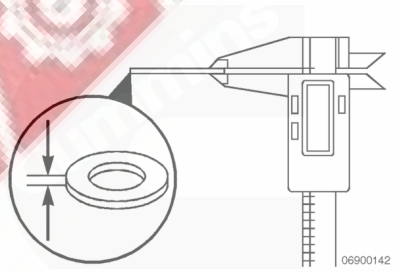
Use a small heel-bar to pry up on the injector clamp hold-down flange (part of the injector body just above the cylinder head casting).



Clean and Inspect for Reuse

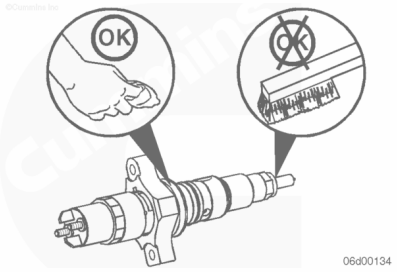
Install a new combustion sealing washer on the injector.

Verify the new injector sealing washer is the correct thickness. An incorrect sealing washer can cause high pressure fuel leaks and/or performance problems, due to incorrect injector protrusion.



⚠ WARNING ⚠

When using solvents, acids, or alkaline materials for cleaning, follow the manufacturer's recommendations for use. Wear goggles and protective clothing to avoid personal injury.



⚠ WARNING ⚠

Some solvents are flammable and toxic. Read the manufacturer's instructions before using.

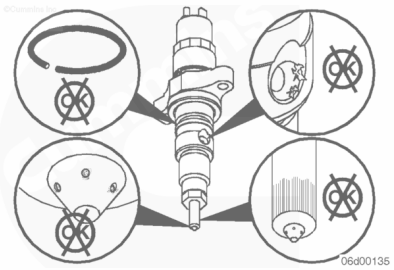
⚠ CAUTION ⚠

Do not use any abrasives (such as glass beading, sand paper, emery cloth, Scotch-Brite™ pads, etc) or metallic items (including wire brushes made of any metallic material) to clean the injectors. The use of any cleaning method other than safety solvent and a soft, clean, lint-free cloth will damage the nozzle holes and cause performance issues.

ANADOLU ISUZU PARTS

Clean the injector tip and body. Use safety solvent and a soft, clean cloth.

Inspect the injector and high-pressure connector o-rings for damage. Replace, if necessary. Refer to Procedure 006-052 in Section 6. (/qs3/pubsys2/xml/en/procedures/425/425-006-052.html)



Inspect the injector inlet, high-pressure connector tip, and high-pressure connector inlet for damage.

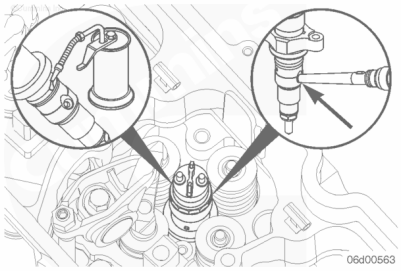
Check the nozzle holes for any signs of damage, such as hole erosion or hole plugging.

Spray safety solvent on the injector body. Inspect the fuel inlet passage for small cracks that can allow high-pressure fuel to leak to the injector drain passage.

Inspect the solenoid terminals for damage.

Install

Note : If a new injector is being installed, a new fuel connector **must** be used.



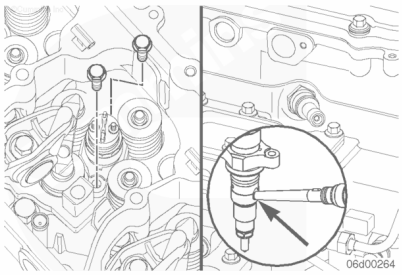
Make sure the injector bore is clean and **only** one (1) sealing washer is installed on the injector nozzle.

Lubricate the injector o-ring. Use clean engine oil.

Place the injector in the cylinder head in the proper orientation (fuel inlet toward the high-pressure fuel connector).

Press down firmly on the injector to make sure it is seated in the injector bore.

Note : Start the injector hold-down clamp capscrews, but do **not** tighten.



Start the injector hold-down clamp capscrews. Tighten hand-tight.

Install the high-pressure fuel connector, making sure the end of the high-pressure fuel connector is in the injector inlet port.

ANADOLU ISUZU OTOSAN

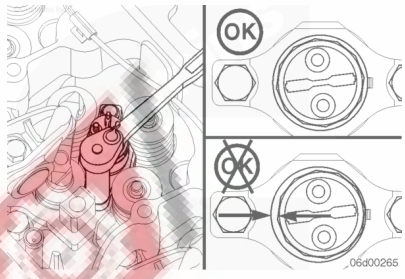
Note : The high-pressure fuel connector should click into place if it is seated in the injector inlet port correctly.

Start the high-pressure fuel connector retaining nut. Tighten partially.

Torque Value: 15 n•m [133 in-lb]

Note : This is **not** the final torque for the high-pressure fuel connector retaining nut.

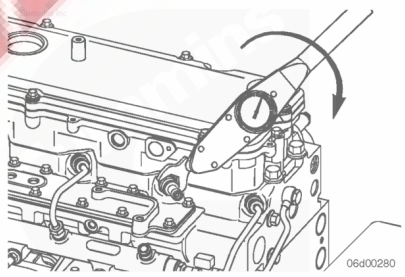
Tighten the injector hold-down clamp capscrews.



Note : Make sure to tighten the hold-down clamp capscrews evenly. Check to make sure the gap between the hold-down clamp and injector is equally spaced around the injector body.

Torque Value: 10 n•m [89 in-lb]

Tighten the high pressure fuel connector retaining nut.

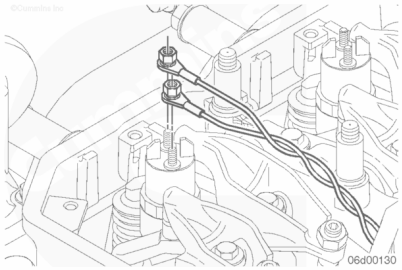


Use the following procedure for the final torque value. Refer to Procedure 006-052 in Section 6. (/qs3/pubsys2/xml/en/procedures/425/425-006-052.html)

Note : The high-pressure fuel connector **must** be properly tightened or an internal fuel leak can result, causing poor engine performance. A torque wrench **must** be used.

⚠ CAUTION ⚠

Do not overtighten the injector harness. The injector terminals will be damaged if excessively over-tightened.



Install the injector wiring harness to the injector.

Torque Value: 2 n•m [18 in-lb]

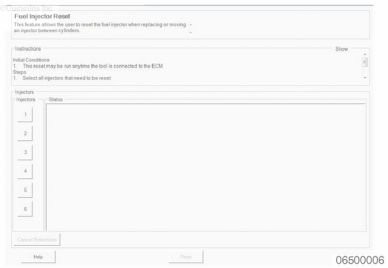
Note : Polarity of the wiring is **not** significant. The signal and return wires can be connected to either injector terminal.

Note : Orient the injector wires so they will **not** interfere with a rocker lever or engine brake housing. If the rocker lever is able to come into contact with the injector harness, it will rub through the wire insulation and cause injector circuit fault codes.

Finishing Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.



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- Orient the injector wires so they will **not** interfere with a rocker lever or engine brake housing. If the rocker lever is able to come into contact with the injector harness, it will rub through the wire insulation and cause injector circuit fault codes.
- Install the exhaust rocker lever assembly. Refer to Procedure 003-008 in Section 3. (/qs3/pubsys2/xml/en/procedures/425/425-003-008.html)
- Install the engine brake, if equipped. Refer to Procedure 020-004 in Section 20. (/qs3/pubsys2/xml/en/procedures/425/425-020-004-tr.html)
- Install the high pressure fuel lines. Refer to Procedure 006-051 in Section 6. (/qs3/pubsys2/xml/en/procedures/425/425-006-051.html)
- Install the rocker lever cover. Refer to Procedure 003-011 in Section 3. (/qs3/pubsys2/xml/en/procedures/425/425-003-011.html)
- If a malfunction resulted in coolant, excessive fuel, or excessive black smoke entering the exhaust system, the aftertreatment system **must** be inspected. Refer to Procedure 014-015 (/qs3/pubsys2/xml/en/procedures/425/425-014-015.html), Refer to Procedure 014-016 (/qs3/pubsys2/xml/en/procedures/425/425-014-016.html), or Refer to Procedure 014-017 in Section 14. (/qs3/pubsys2/xml/en/procedures/425/425-014-017.html)
- Open the fuel supply and return valves. See equipment manufacturer service information.

ANADOLU ISUZU AFTER SALES

- Connect the batteries. See equipment manufacturer service information.

Injector Reset Installation Instructions: INSITE™ 7.6 and Newer

1. Connect INSITE™ electronic service tool to the engine control module (ECM).
2. Select "Advanced ECM Data".
3. Select "Fuel Injector Reset".
4. Read the information listed under the "Fuel Injector Reset" and "Instructions" headings.
5. After INSITE™ electronic service tool completes the "Fuel Injector Reset" and the status box reads "All injector reset commands have been sent to ECM", clear all fault codes.
6. Operate the engine. Check for leaks.
7. Perform five throttle snaps.
8. Verify there are no injector related fault codes.

ANADOLU ISUZU AFTER SALES

Last Modified: 01-Nov-2016

Select Service Tools

Recommended Cummins® Service Tools

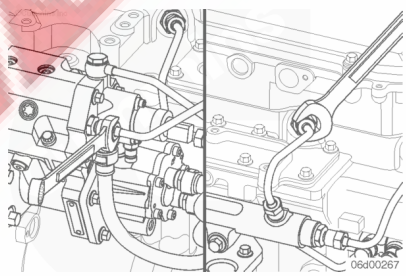
- Contact cleaner, Part Number 3824510, or equivalent

Additional Service Items

- Torque wrench

Initial Check

Note : The nuts **must** be properly tightened or an external fuel leak can result in poor engine performance. A torque wrench **must** be used.



Check the fuel pump connection.

Torque Value: 50 n•m [37 ft-lb]

Check the cylinder head connections.

Torque Value: 50 n•m [37 ft-lb]

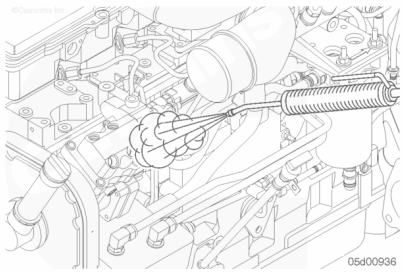
Check the fuel rail connections.

Torque Value: 65 n•m [48 ft-lb]

Preparatory Steps

⚠ WARNING ⚠

Fuel is flammable. Keep all cigarettes, flames, pilot lights, arcing equipment, and switches out of the work area and areas sharing ventilation to reduce the possibility of severe personal injury or death when working on the fuel system.



⚠ WARNING ⚠

ANADOLU ISUZU AFTER SALES

Wear appropriate eye and face protection when using compressed air. Flying debris and dirt can cause personal injury.

⚠ WARNING ⚠

When using a steam cleaner, wear safety glasses or a face shield, as well as protective clothing. Hot steam can cause serious personal injury.

⚠ CAUTION ⚠

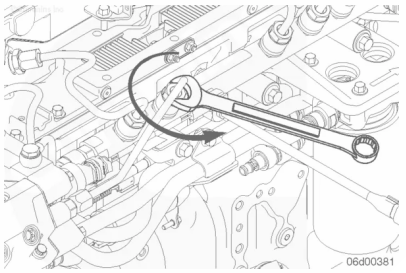
Clean all fittings before disassembly. Dirt or contaminants can damage the fuel system.

Before servicing **any** fuel system components, (such as fuel lines, fuel pump, injectors, etc.) which would expose the fuel system or internal engine component to potential contaminants prior to disassembly, clean the fittings, mounting hardware, and the area around the component to be removed. Dirt or contaminants can be introduced into the fuel system and engine if the surrounding areas are **not** cleaned, resulting in damage to the fuel system and engine.

- Clean the engine. Refer to Procedure 000-009 in Section 0. (/qs3/pubsys2/xml/en/procedures/99/99-000-009.html) Refer to Procedure 204-008 in Section i. (/qs3/pubsys2/xml/en/procedures/99/99-204-008.html)
- Use electrical contact cleaner, Part Number 3824510, or equivalent, to thoroughly clean all fuel lines before removal from the engine. Clean the connector fittings to remove as much debris as possible. It is very important extra care is taken to keep the fuel connections clean during removal and installation. Refer to Procedure 204-008 in Section i. (/qs3/pubsys2/xml/en/procedures/99/99-204-008.html)
- Make sure debris, water, steam, or cleaning solution does **not** get inside the fuel system.

⚠ WARNING ⚠

Normal engine operation creates highly pressurized fuel in the fuel line which will remain in the fuel line after engine shutdown. Never open the fuel system when the engine is operating. Before servicing the fuel system, always loosen the pump-to-rail fuel line at the rail to



vent the pressure. Keep hands clear of the line when loosening. High-pressure fuel spray can penetrate the skin, resulting in serious personal injury or death.

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

⚠ WARNING ⚠

Fuel is flammable. Keep all cigarettes, flames, pilot lights, arcing equipment, and switches out of the work area and areas sharing ventilation to reduce the possibility of severe personal injury or death when working on the fuel system.

Before servicing the fuel system, loosen the pump-to-rail line at the rail to vent the pressure.

Keep hands clear of the line when loosening.

Tighten the fuel rail nut.

Torque Value: 65 n•m [48 ft-lb]

Note : A machined slot in this fitting directs the fuel spray toward the engine block.

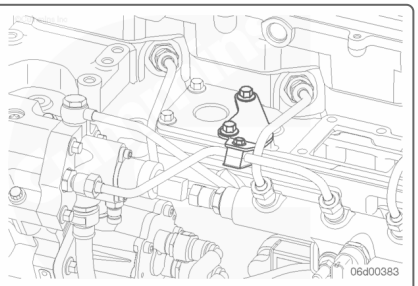
- Disconnect the batteries. See equipment manufacturer service information.

ANADOLU ISUZU SPARE PARTS SALES

Remove

⚠ WARNING ⚠

Depending on the circumstance, diesel fuel is flammable. When inspecting or performing service or repairs on the fuel system, to reduce the possibility of fire and resulting severe personal injury, death, or property damage, never smoke or allow sparks or flames (such as pilot lights, electrical switches, or welding equipment) in the work area.



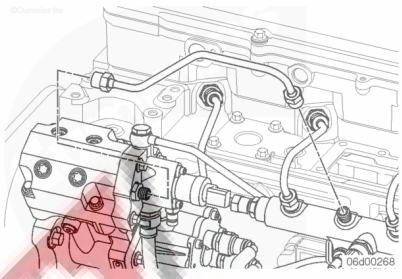
Loosen the fuel lines at the fuel rail, the fuel connector, and the high-pressure fuel pump outlet fitting.

Loosen the capscrews on the fuel line support bracket and isolator.

Remove the high-pressure fuel lines.

Loosen the fuel lines at the fuel rail, the fuel connector, and the high-pressure fuel pump outlet fitting.

Remove the high-pressure fuel lines.



Clean and Inspect for Reuse

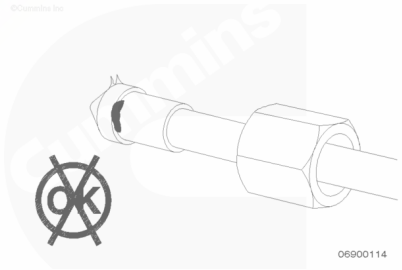
Inspect the high-pressure fuel supply line ferrules for signs of burrs, foreign material, rounding, or cracking.

Inspect the ends of the high-pressure lines for damaged sealing surfaces and signs of rust corrosion.

Check the high-pressure supply line body and ferrules for cracks, wear, or pinched areas.

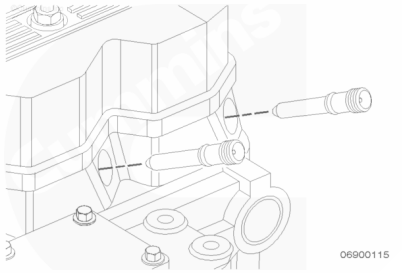
Inspect the high-pressure lines for binding between the line ferrules and mounting nuts.

If the high-pressure fuel line(s) do **not** meet the criteria listed above, the damaged fuel line(s) **must** be replaced.



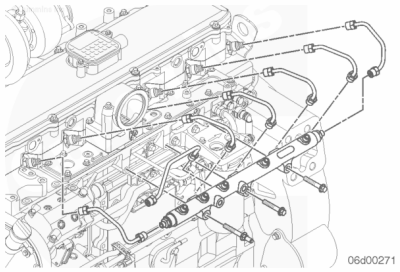
Install

Before installing the injector supply lines, make sure the fuel connector is fully and properly seated against the injector. Make sure the high-pressure connector retaining nut is tightened. Refer to Procedure 006-052 in Section 6. (/qs3/pubsys2/xml/en/procedures/425/425-006-052.html)



⚠ WARNING ⚠

Depending on the circumstance, diesel fuel is flammable. When inspecting or performing service or repairs on the fuel system, to reduce the possibility of fire and resulting severe personal injury, death or property damage, never smoke or allow sparks or flames (such as pilot lights, electrical switches, or welding equipment) in the work area.



Follow the proper sequence to make sure the high-pressure fuel lines are properly aligned:

1. Loosen the fuel rail capscrews so that they are **only** finger-tight but maintain even contact between the rail mounting feet and the cylinder head.

2. Install the fuel line from the high-pressure pump to the fuel rail. Hand tighten.

3. Install the fuel lines from the fuel rail to the fuel connectors. Hand-tighten.

4. Install fuel line support bracket capscrews. Hand tighten.

5. Tighten the high-pressure fuel lines at the high-pressure fuel connectors and the pump to rail line at the pump connector.

Torque Value: 50 n•m [37 ft-lb]

6. Tighten the high-pressure fuel lines and the pump to rail line at the rail.

Torque Value: 65 n•m [48 ft-lb]

7. Tighten the fuel line support bracket capscrews.

Torque Value: 24 n•m [212 in-lb]

8. Tighten the fuel rail assembly capscrews.

Torque Value: 43 n•m [32 ft-lb]

ANADOLU ISUZU PARTS SALES

Finishing Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

- If removed, install the air intake connection. Refer to Procedure 010-080 in Section 10. (/qs3/pubsys2/xml/en/procedures/425/425-010-080.html)
- Connect the batteries. See equipment manufacturer service information.
- Operate the engine. Check for leaks.

Last Modified: 01-Nov-2016

ANADOLU ISUZU AFTER SALES

Select Service Tools

Recommended Cummins® Service Tools

- Contact cleaner, Part Number 3824510, or equivalent
- Fuel connector puller, Part Number 3164025

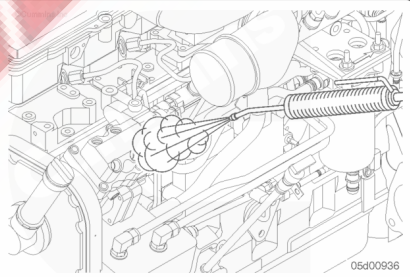
Additional Service Items

- No additional service items required.

Preparatory Steps

⚠ WARNING ⚠

Fuel is flammable. Keep all cigarettes, flames, pilot lights, arcing equipment, and switches out of the work area and areas sharing ventilation to reduce the possibility of severe personal injury or death when working on the fuel system.



⚠ WARNING ⚠

Wear appropriate eye and face protection when using compressed air. Flying debris and dirt can cause personal injury.

⚠ WARNING ⚠

When using a steam cleaner, wear safety glasses or a face shield, as well as protective clothing. Hot steam can cause serious personal injury.

⚠ CAUTION ⚠

Clean all fittings before disassembly. Dirt or contaminants can damage the fuel system.

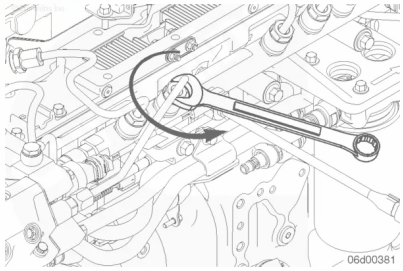
Before servicing **any** fuel system components, (such as fuel lines, fuel pump, injectors, etc.) which would expose the fuel system or internal engine component to potential

contaminants prior to disassembly, clean the fittings, mounting hardware, and the area around the component to be removed. Dirt or contaminants can be introduced into the fuel system and engine if the surrounding areas are **not** cleaned, resulting in damage to the fuel system and engine.

- Clean the engine. Refer to Procedure 000-009 in Section 0. (/qs3/pubsys2/xml/en/procedures/99/99-000-009.html) Refer to Procedure 204-008 in Section i. (/qs3/pubsys2/xml/en/procedures/99/99-204-008.html)
- Use contact cleaner, Part Number 3824510, or equivalent, to thoroughly clean all fuel lines before removal from the engine. Clean the connector fittings to remove as much debris as possible. It is very important extra care is taken to keep the fuel connections clean during removal and installation. Refer to Procedure 204-008 in Section i. (/qs3/pubsys2/xml/en/procedures/99/99-204-008.html)
- Make sure debris, water, steam, or cleaning solution does **not** get inside the fuel system.

⚠ WARNING ⚠

Normal engine operation creates highly pressurized fuel in the fuel line which will remain in the fuel line after engine shutdown. Never open the fuel system when the engine is operating. Before servicing the fuel system, always loosen the pump-to-rail fuel line at the rail to vent the pressure. Keep hands clear of the line when loosening. High-pressure fuel spray can penetrate the skin, resulting in serious personal injury or death.



⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

⚠ WARNING ⚠

Fuel is flammable. Keep all cigarettes, flames, pilot lights, arcing equipment, and switches out of the work area and areas sharing ventilation to reduce the possibility of severe personal injury or death when working on the fuel system.

Before servicing the fuel system, loosen the pump-to-rail line at the rail to vent the pressure.

Keep hands clear of the line when loosening.

Tighten the fuel rail nut.

Torque Value: 65 n•m [48 ft-lb]

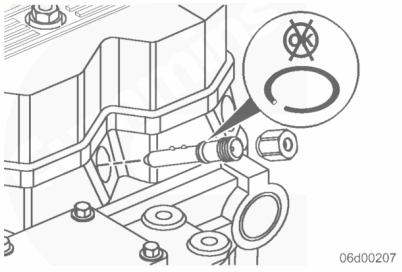
Note : A machined slot in this fitting directs the fuel spray toward the engine block.

- Disconnect the batteries. See equipment manufacturer service information.
- Remove the high-pressure fuel supply lines. Refer to Procedure 006-051 in Section 6. (/qs3/pubsys2/xml/en/procedures/425/425-006-051.html)

Remove

Remove the fuel connector retaining nut.

Use fuel connector puller, Part Number 3164025, to remove the fuel connector from the cylinder head.



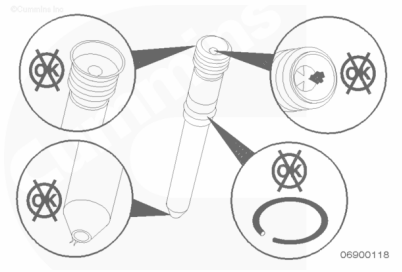
Inspect for Reuse

A new high-pressure connector **must** be installed if a new injector is being installed.

Inspect the fuel connector. Look for burrs or deformation around the inlet and outlet sides of the connector.

Check the edge filter for signs of plugging or material contamination. Do **not** reuse a high-pressure fuel connector if debris is present.

Check the o-ring for tearing or deterioration.

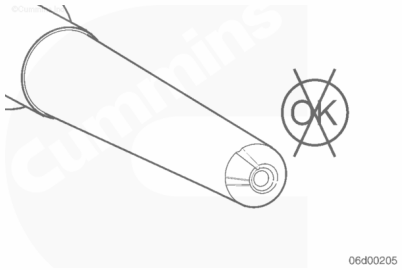


ANADOLU ISUZU AFTER SALES

Inspect the outlet sealing surface of the high-pressure connector for wear, an uneven seating surface, or signs of leakage.

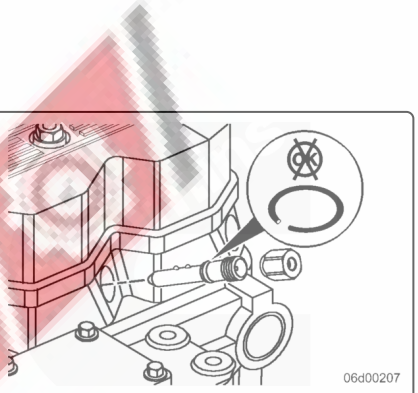
When a high-pressure fuel leak is present, small lines or cuts in the connector will be eroded into the seating surface.

The high-pressure connector and injector **must** be replaced when this condition is observed.



Install

Note : If the injector was removed along with the high-pressure fuel connector, the installation steps **must** be followed. Refer to Procedure 006-026 in Section 6. (/qs3/pubsys2/xml/en/procedures/425/425-006-026.html)



Tighten the fuel connector retaining nut.

Torque Value: 55 n•m [41 ft-lb]

The high-pressure fuel connector **must** be properly tightened or an internal fuel leak can result, causing poor engine performance. A torque wrench **must** be used.

Finishing Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

- Install the high-pressure fuel supply lines. Refer to Procedure 006-051 in Section 6. (/qs3/pubsys2/xml/en/procedures/425/425-006-051.html)
- Connect the batteries. See equipment manufacturer service information.
- Operate the engine. Check for leaks.

ANADOLU ISUZU PARTS SALES


ANADOLU ISUZU
AFTER SALES

Select Service Tools

Recommended Cummins® Service Tools

- Contact cleaner, Part Number 3824510, or equivalent
- Assembly lubricant, Part Number 3163087, or equivalent

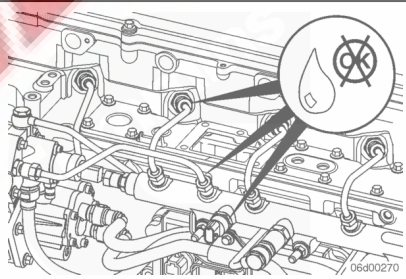
Additional Service Items

- Allen wrench

Initial Check

⚠ WARNING ⚠

The fuel pump, high-pressure fuel lines, and fuel rail contain very high-pressure fuel. Do not loosen any fittings while the engine is running. Wait at least 10 minutes after shutting down the engine before loosening any fittings in the high-pressure fuel system to allow pressure to decrease to a lower level.



⚠ WARNING ⚠

High pressure fuel spray can cause serious injury or death.

⚠ WARNING ⚠

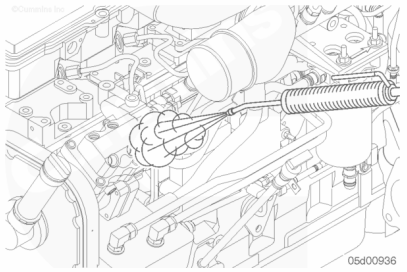
The fuel pump, high-pressure fuel lines, and fuel rail contain very high-pressure fuel. To reduce the possibility of personal injury, never loosen any fittings while the engine is running.

Inspect the fuel pressure sensor, high-pressure fuel line connections, and male unions for leaks.

Preparatory Steps

⚠ WARNING ⚠

Wear appropriate eye and face protection when using compressed air. Flying debris and dirt can cause personal injury.



⚠ WARNING ⚠

When using a steam cleaner, wear safety glasses or a face shield, as well as protective clothing. Hot steam can cause serious personal injury.

⚠ CAUTION ⚠

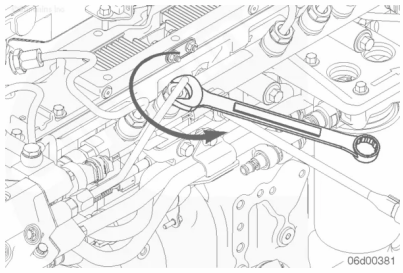
Clean all fittings before disassembly. Dirt or contaminants can damage the fuel system.

Before servicing **any** fuel system components, (such as fuel lines, fuel pump, injectors, etc.) which would expose the fuel system or internal engine component to potential contaminants prior to disassembly, clean the fittings, mounting hardware, and the area around the component to be removed. Dirt or contaminants can be introduced into the fuel system and engine if the surrounding areas are **not** cleaned, resulting in damage to the fuel system and engine.

- Clean the engine. Refer to Procedure 000-009 in Section 0. (/qs3/pubsys2/xml/en/procedures/99/99-000-009.html) Refer to Procedure 204-008 in Section i. (/qs3/pubsys2/xml/en/procedures/99/99-204-008.html)
- Use contact cleaner, Part Number 3824510, or equivalent, to thoroughly clean all fuel lines before removal from the engine. Clean the connector fittings to remove as much debris as possible. It is very important extra care is taken to keep the fuel connections clean during removal and installation. Refer to Procedure 204-008 in Section i. (/qs3/pubsys2/xml/en/procedures/99/99-204-008.html)
- Make sure debris, water, steam, or cleaning solution does **not** get inside the fuel system.

⚠ WARNING ⚠

Normal engine operation creates highly pressurized fuel in the fuel line which will remain in the fuel line after engine shutdown. Never open the fuel system when the engine is operating. Before servicing the fuel system, always loosen the pump to rail fuel line at the rail to vent the pressure. Keep hands clear of the line when loosening. High-pressure fuel spray can penetrate the skin, resulting in serious personal injury or death.



- Before servicing the fuel system, loosen the pump-to-rail line at the rail to vent the pressure.
- Keep hands clear of the line when loosening.
- Tighten the pump-to-rail line nut.

Torque Value: 65 n•m [48 ft-lb]

Note : A machined slot in this fitting directs the fuel spray toward the cylinder block.

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

⚠ WARNING ⚠

Fuel is flammable. Keep all cigarettes, flames, pilot lights, arcing equipment, and switches out of the work area and areas sharing ventilation to reduce the possibility of severe personal injury or death when working on the fuel system.

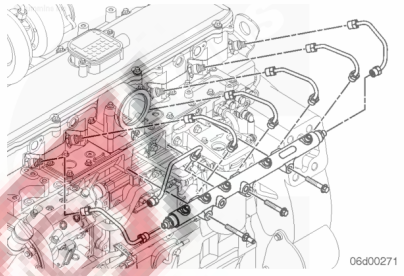
- Disconnect the batteries. See equipment manufacturer service information.
- Shut off the fuel supply and drain valves. See equipment manufacturer service information.
- Disconnect the rail fuel pressure sensor from the engine wiring harness. Refer to Procedure 019-115 in Section 19. (/qs3/pubsys2/xml/en/procedures/425/425-019-115.html)
- Remove the high-pressure fuel lines from the fuel rail. Refer to Procedure 006-051 in Section 6. (/qs3/pubsys2/xml/en/procedures/425/425-006-051.html)

- Remove the fuel drain line from the fuel pressure relief valve. Refer to Procedure 006-013 in Section 6. (/qs3/pubsys2/xml/en/procedures/425/425-006-013.html)

Remove

Remove the capscrews that secure the fuel rail to the cylinder head.

Remove the fuel rail assembly.



Disassemble

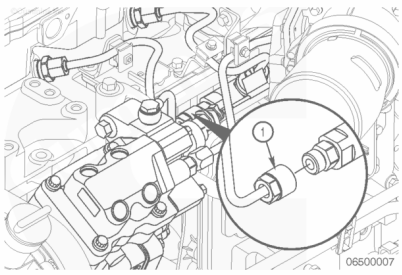
Remove the high-pressure fuel line fitting (1) from the end of the fuel rail.

Remove and discard the sealing washer.

A flat sealing washer is swaged into the inlet fitting bore during installation.

A special tool can be created to aid in its removal by grinding a 45 degree angle on the short leg of a 1/8 inch or 3/16 inch Allen wrench, so the wrench is no longer than 13 mm [1/2 in] long (measured from the outside of the long leg).

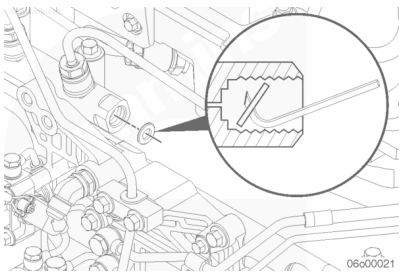
This tool acts as a mini heel bar to pry out the sealing washer without damaging the back of the hole.



The sealing washer **must** be replaced if the number 1 fuel line rail fitting is removed.

Use the modified Allen wrench to pry out the old sealing washer from the threaded hole in the fuel rail.

Note : Considerable force is required to remove the sealing washer.

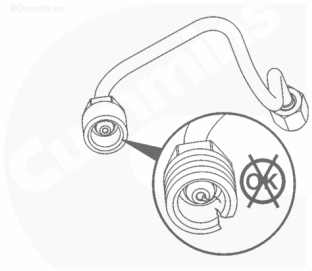


ANADOLU ISUZU ASTER SALES

Inspect for Reuse

If the number 1 fuel line rail fitting exhibits excessive leakage to drain, it **must not** be reused.

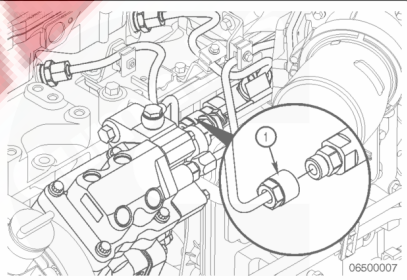
Inspect the high-pressure seal surface on the fuel line rail fitting and in the fuel rail for damage. Do **not** reuse components if the high-pressure seal joint is damaged.



Assemble

Install the fuel line rail fitting (1) and a new sealing washer. Use assembly lubricant, Part Number 3163087, or equivalent, on the threads.

Tighten the fuel line rail fitting (1) with the torque plus angle method.

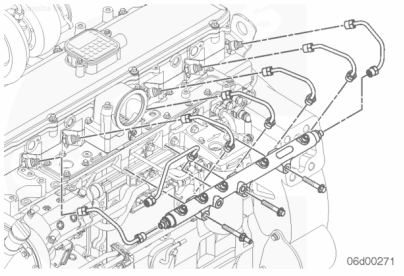


Torque Value:

1. 27 n•m [239 in-lb]
2. Rotate 90 degrees.

Install

Install the fuel rail assembly. Follow the proper sequence to make sure that high-pressure fuel lines are properly aligned. Refer to Procedure 006-051 in Section 6. (/qs3/pubsys2/xml/en/procedures/425/425-006-051.html)



Finishing Steps

ANADOLU ISUZU AFTER SALES

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

- Install the fuel drain line to the fuel pressure relief valve. Refer to Procedure 006-013 in Section 6. (/qs3/pubsys2/xml/en/procedures/425/425-006-013.html)
- Install the high-pressure fuel lines to the fuel rail. Refer to Procedure 006-051 in Section 6. (/qs3/pubsys2/xml/en/procedures/425/425-006-051.html)
- Install the rail fuel pressure sensor to the engine wiring harness. Refer to Procedure 019-115 in Section 19. (/qs3/pubsys2/xml/en/procedures/425/425-019-115.html)
- Open the fuel supply and drain valves. See equipment manufacturer service information.
- Connect the batteries. See equipment manufacturer service information.
- Operate the engine. Check for leaks.

Last Modified: 01-Nov-2016

ANADOLU ISUZU AFTER SALES

Select Service Tools

Recommended Cummins® Service Tools

- Contact cleaner, Part Number 3824510, or equivalent
- Assembly lubricant, Part Number 3163087, or equivalent

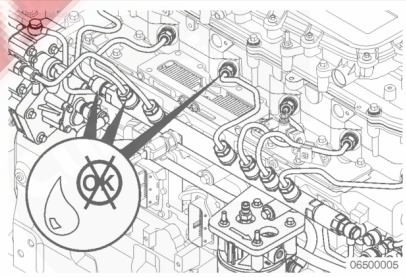
Additional Service Items

- Allen wrench

Initial Check

⚠ WARNING ⚠

The fuel pump, high-pressure fuel lines, and fuel rail contain very high-pressure fuel. Do not loosen any fittings while the engine is running. Wait at least 10 minutes after shutting down the engine before loosening any fittings in the high-pressure fuel system to allow pressure to decrease to a lower level.



⚠ WARNING ⚠

The fuel pump, high-pressure fuel lines, and fuel rail contain very high-pressure fuel. To reduce the possibility of personal injury, never loosen any fittings while the engine is running.

⚠ WARNING ⚠

High pressure fuel spray can cause serious injury or death.

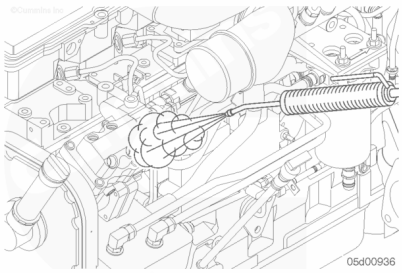
Operate the engine. Check for external fuel leaks.

Note : Use the following procedure for all fuel system diagnostics procedures and component specifications. Refer to Procedure 005-236 in Section 5. (/qs3/pubsys2/xml/en/procedures/425/425-005-236.html)

Preparatory Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.



⚠ WARNING ⚠

Fuel is flammable. Keep all cigarettes, flames, pilot lights, arcing equipment, and switches out of the work area and areas sharing ventilation to reduce the possibility of severe personal injury or death when working on the fuel system.

⚠ WARNING ⚠

Wear appropriate eye and face protection when using compressed air. Flying debris and dirt can cause personal injury.

⚠ WARNING ⚠

When using a steam cleaner, wear safety glasses or a face shield, as well as protective clothing. Hot steam can cause serious personal injury.

⚠ WARNING ⚠

Normal engine operation creates highly pressurized fuel in the fuel line which will remain in the fuel line after engine shutdown. Never open the fuel system when the engine is operating. Before servicing the fuel system, always loosen the pump to rail fuel line at the rail to vent the pressure. Keep hands clear of the line when loosening. High pressure fuel spray can penetrate the skin, resulting in serious personal injury or death.

⚠ CAUTION ⚠

ANADOLU ISUZU PARTS SALES

Clean all fittings before disassembly. Dirt or contaminants can damage the fuel system.

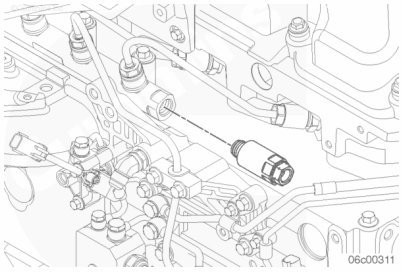
- Before servicing **any** fuel system components, (such as fuel lines, fuel pump, injectors, etc.) which would expose the fuel system or internal engine component to potential contaminants prior to disassembly, clean the fittings, mounting hardware, and the area around the component to be removed. Dirt or contaminants can be introduced into the fuel system and engine if the surrounding areas are **not** cleaned, resulting in damage to the fuel system and engine.
- Clean the engine. Refer to Procedure 000-009 in Section 0. (/qs3/pubsys2/xml/en/procedures/99/99-000-009.html)
- Use contact cleaner, Part Number 3824510, or equivalent, to thoroughly clean all fuel lines before removal from the engine. Clean the connector fittings to remove as much debris as possible. It is very important extra care is taken to keep the fuel connections clean during removal and installation. Refer to Procedure 204-008 in Section i. (/qs3/pubsys2/xml/en/procedures/99/99-204-008.html)
- Make sure debris, water, steam, or cleaning solution does **not** get inside the fuel system.
- Before servicing the fuel system, loosen the pump-to-rail line at the rail to vent the pressure.
- Keep hands clear of the line when loosening.
- Tighten the pump to rail line nut.

Torque Value: 65 n•m [48 ft-lb]

- Close the fuel supply and drain valves. See equipment manufacturer service information.
- Disconnect the batteries. See equipment manufacturer service information.
- Remove the fuel drain line from the fuel rail pressure relief valve. Refer to Procedure 006-013 in Section 6. (/qs3/pubsys2/xml/en/procedures/425/425-006-013.html)
- Remove the fuel pressure relief valve reducer, if required.

Remove

Remove the fuel pressure relief valve.



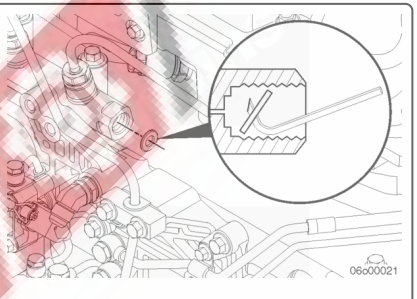
Remove and discard the sealing washer.

A flat sealing washer is swaged into the inlet fitting bore during installation.

A special tool can be created to aid in its removal by grinding a 45 degree angle on the short leg of a 1/8 inch or 3/16 inch Allen wrench, so the wrench is no longer than 13 mm [1/2 in] long (measured from the outside of the long leg.)

This tool acts as a mini heel bar to pry out the sealing washer without damaging the back of the hole.

Note : Considerable force is required to remove the sealing washer.



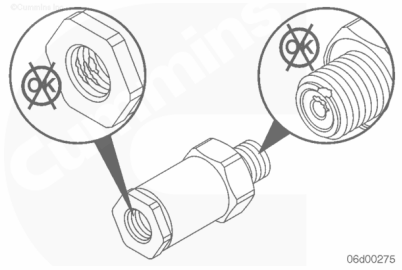
The high-pressure relief valve sealing washer **must** be replaced if the high-pressure relief valve is removed.

Pry out the old sealing washer from the threaded hole in the fuel rail. Use the modified Allen wrench.

ANADOLU ISUZU
AFTER SALES

Inspect for Reuse

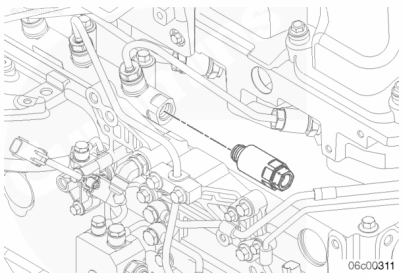
If the fuel pressure relief valve exhibits excessive leakage to drain, it **must not** be reused.



Inspect the high-pressure seal surface on the fuel pressure relief valve and in the fuel rail for damage. Do **not** reuse components if the high-pressure seal joint is damaged.

Install

Install the fuel pressure relief valve and a new sealing washer. Use assembly lubricant, Part Number 3163087, or equivalent, on the threads. Tighten the pressure relief valve. Use the torque plus angle method.



Torque Value:

1. 27 n•m [239 in-lb]

2. Rotate 90 degrees.

Finishing Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

- Install the fuel drain line to the fuel pressure relief valve. Refer to Procedure 006-013 in Section 6. (/qs3/pubsys2/xml/en/procedures/425/425-006-013.html)
- Open the fuel supply and drain valves. See equipment manufacturer service information.
- Connect the batteries. See equipment manufacturer service information.
- Operate the engine. Check for leaks.

ANADOLU ISUZU AFTER SALES

Last Modified: 01-Nov-2016

Select Service Tools

Recommended Cummins® Service Tools

- Contact cleaner, Part Number 3824510, or equivalent

Additional Service Items

- Container suitable for fuel

Preparatory Steps

⚠ WARNING ⚠

When using solvents, acids, or alkaline materials for cleaning, follow the manufacturer's recommendations for use. Wear goggles and protective clothing to reduce the possibility of personal injury.

⚠ WARNING ⚠

Wear safety glasses or a face shield, as well as protective clothing, to prevent personal injury when using a steam cleaner or high-pressure water.

⚠ WARNING ⚠

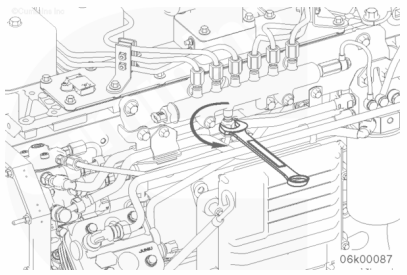
Wear appropriate eye and face protection when using compressed air. Flying debris and dirt can cause personal injury.

⚠ CAUTION ⚠

Fuel system is extremely sensitive to dirt and debris. All connections and ports must be cleaned and covered. Even a very small amount of debris can result in fuel system malfunction.

- Thoroughly clean the joint area between fuel rail and pump-to-rail lines. Use high-pressure water or contact cleaner, Part Number 3824510, or equivalent. Dry with compressed air.

Relieve Pressure



⚠ WARNING ⚠

Depending on the circumstance, diesel fuel is flammable. When inspecting or performing service or repairs on the fuel system, to reduce the possibility of fire and resulting severe personal injury, death, or property damage, never smoke or allow sparks or flames (such as pilot lights, electrical switches, or welding equipment) in the work area.

⚠ WARNING ⚠

High pressure fuel spray can cause serious injury or death.

⚠ WARNING ⚠

Normal engine operation creates highly pressurized fuel in the fuel line which will remain in the fuel line after engine shutdown. Never open the fuel system when the engine is operating. Before servicing the fuel system, always loosen the pump to rail fuel line at the rail to vent the pressure. Keep hands clear of the line when loosening. High-pressure fuel spray can penetrate the skin, resulting in serious personal injury or death.

⚠ CAUTION ⚠

Fuel system is extremely sensitive to dirt and debris. All connections and ports must be cleaned and covered. Even a very small amount of debris can result in fuel system malfunction.

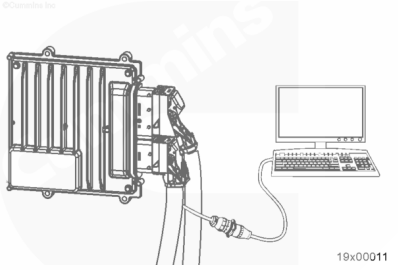
Slowly loosen the pump-to-rail lines at the rail to vent the fuel pressure.

Keep hands clear of the lines when loosening.

Connect INSITE™ electronic service tool to engine data link.

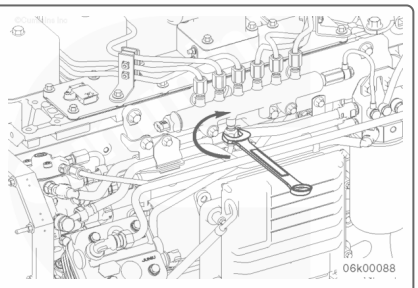
Turn keyswitch to ON position.

Verify fuel pressure has decreased to 0 bar [0 psi] by monitoring Fuel Rail Pressure Measured parameter.



Tighten the fuel rail nut.

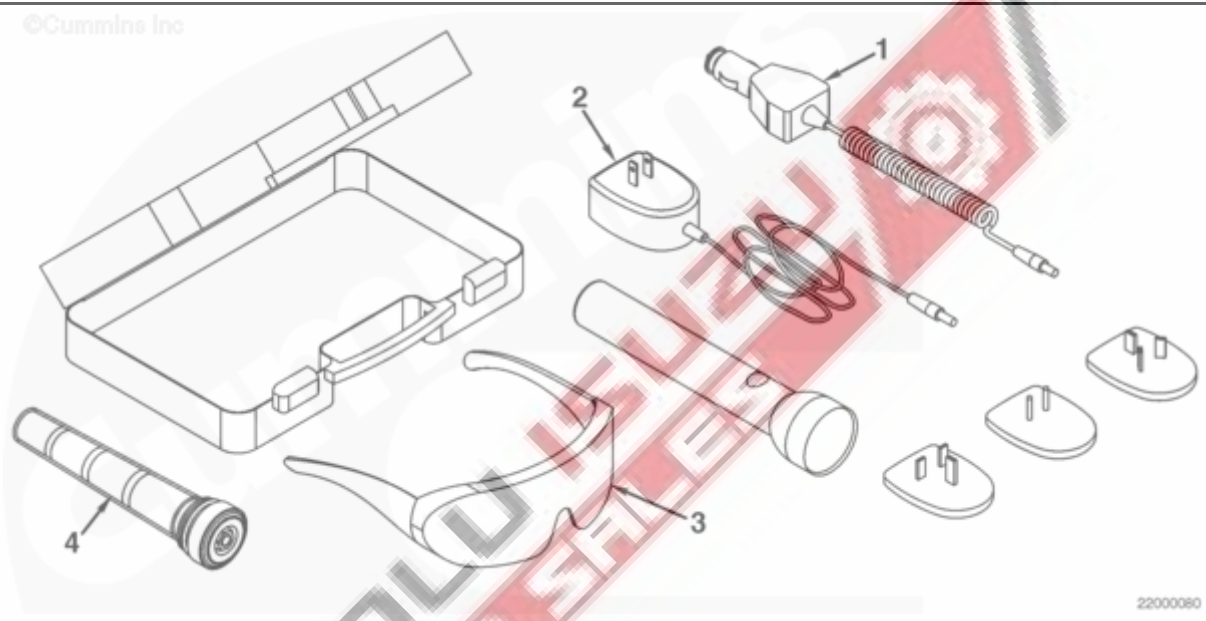
Torque Value: 40 n•m [30 ft-lb]

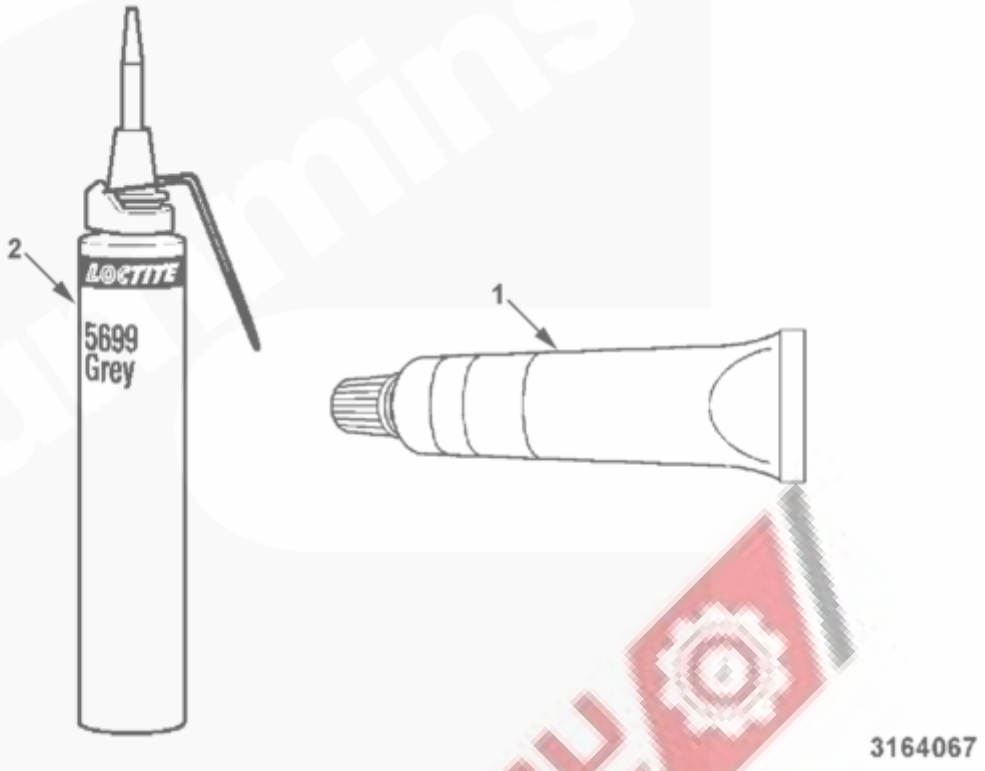


Last Modified: 04-Nov-2016

ANADOLU ISUZU
AFTER SALES

Lubricating Oil System

Tool Number 2892320
Black Light Lamp (12 volt) Black light with rechargeable battery and charger used with fluorescent tracer, Part Number 3376891, to locate oil leaks.

Tool Number 3164067
Silicone Sealant Loctite® 5699 Grey RTV silicone sealant is very durable and was released to be used for multiple applications. It can provide a seal in the T-gasket joint on oil pan gaskets.

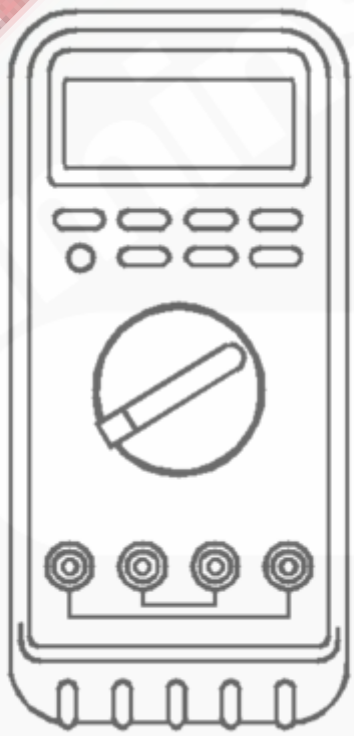


Tool Number

3164489

Deluxe Digital Multimeter

This digital multimeter includes the functions of frequency, capacitance, and temperature (with a built-in temperature module). Also included are these functions: RPM, Dwell, Duty Cycle, and Pulse Width and comes with test leads, protective boot, inductive pick-up, bead-type temperature probe. Nylon carrying case available separately, Part Number 3164497.

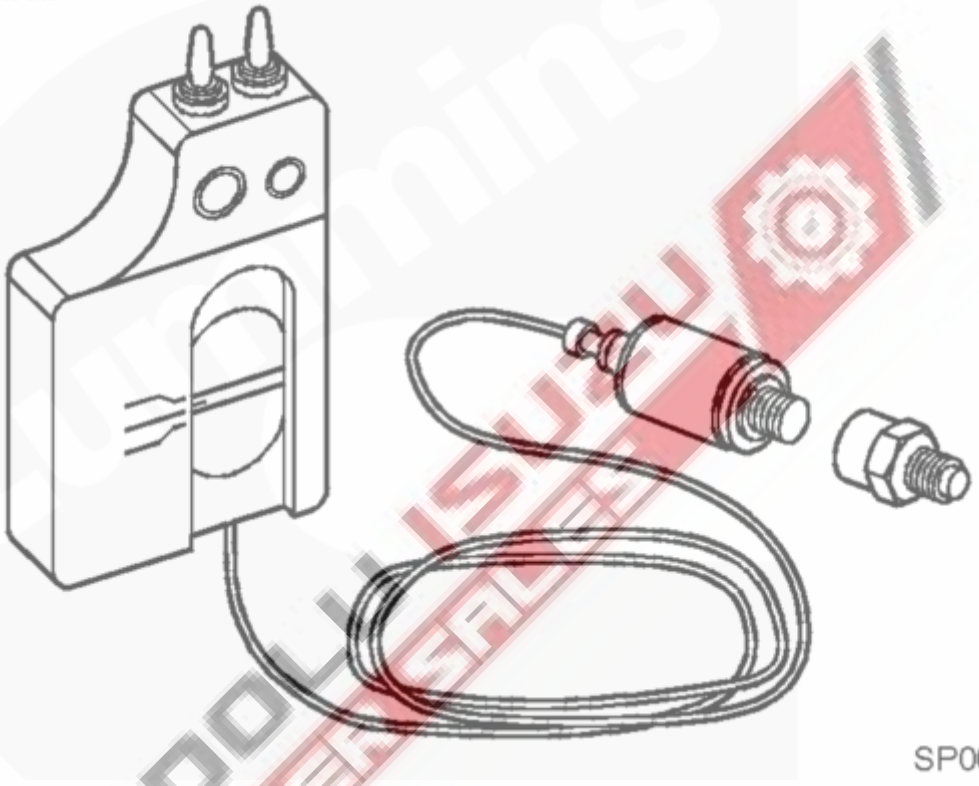


Tool Number

3164491

Pressure/Vacuum Adapter

This pressure/vacuum adapter is used with digital multimeter, Part Number 3164488, or deluxe digital multimeter, Part Number 3164489, to measure up to 500 psi pressure and vacuum to -30in-hg. By using this unit as specified, it is an excellent way to obtain digital pressure or vacuum readings in many applications within the range mentioned.

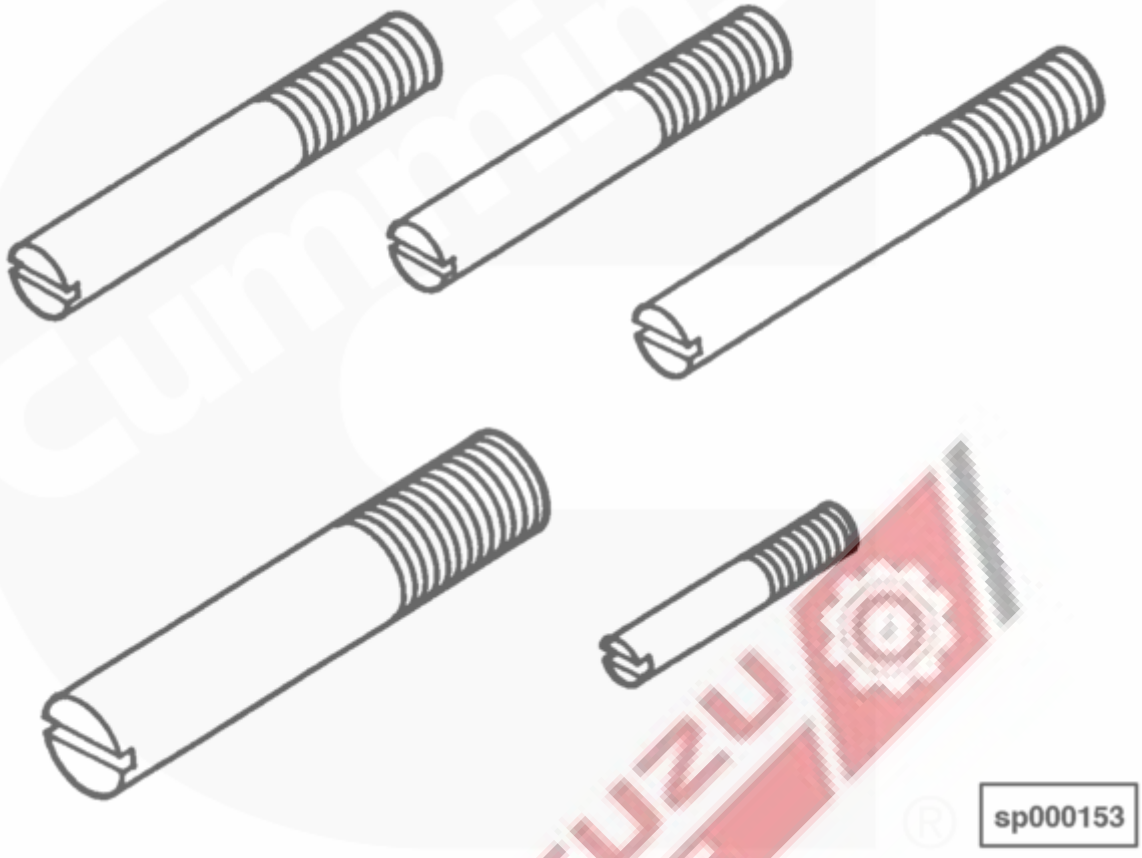


Tool Number

3164977

Guide Pins

These various size guide pins are used during assembly and/or disassembly to align parts and aid in the control of the parts. The use of one or more guide pins can `free-up' a hand to turn capscrews etc.

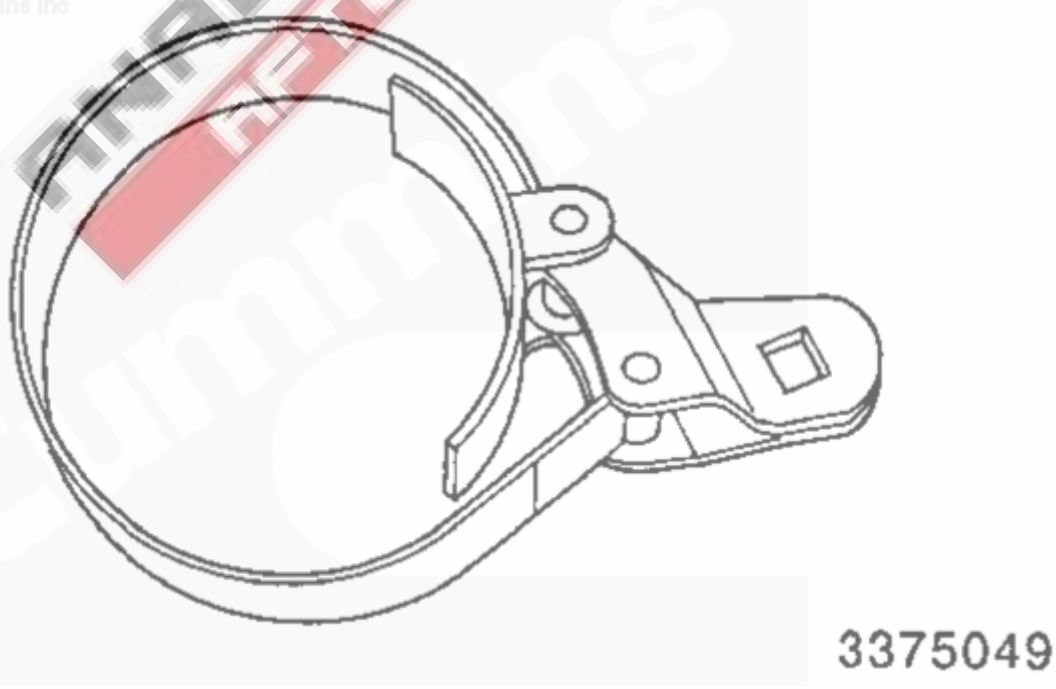


Tool Number

3375049

Oil Filter Wrench

Used to remove the oil filter.

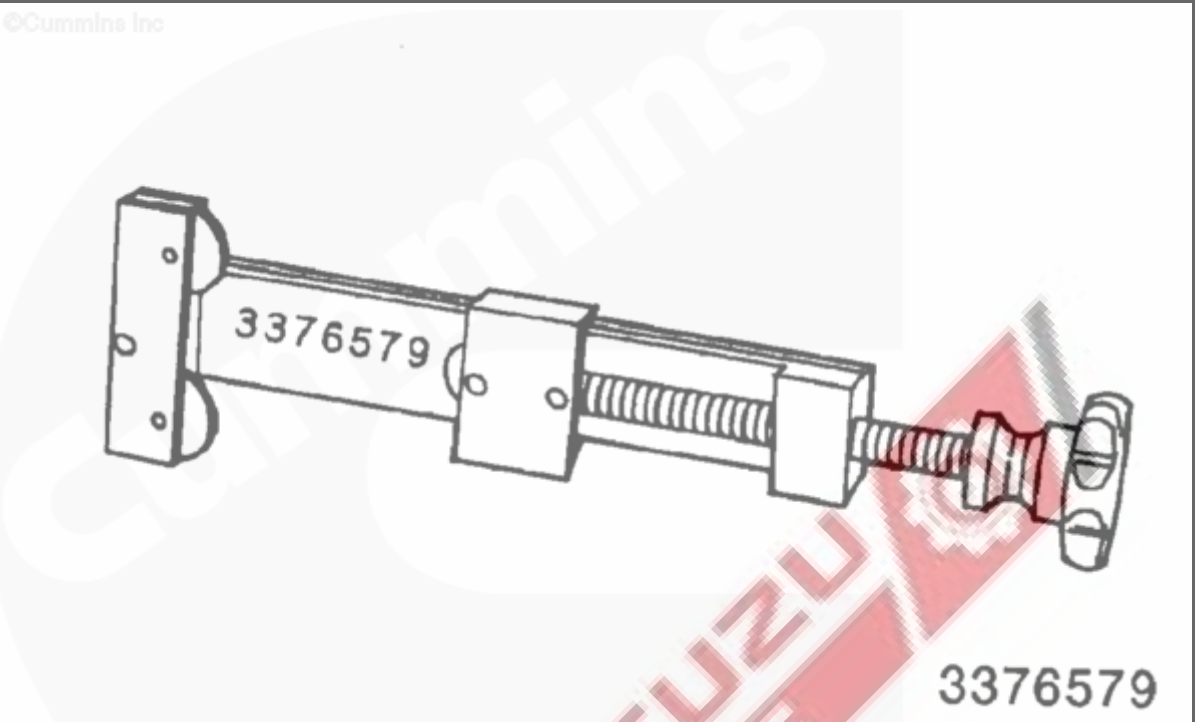


Tool Number

3376579

Tube (Filter) Cutter

Used to cut open the filter to permit inspection of the filter element.



Tool Number

3376891

Fluorescent Tracer

This special dye, when mixed in the cooling system or lubricating system, will help determine the source of leaks. Used with leak test kit, Part Number 2892320, black lights must be used to illuminate the fluorescent dye.

ANADOLU ISUZU AFTER SALES



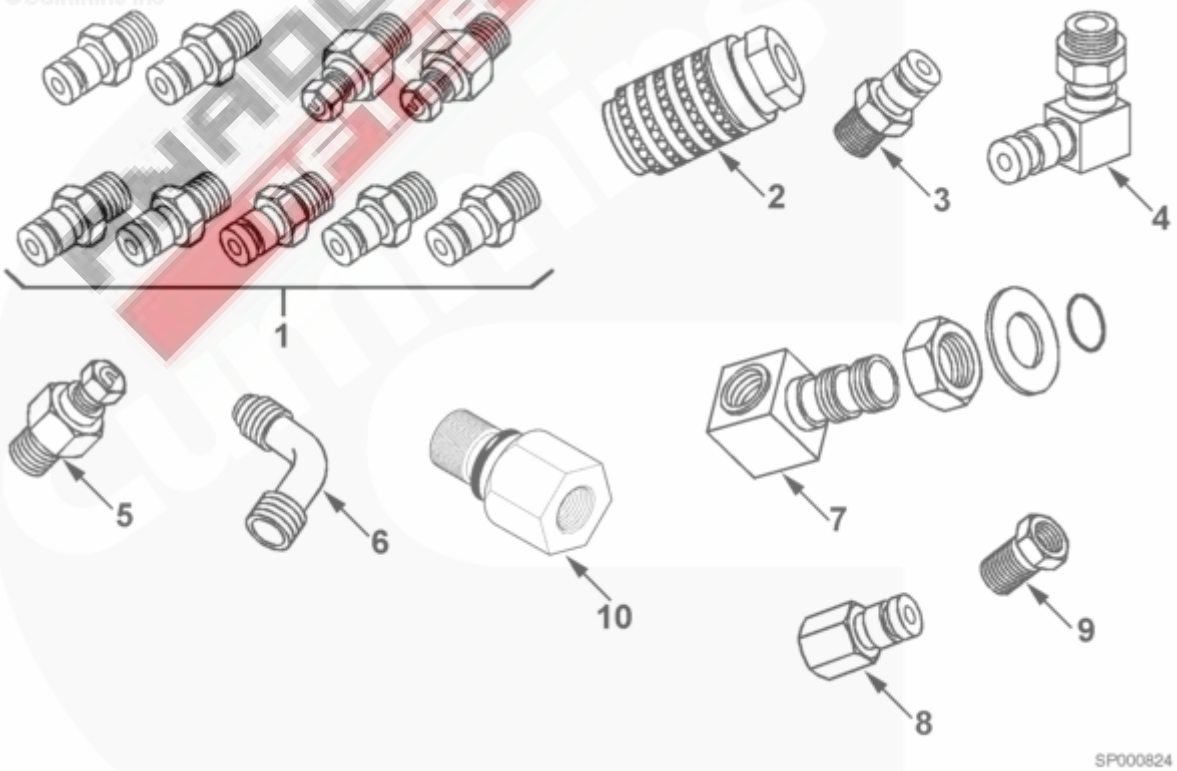
SP000785

Tool Number

3376920

Compuchek Coupling

The following miscellaneous fittings are quick connect fittings used when troubleshooting or diagnosing various pressure points of an engine. Female Quick Connect ¼ NPT (2).



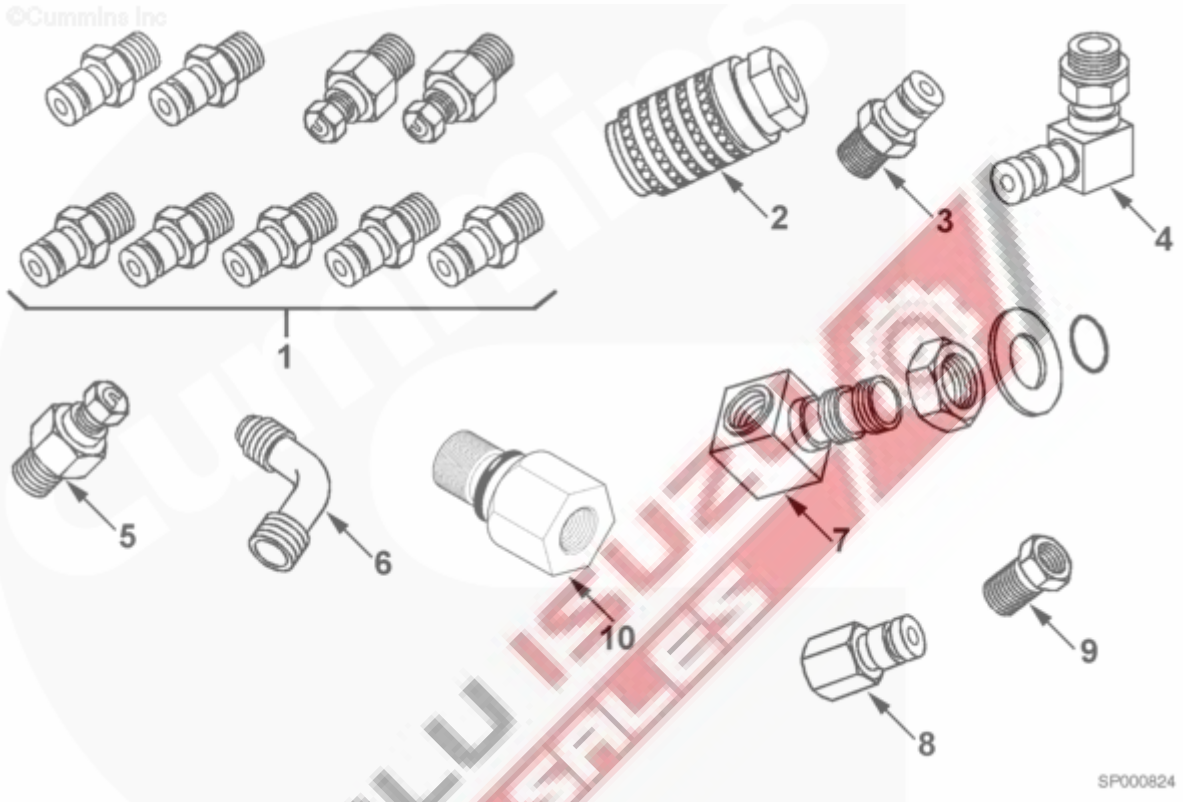
SP000824

Tool Number

3377244

Compuchek™ Fitting

The following miscellaneous fittings are quick connect fittings used when troubleshooting or diagnosing various pressure points of an engine. Fitting kit (1) contains seven of Part Number 3377244.



Tool Number

3823718

Retaining Compound (50 ml bottle)

This special retaining compound is a low viscosity rapid curing liquid. It augments the strength of press fitted assemblies and can be used on slip fits up to .005 “ diametrical clearance. This retaining compound fixes in 10 minutes on unprimed steel at room temperature, providing a sheer strength of 3000 psi at full cure.



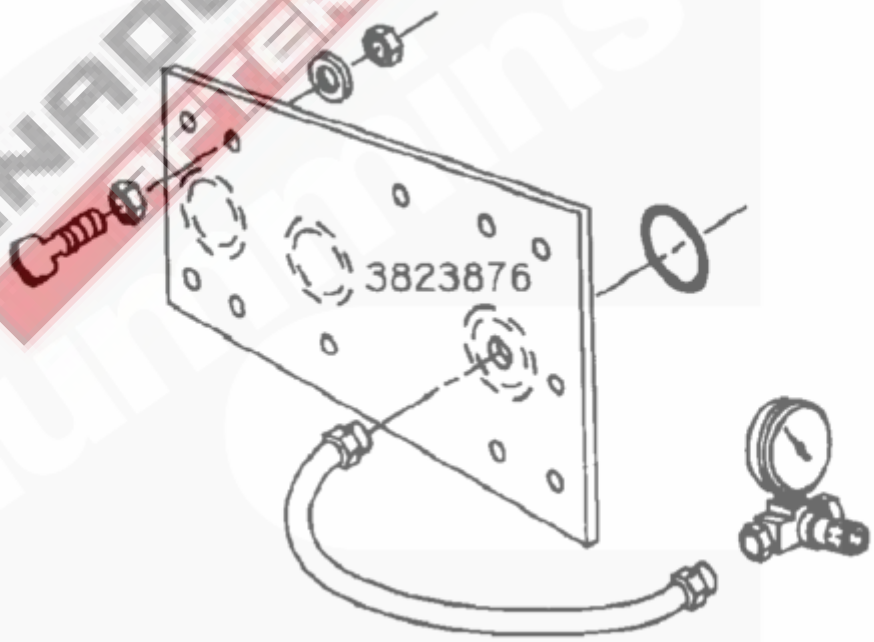
SP000776

Tool Number

3823876

Lubricating Oil Cooler Pressure Test Kit

Used to seal and pressurize the lube oil cooler to test for leaks. Requires regulated pressure supply, Part Number 3164231, or equivalent (purchased separately).



Last Modified: 10-Aug-2016



Select Service Tools

Recommended Cummins® Service Tools

- No Cummins® service tools required.

Additional Service Items

- No additional service items required.

Preparatory Steps

⚠ WARNING ⚠

Some state and federal agencies have determined that used engine oil can be carcinogenic and cause reproductive toxicity. Avoid inhalation of vapors, ingestion, and prolonged contact with used engine oil. If not reused, dispose of in accordance with local environmental regulations.

⚠ WARNING ⚠

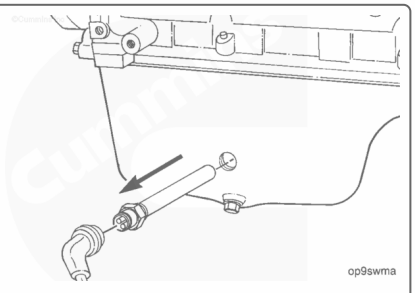
To reduce the possibility of personal injury, avoid direct contact of hot oil with your skin.

- Drain the lubricating oil. Refer to Procedure 007-037 in Section 7. (/qs3/pubsys2/xml/en/procedures/425/425-007-037.html)

Remove

Disconnect the oil heater electrical cord.

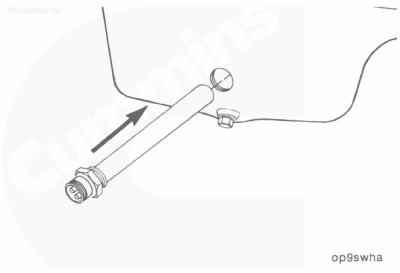
Remove the heater element.



Install

Install the heater element.

Torque Value: 120 n•m [89 ft-lb]



Finishing Steps

- Connect the oil heater electrical cord.
- Fill the engine with lubricating oil. Refer to Procedure 007-037 in Section 7. (/qs3/pubsys2/xml/en/procedures/425/425-007-037.html)
- Operate the engine. Check for leaks.

Last Modified: 01-Nov-2016

ANADOLU ISUZU AFTER SALES

Select Service Tools

Recommended Cummins® Service Tools

- Lubricating oil cooler pressure test kit, Part Number 3823876

Additional Service Items

- Brush
- Shop air
- Cleaning Tank
- Screwdriver
- Gasket scraper

Preparatory Steps

⚠ WARNING ⚠

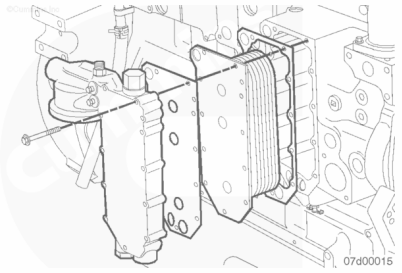
Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

- Disconnect the batteries. See equipment manufacturer service information.
- Drain the coolant. Refer to Procedure 008-018 in Section 8. (/qs3/pubsys2/xml/en/procedures/425/425-008-018-tr.html)
- Clean the area around the lubricating oil cooler cover.
- Remove the lubricating oil filter. Refer to Procedure 007-013 in Section 7. (/qs3/pubsys2/xml/en/procedures/425/425-007-013-tr.html)
- Remove the turbocharger oil supply line. Refer to Procedure 010-046 in Section 10. (/qs3/pubsys2/xml/en/procedures/425/425-010-046.html)
- Remove the exhaust gas recirculation (EGR) cooler coolant line. Refer to Procedure 011-031 in Section 11. (/qs3/pubsys2/xml/en/procedures/425/425-011-031.html)
- Remove the EGR cooler mounting bracket. Refer to Procedure 011-029 in Section 11. (/qs3/pubsys2/xml/en/procedures/425/425-011-029.html)

Remove

Remove the lubricating oil cooler cover, gaskets, and oil cooler element.

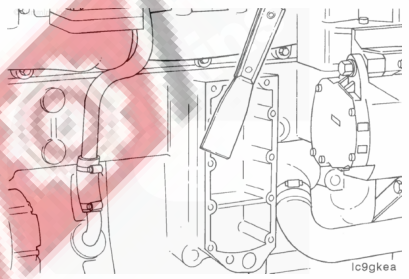
Discard the gaskets.



Clean and Inspect for Reuse

⚠ WARNING ⚠

When using solvent, acids, or alkaline materials for cleaning, follow the manufacturer's recommendations for use. Wear goggles and protective clothing to reduce the possibility of personal injury.



⚠ CAUTION ⚠

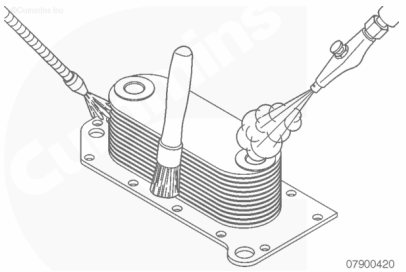
Use a solvent that will not harm copper to clean the oil cooler elements.

Clean the sealing surfaces of the cylinder block and the oil cooler cover.

Note : Replace the lubricating oil cooler if any debris is found in the lubricating oil filter, or if the engine has had a debris-generating malfunction that introduced debris into the lubricating oil system.

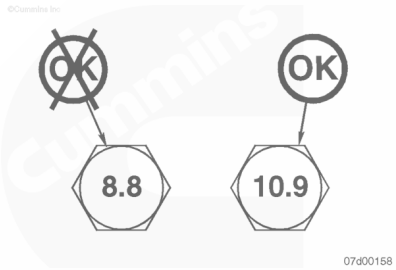
⚠ CAUTION ⚠

Do not reuse an oil cooler core after a debris related engine malfunction since there is no practical method for cleaning the cooler core. Metal particles which can circulate through the lubricating oil system can remain in the cooler core and cause engine damage.



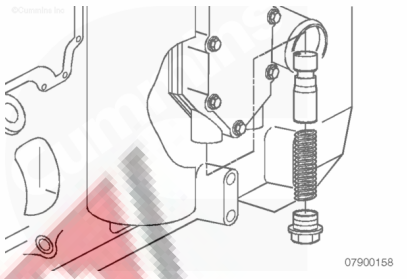
Inspect the capscrews. If they are Grade 10.9 or higher, they can be reused.

If the capscrews are lower than Grade 10.9, they **must** be replaced with Grade 10.9 or higher capscrews.



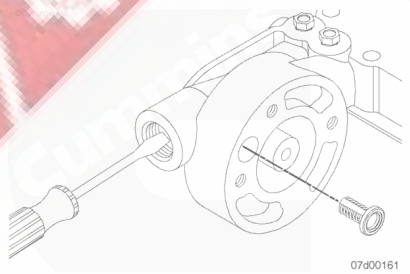
07d00158

If any debris is suspected to have gone through the engine, or if troubleshooting a lubricating oil pressure issue, remove and inspect the lubricating oil pressure regulator located in the lubricating oil cooler cover. Replace if necessary. Refer to Procedure 007-029 in Section 7. (/qs3/pubsys2/xml/en/procedures/425/425-007-029.html)


07900158

If any debris is suspected to have gone through the engine, inspect the oil filter bypass valve located in the lubricating cooler cover. Make sure the valve is fully seated and opens and closes freely. Replace, if necessary.

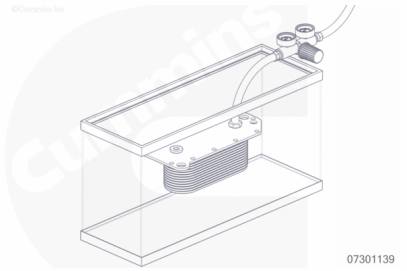
The bypass valve requires a 345 kPa [50 psi] pressure differential to open.


07d00161

Leak Test

Pressure test the element to check for leaks. If leaks are detected, replace the element.

Air Pressure Test		
kpa		psi
449	MIN	65
518	MAX	75

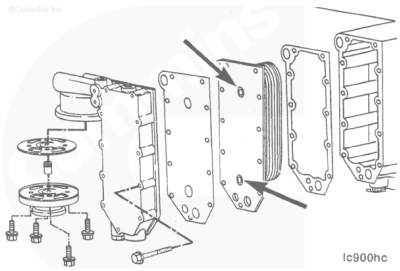

07301139

Install

Note : Make sure to remove the shipping plugs from a new oil cooler element.

ANADOLU ISUZU AFTER SALES

Assemble the lubricating oil cooler gaskets, element, and cover. Use new gaskets.



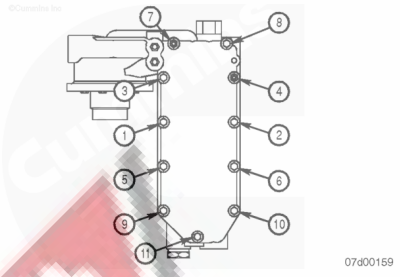
Tighten the capscrews in the sequence shown.

Torque Value:

1. 15 n•m [11 ft-lb]
2. 33 n•m [24 ft-lb]

Retorque capscrews 1 and 2 by using the torque value listed below:

Torque Value: 33 n•m [24 ft-lb]



Finishing Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

- Install the EGR cooler mounting bracket. Refer to Procedure 011-029 in Section 11. (/qs3/pubsys2/xml/en/procedures/425/425-011-029.html)
- Install the EGR cooler coolant line. Refer to Procedure 011-031 in Section 11. (/qs3/pubsys2/xml/en/procedures/425/425-011-031.html)
- Install the turbocharger oil supply line. Refer to Procedure 010-046 in Section 10. (/qs3/pubsys2/xml/en/procedures/425/425-010-046.html)
- Install the lubricating oil filter. Refer to Procedure 007-013 in Section 7. (/qs3/pubsys2/xml/en/procedures/425/425-007-013-tr.html)
- Fill the cooling system. Refer to Procedure 008-018 in Section 8. (/qs3/pubsys2/xml/en/procedures/425/425-008-018-tr.html)
- Connect the batteries. See equipment manufacturer service information.
- Operate the engine. Check for leaks.


ANADOLU ISUZU
AFTER SALES

Select Service Tools

Recommended Cummins® Service Tools

- No Cummins® Service Tools required.

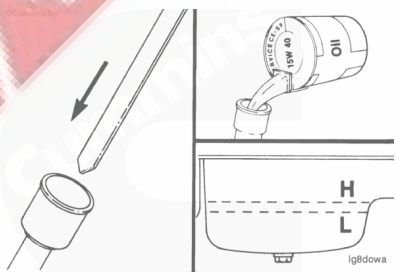
Additional Service Items

- No additional service items required.

Calibrate

⚠ WARNING ⚠

Some state and federal agencies have determined that used engine oil can be carcinogenic and can cause reproductive toxicity. Avoid inhalation of vapors, ingestion, and prolonged contact with used engine oil. If not reused, dispose of in accordance with local environmental regulations.



⚠ WARNING ⚠

To reduce the possibility of personal injury, avoid direct contact of hot oil with your skin.

Drain the lubricating oil. Refer to Procedure 007-037 in Section 7. (/qs3/pubsys2/xml/en/procedures/425/425-007-037.html)

Install the dipstick in the dipstick tube housing.

Use clean lubricating oil to fill the oil pan to the specified LOW oil level. Refer to Procedure 018-017 in Section V. (/qs3/pubsys2/xml/en/procedures/425/425-018-017.html)

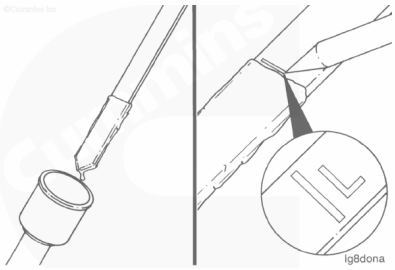
⚠ CAUTION ⚠

Use care when marking the dipstick. The dipstick will break if the scribe mark is too deep.

ANADOLU ISUZU SPARE PARTS SALES

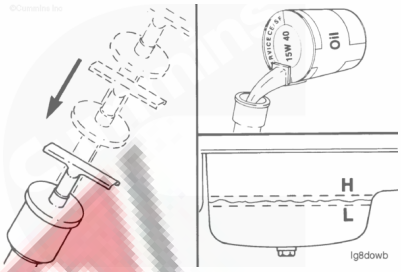
Remove the dipstick. Scribe a mark across the stick at the oil level. Label the mark with an L to indicate the "LOW" oil level.

Note : If a new blank dipstick is being used, cut the dipstick off approximately 38 mm [1.5 in] below the LOW oil level mark.



Wipe off the dipstick. Install it in the dipstick tube housing.

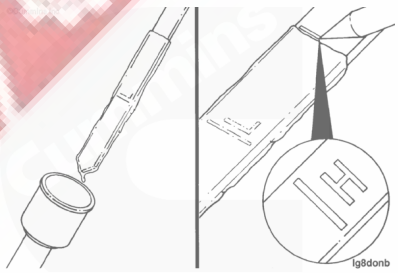
Use clean lubricating oil to fill the oil pan to the specified HIGH oil level. Refer to Procedure 018-017 in Section V. (/qs3/pubsys2/xml/en/procedures/425/425-018-017.html)



⚠ CAUTION ⚠

Use care when marking the dipstick. The dipstick will break if the scribe mark is too deep.

Remove the dipstick. Scribe a mark across the stick at the oil level. Label the mark with an H to indicate the HIGH oil level.



ANADOLU ISUZU AFTER SALES

Last Modified: 27-Jul-2016

Select Service Tools

Recommended Cummins® Service Tools

- Sleeve retaining compound, Part Number 3823718, or equivalent

Additional Service Items

- Dent puller
- M8 x 1.25 x 21 mm self-tapping capscrew

Preparatory Steps

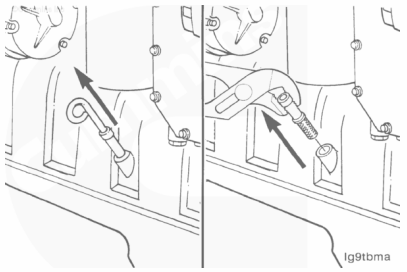
- Clean the area around the dipstick tube before removal to prevent debris from entering the oil system.

Remove

Remove the dipstick from the dipstick tube.

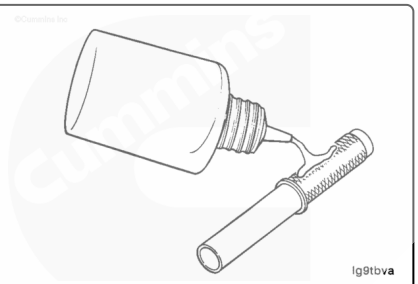
Remove the dipstick tube from the cylinder block.

Service Tip: Use a dent puller and a M8 x 1.25 x 21 mm self-tapping capscrew. Thread the capscrew into the dipstick tube. Remove the tube.



Install

Apply a thin bead of sleeve retaining compound, Part Number 3823718, or equivalent, around the bottom of the knurled end of the tube.



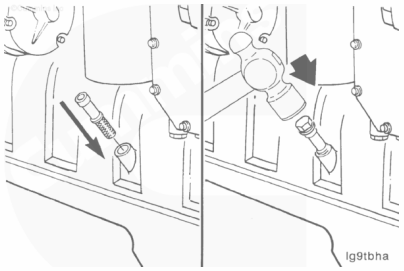
ANADOLU ISUZU GENUINE SALES

Place the knurled end of the tube into the dipstick tube bore in the cylinder block.

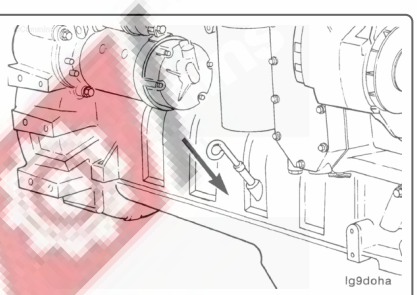
Use a flat washer and hex head capscrew to drive the tube into the cylinder block.

Lightly drive the dipstick tube until it seats against the block casting.

Remove the flat washer and hex head capscrew.



Install the dipstick into the dipstick tube.



Finishing Steps

- Operate the engine. Check for leaks.

ANADOLU ISUZU AFTER SALES

Last Modified: 27-Jul-2016

Select Service Tools

Recommended Cummins® Service Tools

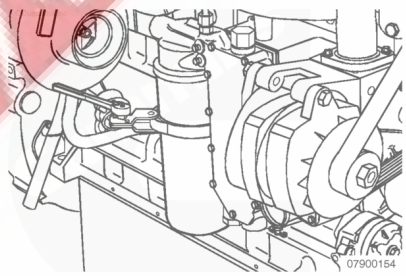
- Oil filter wrench, Part Number 3375049, or equivalent

Additional Service Items

- No additional service items required.

Measure

Remove the oil plugs from the lubricating oil cooler housing at the filter inlet and outlet pressure ports and install manual gauges.



The following parts, or equivalent, are available for use:

Part Number	Description
3377244	Compuchek™ fitting (1/8 inch 27 NPT)
3376920	Compuchek™ coupling (1/4 inch pipe thread)
3164491	Electronic pressure adapter for multimeter (1/4 NPT pipe)
3164488 or 3164489	Electronic digital multimeter
Engine Information	
Oil Filter Type	
Miles on Filter	
Oil Type	

Operate the engine at each rpm indicated. Record the corresponding pressure values:

	Engine RPM	Oil Pressure Filter Inlet	Oil Filter Pressure Outlet	Inlet - Outlet = Differential Pressure	INSITE™ electronic service tool
Low Idle					
High Idle					

A pressure drop greater than 172 kPa [25 psi], at operating temperature using engine oil, indicates the filter is plugged.

Identify the causes of a plugged filter. Verify Cummins Inc. maintenance guidelines are being met.

Use the following procedure to check for possible fluid contamination. Refer to Procedure 007-083 in Section 7. (/qs3/pubsys2/xml/en/procedures/425/425-007-083.html)

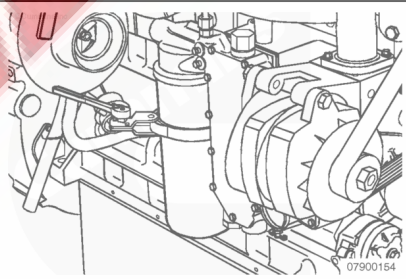
Change both the lubricating oil and the lubricating oil filter, if the filter is plugged.

See the following bulletin for additional information about lubricating oil filter plugging. Refer to Service Bulletin, Cummins® Engine Oil and Oil Analysis Recommendations, Bulletin 3810340. (/qs3/pubsys2/xml/en/bulletin/3810340.html)

Remove

⚠ CAUTION ⚠

Use caution when replacing filters that oil is not spilled or drained into the bilge area. Do not drop or throw filter elements into the bilge area. The oil and oil filters must be discarded in accordance with local environmental regulations.



Clean the area around the lubricating oil filter head.

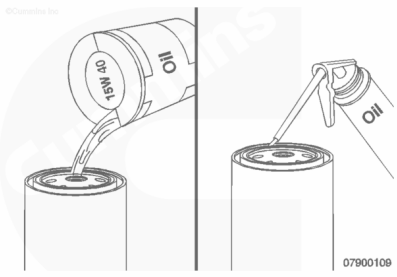
Remove the lubricating oil filter. Use oil filter wrench, Part Number 3375049, or equivalent.

Clean the gasket surface of the filter head. Use a clean lint-free cloth.

Install

⚠ CAUTION ⚠

The lubricating oil filter should be full of oil at start-up to prevent engine damage.



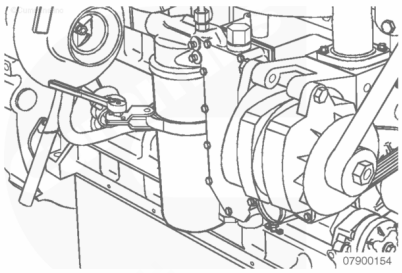
Use clean engine oil to coat the gasket surface of the filter.

Fill the filter with clean engine oil.

Note : Lubricating oil filters **must** have a filter bypass valve. Using a lubricating oil filter without a filter bypass valve will result in low engine oil pressure if the filter becomes plugged.

⚠ CAUTION ⚠

Mechanical overtightening of the filter can distort the threads or damage the filter element seal.



Install the filter on the oil filter head. Tighten the filter until the gasket contacts the filter head surface.

Use an oil filter wrench to tighten the filter. See filter manufacturer instructions supplied with the filter.

ANADOLU ISUZU AFTER SALES

Last Modified: 14-Sep-2016

Select Service Tools

Recommended Cummins® Service Tools

- No Cummins® Service Tools required.

Additional Service Items

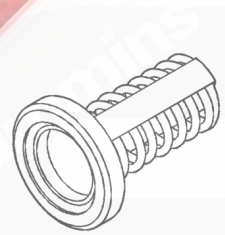
- Screwdriver

General Information

If the pressure drop across the lubricating oil filter exceeds a predetermined set point, the oil filter bypass valve opens and allows lubricating oil to bypass the lubricating oil filter.

This condition can occur during cold ambient (cold lubricating oil) engine start-ups.

The purpose of the bypass valve is to maintain lubricating oil flow to the engine and prevent an oil filter collapse.



07d00160

Preparatory Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

⚠ WARNING ⚠

Some state and federal agencies have determined that used engine oil can be carcinogenic and cause reproductive toxicity. Avoid inhalation of vapors, ingestion, and prolonged contact with used engine oil. If not reused, dispose of in accordance with local environmental regulations.

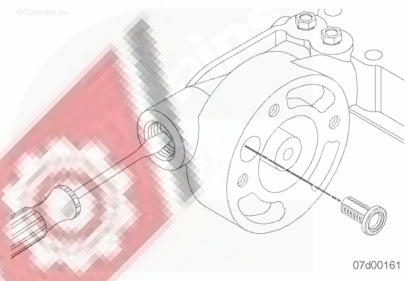
- Disconnect the batteries. See equipment manufacturer service information.

- Remove the lubricating oil filter. Refer to Procedure 007-013 in Section 7. (/qs3/pubsys2/xml/en/procedures/425/425-007-013-tr.html)
- Remove the lubricating oil filter head. Refer to Procedure 007-015 in Section 7. (/qs3/pubsys2/xml/en/procedures/425/425-007-015.html)
- Remove the 3/4-inch pipe plug from the end of the oil filter head.

Remove

Remove the 3/4 inch pipe plug from the end of the oil filter head.

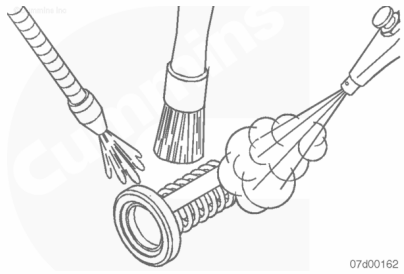
Gently push down on the top of the bypass valve to remove it from the bore. Use a screwdriver.



Clean and Inspect for Reuse

⚠ WARNING ⚠

When using solvents, acids, or alkaline materials for cleaning, follow the manufacturer's recommendations for use. Wear goggles and protective clothing to reduce the possibility of personal injury.



⚠ WARNING ⚠

Some solvents are flammable and toxic. Read the manufacturer's instructions before using.

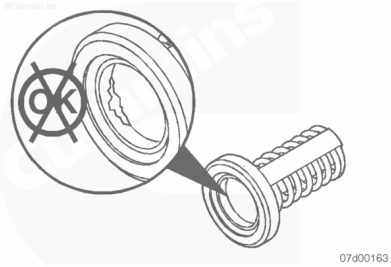
⚠ WARNING ⚠

Wear appropriate eye and face protection when using compressed air. Flying debris and dirt can cause personal injury.

Clean the bypass valve. Use solvent. Dry with compressed air.

ANADOLU ISUZU PARTS SALES

Inspect the bypass valve seat for damage. Make sure the valve fully closes.



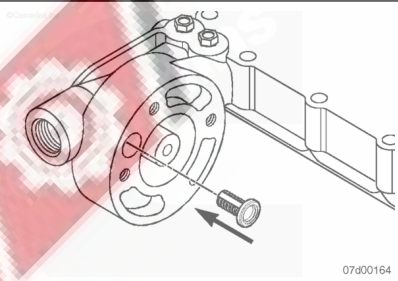
Install

Insert the bypass valve into the bore. The spring should be pointing upward into the bore.

Gently push the bypass valve into the bore until it seats.

Install the 3/4 inch pipe plug into the end of the oil filter head.

Torque Value: 45 n•m [33 ft-lb]



Finishing Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

- Install the lubricating oil filter head. Refer to Procedure 007-015 in Section 7. (/qs3/pubsys2/xml/en/procedures/425/425-007-015.html)
- Install the lubricating oil filter. Refer to Procedure 007-013 in Section 7. (/qs3/pubsys2/xml/en/procedures/425/425-007-013-tr.html)
- Connect the batteries. See equipment manufacturer service information.
- Operate the engine. Check for leaks.

ANADOLU ISUZU AFTER SALES


ANADOLU ISUZU
AFTER SALES

Select Service Tools

Recommended Cummins® Service Tools

- No Cummins® service tools required.

Additional Service Items

- No additional service items required.

Preparatory Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

⚠ WARNING ⚠

Do not remove the pressure cap from a hot engine. Wait until the coolant temperature is below 50°C [120°F] before removing the pressure cap. Heated coolant spray or steam can cause personal injury.

⚠ WARNING ⚠

Coolant is toxic. Keep away from children and pets. If not reused, dispose of in accordance with local environmental regulations.

⚠ WARNING ⚠

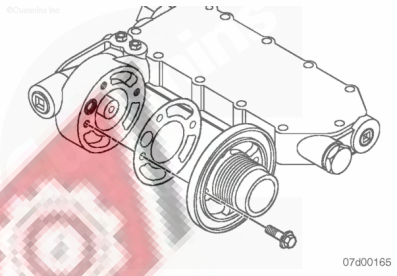
Some state and federal agencies have determined that used engine oil can be carcinogenic and cause reproductive toxicity. Avoid inhalation of vapors, ingestion, and prolonged contact with used engine oil. If not reused, dispose of in accordance with local environmental regulations.

- Disconnect the batteries. See equipment manufacturer service information.
- Drain the coolant. Refer to Procedure 008-018 in Section 8. (/qs3/pubsys2/xml/en/procedures/425/425-008-018-tr.html)

- Remove the lubricating oil filter. Refer to Procedure 007-013 in Section 7. (/qs3/pubsys2/xml/en/procedures/425/425-007-013-tr.html)
- Remove the lubricating oil cooler. Refer to Procedure 007-003 in Section 7. (/qs3/pubsys2/xml/en/procedures/425/425-007-003.html)

Remove

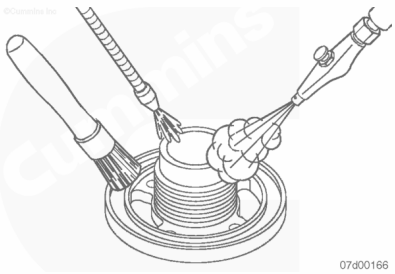
Remove the lubricating oil filter head adapter capscrews, filter head adapter, and gasket.



Clean and Inspect for Reuse

⚠ WARNING ⚠

When using solvents, acids, or alkaline materials for cleaning, follow the manufacturer's recommendations for use. Wear goggles and protective clothing to reduce the possibility of personal injury.

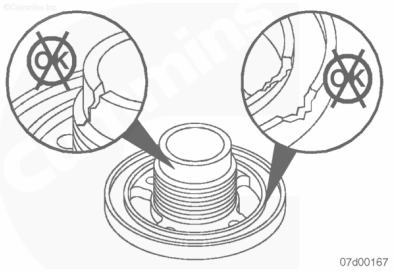


⚠ WARNING ⚠

Some solvents are flammable and toxic. Read the manufacturer's instructions before using.

Clean the filter head adapter. Use solvent.

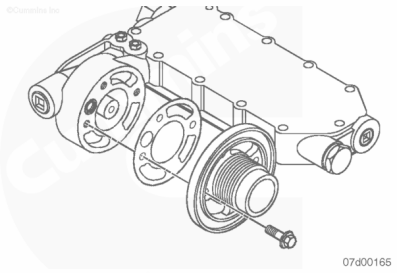
Inspect the filter head adapter for cracks and other damage.



Install

Install the gasket, lubricating oil filter head adapter, and capscrews.

Torque Value: 24 n•m [212 in-lb]



Finishing Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

- Install the lubricating oil cooler. Refer to Procedure 007-003 in Section 7. (/qs3/pubsys2/xml/en/procedures/425/425-007-003.html)
- Install the lubricating oil filter. Refer to Procedure 007-013 in Section 7. (/qs3/pubsys2/xml/en/procedures/425/425-007-013-tr.html)
- Fill the cooling system. Refer to Procedure 008-018 in Section 8. (/qs3/pubsys2/xml/en/procedures/425/425-008-018-tr.html)
- Connect the batteries. See equipment manufacturer service information.
- Operate the engine. Check for leaks.

ANADOLU ISUZU

Last Modified: 01-Nov-2016

Select Service Tools

Recommended Cummins® Service Tools

- Flourescent tracer, Part Number 3376891
- Black Light Kit, Part Number 3163338

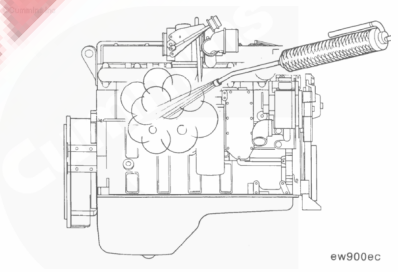
Additional Service Items

- No additional service items required.

Initial Check

⚠ WARNING ⚠

Wear safety glasses or a face shield, as well as protective clothing, to prevent personal injury when using a steam cleaner or high-pressure water.

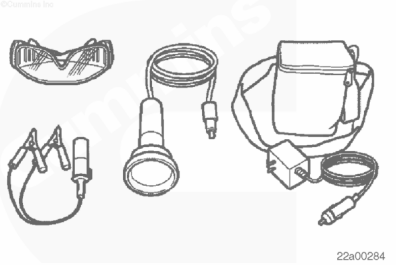


Clean the engine. Use a steam cleaner or high-pressure washer.

Add fluorescent tracer, Part Number 3376891, before running the engine.

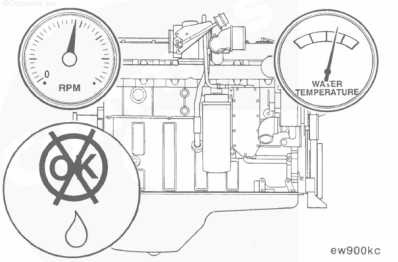
Use Black Light Kit, Part Number 3163338, to help identify the source of an oil leak.

The tracer will be highlighted by the black light to help identify the source of the oil leak.



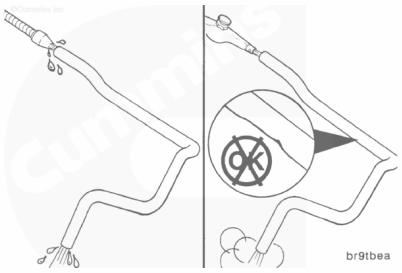
Operate the engine until the coolant temperature reaches 82°C [180°F]. If necessary, run the engine under load to create the conditions of the oil leak. Perform stall tests or a road test. Inspect the exterior of the engine for leaking gaskets, seals, o-rings, pipe plugs, or fittings.

Note : Before replacing any gaskets, check the capscrews to make sure they are tightened to the correct torque values.

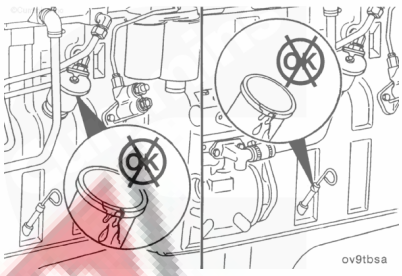


ANADOLU ISUZU PARTS SALES

Inspect the engine crankcase breather tube and hose for restriction or leaks. Refer to Procedure 003-018 in Section 3. (/qs3/pubsys2/xml/en/procedures/425/425-003-018.html)



Check for a loose or missing oil dipstick tube, dipstick, or oil fill cap.



Last Modified: 27-Jul-2016

ANADOLU ISUZU AFTER SALES

Select Service Tools

Recommended Cummins® Service Tools

- Sealant, Part Number 3164067, or equivalent
- Guide pins, Part Number 3164977 - Quantity 3

Additional Service Items

- Utility or putty knife

Preparatory Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

⚠ WARNING ⚠

To reduce the possibility of personal injury, avoid direct contact of hot oil with your skin.

⚠ WARNING ⚠

Some state and federal agencies have determined that used engine oil can be carcinogenic and cause reproductive toxicity. Avoid inhalation of vapors, ingestion, and prolonged contact with used engine oil. If not reused, dispose of in accordance with local environmental regulations.

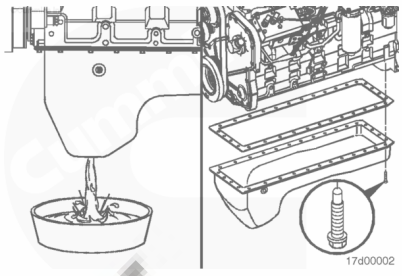
Note : The engines use a variety of combinations of gaskets and/or RTV for sealing. When installing the oil pan, use the same combinations of gasket and/or RTV that were on the pan.

- Disconnect the batteries. See equipment manufacturer service information.
- Inspect the area around the lubricating oil pan plug. If there are signs of leakage, the lubricating oil pan plug sealing washer needs to be replaced.
- Drain the lubricating oil. Refer to Procedure 007-037 in Section 7. (/qs3/pubsys2/xml/en/procedures/425/425-007-037.html)

Remove

⚠ CAUTION ⚠

Do not use a prybar or screwdriver to remove the oil pan. The lubricating oil pan flange can be damaged if a prybar or screwdriver is used to break the sealant at the corners of the oil pan. Use a utility knife or the edge of a putty knife to cut the seal and loosen the pan.



Remove the lubricating oil pan and gasket.

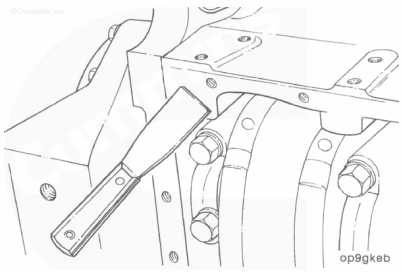
Remove the suction tube, if necessary. Refer to Procedure 007-035 in Section 7. (/qs3/pubsys2/xml/en/procedures/425/425-007-035.html)

Remove the block stiffener plate, if equipped. Refer to Procedure 001-089 in Section 1. (/qs3/pubsys2/xml/en/procedures/425/425-001-089.html)

Clean and Inspect for Reuse

⚠ WARNING ⚠

When using a steam cleaner, wear safety glasses or a face shield, as well as protective clothing. Hot steam can cause serious personal injury.



⚠ WARNING ⚠

Wear appropriate eye and face protection when using compressed air. Flying debris and dirt can cause personal injury.

⚠ CAUTION ⚠

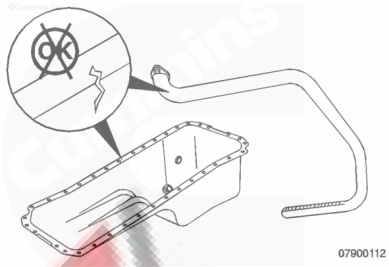
Do not use air or power tools, such as a high speed sander with an abrasive pad, to clean the gasket material from the oil pan. Air or power tools can overheat the oil pan and cause damage to the sealing flange.

ANADOLU ISUZU PARTS SALES

Remove all gasket material from the cylinder block and lubricating oil pan surface.

Clean the lubricating oil pan. Use steam. Dry with compressed air.

Note : If cracks or other damage is found, replace the damaged part. Do **not** attempt to repair the oil pan by welding.

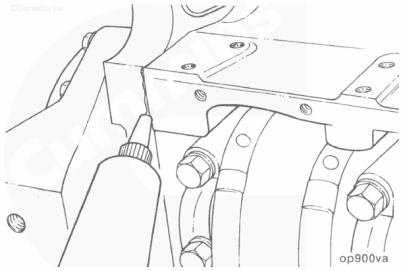


Inspect the oil pan, suction tube, and tube braces for cracks or other damage.

Use the following procedure if the suction tube **must** be replaced. Refer to Procedure 007-035 in Section 7. (/qs3/pubsys2/xml/en/procedures/425/425-007-035.html)

Install

Note : The engines use a variety of combinations of gaskets and/or RTV for sealing. When installing the oil pan, use the same combinations of gaskets and/or RTV that were on the pan.



Note : To achieve a proper seal, gaskets should not be reused.

Note : If the engine is equipped with a block stiffener plate, it is recommended that paper gaskets not be used for sealing.

Apply a 4 mm [1/8 in] bead of sealant, Part Number 3164067, or equivalent, to the oil pan mounting surfaces at the cylinder block to front gear cover joints and the cylinder block to rear gear housing joints.

Note : Install the oil pan within 10 minutes of applying the sealant, or it will **not** seal correctly. Once installed, allow the sealant to dry for a minimum of 30 minutes before running the engine.

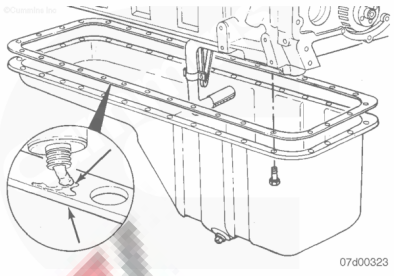
Install the suction tube, if applicable. Refer to Procedure 007-035 in Section 7. (/qs3/pubsys2/xml/en/procedures/425/425-007-035.html)

Note : Install three guide pins, Part Number 3164977, to improve the alignment of the oil pan sealing components to the cylinder block. It is recommended

to install two of the guide pins at opposite corners and one in the middle.

Install the block stiffener, if applicable. Refer to Procedure 001-089 in Section 1. (/qs3/pubsys2/xml/en/procedures/425/425-001-089.html)

Install the gasket and lubricating oil pan.



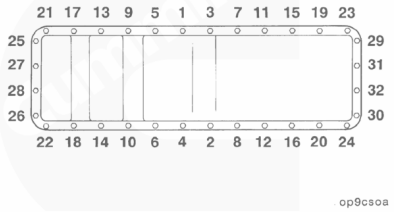
Service Tip: To aid in installation of the gasket, apply a small amount of sealant, Part Number 3164067, or high tack spray adhesive to the gasket and oil pan flange. This will help hold the gasket in place during assembly.

If RTV sealant is used to seal the oil pan, apply a 4 mm [1/8 in] bead of sealant, Part Number 3164067, or equivalent, to the oil pan flange and around the bolt holes.

Install the oil pan corner braces, if equipped.

Note : Install the oil pan within 10 minutes of applying the sealant, or it will **not** seal correctly. Once installed, allow the sealant to dry for a minimum of 30 minutes before running the engine.

Assemble the washers and capscrews to secure the lubricating oil pan, as illustrated.

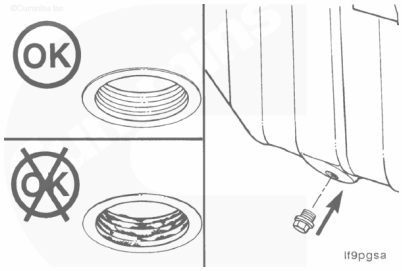


Tighten all capscrews in the sequence shown in the accompanying chart.

Torque Value: 28 n•m [248 in-lb]

Note : Make sure to follow the torque sequence shown. This allows for minimal assembly strains and evenly distributes pressure along the oil pan flange. Failure to follow the torque sequence can lead to a cracked oil pan or joint leaks.

Clean and check the lubricating oil drain plug threads and sealing surface.



Install a new sealing washer if the lubricating oil pan plug was leaking or if the sealing washer is damaged.

Install and tighten the lubricating oil pan drain plug.

Torque Value:
Steel Pan, M18 Plug 60 n•m [44 ft-lb]

Torque Value:
Steel Pan, M22 Plug 80 n•m [59 ft-lb]

Torque Value:
Cast Aluminum Pan, M18 Plug 60 n•m [44 ft-lb]

Torque Value:
Cast Aluminum Pan, M22 Plug 60 n•m [44 ft-lb]

Finishing Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

- Fill the lubricating oil system. Refer to Procedure 007-037 in Section 7. (/qs3/pubsys2/xml/en/procedures/425/425-007-037.html)
- Connect the batteries. See equipment manufacturer service information.
- Operate the engine. Check for leaks.

ANADOLU ISUZU AFTER SALES

Last Modified: 04-Mar-2021

Select Service Tools

Recommended Cummins® Service Tools

- No Cummins® Service Tools required.

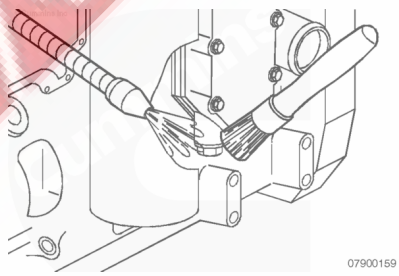
Additional Service Items

- No additional service items required.

Remove

⚠ WARNING ⚠

When using solvents, acids, or alkaline materials for cleaning, follow the manufacturer's recommendations for use. Wear goggles and protective clothing to reduce the possibility of personal injury.



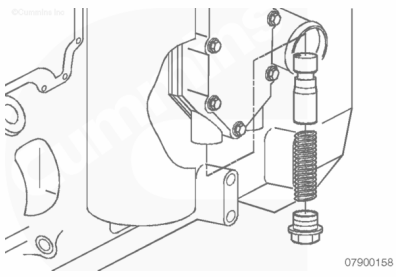
⚠ WARNING ⚠

Some solvents are flammable and toxic. Read the manufacturer's instructions before using.

Thoroughly clean the area around the pressure regulator plug with clean solvent to prevent debris from falling into the plunger bore when the plug is removed.

Remove the threaded plug, spring, and plunger.

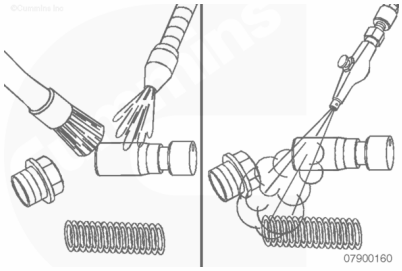
Service Tip: The plunger normally can be removed by inserting one finger into the plunger bore until snug and pulling down. If the plunger can **not** be removed in this manner, the plunger is probably stuck and will require removal of the housing for cleaning the plunger.



Clean and Inspect for Reuse

⚠ WARNING ⚠

When using solvents, acids, or alkaline materials for cleaning, follow the manufacturer's recommendations for use. Wear goggles and protective clothing to reduce the possibility of personal injury.



⚠ WARNING ⚠

Some solvents are flammable and toxic. Read the manufacturer's instructions before using.

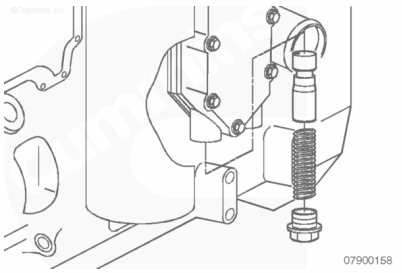
⚠ WARNING ⚠

Wear appropriate eye and face protection when using compressed air. Flying debris and dirt can cause personal injury.

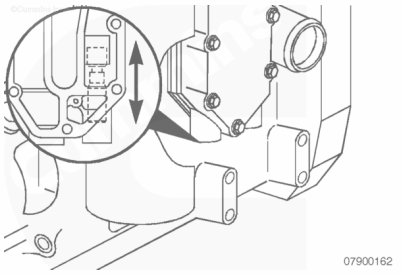
Note : If the plunger bore requires cleaning, remove the housing to avoid flushing debris into the engine.

Thoroughly clean all components. Use clean solvent. Dry with compressed air.

Inspect the plunger and plunger bore. Polished areas on the plunger and bore are acceptable.



Verify the plunger moves freely in the bore.

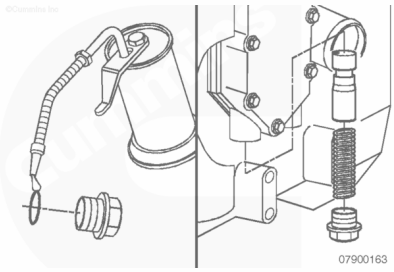


ANADOLU ISUZU AFTER SALES

Install

Install a new sealing o-ring on the threaded plug. Lubricate with clean engine oil. Install the pressure regulator assembly.

Torque Value: 80 n•m [59 ft-lb]



Last Modified: 28-Jul-2016

ANADOLU ISUZU AFTER SALES

Select Service Tools

Recommended Cummins® Service Tools

- No Cummins® Service Tools required.

Additional Service Items

- No additional service items required.

Preparatory Steps

⚠ WARNING ⚠

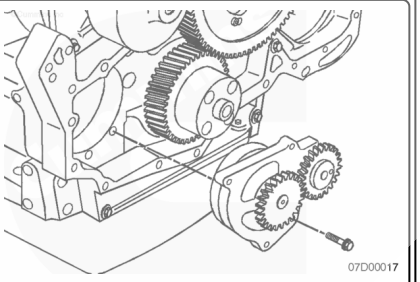
Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

- Disconnect the batteries. See equipment manufacturer service information.
- Remove the drive belt. Refer to Procedure 008-002 in Section 8. (/qs3/pubsys2/xml/en/procedures/425/425-008-002-tr.html)
- Remove the rubber vibration damper, if installed. Refer to Procedure 001-051 in Section 1. (/qs3/pubsys2/xml/en/procedures/425/425-001-051.html)
- Remove the viscous vibration damper, if installed. Refer to Procedure 001-052 in Section 1. (/qs3/pubsys2/xml/en/procedures/425/425-001-052.html)
- Remove the front cover. Refer to Procedure 001-031 in Section 1. (/qs3/pubsys2/xml/en/procedures/425/425-001-031.html)

Remove

Remove the four mounting capscrews.

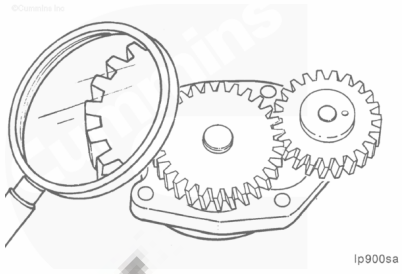
Remove the lubricating oil pump from the bore in the cylinder block.



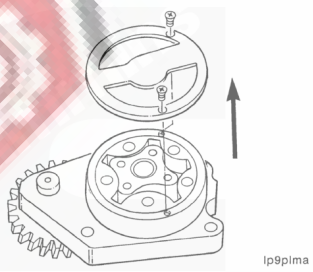
Disassemble

If the lubricating oil pump is to be inspected for reuse, follow these steps.

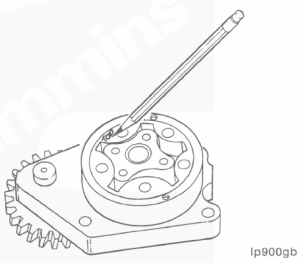
Inspect the lubricating oil pump gears for chips, cracks, or excessive wear.



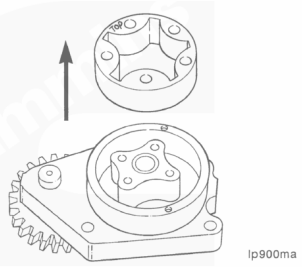
Remove the back plate.



Mark TOP on the gerotor planetary.



Remove the gerotor planetary.

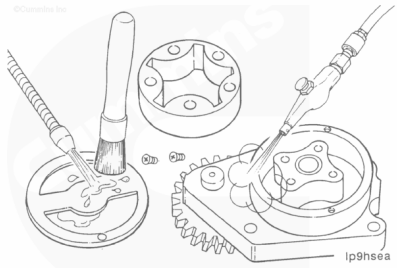


Clean and Inspect for Reuse

⚠ WARNING ⚠

ANADOLU ISUZU AFTER SALES

When using solvents, acids, or alkaline materials for cleaning, follow the manufacturer's recommendations for use. Wear goggles and protective clothing to reduce the possibility of personal injury.



⚠ WARNING ⚠

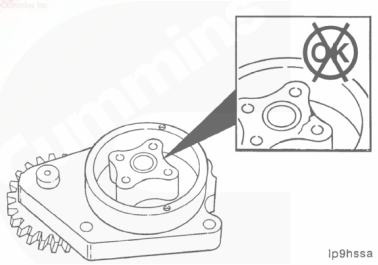
Some solvents are flammable and toxic. Read the manufacturer's instructions before using.

⚠ WARNING ⚠

Wear appropriate eye and face protection when using compressed air. Flying debris and dirt can cause personal injury.

Clean all parts. Use solvent. Dry with compressed air.

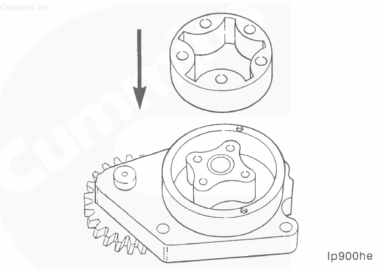
Inspect the lubricating oil pump housing, gerotor drive, and gerotor for damage and excessive wear.



Measure

⚠ CAUTION ⚠

Make sure that the gerotor planetary is installed in the original position.



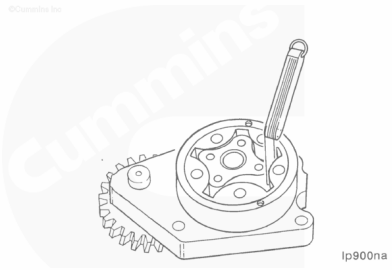
Install the gerotor planetary.

Measure the tip clearance.

Tip Clearance		
mm		in
0.0254	MIN	0.001

ANADOLU ISUZU AFTER SALES

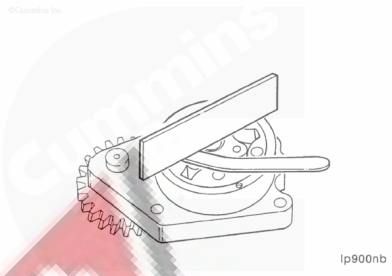
Tip Clearance		
mm		in
0.1778	MAX	0.007



Replace the lubricating oil pump if the tip clearance is out of specification.

Measure the clearance of the gerotor drive/gerotor planetary to port plate.

Gerotor Drive/Gerotor Planetary to Port Plate Clearance		
mm		in
0.0254	MIN	0.001
0.1270	MAX	0.005



Replace the lubricating oil pump if the geroter drive/geroter planetary to port plate clearance is out of specification.

Measure the clearance of the gerotor planetary to the body bore.

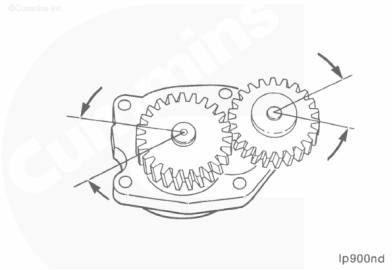
Gerotor Planetary to Body Bore Clearance		
mm		in
0.1778	MIN	0.007
0.3810	MAX	0.015



Replace the lubricating oil pump if the geroter planetary to body bore clearance is out of specification.

Measure the backlash.

Lubricating Oil Pump Gears Backlash Limits (Used Pump)		
mm		in
0.0762	MIN	0.003
0.3302	MAX	0.013

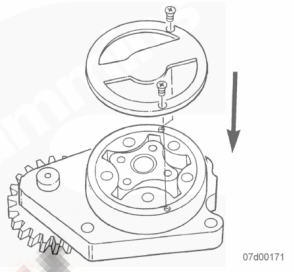


Note : Hold the adjoining gears to keep them from moving when checking backlash or else the reading will be the total of both gears.

Replace the lubricating oil pump if the gear backlash is out of specification.

Assemble

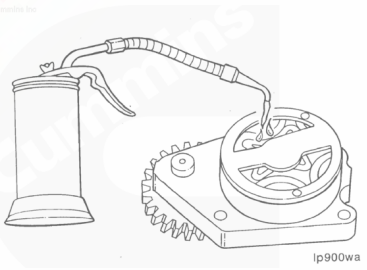
Install the back plate.



Install

⚠ CAUTION ⚠

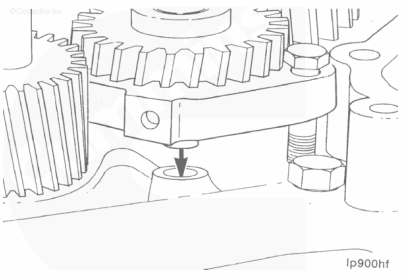
Failure to fill the pump with oil at installation can result in the lubricating oil pump not priming at initial engine start-up, resulting in severe engine damage.



Lubricate the lubricating oil pump. Use clean engine oil.

⚠ CAUTION ⚠

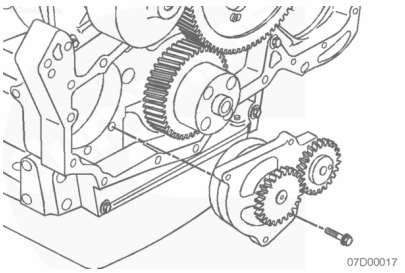
Make sure the idler gear pin is installed in the locating bore in the cylinder block.



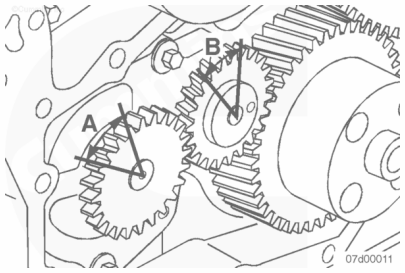
Install the lubricating oil pump.

Tighten the capscrews in a crisscross pattern, starting with the upper right capscrew.

Torque Value: 24 n•m [212 in-lb]



Note : Make sure the gear backlash is correct if installing a new lubricating oil pump.

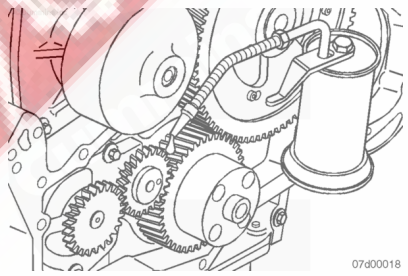


Measure the gear backlash.

Lubricating Oil Pump Gears Backlash Limits (Installed)			
	mm		in
A	0.0762	MIN	0.003
	0.3302	MAX	0.013
B	0.0762	MIN	0.003
	0.3302	MAX	0.013

Note : If the adjoining gear moves when you measure the backlash, the reading will be incorrect.

Lubricate the front gear train. Use clean engine oil.



ANADOLU ISUZU AFTER SALES

Finishing Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

- Install the front cover. Refer to Procedure 001-031 in Section 1. (/qs3/pubsys2/xml/en/procedures/425/425-001-031.html)
- Install the rubber vibration damper, if removed. Refer to Procedure 001-051 in Section 1. (/qs3/pubsys2/xml/en/procedures/425/425-001-051.html)
- Install the viscous vibration damper, if removed. Refer to Procedure 001-052 in Section 1. (/qs3/pubsys2/xml/en/procedures/425/425-001-052.html)
- Install the drive belt. Refer to Procedure 008-002 in Section 8. (/qs3/pubsys2/xml/en/procedures/425/425-008-002-tr.html)
- Connect the batteries. See equipment manufacturer service information.
- Operate the engine. Check for leaks.

Last Modified: 14-Sep-2016



Select Service Tools

Recommended Cummins® Service Tools

- No Cummins® Service Tools required.

Additional Service Items

- No additional service items required.

Preparatory Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

⚠ WARNING ⚠

To reduce the possibility of personal injury, avoid direct contact of hot oil with your skin.

⚠ WARNING ⚠

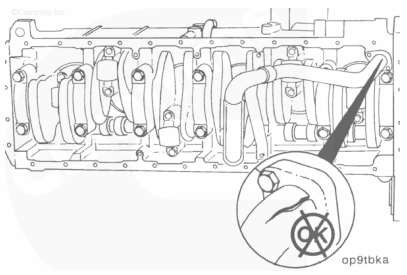
Some state and federal agencies have determined that used engine oil can be carcinogenic and cause reproductive toxicity. Avoid inhalation of vapors, ingestion, and prolonged contact with used engine oil. If not reused, dispose of in accordance with local environmental regulations.

- Disconnect the batteries. See equipment manufacturer service information.
- Drain the lubricating oil. Refer to Procedure 007-037 in Section 7. (/qs3/pubsys2/xml/en/procedures/425/425-007-037.html)
- Remove the lubricating oil pan and gasket. Refer to Procedure 007-025 in Section 7. (/qs3/pubsys2/xml/en/procedures/425/425-007-025.html)

ANADOLU ISUZU PARTS SERVICE

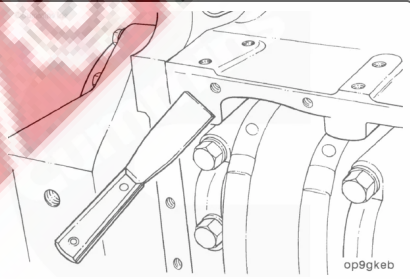
Remove

Remove the lubricating oil suction tube.

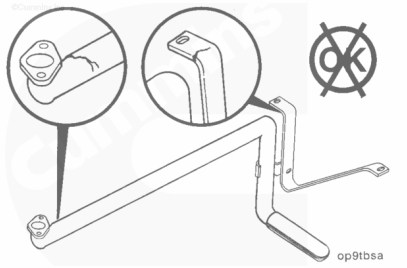


Clean and Inspect for Reuse

Clean the gasket surfaces.



Inspect the suction tube for cracks.



ANADOLU ISUZU
AFTER SALES

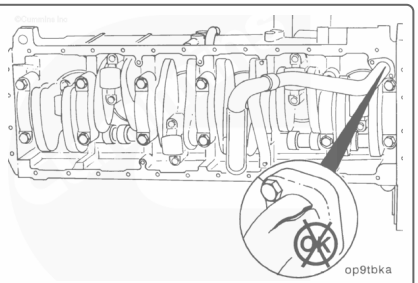
Install

Install the lubricating oil suction tube and new gasket.

- Install all capscrews finger-tight. Check for correct alignment.
- Tighten the lubricating oil suction tube to the block.

Torque Value: 10 n•m [89 in-lb]

- Tighten the lubricating oil suction tube brace to the engine block.



Torque Value: 10 n•m [89 in-lb]

- Tighten the lubricating oil suction tube to the brace.

Torque Value: 10 n•m [89 in-lb]

Finishing Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

- Install the lubricating oil pan and gasket. Refer to Procedure 007-025 in Section 7. (/qs3/pubsys2/xml/en/procedures/425/425-007-025.html)
- Fill the lubricating oil system. Refer to Procedure 007-037 in Section 7. (/qs3/pubsys2/xml/en/procedures/425/425-007-037.html)
- Connect the batteries. See equipment manufacturer service information.
- Operate the engine. Check for leaks.

ANADOLU ISUZU AFTER SALES

Last Modified: 03-Aug-2016

Select Service Tools

Recommended Cummins® Service Tools

- No Cummins® Service Tools required.

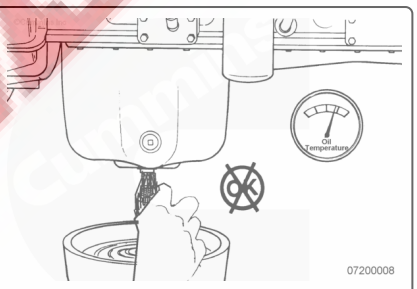
Additional Service Items

- Container suitable for lubricating oil

Drain

⚠ WARNING ⚠

To reduce the possibility of personal injury, avoid direct contact of hot oil with your skin.



⚠ WARNING ⚠

Some state and federal agencies have determined that used engine oil can be carcinogenic and cause reproductive toxicity. Avoid inhalation of vapors, ingestion, and prolonged contact with used engine oil. If not reused, dispose of in accordance with local environmental regulations.

Note : Use a container that can hold at least 28.4 liters [30 qt] of lubricating oil.

- Operate the engine until the coolant temperature reaches 60°C [140°F]. Shut the engine OFF.

Note : Make sure to remove the front and rear oil drain plugs, if equipped. Failure to do so will result in incomplete draining of oil from the lubricating oil pan.

- Remove the oil drain plug.
- Drain the oil immediately to make sure all the oil and suspended contaminants are removed from the engine.
- If performing an oil drain as part of a service maintenance interval, remove and replace the oil filter. Refer to Procedure 007-013 in Section 7.

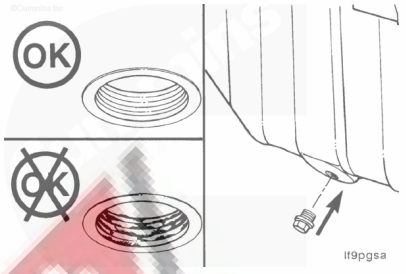
(/qs3/pubsys2/xml/en/procedures/425/425-007-013-tr.html)

Fill

Clean and check the lubricating oil drain plug threads and sealing surface.

Install the lubricating oil pan drain plug.

Torque Value: 50 n•m [35 ft-lb]



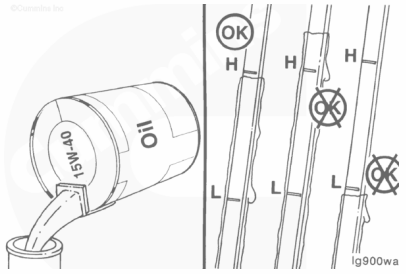
Note : Use a high quality, multi-viscosity oil, such as Cummins® Premium Blue™, or equivalent, in Cummins® engines. Use the following procedure in the L9 CM2350 L119B Operation and Maintenance Manual, Bulletin 5411268. Refer to Procedure 018-003 in Section V. (/qs3/pubsys2/xml/en/procedures/425/425-018-003.html)



Fill the engine with clean lubricating oil to the proper level.

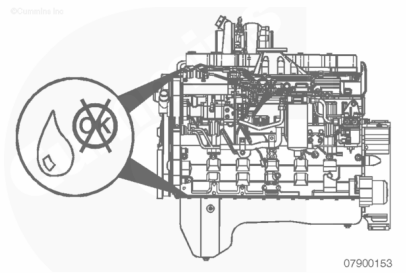
Note : When filling the oil pan, use the fill tube on the side of the engine rather than on top of the rocker lever cover.

Verify lubricating oil pan capacities. Refer to Procedure 018-017 in Section V. (/qs3/pubsys2/xml/en/procedures/425/425-018-017.html)



⚠ CAUTION ⚠

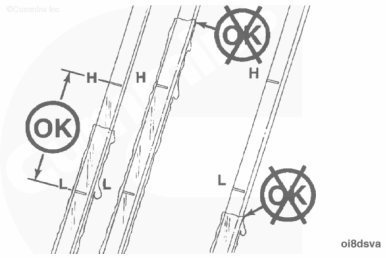
If no oil pressure is noted within 15 seconds after the engine is started, shut down the engine to reduce the possibility of internal engine damage.



Idle the engine to inspect for leaks at the drain plug.

Shut the engine OFF. Wait approximately 10 minutes to let the oil drain from the upper parts of the engine. Check the level again.

Add oil as necessary to bring the oil level to the "H" (high) mark on the dipstick.



Last Modified: 24-Sep-2018

ANADOLU ISUZU
AFTER SALES

Select Service Tools

Recommended Cummins® Service Tools

- No Cummins® Service Tools required.

Additional Service Items

- No additional service items required.

Preparatory Steps

⚠ WARNING ⚠

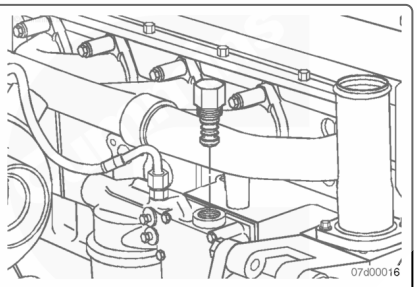
Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment befoe servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

- Disconnect the batteries. See equipment manufacturer service information.
- Remove the exhaust gas recirculation (EGR) cooler mounting bracket. Refer to Procedure 011-029 in Section 11. (/qs3/pubsys2/xml/en/procedures/425/425-011-029.html)
- Some applications can require removal of the EGR coolant return line to the water inlet connection. Refer to Procedure 011-031 in Section 11. (/qs3/pubsys2/xml/en/procedures/425/425-011-031.html)
- Clean the area around the lubricating oil thermostat to prevent debris from entering the system.

Remove

⚠ WARNING ⚠

To reduce the possibility of personal injury, avoid direct contact of hot oil with your skin.



⚠ WARNING ⚠

Some state and federal agencies have determined that used engine oil can be carcinogenic and cause reproductive toxicity. Avoid inhalation of vapors, ingestion, and prolonged contact with used engine oil. If not reused, dispose of in accordance with local environmental regulations.

⚠ CAUTION ⚠

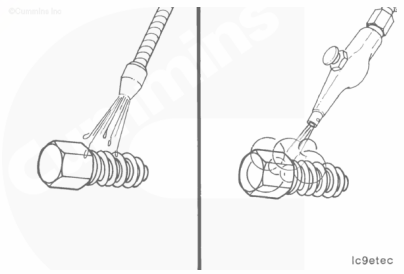
Use caution when draining lubricating oil that is not spilled or drained into the bilge area. The lubricating oil must be disposed in accordance with local environmental regulations.

Remove the lubricating oil thermostat.

Clean and Inspect for Reuse

⚠ WARNING ⚠

When using solvents, acids, or alkaline materials for cleaning, follow the manufacturer's recommendations for use. Wear goggles and protective clothing to reduce the possibility of personal injury.



⚠ WARNING ⚠

Some solvents are flammable and toxic. Read the manufacturer's instructions before using.

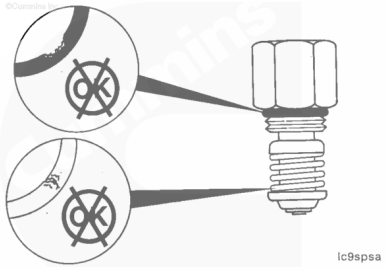
⚠ WARNING ⚠

Wear appropriate eye and face protection when using compressed air. Flying debris and dirt can cause personal injury.

Clean the thermostat. Use solvent. Dry with compressed air.

Inspect for a damaged o-ring, broken spring, or other damage.

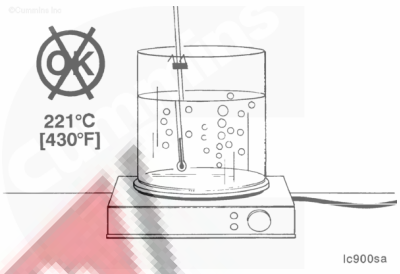
If any damage is found, the component must be replaced.



Ic9spsa

⚠ WARNING ⚠

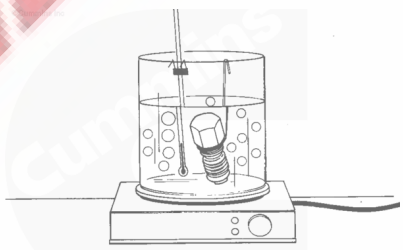
The flash point of new lubricating oil is approximately 221°C [430°F]. Do not allow oil temperature in the container to exceed 150°C [300°F]. Do not allow water droplets to enter the container of hot oil. Water droplets will cause a violent reaction, that can cause personal injury.



Ic900sa

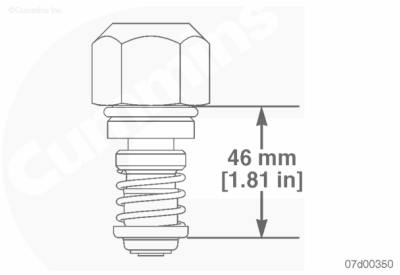
Suspend the thermostat and a 116°C [240°F] thermometer in a container of new lubricating oil. Do **not** allow the thermostat or the thermometer to touch the sides of the container.

Heat the lubricating oil.


Ic900sb

Note : Record the temperature when the thermostat is fully extended. The thermostat **must** be fully extended at least 46 mm [1.81 in] when the temperature reaches 116°C [240°F].

Replace the thermostat if it does **not** operate as described.

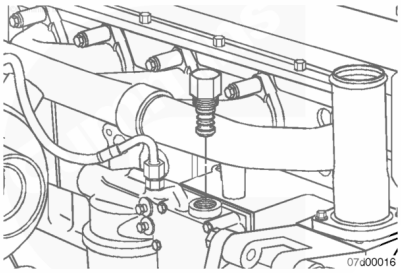


07d00350

Install

Install the lubricating oil thermostat.

Torque Value: 50 n•m [37 ft-lb]


07d00016

ANADOLU ISUZU
ONLINE SALES

Finishing Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment befoe servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.



- Install the EGR coolant return line. Refer to Procedure 011-031 in Section 11. (/qs3/pubsys2/xml/en/procedures/425/425-011-031.html)
- Install the EGR cooler mounting bracket. Refer to Procedure 011-029 in Section 11. (/qs3/pubsys2/xml/en/procedures/425/425-011-029.html)
- Connect the batteries. See equipment manufacturer service information.
- Operate the engine. Check for leaks.

ANADOLU ISUZU AFTER SALES

Last Modified: 03-Aug-2016

Select Service Tools

Recommended Cummins® Service Tools

- Flourescent tracer, Part Number 3376891
- Black light, Part Number 3163337, or equivalent

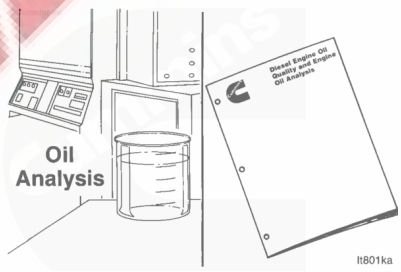
Additional Service Items

- No additional service items required.

General Information

A used oil analysis can help diagnose internal damage and determine if it was caused by one of the following:

- Oil diluted with coolant
- Oil diluted with fuel.

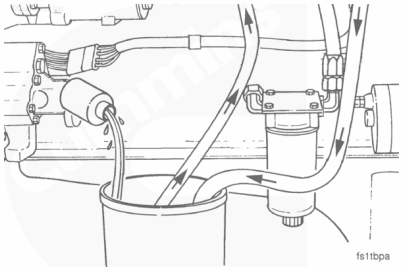


Fluorescent Dye Tracer

Note : This test is **not** effective on a cold engine, less than 21°C [70°F] coolant temperature, or with a loose overhead setting.

Install an isolated fuel supply tank at the fuel inlet supply line and at the fuel drain line.

Add fluorescent tracer, Part Number 3376891, or equivalent, to the isolated fuel supply tank. See the instructions on the fluorescent tracer bottle for the proper tracer-to-fuel ratio.

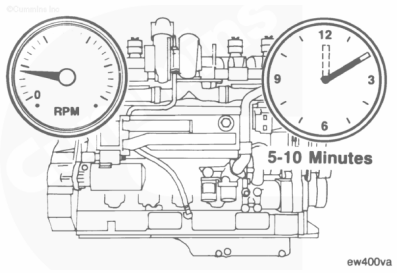


- Connect INSITE™ electronic service tool.
- Start the engine.
- Operate the engine at idle for 3 minutes.
- After 3 minutes, use INSITE™ electronic service tool High-Pressure Leakage Test to create high fuel rail

pressure.

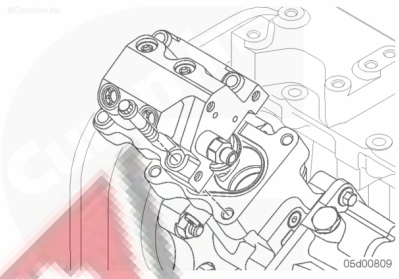
- Operate the engine at high fuel pressure for 3 minutes.
- Shut the engine down.

Note : Do **not** allow the engine to operate from a remote fuel source for more than 10 minutes.



⚠ WARNING ⚠

Normal engine operation creates highly pressurized fuel in the fuel line which will remain in the fuel line after engine shutdown. Never open the fuel system when the engine is operating. Before servicing the fuel system, always loosen the pump to rail fuel line at the rail to vent the pressure. Keep hands clear of the line when loosening. High pressure fuel spray can penetrate the skin, resulting in serious personal injury or death.



Remove the fuel pump head. Refer to Procedure 005-227 in Section 5. (/qs3/pubsys2/xml/en/procedures/425/425-005-227.html)

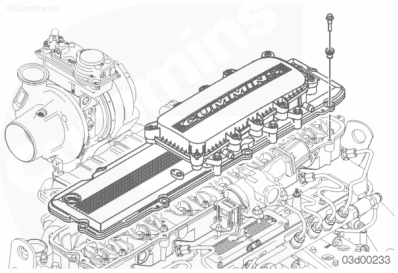
Use black light, Part Number 3163337, or equivalent, to inspect the camshaft housing for signs of fuel. Fuel will appear to be yellow if present.

Note : Do **not** remove the springs. A small amount of fuel on the pumping plungers is normal.

If there are signs of a significant amount of fuel in the camshaft housing or on the tappet springs, replace the fuel pump head.

Install the fuel pump head. Refer to Procedure 005-227 in Section 5. (/qs3/pubsys2/xml/en/procedures/425/425-005-227.html)

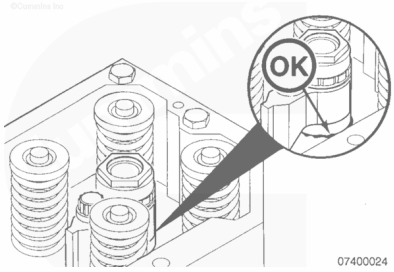
Remove the rocker lever cover. Refer to Procedure 003-011 in Section 3. (/qs3/pubsys2/xml/en/procedures/425/425-003-011.html)



Use black light, Part Number 3163337, or equivalent, to find fuel leaks from inside or around the injectors.

ANADOLU ISUZU SPARES

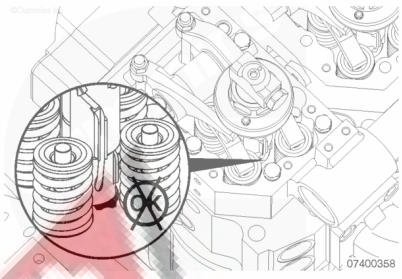
Fuel will appear to be yellow.



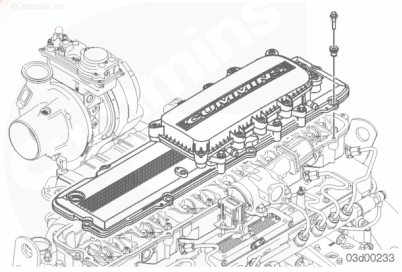
If there is excess leakage around the outside of the injector:

- Check the injector hold-down clamp capscrew torque.
- Remove the injectors. Inspect the injector o-rings and injector body for damage.
- Replace the injector o-rings and injector sealing washers if the injector is installed.
- Replace the injector if injector body damage is present.

Refer to Procedure 006-026 in Section 6. (/qs3/pubsys2/xml/en/procedures/425/425-006-026.html)



Install the rocker lever cover. Refer to Procedure 003-011 in Section 3. (/qs3/pubsys2/xml/en/procedures/425/425-003-011.html)



ANADOLU ISUZU AFTER SALES

Last Modified: 03-Aug-2016

Select Service Tools

Recommended Cummins® Service Tools

- Blck Light Kit, Part Number 3163338, or equivalent
- Flourescent tracer, Part Number 3376891, or equivale

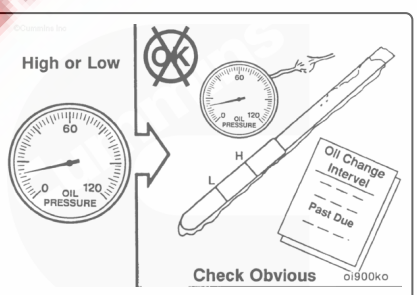
Additional Service Items

- No additional service items required.

General Information

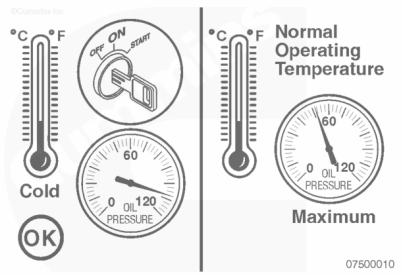
Lubricating Oil Pressure

When the lubricating system malfunctions, check all obvious items related to oil pressure, such as gauges, high and low oil level, excessive oil contamination, and oil viscosity.



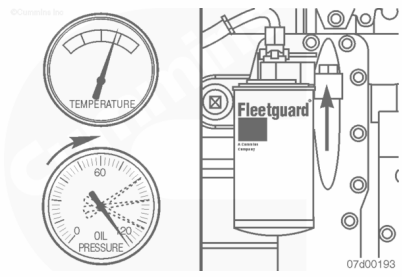
High lubricating oil pressure occurs after the engine is first started in cold weather. Cold-start oil pressure typically will be approximately 689 to 827 kPa [100 to 120 psi].

If the pressure regulator plunger is operating properly, the oil rifle pressure is approximately 379 kPa [55 psi] when normal operating temperature is reached.

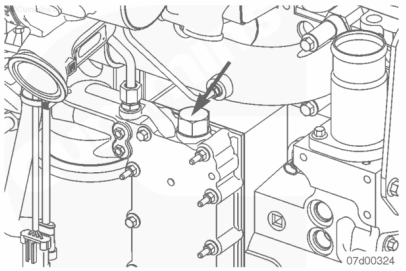


The engine will have high oil pressure at normal operating temperature if the lubricating oil pressure regulator valve sticks in the closed position.

Check the regulator for freedom of movement. Refer to Procedure 007-029 in Section 7. (/qs3/pubsys2/xml/en/procedures/425/425-007-029.html)

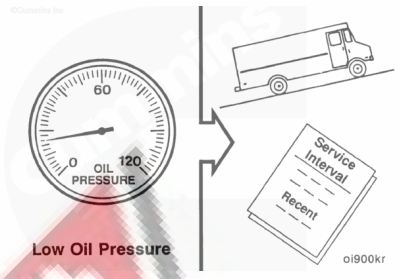


The lubricating oil cooler contains a lubricating oil thermostat which allows the lubricating oil to bypass the oil cooler to regulate the lubricating oil temperature to 116°C [240°F]. Verify oil thermostat operation. Refer to Procedure 007-039 in Section 7. (/qs3/pubsys2/xml/en/procedures/425/425-007-039.html)

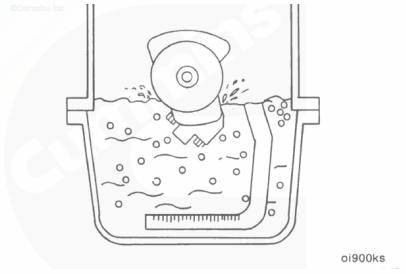


Low lubricating oil pressure (or no oil pressure) can be caused by several lubricating system-related malfunctions. To begin the investigation, determine the engine operating conditions when the low pressure was first observed. The following are possible conditions for low lubricating oil pressure:

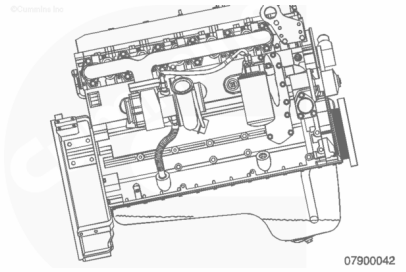
- Following a service interval
- At idle **only**
- Operating on a steep grade
- Operating in rough seas.



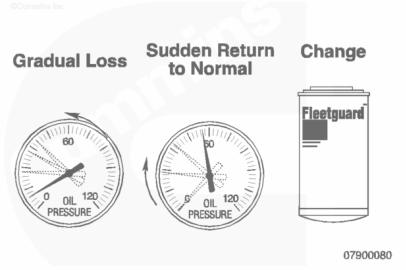
High lubricating oil level can cause low oil pressure. If the oil level is high enough for the connecting rods to dip into the oil while operating, the oil can become aerated, resulting in low oil pressure.



Low oil level will **not** normally appear as low oil pressure. Typically, it will appear as an intermittent loss of oil pressure when rounding a corner or operating on a steep grade. This condition exists when the oil level is extremely low and the suction tube can **not** pick up oil during all modes of operation.

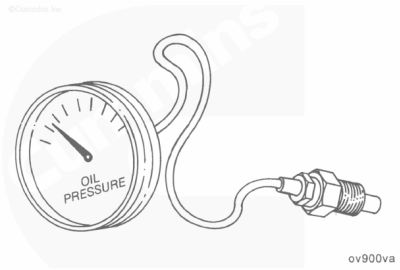


A plugged lubricating oil filter will cause a gradual reduction in oil pressure by approximately 69 kPa [10 psi]. The pressure will return to normal when the filter bypass valve opens. If **not** corrected, this will result in severe engine wear, as the engine is running on unfiltered oil when the bypass valve is open.

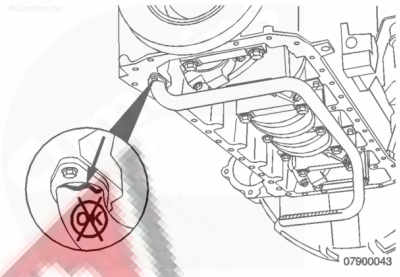


FREEDOM ISUZU TRUCK SALES

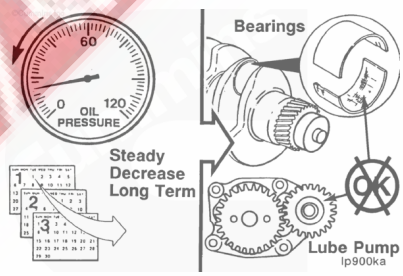
Verify the pressure with a manual gauge to make sure the lubricating oil gauge and sending unit are operating correctly.



A loose lubricating oil suction tube, damaged gasket, or crack in the suction tube can cause a loss of prime for the oil pump. The engine will have low pressure or no oil pressure during starting, possibly followed by normal oil pressure.



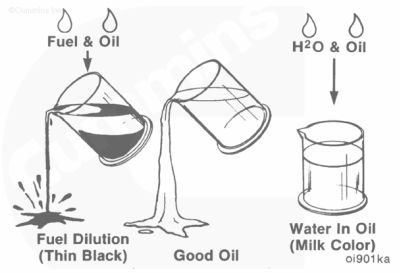
A steady decrease in oil pressure over a long period can be an indication of worn bearings or excessive lubricating oil pump wear.



Lubricating Oil Dilution

⚠ CAUTION ⚠

Using diluted oil can cause severe engine damage.

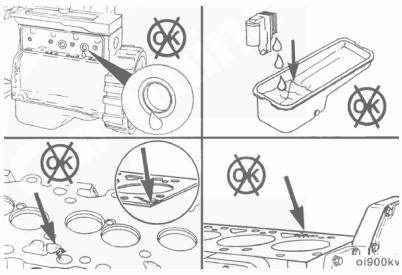


Check the condition of the lubricating oil:

- Thin, black oil is an indication of fuel in the oil
- Milky discoloration is an indication of coolant in the oil.

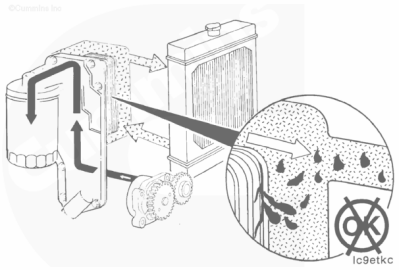
Coolant in the oil can be caused by:

- Expansion plugs leaking
- Oil cooler element leaking
- Damaged cylinder head or gasket
- Cracked engine block
- Casting porosity
- Damaged turbocharger
- Damaged exhaust gas recirculation (EGR) cooler
- Damaged air compressor.



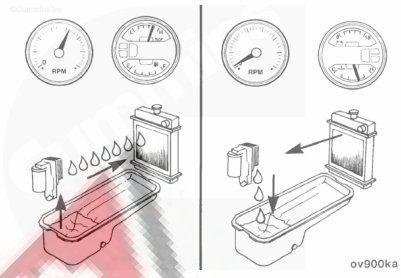
ANADOLU ISUZU
OFFICIAL SALES

There are two places within the oil cooler assembly where oil and coolant could mix, the oil cooler gasket or lubricating oil cooler element. Refer to Procedure 007-003 in Section 7. (/qs3/pubsys2/xml/en/procedures/425/425-007-003.html)



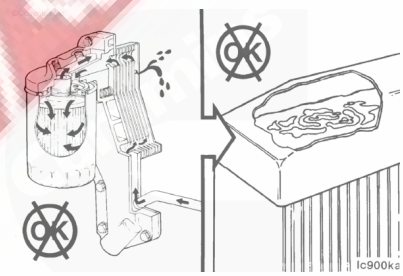
While operating, the oil pressure will be higher than coolant pressure. A leak in the oil cooler will show as oil in the coolant.

However, following an engine shutdown, the residual pressure in the coolant system can cause coolant to seep through the leak path into the oil.



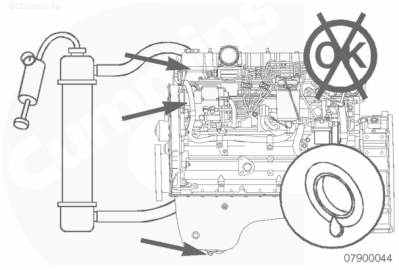
If the oil cooler element ruptures, the oil pressure will force oil into the coolant system.

Oil in the coolant will be visible when the radiator cap is removed. Refer to Procedure 007-003 in Section 7. (/qs3/pubsys2/xml/en/procedures/425/425-007-003.html)



To check for leaks, pressurize the cooling system to 140 kPa [20 psi]. With the system pressurized, remove the following components and inspect for leaks:

- Rocker lever cover. Refer to Procedure 003-011 in Section 3. (/qs3/pubsys2/xml/en/procedures/425/425-003-011.html) Leaks indicate a cracked cylinder head.
- Lubricating oil drain plug. Refer to Procedure 007-037 in Section 7. (/qs3/pubsys2/xml/en/procedures/425/425-007-037.html) Leaks indicate a malfunctioning oil cooler or cylinder head gasket, or a cracked cylinder head or block.



Coolant in the lubricating oil can be caused by a damaged cylinder head gasket or a cracked cylinder head or block.

Remove the cylinder head and gasket. Refer to Procedure 002-004 in Section 2. (/qs3/pubsys2/xml/en/procedures/425/425-002-004.html)

Inspect for cracks or any other damage.

Fuel-Diluted Lubricating Oil:

Use the following logic to determine the source of the oil dilution with fuel.

Fuel dilution is limited to three sources:

- Injection pump head
- Fuel leaking past the rings
- Injector leakage.

A cracked or damaged fuel pump head can cause fuel to leak in to the camshaft housing and then in to the lubricating oil pan.

A damaged or missing o-ring seal on the injector(s) can cause fuel dilution of the lubricating oil system. The o-ring seal on the injector seals the injector return fuel in the internal cylinder head drilling.

Incomplete combustion in the cylinders can result in unburned fuel draining into the oil pan.

This condition can be caused by a leaking injector or reduced compression caused by inadequate piston ring sealing.

Lubricating Oil Consumption and Leaks

Various gaskets, seals, and plugs are used to contain the lubricating oil. Most leaks can be identified during routine inspections of the engine and vehicle.

A blown expansion plug can allow a relatively large quantity of lubricating oil to escape, resulting in a sudden drop in the lubricating oil pressure.

When checking for such a leak, make sure to check all expansion plugs visually obscured by chassis parts.

Lubricating oil blowing out of the breather is an indicator of a blown expansion plug.

A Black Light Kit, Part Number 3163338, or equivalent, and fluorescent tracer, Part Number 3376891, or equivalent, **must** be used to verify the source of the oil leak.

ANADOLU ISUZU PARTS SALES

Worn or damaged seals in the turbocharger can also allow oil to leak into the charge air cooler system and be burned in the engine.

The condition can be verified by removing the air crossover tube or charge air cooler tubing and looking for oil. Refer to Procedure 010-019 in Section 10. (/qs3/pubsys2/xml/en/procedures/425/425-010-019.html) Refer to Procedure 010-027 in Section 10. (/qs3/pubsys2/xml/en/procedures/425/425-010-027.html)

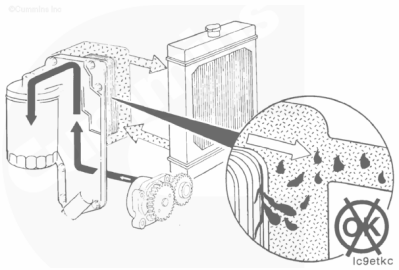
Note : If the engine experiences a turbocharger malfunction or any other occasion where oil or debris is put into the charge air cooler, the charge air cooler must be cleaned and the EGR differential pressure sensor ports must be cleaned. Refer to Procedure 010-027 in Section 10. (/qs3/pubsys2/xml/en/procedures/425/425-010-027.html) Refer to Procedure 010-080 in Section 10. (/qs3/pubsys2/xml/en/procedures/425/425-010-080.html)

Inadequate sealing of the piston rings will result in excessive oil out of the crankcase breather system and/or oil being consumed by the engine.

Lubricating oil can also be lost through a worn or malfunctioning air compressor. Look for carbon buildup in the air line from the compressor to the air tank.

Also, a malfunctioning air compressor head gasket or cylinder head gasket can allow oil to leak into the coolant or coolant to leak into the oil during a hot shutdown.

If the lubricating oil cooler element ruptures, the lubricating oil pressure can force lubricating oil into the cooling system. Lubricating oil in the coolant should be visible when the radiator cap is removed. Refer to Procedure 007-003 in Section 7. (/qs3/pubsys2/xml/en/procedures/425/425-007-003.html)



The lubricating oil cooler contains two ports for measuring oil pressure or recording oil pressure drop across the lubricating oil filter. The top port is after the lubricating oil filter, filtered oil pressure port (A). The bottom port is before the lubricating oil filter, unfiltered oil pressure port (B).

Lubricating Oil Filters

The filter is a spin-on element and contains an internal venturi that provides filter bypass oil flow through a stacked disk section of the filter. Lubricating oil filters **must** be of the venturi style. The use of a lubricating oil filter without a venturi will result in premature engine wear.

Last Modified: 03-Aug-2016

ANADOLU ISUZU AFTER SALES

Select Service Tools

Recommended Cummins® Service Tools

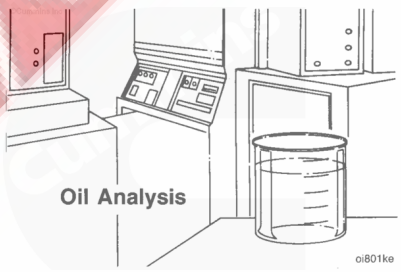
- Tube cutter, Part Number 3376579

Additional Service Items

- No additional service items required.

Inspect

An analysis of used oil can help diagnose internal engine damage and determine if it was caused by one of the following:



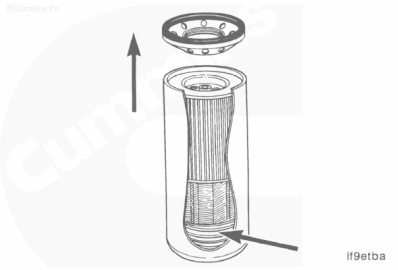
- Intake air filter malfunction
- Coolant leaks
- Oil diluted with fuel
- Metal particles causing wear.

For additional oil analysis information, refer to Service Bulletin, Cummins® Engine Oil and Oil Analysis Recommendations, Bulletin 3810340. (/qs3/pubsys2/xml/en/bulletin/3810340.html)

Note : Do **not** disassemble an engine for repair based solely on the results of an oil analysis. Inspect the oil filters. If an oil filter shows evidence of internal engine damage, find the source of the problem and repair the damage. See the appropriate procedure(s) based on the following oil filter inspection.

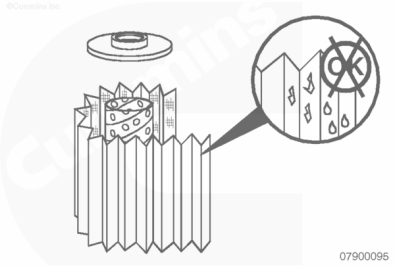
⚠ WARNING ⚠

Restrain the full flow lubricating oil filter and use care when cutting open the upper section of the combination filter. The filter element spring is under compression and can cause personal injury.



Use tube cutter, Part Number 3376579, to open the upper section of the bypass full-flow oil filter.

Inspect the filter element and oil for evidence of moisture or metal particles.



Metal	Possible Source
Copper	Bearings and bushings, lubricating oil cooler[1]
Chromium	Piston rings
Iron	Cylinder liners
Lead	Bearing overlay material
Aluminum	Piston wear or scuffing
[1]Copper leach from the lubricating oil cooler element diminishes significantly after the first oil change maintenance interval.	

Clean and Inspect for Reuse

⚠ WARNING ⚠

Wear appropriate eye and face protection when using compressed air. Flying debris and dirt can cause personal injury.

For all other internal engine malfunctions which introduce debris into the lubricating oil system, complete the following:

- Replace lubricating oil filter (spin-on). Refer to Procedure 007-013 in Section 7. (/qs3/pubsys2/xml/en/procedures/425/425-007-013-tr.html)
- Replace lubricating oil cooler element. Refer to Procedure 007-003 in Section 7. (/qs3/pubsys2/xml/en/procedures/425/425-007-003.html)
- Replace lubricating oil filter bypass valve. Refer to Procedure 007-014 in Section 7. (/qs3/pubsys2/xml/en/procedures/425/425-007-014.html)
- Replace lubricating oil thermostat. Refer to Procedure 007-039 in Section 7. (/qs3/pubsys2/xml/en/procedures/425/425-007-039.html)
- Special care **must** be taken to be sure these parts are kept extremely clean if removed.
- Do **not** use cleaning agents, other than contact cleaner.
- Clean lubricating oil cooler housing. Refer to Procedure 007-003 in Section 7. (/qs3/pubsys2/xml/en/procedures/425/425-007-003.html)
- Clean the lubricating oil pan. Refer to Procedure 007-025 in Section 7. (/qs3/pubsys2/xml/en/procedures/425/425-007-025.html)
- Clean and inspect crankshaft journals for reuse. Refer to Procedure 001-016 in Section 1. (/qs3/pubsys2/xml/en/procedures/425/425-001-016.html)
- Remove and inspect the Lubricating oil pump for reuse. Refer to Procedure 007-031 in Section 7. (/qs3/pubsys2/xml/en/procedures/425/425-007-031.html)

- If damage is found on number 1 and number 4 rod bearings, roll new connecting rod bearings in on all 6 journals. Refer to Procedure 001-006 in Section 1. (/qs3/pubsys2/xml/en/procedures/425/425-001-006.html) Refer to Procedure 001-014 in Section 1 (/qs3/pubsys2/xml/en/procedures/425/425-001-014.html). Otherwise, replace **only** number 1 and number 4 rod bearings.
- Roll new main bearings in on all 7 main journals and new thrust bearings on number 4 main journal.

Finishing Steps

- Install lubricating oil pan and other components removed to access main bearings. Refer to Procedure 007-025 in Section 7. (/qs3/pubsys2/xml/en/procedures/425/425-007-025.html)
- Install lubricating oil filter. Refer to Procedure 007-013 in Section 7. (/qs3/pubsys2/xml/en/procedures/425/425-007-013-tr.html)
- Prime and fill the engine with new lubricating oil. Refer to Procedure 007-037 in Section 7. (/qs3/pubsys2/xml/en/procedures/425/425-007-037.html)
- Operate the engine to normal operating temperature and check for leaks and proper operation.

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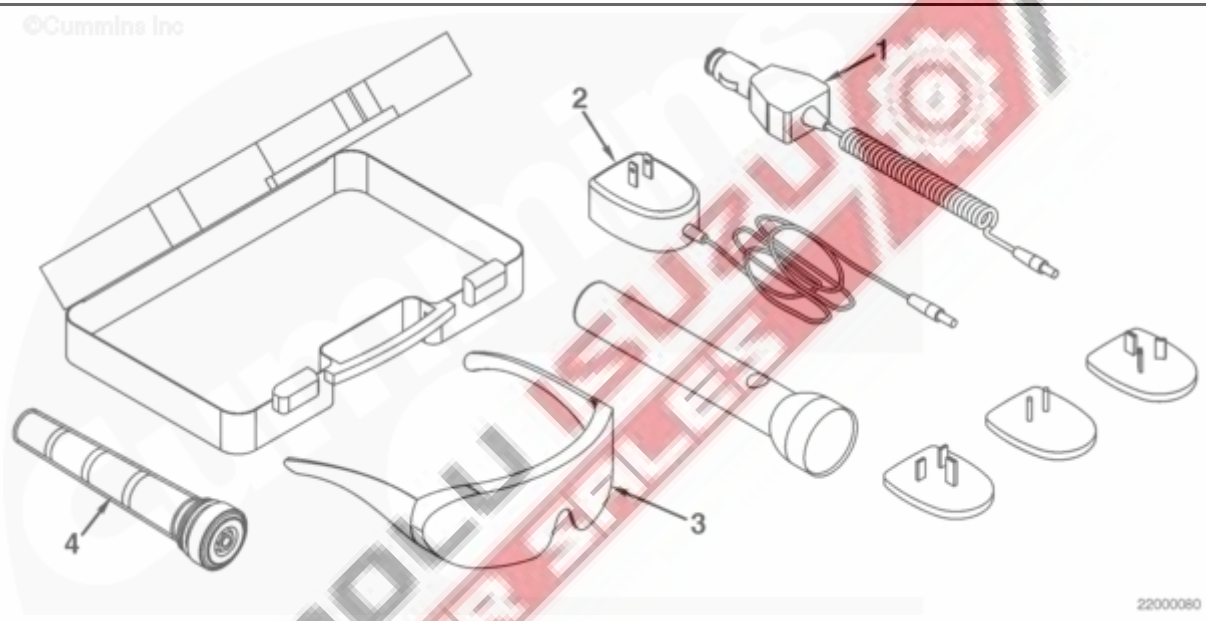
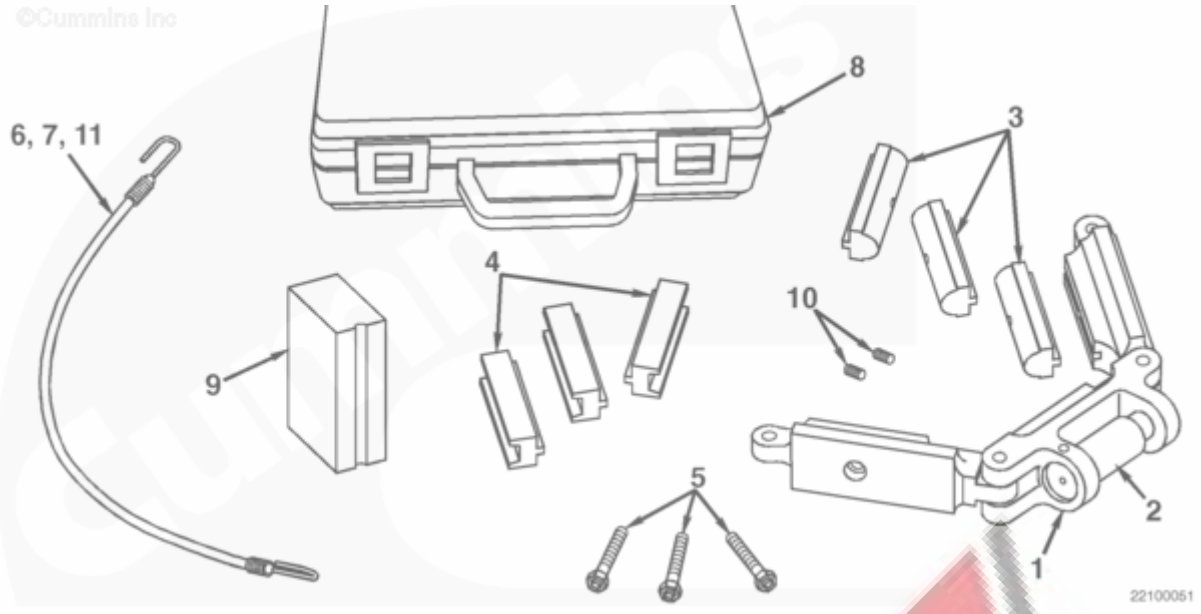
Last Modified: 26-Feb-2021

Cooling System

Tool Number 2892320
Leak Test Kit This kit is used to detect leaks in all engine fluid systems (lubrication, coolant, and fuel) using a cordless "True UV" light that will detect the presence of fluorescent dye additive. The kit is also capable of detecting leaks in air conditioning systems, using the appropriate dye.

Tool Number 3163524
Pulley Alignment Tool This fixture allows technicians to use a laser light positioned on one pulley to target a second pulley.



Tool Number

3377438

Fluorescent Tracer

This special dye, when mixed in the cooling system or lubricating system, will help determine the source of leaks. Use with Leak Test Kit, Part Number 2892320, black lights must be used to illuminate the fluorescent dye.



SP000785

Tool Number

3375066

Thread Sealant

This product locks and seals threaded fluid fitting. This product resists leakage, vibration loosening, moisture, hydraulic fluids and diesel fuels and other liquids. It also lubricates the threads for easy assembly and disassembly.



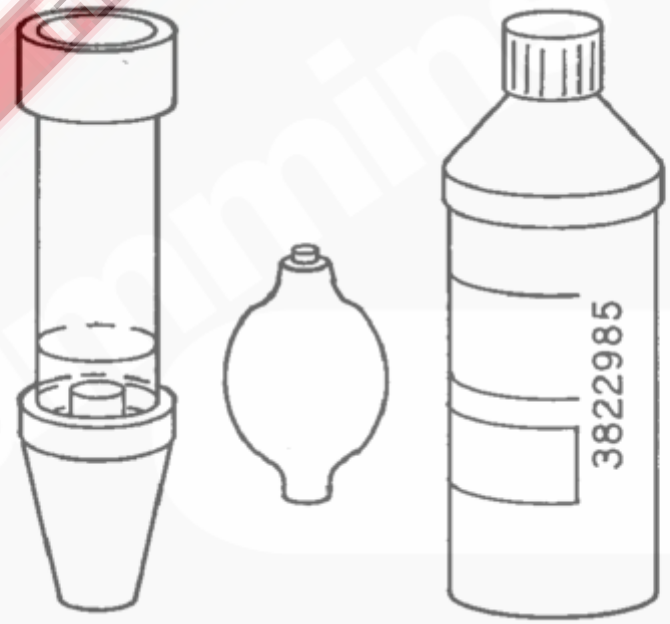
SP000797

Tool Number

3822985

Combustion Gas Leak Test Kit

Used to detect leaks. Includes Part Number 3822986, test fluid, Part Number 3822987, adapter, and Part Number 3877612, instructions.



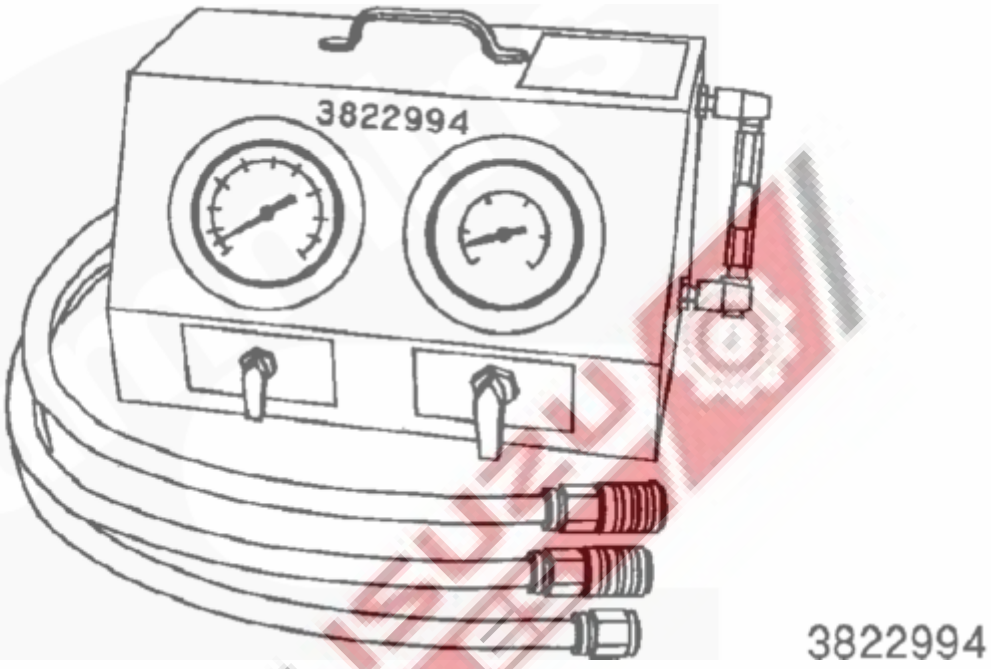
3822985

Tool Number

3822994

Engine Coolant Analyzer

The engine coolant analyzer is used to troubleshoot pressure loss, restriction, and improper temperature control.

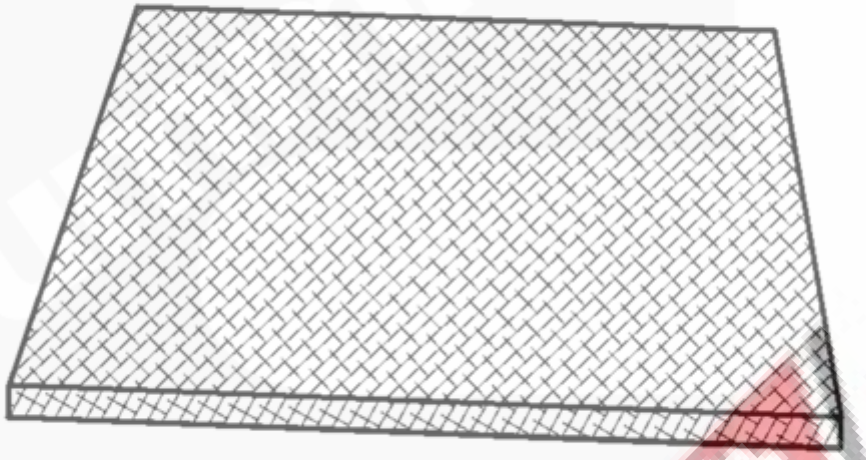


Tool Number

3823258

Abrasive Pad

These pads are used to clean carbon from the upper liner bores, removing rust and corrosion from the engine block and parts, scuffing surfaces prior to painting, and removing burrs from aluminum and other soft metals. These hand cleaning pads are superior to emery cloth or sandpaper, which can inadvertently embed in the metal parts being cleaned. Size: 6” x 9 ½”.



SP000699

Tool Number

3824319

Coolant Dam/Pressure Tester

Using shop air pressure, the coolant dam creates a vacuum, holding the coolant in with little or no coolant loss.



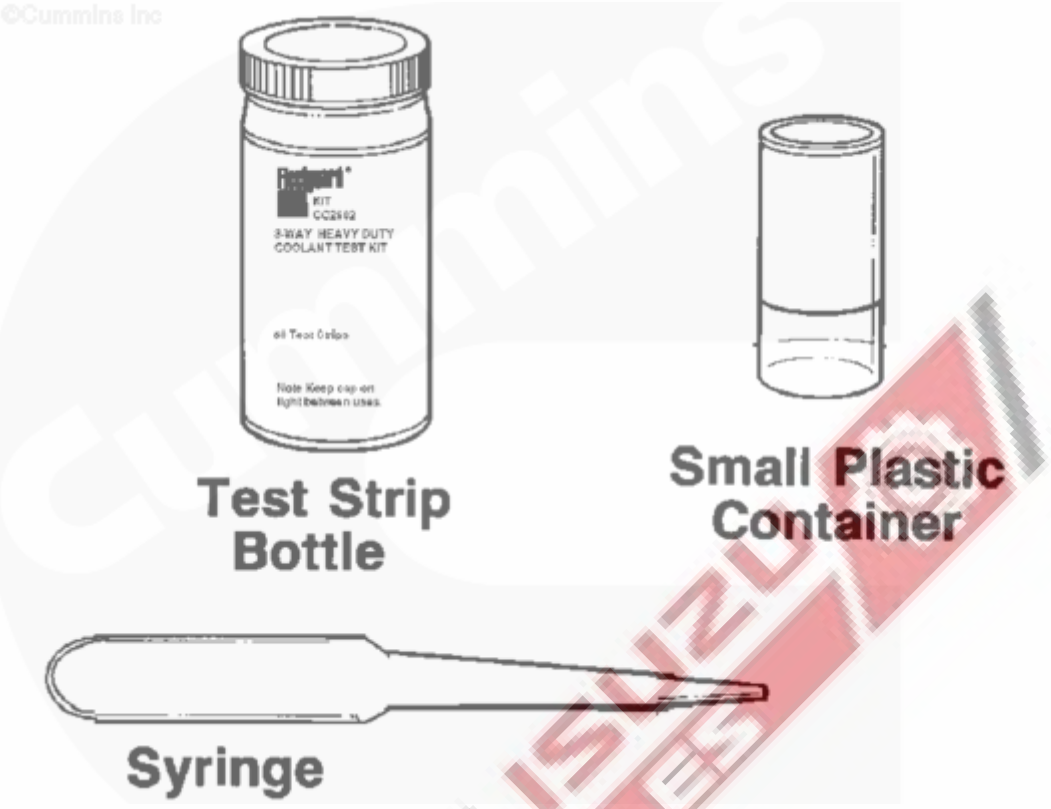
22d00167

Tool Number

CC 2626

Cooling System Test Kit

The Fleetguard® Coolant Test Kit is used to check the concentration of coolant additives in the cooling system.



Tool Number

CC 2800

Refractometer

The Fleetguard® refractometer is used to measure the freezing point protection and antifreeze concentration.

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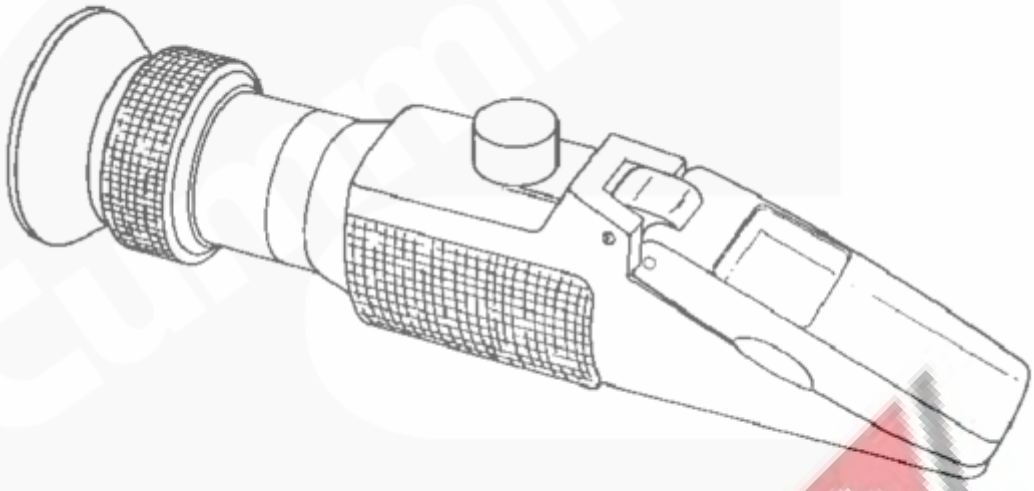

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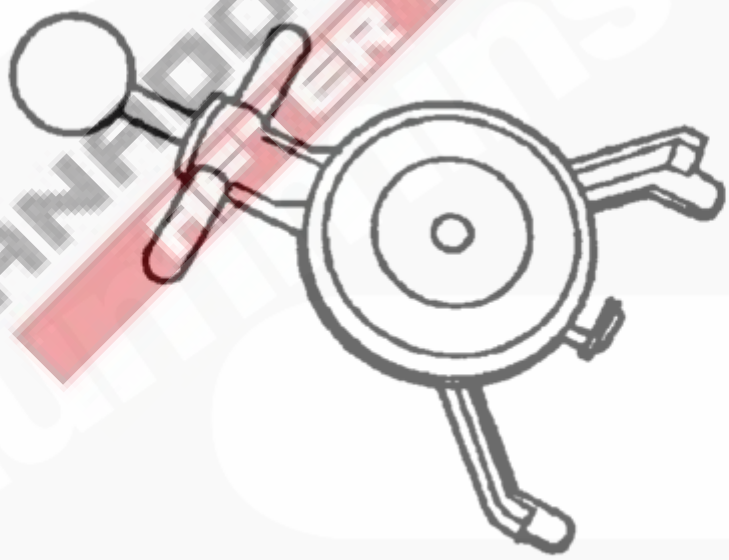
Tool Number

ST 1293

Belt Tension Gauge

Used to measure the tension in the drive belt.

©Cummins Inc



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ANADOLU ISUZU
AFTER SALES

Select Service Tools

Recommended Cummins® Service Tools

- Belt alignment laser tool, Part Number 3163524, or equivalent

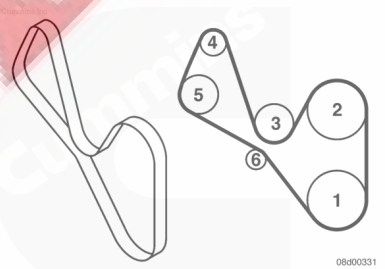
Additional Service Items

- Electronic stethoscope, or equivalent

General Information

Due to the number of drive belt arrangements, this procedure does **not** cover all available cooling fan drive belt routing.

To make sure the cooling fan drive belt is routed correctly upon installation, make a diagram of the cooling fan belt routing prior to removing the belt, as shown in the illustration.



The cooling fan belt routing typically consists of the following components, but may **not** include all of them:

1. Crankshaft pulley/vibration damper
2. Fan pulley
3. Water pump pulley
4. Refrigerant compressor pulley
5. Alternator pulley
6. Belt tensioner pulley.

Note : Some engine-driven belts are installed/supplied by the vehicle original equipment manufacturer (OEM). See equipment manufacturer service information for removal and installation instructions.

Troubleshooting

Note : This content in this section is generic and may **not** apply to all available cooling fan drive belt systems.

The following section contains diagnostic information and procedures to aid in identifying drive belt and accessory drive issues. These issues may include:

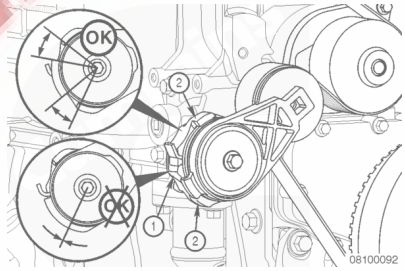
- Belt noise (squeal and chirp)
- Belt tracking (jumping)
- Belt fraying
- Snub breaks and punctures.

Common causes of drive belt noise, fraying, and breaks are:

- Drive pulley misalignment
- Embedded debris in drive pulley grooves
- Incorrect belt material and/or belt length
- Damaged or incorrect automatic belt tensioner
- Improper drive belt routing
- Improper fan size and/or fan clutch.

The original drive belt and tensioner should be used, if possible, while troubleshooting drive belt issues. Replacement of a belt and/or tensioner prior to troubleshooting can mask the root cause of the issue due to the break-in time required for a belt and tensioner.

Note : A newly installed belt and/or tensioner will **not** come to rest properly until the engine is operated. Always operate the engine for a brief period of time prior to verifying the tensioner resting location.

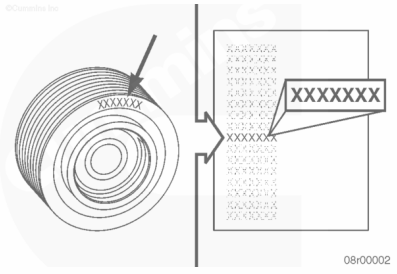


Inspect the automatic belt tensioner. Refer to Procedure 008-080 in Section 8. (/qs3/pubsys2/xml/en/procedures/425/425-008-080-tr.html) If the belt tensioner does **not** meet the reuse criteria, the belt tensioner **must** be replaced.

With the belt installed, check the automatic belt tensioner resting position. If the belt tensioner arm stop is contacting either of the spring case stops:

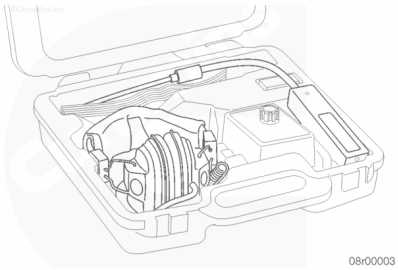
- Verify the correct belt part number is installed.
- If the correct belt is installed, replace the belt.

Verify all accessory drive components and pulleys are correct. Components yielding incorrect part numbers, or installed without the appropriate spacers and/or brackets may contribute to gross drive belt misalignment.

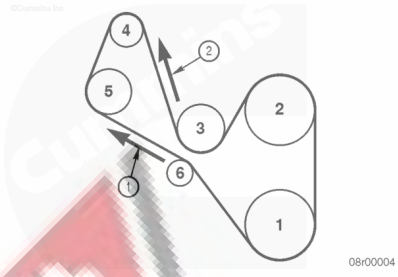


Verify proper drive belt routing, if available. See equipment manufacturer service information.

Isolating the source of drive belt noise can be done by use of an electronic stethoscope, or an equivalent device designed to block audible noise other than that desired, by use of a microphone.



Drive belt noise can be difficult to isolate and troubleshoot. The origin of drive belt noise may **not** be located at the pulley out of alignment, rather ‘upstream’ from the noise origin.

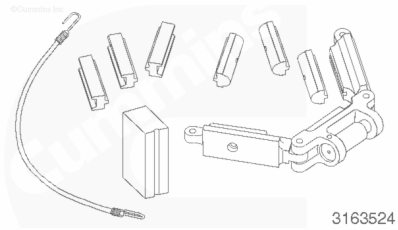


Troubleshooting should always be completed in a direction opposite belt travel (i.e. **counterclockwise**) beginning at the pulley where the noise originates.

Arrow number (1) indicates belt travel direction, whereas arrow number (2) represents the direction in which troubleshooting should be conducted.

- Flat pulleys should be inspected for uneven wear patterns.
- Grooved pulleys should be inspected for embedded debris, belt dust buildup, and pulley alignment.

Note : The belt alignment laser tool can identify misalignment of pulleys down to ½ of a belt rib. The capability of the alignment fixture is contingent upon proper calibration. Make sure all set-up and calibration procedures are followed before verifying pulley alignment.



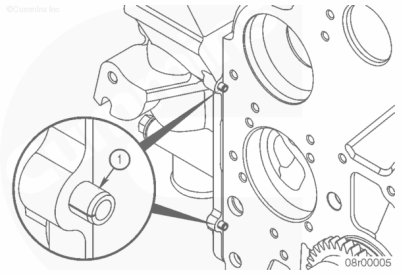
Verify all pulleys are aligned correctly using one of the following pulley alignment fixture tools or equivalent:

- Part Number 3163524
- Part Number 93874 (Dayco)

Pulley alignment should always be checked from the fan pulley, and crankshaft pulley to other front end mounted grooved pulleys. Contact a Cummins® Authorized Repair Location for drive belt alignment.

If a pulley is identified as out of alignment, verify the component mounting bracket installation.

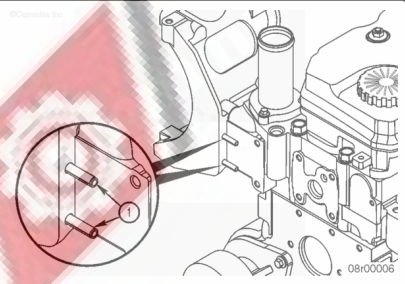
Certain engines feature an automatic belt tensioner mounted to the water inlet connection. Verify the locating roll pins (1) are:



- Installed into the connection
- In contact with the front face of the cylinder block
- Do **not** appear to be bent or out of place.

If the water inlet connection and/or roll pins are **not** installed correctly, remount the water inlet connection. Refer to Procedure 008-082 in Section 8. (/qs3/pubsys2/xml/en/procedures/425/425-008-082.html)

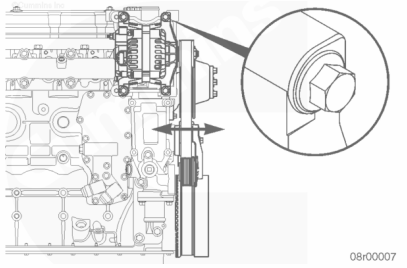
Certain alternator mounting brackets are aligned to the cylinder head by roll pins. Verify the locating roll pins (1) are:



- Installed into the alternator bracket
- In contact with the front face of the cylinder block
- Do **not** appear to be bent or out of place.

If the alternator bracket and/or roll pins are **not** installed correctly, remount the alternator bracket. Refer to Procedure 013-003 in Section 13. (/qs3/pubsys2/xml/en/procedures/425/425-013-003.html)

Check drive pulley alignment with belt alignment laser tool, Part Number 3163524, or equivalent, after any bracket adjustments are made.



Certain ‘pad mounted’ components which do **not** contain locating features can be positioned on the mounting brackets for fine adjustments.

Preparatory Steps

⚠ WARNING ⚠

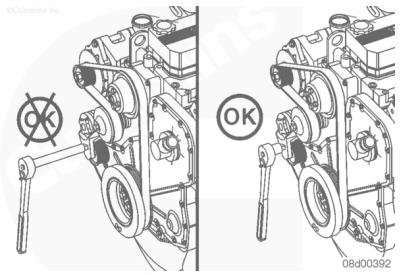
Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

- Disconnect the batteries. See equipment manufacturer service information.

Remove

⚠ CAUTION ⚠

The belt tensioner is spring-loaded and must be pivoted away from the drive belt. Pivoting in the wrong direction can result in damage to the belt tensioner.



⚠ CAUTION ⚠

Applying excessive force in the opposite direction of windup or after the tensioner has been wound up to the positive stop can cause the tensioner arm to crack or break

⚠ CAUTION ⚠

Using a socket extension is not recommended because it can cause axial twisting damage to the belt tensioner.

Lift the tensioner to remove the drive belt.

Note : If a socket extension is necessary, support the head of the ratchet with one hand to prevent the belt tensioner arm from unintended loading.

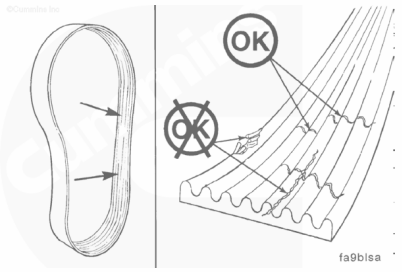
Inspect for Reuse

Inspect the drive belt for damage.

Transverse (across the belt) cracks are acceptable.

Longitudinal (direction of belt ribs) cracks that intersect with transverse cracks are **not** acceptable.

If the belt is frayed, punctured, or material is missing, the belt is unacceptable for reuse and **must** be replaced.



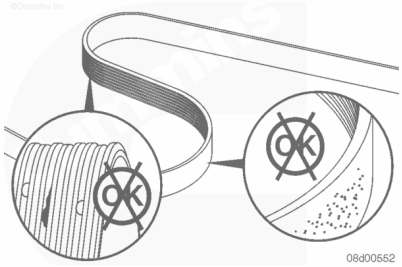
Inspect the belt grooves for:

- Embedded debris
- Uneven/excessive rib wear
- Exposed belt cords.

Inspect the backside of the belt for:

- Glazing (high heat)
- Uneven/excessive rib wear
- Exposed belt cords.

If any of the above conditions are present, the belt is unacceptable for reuse and **must** be replaced.



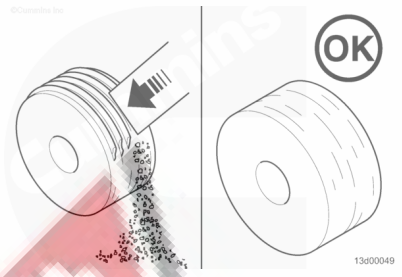
Inspect the idler and drive pulleys for wear or cracks.

Plastic pulleys often have a buildup of road dirt and belt material **not** to be confused with wear.

The dirt can be removed with a suitable tool to check for wear.

Clean, check, and reuse all pulleys in the front end accessory drive if **not** damaged, rather than replacing. Pulleys damaged from embedded debris **must** be replaced.

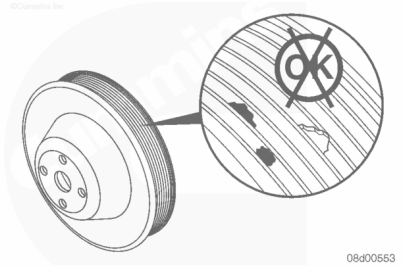
Inspect the tensioner. Refer to Procedure 008-080 in Section 8. (/qs3/pubsys2/xml/en/procedures/425/425-008-080-tr.html)



Inspect all system pulleys for embedded debris:

- Rocks, stones
- Metal
- Belt material.

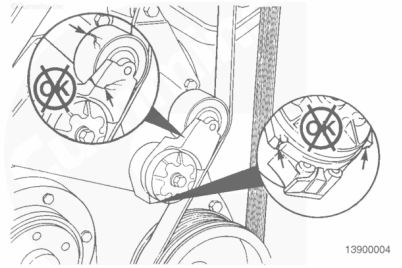
Remove any debris from the grooves of the pulley. If the pulley has been deformed as a result of foreign material embedment, the pulley **must** be replaced.



Inspect the drive belt pulleys and idlers for cracked or broken grooves.

See the following procedures if a pulley or idler is damaged:

- Inspect the fan pulley. Refer to Procedure 008-039 in Section 8. (/qs3/pubsys2/xml/en/procedures/425/425-008-039.html)
- Inspect the crankshaft pulley. Refer to Procedure 001-022 in Section 1. (/qs3/pubsys2/xml/en/procedures/425/425-001-022.html)
- Inspect the belt tensioner pulley. Refer to Procedure 008-080 in Section 8. (/qs3/pubsys2/xml/en/procedures/425/425-008-080-tr.html)



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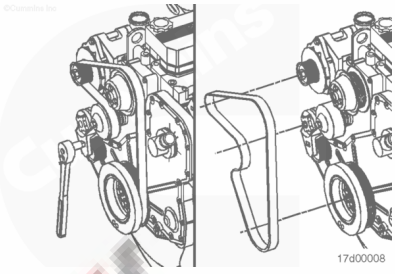
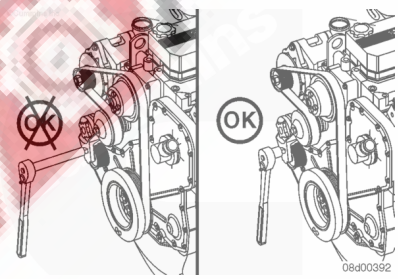
Install

Route the drive belt on the engine. Use the belt diagram created in the Remove section. Do **not** install the belt over the water pump pulley at this time.



⚠ CAUTION ⚠

The belt tensioner is spring-loaded and must be pivoted away from the drive belt. Pivoting in the wrong direction can result in damage to the belt tensioner.



⚠ CAUTION ⚠

Applying excessive force in the opposite direction of windup or after the tensioner has been wound up to the positive stop can cause the tensioner arm to crack or break.

⚠ CAUTION ⚠

A socket extension is not recommended because it can cause axial twisting damage to the belt tensioner.

Pivot the tensioner in the direction of the spring tang. Install the drive belt, slipping the belt over the water pump pulley last.

Slowly, release the belt tensioner to apply tension to the drive belt.

Note : If a socket extension is necessary, support the head of the ratchet with one hand to prevent the belt tensioner arm from unintended loading.

Check the alignment of the belt with the tensioner and the rest of the front-end accessory drive.

Finishing Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

- Connect the batteries. See equipment manufacturer service information.
- Operate the engine. Check for belt squeal. Excessive belt squeal indicates excessive belt slip.
- If belt squeal is present, check the routing of the belt to make sure the belt is installed correctly on each pulley.

ANADOLU ISUZU AFTER SALES

Last Modified: 24-Nov-2020

Select Service Tools

Recommended Cummins® Service Tools

- No Cummins® Service Tools required.

Additional Service Items

- No additional service items required.

Preparatory Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

⚠ WARNING ⚠

Do not remove the pressure cap from a hot engine. Wait until the coolant temperature is below 50°C [120°F] before removing the pressure cap. Heated coolant spray or steam can cause personal injury.

⚠ WARNING ⚠

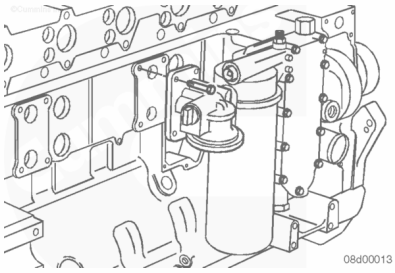
Coolant is toxic. Keep away from children and pets. If not reused, dispose of in accordance with local environmental regulations.

- Disconnect the batteries. See equipment manufacturer service information.
- Drain the engine coolant. Refer to Procedure 008-018 in Section 8. (/qs3/pubsys2/xml/en/procedures/425/425-008-018-tr.html)
- Remove the coolant filter. Refer to Procedure 008-006 in Section 8. (/qs3/pubsys2/xml/en/procedures/425/425-008-006-tr.html)

Remove

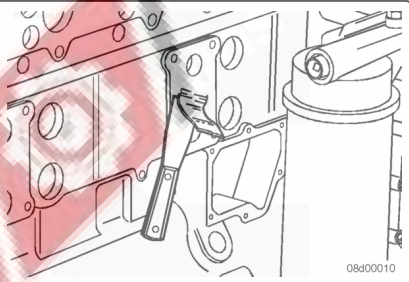
Loosen the four filter head capscrews.

Remove the filter head and gasket.



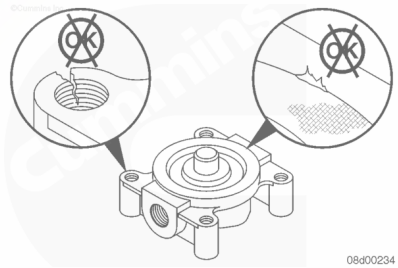
Clean and Inspect for Reuse

Clean the mating surfaces.



Inspect the filter head for cracks, burrs, or other damage.

Replace the filter head if it is damaged.

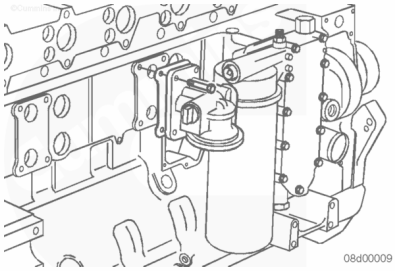


Install

Install a new gasket and the filter head.

Tighten the four capscrews.

Torque Value: 24 n•m [212 in-lb]



ANADOLU ISUZU
AFTER SALES

Finishing Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

- Install the coolant filter. Refer to Procedure 008-006 in Section 8. (/qs3/pubsys2/xml/en/procedures/425/425-008-006-tr.html)
- Fill the cooling system with either a 50/50 mixture of good-quality water and fully formulated antifreeze or fully formulated coolant. The fully formulated antifreeze or coolant **must** meet ASTM D6210 (EG) and ASTM D6211 (PG) specifications. Refer to Procedure 008-018 in Section 8. (/qs3/pubsys2/xml/en/procedures/425/425-008-018-tr.html)
- Connect the batteries. See equipment manufacturer service information.
- Operate the engine. Check for leaks.

ANADOLU ISUZU AFTER SALES

Last Modified: 04-Aug-2016

Select Service Tools

Recommended Cummins® Service Tools

- No Cummins® Service Tools required.

Additional Service Items

- No additional service items required.

Preparatory Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

⚠ WARNING ⚠

Do not remove the pressure cap from a hot engine. Wait until the coolant temperature is below 50°C [120°F] before removing the pressure cap. Heated coolant spray or steam can cause personal injury.

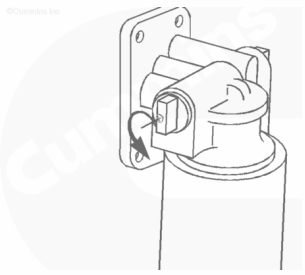
⚠ WARNING ⚠

Coolant is toxic. Keep away from children and pets. If not reused, dispose of in accordance with local environmental regulations.

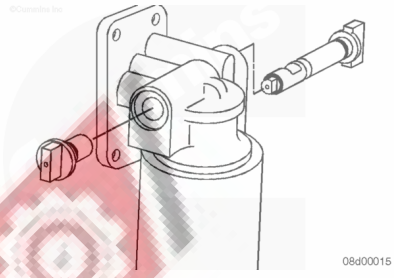
- Disconnect the batteries. See equipment manufacturer service information.
- Drain the engine coolant. Refer to Procedure 008-018 in Section 8. (/qs3/pubsys2/xml/en/procedures/425/425-008-018-tr.html)
- Remove the coolant filter. Refer to Procedure 008-006 in Section 8. (/qs3/pubsys2/xml/en/procedures/425/425-008-006-tr.html)
- Remove the coolant filter head. Refer to Procedure 008-007 in Section 8. (/qs3/pubsys2/xml/en/procedures/425/425-008-007.html)

Remove

Loosen the shutoff valve screw from the end of the valve.



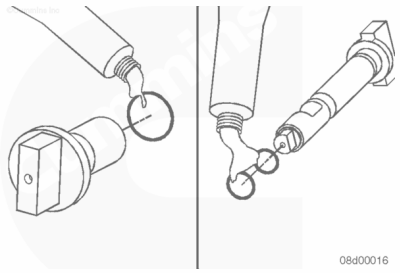
Remove the two pieces of the shutoff valve from both sides of the valve bore.



Install

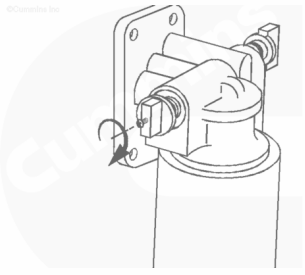
Replace the shutoff valve o-rings.

Lubricate the o-rings before installing the valve pieces back into the bore.



Tighten the shutoff valve screw to tighten the two pieces of the valve together.

Torque Value: 1.5 n•m [12 in-lb]



Finishing Steps

⚠ WARNING ⚠

ANADOLU ISUZU AFTER SALES

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

- Install the coolant filter head on the engine. Refer to Procedure 008-007 in Section 8. (/qs3/pubsys2/xml/en/procedures/425/425-008-007.html)
- Install the coolant filter. Refer to Procedure 008-006 in Section 8. (/qs3/pubsys2/xml/en/procedures/425/425-008-006-tr.html)
- Fill the engine coolant. Refer to Procedure 008-018 in Section 8. (/qs3/pubsys2/xml/en/procedures/425/425-008-018-tr.html)
- Connect the batteries. See equipment manufacturer service information.
- Operate the engine. Check for leaks.

Last Modified: 04-Aug-2016

ANADOLU ISUZU AFTER SALES

Select Service Tools

Recommended Cummins® Service Tools

- No Cummins® Service Tools required.

Additional Service Items

- No additional service items required.

Preparatory Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

⚠ WARNING ⚠

Do not remove the pressure cap from a hot engine. Wait until the coolant temperature is below 50°C [120°F] before removing the pressure cap. Heated coolant spray or steam can cause personal injury.

⚠ WARNING ⚠

Coolant is toxic. Keep away from children and pets. If not reused, dispose of in accordance with local environmental regulations.

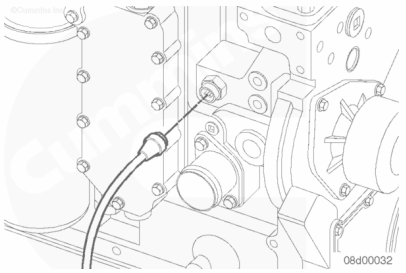
⚠ CAUTION ⚠

Use caution when draining coolant that coolant is not spilled or drained into the bilge area. Do not pump the coolant overboard. If the coolant is not reused, it must be discarded in accordance with local environmental regulations.

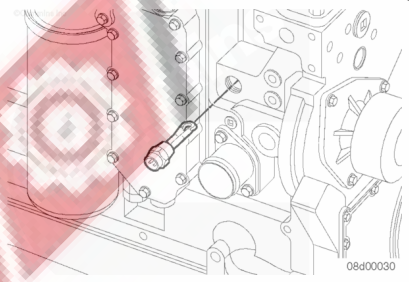
- Disconnect the batteries. See equipment manufacturer service information.
- Drain the engine coolant. Refer to Procedure 008-018 in Section 8. (/qs3/pubsys2/xml/en/procedures/425/425-008-018-tr.html)

Remove

Disconnect the coolant heater electrical cord.

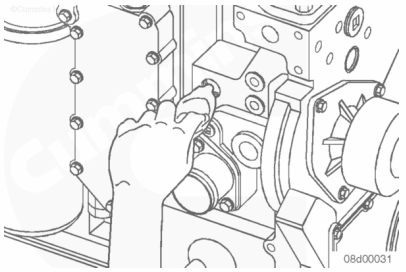


Loosen the coolant heater. Remove it from the cylinder block.



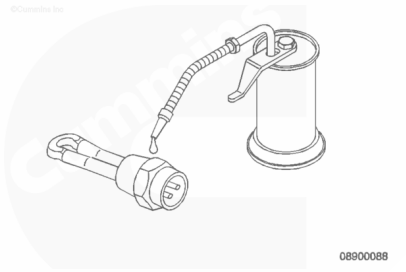
Clean

Clean the coolant heater and block threads thoroughly.



Install

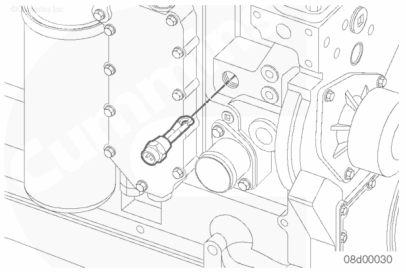
Lubricate the new coolant heater threads. Use clean engine oil.



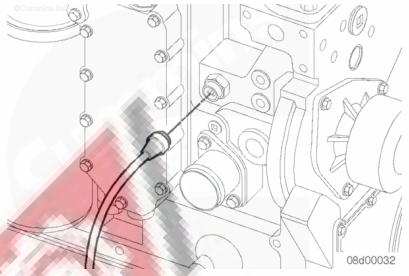
ANADOLU ISUZU AFTERSALES

Install the coolant heater.

Torque Value: 75 n•m [55 ft-lb]



Attach the coolant heater electrical cord.



Finishing Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

- Fill the cooling system. Refer to Procedure 008-018 in Section 8. (/qs3/pubsys2/xml/en/procedures/425/425-008-018-tr.html)
- Connect the batteries. See equipment manufacturer service information.
- Operate the engine. Check for leaks.

ANADOL ISUZU

Last Modified: 04-Aug-2016

Select Service Tools

Recommended Cummins® Service Tools

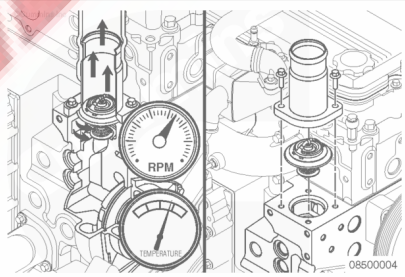
- Abrasive pad, Part Number 3823258, or equivalent

Additional Service Items

- Container suitable for coolant
- Thermometer

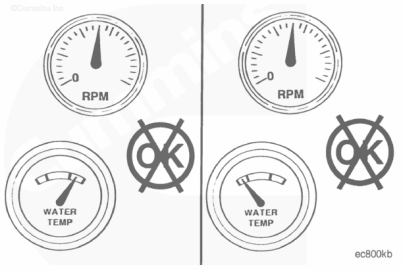
General Information

The thermostat controls the coolant temperature. When the coolant temperature is below operating temperature, coolant is bypassed to the inlet of the water pump. When the coolant temperature reaches the operating range, the thermostat opens, seals off the bypass, and forces coolant to flow to the radiator. The thermostat begins opening at 79°C [175°F] and 83°C or [182°F].



⚠ CAUTION ⚠

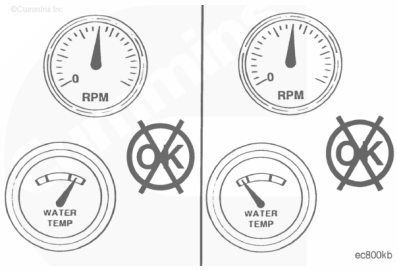
Never operate the engine without a thermostat. Without a thermostat, the path of least resistance for the coolant is through the bypass to the pump inlet. This will cause the engine to overheat.



An incorrect or malfunctioning thermostat can cause the engine to run too hot or too cold.

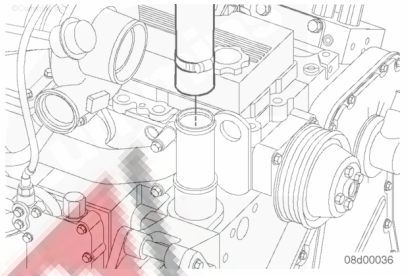
Leak Test

The engine thermostat and thermostat seal **must** operate properly in order for the engine to operate in the most efficient heat range. Overheating or overcooling will shorten engine life.



⚠ WARNING ⚠

Do not remove the pressure cap from a hot engine. Wait until the coolant temperature is below 50°C [120°F] before removing the pressure cap. Heated coolant spray or steam can cause personal injury.



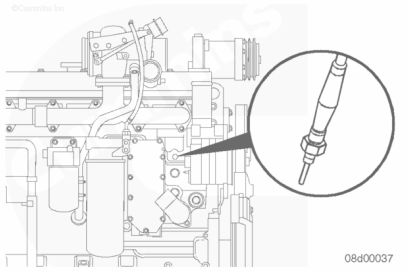
⚠ WARNING ⚠

Coolant is toxic. Keep away from children and pets. If not reused, dispose of in accordance with local environmental regulations.

Drain the coolant. Refer to Procedure 008-018 in Section 8. (/qs3/pubsys2/xml/en/procedures/425/425-008-018-tr.html)

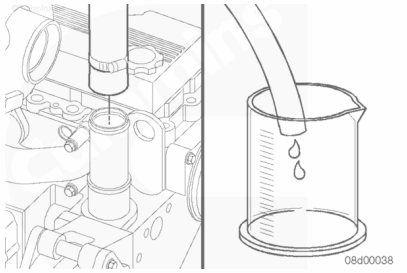
Remove the radiator hose from the water outlet connection.

Use an electronic service tool to monitor the coolant temperature, or install a thermocouple or temperature gauge, which is known to be accurate, in the cylinder block on the engine side of the thermostat.

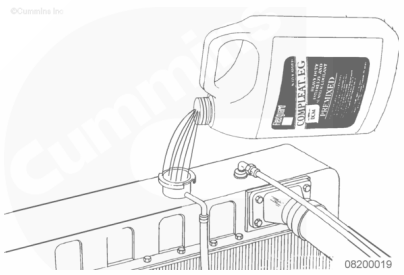


Install and tighten a hose clamp on the housing outlet.

Place the other end of the hose in a dry container.



Fill the cooling system. Refer to Procedure 008-018 in Section 8. (/qs3/pubsys2/xml/en/procedures/425/425-008-018-tr.html)

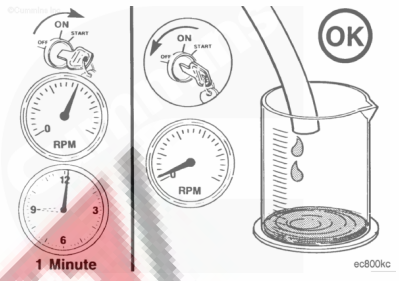


Note : The engine coolant temperature **must** be below the thermostat opening temperature to perform this test.

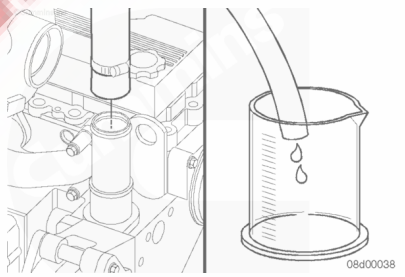
Operate the engine at rated speed for 1 minute.

Shut the engine OFF. Measure the amount of coolant collected in the container.

The amount of coolant collected **must not** be more than 100 cc [3.3 fl oz].

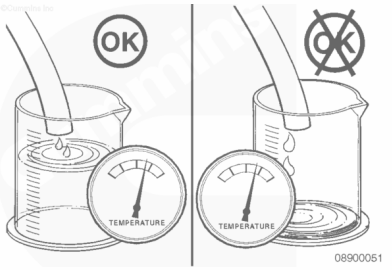


If more than 100 cc [3.3 fl oz] of coolant is collected, the thermostat is leaking and **must** be replaced.



Complete the following test in-chassis to determine thermostat opening temperature.

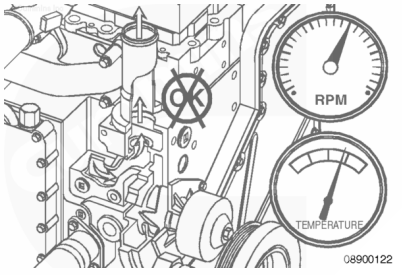
Start the engine. Monitor the coolant temperature with INSITE™ electronic service tool or a gauge. Keep the engine speed below 1500 rpm during the test.



Thermostat Initial Opening Temperature		
celsius		fahrenheit
79	MIN	175
83	MAX	182

Shut the engine OFF when the coolant starts to flow.

If coolant does **not** start flowing into the container during the initial opening temperature range, the thermostat **must** be replaced.



AYAROLU ISUZU DEALER SALES

Preparatory Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

⚠ WARNING ⚠

Do not remove the pressure cap from a hot engine. Wait until the coolant temperature is below 50°C [120°F] before removing the pressure cap. Heated coolant spray or steam can cause personal injury.

⚠ WARNING ⚠

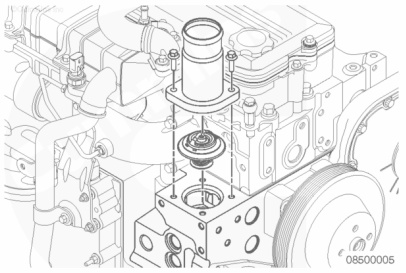
Coolant is toxic. Keep away from children and pets. If not reused, dispose of in accordance with local environmental regulations.

- Disconnect the batteries. See equipment manufacturer service information.
- Drain the coolant. Refer to Procedure 008-018 in Section 8. (/qs3/pubsys2/xml/en/procedures/425/425-008-018-tr.html)
- Remove the radiator hose from the water outlet connection.

Remove

Remove the water outlet connection capscrews and water outlet connection.

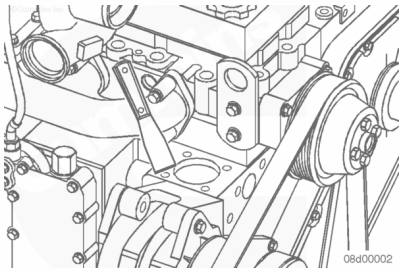
Remove the thermostat.



Clean and Inspect for Reuse

Note : Do **not** let any debris fall into the thermostat cavity when cleaning the surfaces.

Clean all of the mating surfaces with abrasive pad, Part Number 3823258, or equivalent, and clean cloth.



Inspect the thermostat for damage.

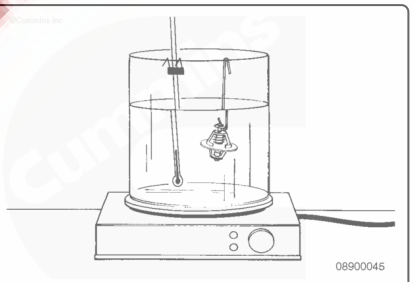
Inspect the thermostat gasket for damage. If the gasket is damaged, it **must** be replaced.



Note : Do **not** allow the thermostat or thermometer to touch the container.

Heat the water and check the thermostat as follows:

Suspend the thermostat and a 100°C [212°F] thermometer in a container of water.



The nominal operating temperature is stamped on the thermostat. The thermostat **must** meet the following criteria:

- The thermostat **must** begin to open within 1°C or 2°F of this nominal temperature.
- The thermostat **must** be fully open within 12°C or 22°F of this nominal temperature.

The fully open distance between the thermostat flange and housing is 10.16 mm [0.400 in].

Install

Note : A new gasket **must** be installed each time the thermostat or water outlet connection is removed.

Install the new thermostat into the cylinder block.

Install a new gasket over the thermostat and onto the block.

Install the water outlet connection and mounting capscrews.

Torque Value: 24 n•m [212 in-lb]

Finishing Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

- Fill the cooling system. Refer to Procedure 008-018 in Section 8. (/qs3/pubsys2/xml/en/procedures/425/425-008-018-tr.html)
- Connect the batteries. See equipment manufacturer service information.
- Operate the engine. Check for leaks.

Last Modified: 04-Aug-2016

ANADOLU ISUZU AFTER SALES

Select Service Tools

Recommended Cummins® Service Tools

- No Cummins® Service Tools required.

Additional Service Items

- No additional service items required.

General Information

Use the following procedure for details on the type of exhaust gas recirculation (EGR) coolers (horizontal plate or vertical plate) in the General Information section. Refer to Procedure 011-019 in Section 11. (/qs3/pubsys2/xml/en/procedures/425/425-011-019.html)

The engine covered in this manual has two possible coolant vent line connections.

In case of horizontal plate EGR coolers, the first is located on top of the EGR cooler and vents the cylinder head and EGR cooler.

The second is located on top of the turbocharger and vents the turbocharger.

In case of vertical plate EGR coolers, there are two vents on the top of the EGR cooler. The vent on the front end of the EGR cooler vents the cylinder head and EGR cooler.

In case of the vertical plate cooler, the vent on the rear end of the EGR cooler is used to vent the turbocharger.

Preparatory Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

⚠ WARNING ⚠

Coolant is toxic. Keep away from children and pets. If not reused, dispose of in accordance with local environmental regulations.

⚠ WARNING ⚠

Do not remove the pressure cap from a hot engine. Wait until the coolant temperature is below 50°C [120°F] before removing the pressure cap. Heated coolant spray or steam can cause personal injury.

Note : Prior to removal, note the routing of the original equipment manufacturer (OEM) coolant vent line. The vent line **must** be routed "uphill" so that coolant is vented properly from the engine.

- Disconnect the batteries. See equipment manufacturer service information.
- Drain the engine coolant. Refer to Procedure 008-018 in Section 8. (/qs3/pubsys2/xml/en/procedures/425/425-008-018-tr.html)
- Disconnect the coolant vent connection from the cylinder head.
- Disconnect the vehicle coolant vent lines from the coolant vent line connections on the EGR cooler and turbocharger actuator, if equipped. See equipment manufacturer service information.

Remove

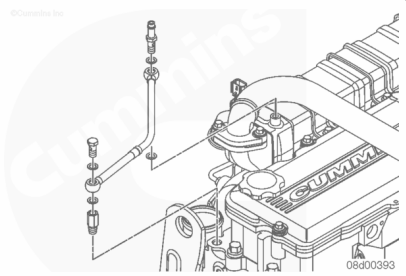
Horizontal Plate

Remove the coolant vent connection from the EGR cooler.

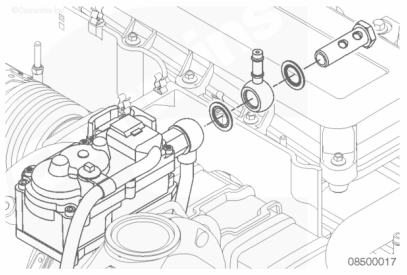
Remove the banjo bolt connecting the coolant vent line to the cylinder head fitting.

Remove the coolant vent line.

Remove the coolant vent line cylinder head fitting.



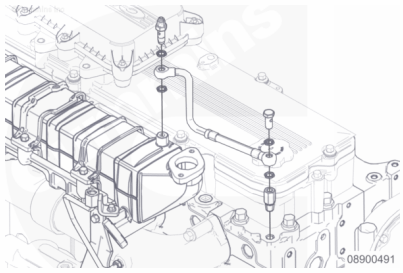
Remove the coolant vent fitting, if equipped, from the turbocharger actuator.



Vertical Plate

ANADOLU ISUZU AFTER SALES

Note : The illustrations shown for the vertical plate EGR cooler are generic. Based on the turbocharger mounting option the vent setup could possibly vary.



Remove the coolant vent connection from the EGR cooler.

Remove the banjo bolt connecting the coolant vent line to the cylinder head fitting.

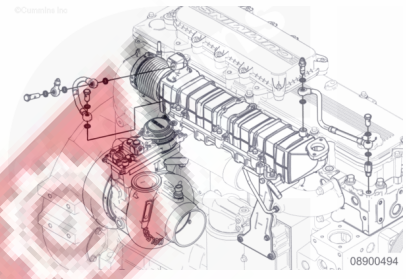
Remove the coolant vent line.

Remove the coolant vent line cylinder head fitting.

Remove the coolant vent connection from the EGR cooler.

Remove the coolant vent fitting from the turbocharger actuator.

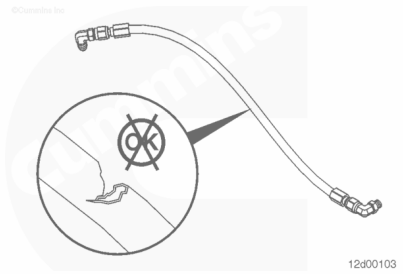
Remove the coolant vent line.



Clean and Inspect for Reuse

Inspect the coolant vent line and fittings for cracks and other damage.

Replace if any damage is found.



Install

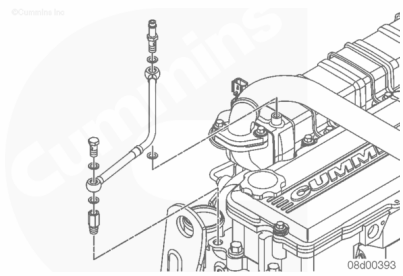
Horizontal Plate

Install the coolant vent line cylinder head fitting.

Torque Value: 18 n•m [160 in-lb]

Install the coolant vent line to the EGR cooler and cylinder head fitting using new sealing washers on both connections.

Tighten the coolant vent connection fitting on the EGR cooler.



ANADOLU ISUZU AFTER SALES

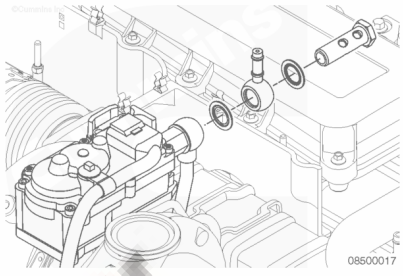
Torque Value: 12 n•m [106 in-lb]

Tighten the M10 banjo bolt at the cylinder head coolant vent line fitting.

Torque Value: 12 n•m [106 in-lb]

Install the coolant vent connection, if equipped, on the turbocharger actuator using a new sealing washer.

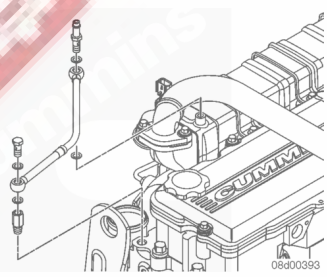
Torque Value:
M18 Banjo Bolt 12 n•m [106 ft-lb]



Vertical Plate

Install the coolant vent line cylinder head fitting.

Torque Value: 25 n•m [221 in-lb]



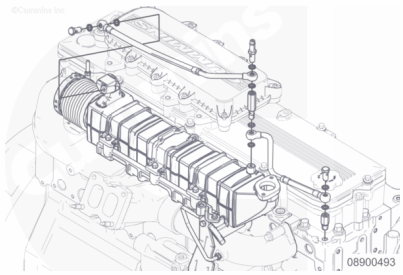
For LMRO turbocharger option:

Install the vent tube connecting the front vent of the EGR cooler and cylinder head vent using a coupling and banjo screw respectively. Use new sealing washers on both connections.

Torque Value: 15 n•m [133 in-lb]

Install the vent line connecting the front and rear vent of the EGR cooler. Use hose bead or quick-connect fitting and banjo screw respectively. Use new sealing washers on both connections.

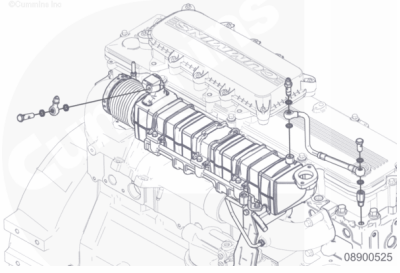
Torque Value: 15 n•m [133 in-lb]



For MMRO turbocharger option:

Install the vent tube connecting the front vent of the EGR cooler and cylinder head vent. Use a hose bead or quick-connect fitting and banjo screw respectively. Use new sealing washers on both connections.

Torque Value: 15 n•m [133 in-lb]

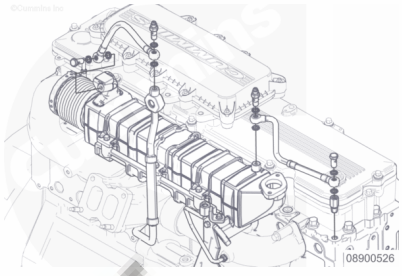


ANADOLU ISUZU
PARTS SALES

Install a banjo fitting on the rear end vent of the EGR cooler. Use new sealing washer. Vent the banjo fitting to the OEM top tank

Torque Value: 15 n•m [133 in-lb]

For HMRO turbocharger option:



Install the vent tube connecting the front vent of the EGR cooler and cylinder head vent. Use a hose bead or quick-connect fitting and banjo screw respectively. Use new sealing washers on both connections.

Torque Value: 15 n•m [133 in-lb]

Install the rear vent tube on the turbocharger vent and EGR cooler rear vent. Use new sealing washers on both connections.

Install the vent tube on the EGR cooler rear vent fitting. Use a screw banjo connector.

Torque Value: 15 n•m [133 in-lb]

Install the vent tube on the turbocharger coolant vent fitting. Use a hose bead or quick-connect.

Torque Value: 15 n•m [133 in-lb]

Finishing Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

- Connect the vehicle coolant vent line to the coolant vent line connections on the EGR cooler and turbocharger actuator. See equipment manufacturer service information.
- Connect the coolant vent connection onto the cylinder head.

Note : The vent line **must** be routed "uphill" so coolant is vented properly from the engine.

- Connect the vehicle coolant vent line to the coolant vent line connections on the EGR cooler. See equipment manufacturer service information.
- Fill the cooling system. Refer to Procedure 008-018 in Section 8. (/qs3/pubsys2/xml/en/procedures/425/425-008-018-tr.html)

ANADOLU ISUZU AFTER SALES

- Connect the batteries. See equipment manufacturer service information.
- Operate the engine. Check for leaks.

Last Modified: 04-Aug-2016

ANADOLU ISUZU AFTER SALES

Select Service Tools

Recommended Cummins® Service Tools

- No Cummins® service tools required.

Additional Service Items

- Container suitable for coolant
- Sodium carbonate or Restore™

General Information

⚠ WARNING ⚠

Do not remove the pressure cap from a hot engine. Wait until the coolant temperature is below 50°C [120°F] before removing the pressure cap. Heated coolant spray or steam can cause personal injury.



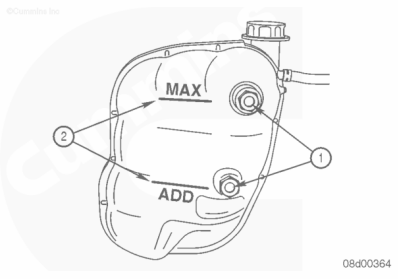
Note : Never use a sealing additive to stop leaks in the coolant system. This can result in coolant system plugging and inadequate coolant flow, causing the engine to overheat.

The engine coolant level **must** be checked daily.

Note : In order for proper engine operation coolant system pressure to be reached, the pressure cap **must** be installed prior to starting and warming up the engine. If the pressure cap is installed or removed while the engine is hot, the cooling system will **not** reach or maintain the proper operating pressure.

⚠ CAUTION ⚠

Do not add cold coolant to a hot engine. Engine castings can be damaged. Allow the engine to cool below 50°C [120°F] before adding coolant.



Note : Use the following procedure to inspect the engine coolant level sensor. Refer to Procedure 019-017 in Section 19.

(/qs3/pubsys2/xml/en/procedures/425/425-019-017.html)

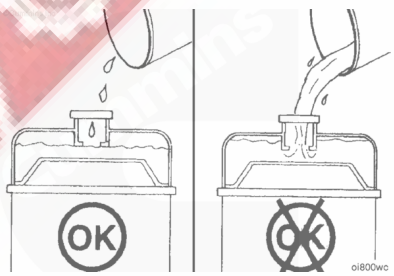
On applications that use a coolant recovery system, check to make sure the coolant is at the appropriate level on the coolant recovery tank for the engine temperature.

Many coolant recovery/expansion tanks, also called "top tanks", have sight glasses (1) or are made of a clear material (**not** shown) to aid in checking the coolant level (2) without removing the radiator cap.

It is important to understand the impact of temperature on the expansion of the coolant. Most "top tanks" do **not** have a provision for a "FULL HOT" coolant level. Filling the "top tank" while hot will result in a low operating level once the system has cooled.

Fill the cooling system with coolant to the bottom of the fill neck in the radiator fill or recovery/expansion tank.

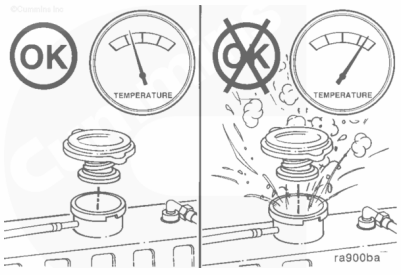
Note : Some radiators have two fill necks, both of which **must** be filled when the cooling system is drained.



Drain

⚠ WARNING ⚠

Do not remove the pressure cap from a hot engine. Wait until the coolant temperature is below 50°C [120°F] before removing the pressure cap. Heated coolant spray or steam can cause personal injury.



Position the vehicle or equipment on a level surface.

Isolate the engine from the vehicle cooling system by closing coolant flow valves to the equipment heating systems before initiating repair. This will prevent the heater circuit from draining, minimizing the chance for air pockets to be present during the fill process. See equipment manufacturer service information for system isolation valve locations.

This air can be very difficult to purge in some applications that have several feet of plumbing and multiple heater cores.

ANADOLU ISUZU PARTS SALES

Note : If the coolant is being changed, or if the cooling system is being flushed, it is desirable to leave the coolant flow valves to the equipment heating systems open, in order to completely drain the system.

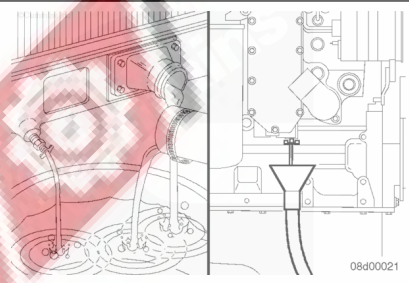
Use equipment manufacturer service information for any special coolant drain and fill requirements.

These special instructions can also be located near the cooling system access or fill door on the vehicle.

Remove all cooling system fill caps to allow the coolant to drain completely.

⚠ WARNING ⚠

Coolant is toxic. Keep away from children and pets. If not reused, dispose of in accordance with local environmental regulations.



Note : If the coolant will be reused, use a clean container in which to drain the coolant. Also, cover the container to prevent coolant contamination after draining.

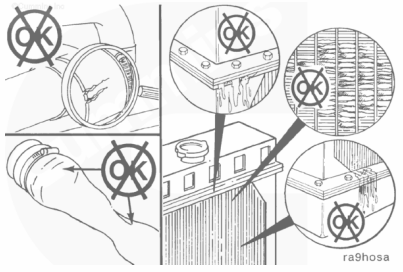
Drain the cooling system by opening the drain valve on the radiator and by opening the drain valve on the bottom of the engine oil cooler housing. A drain pan with a capacity of 57 liters [15 gal] is adequate in most applications.

After the cooling system is completely drained, close the drain valves. See equipment manufacturer service information for complete cooling system drain information.

Check for damaged hoses and loose or damaged hose clamps. Replace as required.

Check the radiator for leaks, damage, and buildup of dirt.

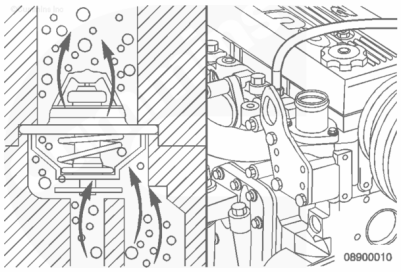
Clean and replace as required.



Flush

⚠ CAUTION ⚠

The system must be filled properly to prevent air locks or serious engine damage can result. During filling, air must be vented from the engine coolant passages. Wait 2 to 3 minutes to allow air to be vented; then add mixture to bring the level to the top.



Make sure air is vented during the filling process:

- Some thermostats have check balls that allow air to vent through the thermostat when the thermostat is closed.
- An air vent port connection, which connects to the top tank/coolant recovery tank of the cooling system, is located next to the water outlet.

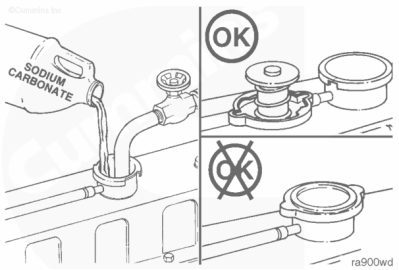
This provides adequate venting for a maximum fill rate of 19 liters [5 gal] per minute.

Note : An alternate to using sodium carbonate, as outlined in this procedure, is to use Restore™.



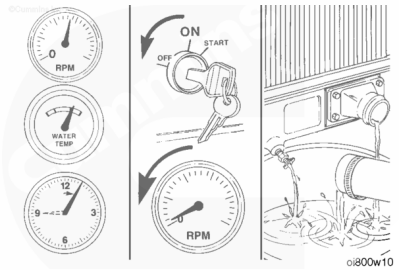
Restore™ is a heavy-duty cooling system cleaner that removes corrosion products, silica gel, and other deposits. The performance of Restore™ is dependent on time, temperature, and concentration levels. An extremely scaled or flow-restricted system, for example, can require higher concentrations of cleaners, higher temperatures, longer cleaning time, or the use of Restore Plus™. Up to twice the recommended concentration levels of Restore™ can be used safely. Restore Plus™ **must** be used **only** at its recommended concentration level. Extremely scaled or fouled systems can require more than one cleaning.

Note : Do **not** install the radiator cap. The engine is to be operated without the cap for this process.



⚠ WARNING ⚠

Coolant is toxic. Keep away from children and pets. If not reused, dispose of in accordance with local environmental regulations.



⚠ WARNING ⚠

Do not stand near surge tank or radiator while operating the engine with the pressure cap off. If the equipment is equipped with a fill door on the side of the surge tank, keep it closed due to coolant expansion.

⚠ CAUTION ⚠

Do not operate the engine with the pressure cap off at temperatures above 93°C [200°F]. This can result in potential engine damage by cavitation of the water pump and localized boiling.

⚠ CAUTION ⚠

Before topping off coolant, allow the system temperature to cool to ambient. This will make sure an adequate amount of coolant is available to the water pump during all periods of operation.

⚠ CAUTION ⚠

Do not relieve the system pressure while hot in order to "top off" immediately before returning the vehicle to service. The system will not be able to generate the pressure through the expansion of the coolant necessary for operation. This can result in potential engine damage by cavitation of the water pump and localized boiling.

Fill the cooling system with a mixture of sodium carbonate and water (or a commercially available equivalent) to the capacity or level stated in the equipment manufacturer service information.

Note : Adequate venting is provided for a maximum fill rate of 19 liters [5 gal] per minute.

Unless indicated otherwise by the original equipment manufacturer (OEM) instructions, it is critical all shutoff valves be returned to their open positions once the system has been refilled and the deaeration process is about to begin. This will help to make sure as much air as possible will be purged from the cooling system. See equipment manufacturer service information for valve locations.

ANADOLU ISUZU

Wait 2 to 3 minutes without starting the engine to allow the system to naturally purge entrained air and the coolant level to stabilize.

Add plain water to bring the level back to FULL.

Turn all cab heater switches to HIGH in order to allow maximum coolant flow through the heater core(s). The blower **must** be turned ON.

With the cooling system fill cap removed:

- Operate the engine at LOW idle for 2 minutes.
- Turn the engine OFF. Add plain water to bring the level back to FULL.

With the cooling system fill cap removed:

- Start the engine.

Note : After starting a cold engine, increase the engine speed (rpm) slowly to provide adequate lubrication to the bearings and to allow the oil pressure to stabilize.

Operate the engine at HIGH idle until the thermostat opens.

Allow the engine to return to LOW idle 2 minutes before shutting it down. This allows adequate cool down of pistons, cylinders, bearings, and turbocharger components.

Turn engine OFF and check the coolant level according to the equipment manufacturer service information recommendations. Add coolant, if necessary, to bring it back to the FULL level.

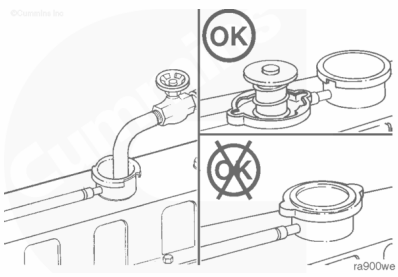
Install the cooling system fill cap.

Operate the engine for 1 to 1½ hours with the coolant temperature above 80°C [176°F].

Turn engine OFF. Allow the coolant temperature to drop to 50° C [122° F] before draining the cooling system.

Drain the cooling system.

Note : Do **not** install the radiator cap.



Fill the cooling system with good quality water to the capacity or level stated in equipment manufacturer service information.

Unless indicated otherwise by OEM instructions, it is critical all shutoff valves be returned to their open positions once the system has been refilled and the deaeration process is about

to begin. This will help to make sure as much air as possible will be purged from the cooling system. See equipment manufacturer service information for valve locations.

Wait 2 to 3 minutes, without starting the engine, to allow the system to naturally purge entrained air and the coolant level to stabilize.

Add plain water to bring the level back to FULL.

Turn all cab heater switches to HIGH in order to allow maximum coolant flow through the heater core(s). The blower **must** be turned ON.

With the cooling system fill cap removed:

- Operate the engine at LOW idle for 2 minutes.
- Turn off the engine. Add plain water to bring the level back to FULL.

With the cooling system fill cap removed:

- Start the engine.
- Operate the engine at HIGH idle until the thermostat opens.

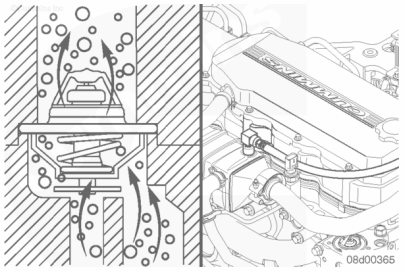
Note : After starting a cold engine, increase the engine speed (rpm) slowly to provide adequate lubrication to the bearings and to allow the oil pressure to stabilize.

Allow the engine to return to LOW idle 2 minutes before shutting it down. This allows adequate cool down of pistons, cylinders, bearings, and turbocharger components.

Fill

⚠ CAUTION ⚠

The system must be filled properly to prevent air locks or serious engine damage can result. During filling, air must be vented from the engine coolant passages. Wait 2 to 3 minutes to allow air to be vented; then add the mixture to bring the level to the top.



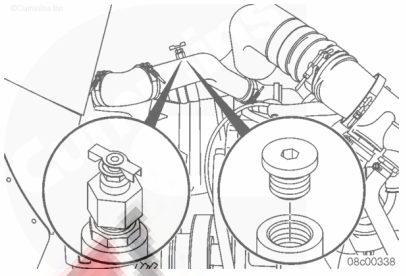
Make sure air is vented during the fill process:

- Some thermostats have check balls that allow air to vent through the thermostat when the thermostat is closed.

- An air vent port connection, which connects to the top tank/coolant recovery tank of the cooling system, is located next to the water outlet.

The system has a design maximum fill rate of up to 19 liters [5 gal] per minute.

Note : Some applications can be equipped with a manual bleed valve which is to be opened to make sure of a proper fill. The upper radiator pipe is a common location for bleed valves. The illustration is for reference **only**.



If applicable, open the manual bleed valve before filling the cooling system.

Once properly filled, make sure to close the manual bleed valve.

⚠ CAUTION ⚠

Never use water alone for coolant. Damage from corrosion can be the result of using water alone for coolant.

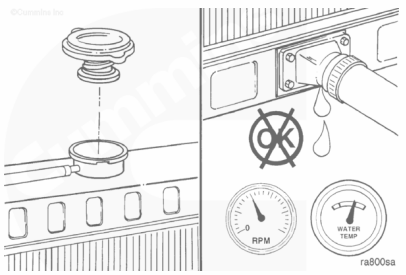


Use the following service bulletin for engine coolant specifications. Refer to Service Bulletin, Cummins® Coolant Requirements and Maintenance, Bulletin 3666132. (/qs3/pubsys2/xml/en/bulletin/3666132.html)

If the coolant is reused, it should be inspected for signs of contamination, concentration levels, and SCA/DCA additives.

⚠ WARNING ⚠

Do not remove the pressure cap from a hot engine. Wait until the coolant temperature is below 50°C [120°F] before removing the pressure cap. Heated coolant spray or steam can cause personal injury.



⚠ WARNING ⚠

Do not stand near surge tank or radiator while operating the engine with the pressure cap off. If the equipment is equipped with a fill door on the side of the surge tank, keep it closed due to coolant expansion.

⚠ CAUTION ⚠

Do not operate the engine with the pressure cap off at temperatures above 93°C [200°F]. This can result in potential engine damage by cavitation of the water pump and localized boiling.

⚠ CAUTION ⚠

Topping off the system while hot is not recommended when using the fill door on transit bus applications equipped with surge tanks. Bringing the level to the bottom of the door while the system is hot will not provide adequate volume of coolant for lower operating temperatures. This can result in cavitation of the water pump and greatly increase the potential for engine damage.

⚠ CAUTION ⚠

Before topping off coolant, allow the system temperature to cool to ambient. This will make sure an adequate amount of coolant is available to the water pump during all periods of operation.

⚠ CAUTION ⚠

Engine and component damage may result if adequate cool down time is not given after the cooling system pressure has been relieved in order to "top off". System pressure is ONLY generated with temperature rise of coolant. Closing the cooling system while hot will not allow pressure to build.

Remove the cooling system fill cap.

Fill the cooling system to the capacity or level stated in the equipment manufacturer service information, using a mixture of 50 percent water and 50 percent ethylene glycol or propylene glycol antifreeze.

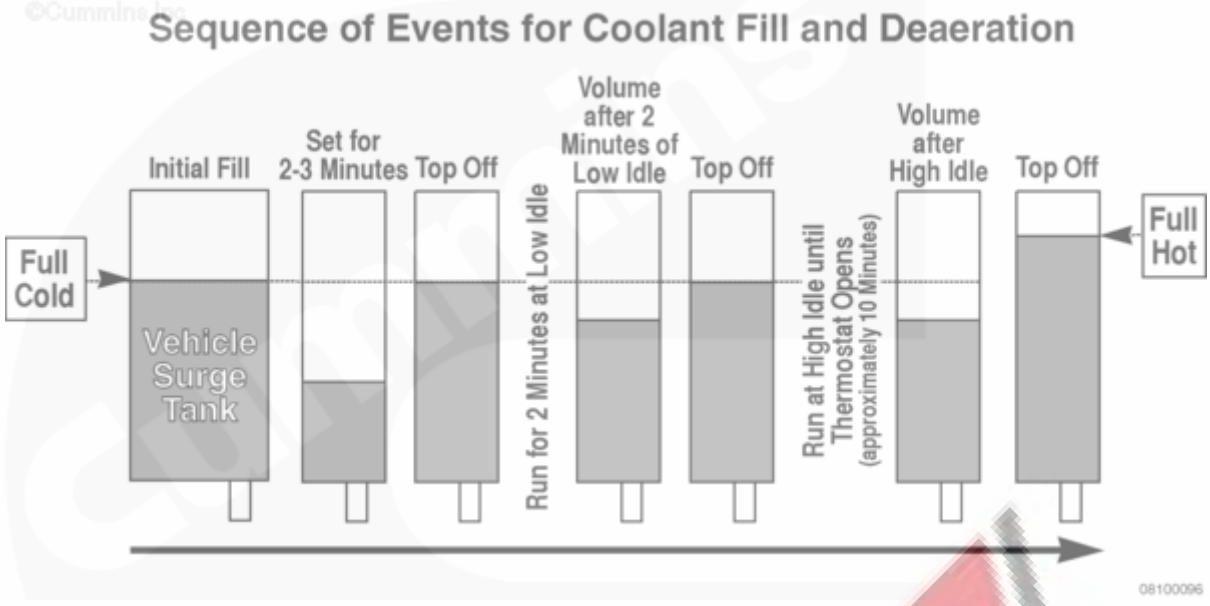


Figure 1: Sequence of Events for Coolant Fill and Deaeration.

Note : If all coolant drained from the system was collected, the same volume or more **must** go back into the system. If any drained coolant remains after filling, this is an indication of an air pocket which **must** be purged before returning the vehicle to service.

Unless indicated otherwise by OEM instructions, it is critical all shutoff valves be returned to their open positions once the system has been refilled and the deaeration process is about to begin. This will help to make sure as much air as possible will be purged from the heating circuit. See equipment manufacturer service information for valve locations.

Wait 2 to 3 minutes, without starting the engine, to allow the system to naturally purge entrained air and coolant level to stabilize.

Add a 50/50 mixture to bring the coolant level back to the FULL cold level.

Turn all cab heater switches to HIGH in order to allow maximum coolant flow through heater core(s). The blower **must** be turned ON.

With the cooling system fill cap removed:

- Operate the engine at LOW idle for 2 minutes.
- Turn off the engine. Add coolant to bring the level back to the FULL cold level, using 50/50 mixture.

With the radiator pressure cap off:

Note : After starting a cold engine, increase the engine speed (rpm) slowly to provide adequate lubrication to the bearings and to allow the oil pressure to stabilize.

- Start the engine.
- Operate the engine at HIGH idle until the thermostats open.

Allow the engine to idle 2 minutes before shutting it down. This allows adequate cool down of pistons, cylinders, bearings, and turbocharger components.

- Turn the engine OFF.

- Top off coolant to the FULL hot level.
- It is the responsibility of the customer to check the cold coolant level and top off if necessary.

Note : Certain applications can require an additional 10 minutes of operation time at HIGH idle for complete deaeration. For best results, see the OEM coolant fill procedure for specific instructions.

Allow the engine to cool to 50°C [122°F] then install the pressure cap. Operate the engine until it reaches a temperature of 80°C [176°F]. Check for coolant leaks.

See Figure 1 for a graphic explanation of the fill process.

Last Modified: 01-Nov-2016

ANADOLU ISUZU AFTER SALES

Select Service Tools

Recommended Cummins® Service Tools

- No Cummins® service tools required.

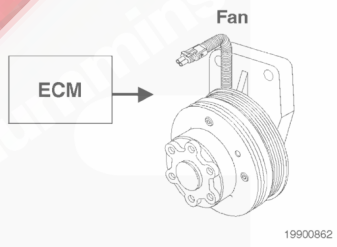
Additional Service Items

- No additional service items required.

General Information

⚠ WARNING ⚠

The cooling fan will engage when the engine is started. To prevent serious personal injury, keep your hands clear of the fan's path when starting the engine and during engine operation.



All fan clutches can be controlled by the engine control module (ECM). The ECM monitors coolant temperature and intake manifold temperature to determine when to engage the cooling fan. Some applications have additional sensors monitored by the ECM for fan control (for example, air conditioner pressure and transmission temperature). The original equipment manufacturer (OEM) can also install a manual override switch to engage the clutch manually at the operator's command.

The ECM is capable of using a 0 VDC, 12 VDC, or 24 VDC signal to engage the fan clutch. The exact enable logic can be selected in the Features and Parameters section of INSITE™ electronic service tool.

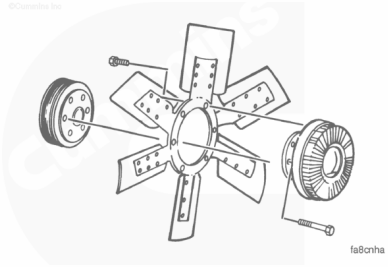
See the equipment manufacturer's service manual for fan clutch troubleshooting and repair information.

These are various fan clutch types such as:

- Air engaged
- Air disengaged
- Electric

- Viscous
- ON-OFF.

See equipment manufacturer service information for all service related information.



Preparatory Steps

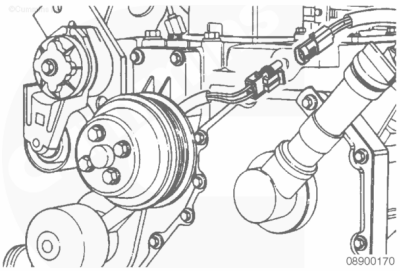
⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

- Disconnect the batteries. See equipment manufacturer service information.
- Remove the cooling fan and spacers. See equipment manufacturer service information.
- Remove the drive belt. Refer to Procedure 008-002 in Section 8. (/qs3/pubsys2/xml/en/procedures/425/425-008-002-tr.html)

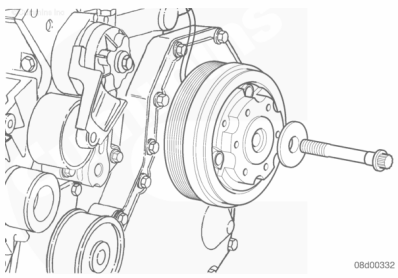
Remove

Disconnect the fan clutch connector on the base harness from the fan clutch. See equipment manufacturer service information.

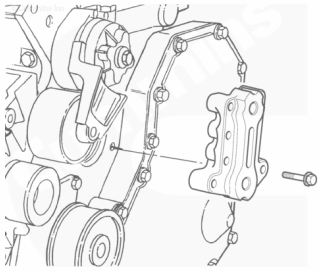


Note : As the electric fan clutch mounting fastener is loosened, make sure to support the clutch.

Remove the electric fan clutch mounting capscrew, washer, and electric fan clutch. See equipment manufacturer service information.



Note : Prior to removing the electric fan clutch support bracket, note the mounting location and orientation of the bracket. The mounting bracket can be installed in different orientations for different fan drive arrangements.



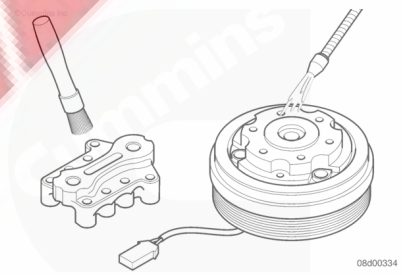
Note : Note the location of the P-clip for the electric fan clutch wiring harness pigtail.

Remove the electric fan clutch support bracket and mounting capscrews. See equipment manufacturer service information.

Clean and Inspect for Reuse

⚠ WARNING ⚠

When using solvents, acids, or alkaline materials for cleaning, follow the manufacturer's recommendations for use. Wear goggles and protective clothing to reduce the possibility of personal injury.

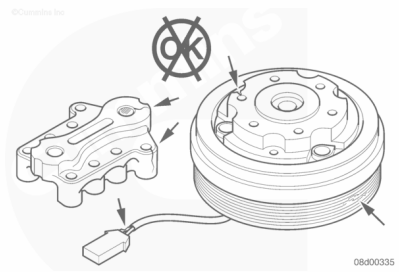


⚠ WARNING ⚠

Wear appropriate eye and face protection when using compressed air. Flying debris and dirt can cause personal injury.

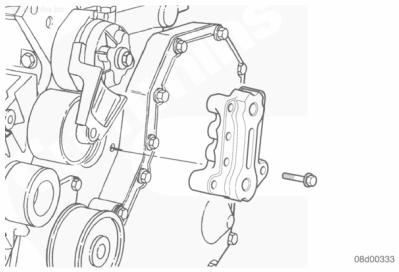
Clean the fan clutch and bracket. Use solvent. Dry with compressed air.

Inspect the fan clutch and bracket for damage. See equipment manufacturer service information.



Install

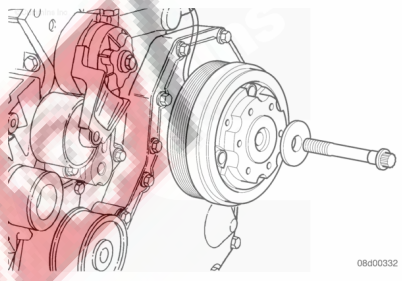
Note : Make sure to install the electric fan clutch mounting bracket in the same orientation and location as removed. The mounting bracket can be installed in different orientations for different fan drive arrangements.



Install the electric fan clutch support bracket, wiring harness pigtail P-clip, and mounting capscrews. See equipment manufacturer service information.

⚠ CAUTION ⚠

Correct loading of the fan clutch joint is necessary for proper cooling system operation. An over-torqued or under-torqued capscrew, caused by the use of air powered tools, an out-of-calibration wrench, or other methods could lead to significant damage to the front end accessory drive.

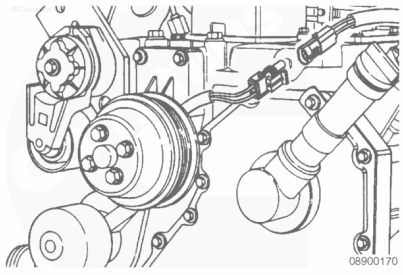


Install the electric fan clutch, washer, and mounting capscrew. See equipment manufacturer service information.

Note : Make sure wires are **not** being pulled at the fan clutch.

Tighten the fan clutch mounting capscrew. See equipment manufacturer service information.

Connect the fan clutch connector on the base harness to the fan clutch. See equipment manufacturer service information.



Finishing Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

- Install the drive belt. Refer to Procedure 008-002 in Section 8. (/qs3/pubsys2/xml/en/procedures/425/425-008-002-tr.html)
- Install the cooling fan and spacers. See equipment manufacturer service information.
- Connect the batteries. See equipment manufacturer service information.
- Operate engine. Check for proper operation.

Last Modified: 01-Nov-2016

ANADOLU ISUZU AFTER SALES

Select Service Tools

Recommended Cummins® Service Tools

- No Cummins® Service Tools required.

Additional Service Items

- No additional service items required.

General Information

Several different fan hub mounting locations and fan hub options are available. The illustrations in this procedure are generic and may **not** represent the hardware on all engines.

Preparatory Steps

⚠ WARNING ⚠

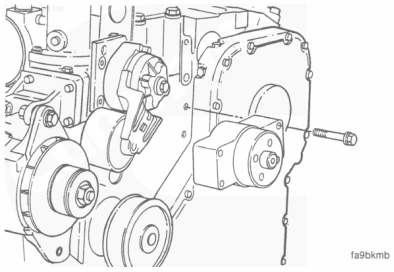
Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

- Disconnect the batteries. See equipment manufacturer service information.
- If necessary, remove the cooling fan. See equipment manufacturer service information.
- Remove the drive belt. Refer to Procedure 008-002 in Section 8. (/qs3/pubsys2/xml/en/procedures/425/425-008-002-tr.html)
- Remove the fan pulley and spacer. Refer to Procedure 008-039 in Section 8. (/qs3/pubsys2/xml/en/procedures/425/425-008-039.html)

Remove

Remove the fan hub mounting capscrews.

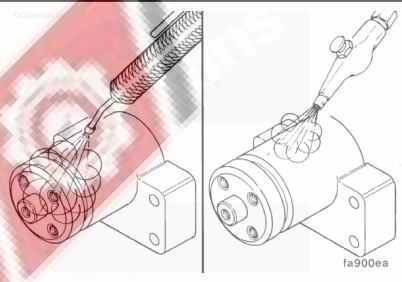
Remove the fan hub.



Clean and Inspect for Reuse

⚠ WARNING ⚠

When using a steam cleaner, wear safety glasses or a face shield, as well as protective clothing. Hot steam can cause serious personal injury.



⚠ WARNING ⚠

Wear appropriate eye and face protection when using compressed air. Flying debris and dirt can cause personal injury.

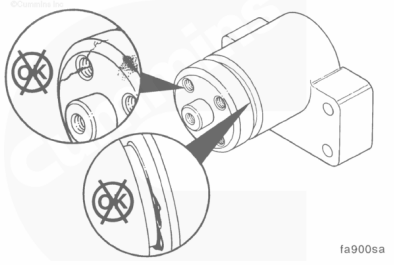
Clean the exterior of the fan hub. Use steam. Dry with compressed air.

Inspect the fan hub for an indication of oil seal leakage.

Inspect the fan hub for cracks or damage.

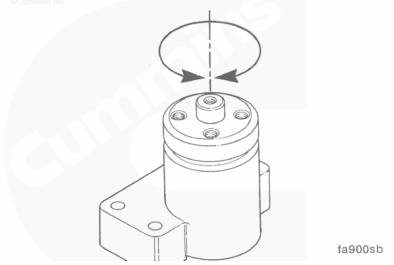
Inspect the fan hub chamfer and pulley mating surface for damage.

Replace the fan hub if damage is found.



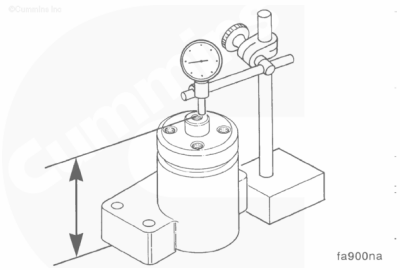
Turn the fan hub by hand to check for freedom of rotation.

The fan hub **must** spin freely without any wobble or excessive end clearance.



Inspect the fan hub bearing for wear.

The bearing **must** have a minimal amount of side-to-side or end clearnce movement.



Replace the fan hub if there is more than 0.15 mm [0.006 in] of end clearance in the fan hub.

Fan Hub End Clearance		
mm		in
0.15	MAX	0.006

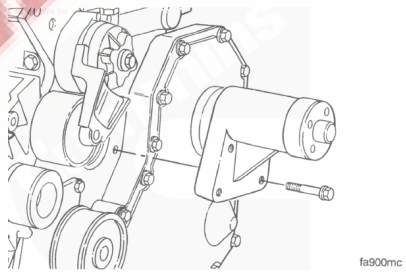
Note : Some fan hub assemblies can be rebuilt with new bearings and related components. Check for part availability before disassembling the fan hub.

Install

Install the fan hub and capscrews.

Tighten the capscrews.

Torque Value: 24 n•m [212 in-lb]



Finishing Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

- Install the fan pulley and spacer. Refer to Procedure 008-039 in Section 8. (/qs3/pubsys2/xml/en/procedures/425/425-008-039.html)
- Install the drive belt. Refer to Procedure 008-002 in Section 8. (/qs3/pubsys2/xml/en/procedures/425/425-008-002-tr.html)
- If removed, install the cooling fan. See equipment manufacturer service information.
- Connect the batteries. See equipment manufacturer service information.
- Operate the engine. Check for leaks.

ANADOLU ISUZU AFTER SALES

Last Modified: 04-Aug-2016



Select Service Tools

Recommended Cummins® Service Tools

- No Cummins® Service Tools required.

Additional Service Items

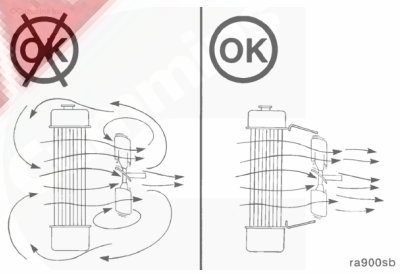
- No additional service items required.

General Information

The radiator or fan shroud is used to direct all air flow across the radiator fins rather than around the edges of the radiator.

An incorrect fan shroud or obstructions can reduce air flow and cause the engine to run hot.

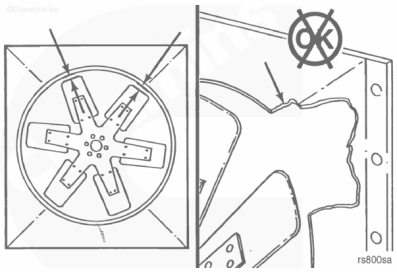
Note : Check to make sure air is **not** recirculating. Check for missing baffles.



Initial Check

⚠ CAUTION ⚠

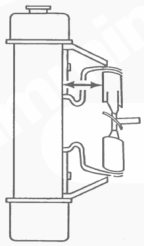
The fan shroud must be installed correctly, be in good condition, and the shroud-to-fan clearance must be within manufacturer specifications to allow proper air flow through the radiator to provide adequate engine cooling.



Inspect the fan shroud for proper fan clearance, cracks, air leaks, and damage. Replace, if necessary. See equipment manufacturer service information for instructions.

Cummins Inc. recommends fan clearance be between 5.08 to 10.16 cm [2 to 4 in] from the radiator core. See equipment manufacturer service information for alternative positions.

ANADOLU ISUZU AFTER SALES



Last Modified: 04-Aug-2016

ANADOLU ISUZU
AFTER SALES

Select Service Tools

Recommended Cummins® Service Tools

- No Cummins® Service Tools required.

Additional Service Items

- No additional service items required.

Preparatory Steps

⚠ WARNING ⚠

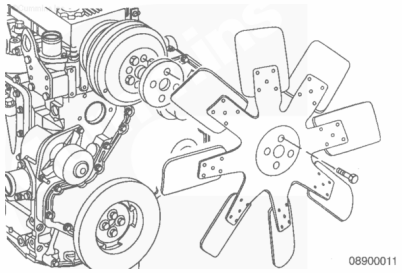
Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

Note : Prior to removing the drive belt, loosen the fan pulley and cooling fan mounting capscrews, if equipped.

- Disconnect the batteries. See equipment manufacturer service information.
- Remove the fan drive belt. Refer to Procedure 008-002 in Section 8. (/qs3/pubsys2/xml/en/procedures/425/425-008-002-tr.html)

Remove

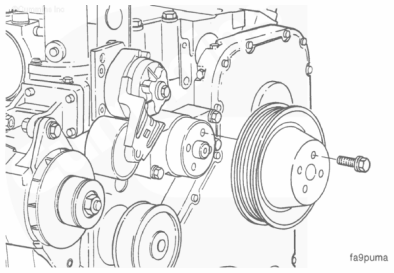
Note : Some applications do **not** have a cooling fan or the cooling fan is located elsewhere on the application.



If equipped, remove the cooling fan. See equipment manufacturer service information for instructions.

For engines equipped with an engine driven cooling fan, the fan holds the fan pulley and spacer in place. Remove the fan pulley and spacer.

If the engine is **not** equipped with an engine driven cooling fan, remove the fan pulley mounting capscrews and fan pulley.



Clean and Inspect for Reuse

⚠ WARNING ⚠

When using solvents, acids, or alkaline materials for cleaning, follow the manufacturer's recommendations for use. Wear goggles and protective clothing to reduce the possibility of personal injury.



⚠ WARNING ⚠

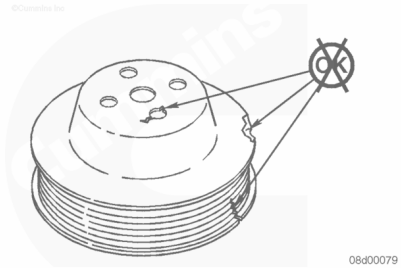
Wear appropriate eye and face protection when using compressed air. Flying debris and dirt can cause personal injury.

Clean the fan pulley and spacer. Use solvent. Dry with compressed air.

Inspect the fan pulley for cracks near bolt holes and for damage at the drive belt contact surface.

If damage is found on the fan pulley, the fan hub **must** also be inspected. Refer to Procedure 008-036 in Section 8. (/qs3/pubsys2/xml/en/procedures/425/425-008-036.html)

Replace the pulley if any damage is found.

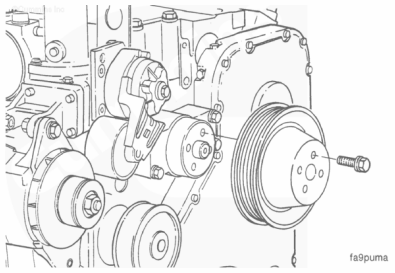


Install

If the engine is **not** equipped with an engine driven cooling fan, install the fan pulley mounting capscrews and fan pulley.

Tighten the mounting capscrews finger-tight.

Tighten the mounting capscrews to the final torque value after the drive belt is installed, using the tension of the drive belt to keep the fan pulley from rotating.

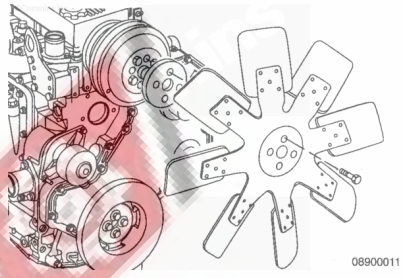


Torque Value:
M6 10 n•m [89 in-lb]

Torque Value:
M10 43 n•m [32 ft-lb]

Torque Value:
M12 77 n•m [57 ft-lb]

For engines equipped with an engine driven cooling fan, the fan holds the fan pulley and spacer in place. Install the fan pulley and spacer.



If removed, install the cooling fan. See equipment manufacturer service information for instructions.

Tighten the mounting capscrews finger-tight.

Tighten the mounting capscrews to the final torque value after the drive belt is installed, using the tension of the drive belt to keep the fan pulley from rotating.

Do **not** hold the fan blades to keep the fan pulley or cooling fan from rotating.

Torque Value:
M6 10 n•m [89 in-lb]

Torque Value:
M10 43 n•m [32 ft-lb]

Torque Value:
M12 77 n•m [57 ft-lb]

ANADOLU ISUZU AFTER SALES

Finishing Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

Note : Tighten the fan pulley and cooling fan mounting capscrews, if equipped.

- Install the fan drive belt. Refer to Procedure 008-002 in Section 8. (/qs3/pubsys2/xml/en/procedures/425/425-008-002-tr.html)
- Connect the batteries. See equipment manufacturer service information.
- Operate the engine. Check for proper operation.

Last Modified: 04-Aug-2016

ANADOLU ISUZU AFTER SALES

Select Service Tools

Recommended Cummins® Service Tools

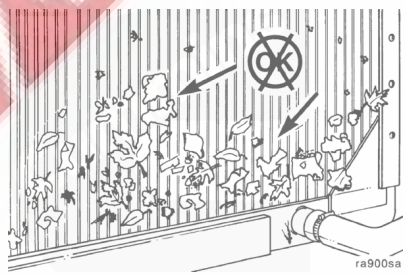
- No Cummins® Service Tools required.

Additional Service Items

- No additional service items required.

General Information

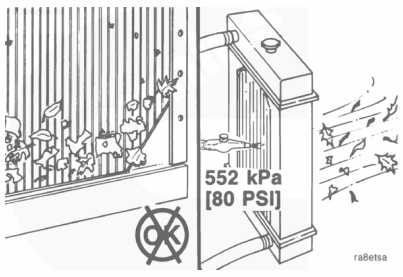
Air forced through the fins of the radiator by a fan cools the coolant pumped through the radiator. Environmental debris (such as paper, straw, lint, and dust) can obstruct the fins and stop the flow of air that will reduce the cooling effect of the radiator.



Initial Check

⚠ WARNING ⚠

Wear appropriate eye and face protection when using compressed air. Flying debris and dirt can cause personal injury.



Inspect for plugged radiator fins.

Use compressed air to blow out the dirt and debris.

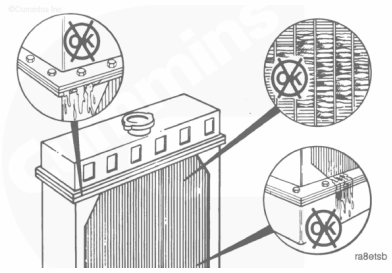
Measurements		
	kpa	psi
Air Pressure:	552	80

Inspect for bent or broken fins.

ANADOLU ISUZU PARTS SALES

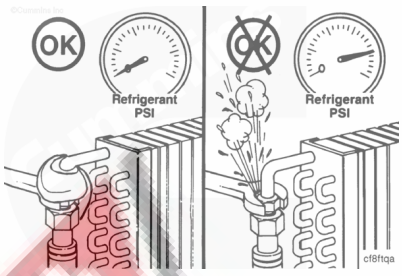
Inspect for radiator core and gasket leaks.

If the radiator **must** be replaced, see the equipment manufacturer service information.



⚠ WARNING ⚠

If a liquid refrigerant system (air conditioning) is used, wear eye and face protection, and wrap a cloth around the fittings before removing. Liquid refrigerant can cause serious eye and skin injuries.



⚠ WARNING ⚠

To protect the environment, liquid refrigerant systems must be properly emptied and filled using equipment that prevents the release of refrigerant gas into the atmosphere. Federal law requires capturing and recycling the refrigerant.

ANADOLU ISUZU AFTER SALES

Last Modified: 04-Aug-2016

Select Service Tools

Recommended Cummins® Service Tools

- No Cummins® Service Tools required.

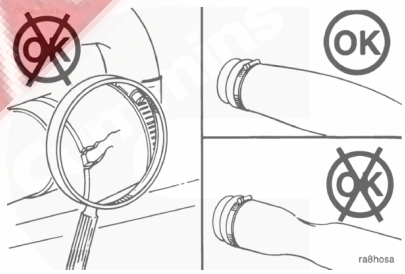
Additional Service Items

- No additional service items required.

Inspect for Reuse

Inspect all hoses for cracks, cuts, or collapsing.

Note : The silicone engine coolant hose will exhibit swelling due to the elasticity of the hose.



ANADOLU ISUZU
AFTER SALES

Last Modified: 04-Aug-2016

Select Service Tools

Recommended Cummins® Service Tools

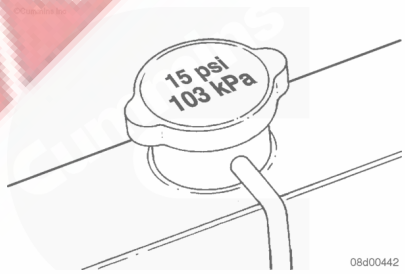
- No Cummins® Service Tools required.

Additional Service Items

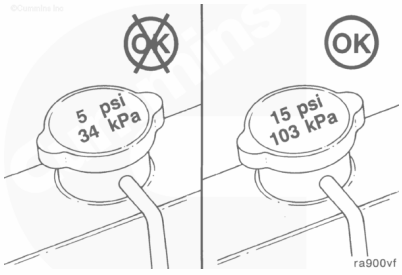
- Air regulator

General Information

The cooling system is designed to use a pressure cap to prevent boiling of the coolant.

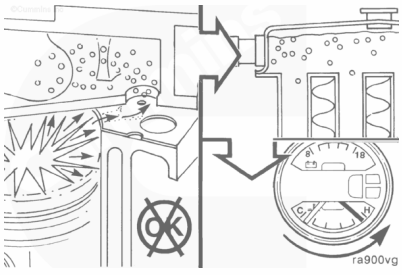


An incorrect or malfunctioning cap can result in the loss of coolant and the engine running hot.



Air in the coolant can result in loss of coolant from the overflow when the aerated coolant is hot. The heated air expands, increasing the pressure in the system, causing the cap to open.

Similarly, coolant can be displaced through the overflow if the head gasket leaks compression gases into the cooling system.

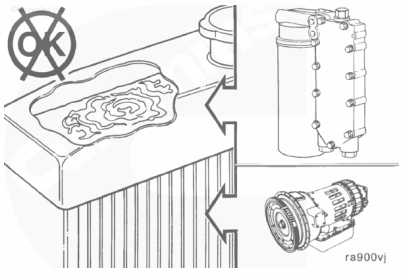


The operating pressure of the cooling system and lubricating system can result in the mixing of the fluids if there is a leak between the systems, such as the head gasket or oil cooler.

ANADOLU ISUZU AFTER SALES

Refer to Procedure 007-037 in Section 7. (/qs3/pubsys2/xml/en/procedures/425/425-007-037.html)

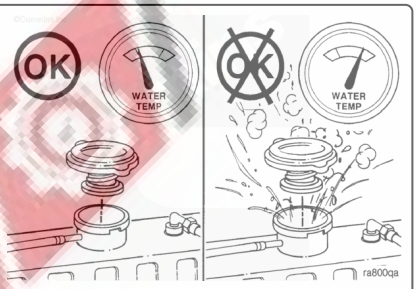
Note : Transmission fluid can also leak into the coolant through radiator bottom tank transmission oil coolers.



Inspect for Reuse

⚠ WARNING ⚠

Do not remove the pressure cap from a hot engine. Wait until the coolant temperature s below 50°C [120°F] before removing the pressure cap. Heated coolant spray or steam can cause personal injury.



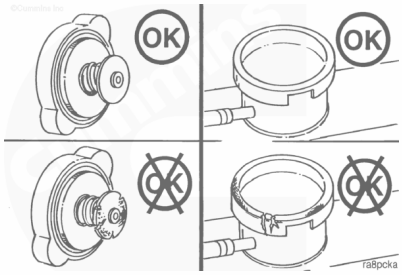
Remove the radiator pressure cap.

Make sure the correct radiator cap is being used. See equipment manufacturer service information for inspection criteria.

Inspect the rubber seal of the pressure cap for damage.

Inspect the radiator fill neck for cracks or other damage.

See equipment manufacturer service information for instructions if the fill neck is damaged.



Test

It is recommended to test the radiator pressure cap sealing capability while installed on the vehicle.

See equipment manufacturer service information for this check, or see the steps below.

For those installations where this is **not** possible, it is acceptable to test the cap off-vehicle using a radiator pressure cap test kit.

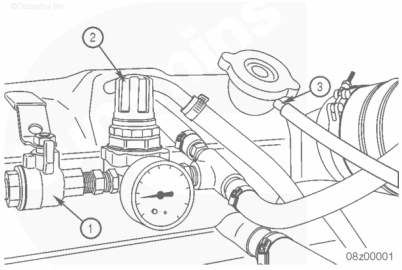


ANADOLU ISUZU PARTS SALES

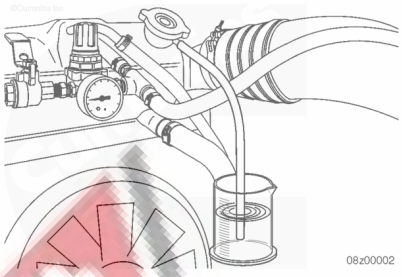
Connect the air line to a vent line on the surge tank.

Install an air regulator (2) between the ball valve (1) or the air line and the surge tank connection.

Attach a hose to the radiator overflow connection (3).

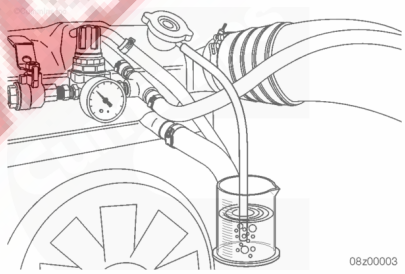


Place the free end of the hose below the water level in a container of water.



⚠ CAUTION ⚠

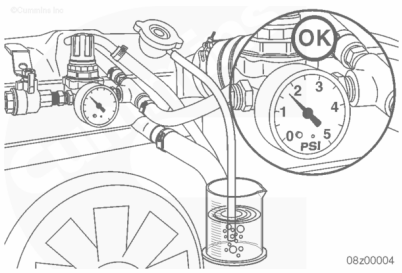
Do not apply more than 140 kPa [20 psi] air pressure to the cooling system. The water pump seal can be damaged.



Pressurize the cooling system slowly to the value printed on the radiator pressure cap or until bubbles can be seen in the overflow bottle.

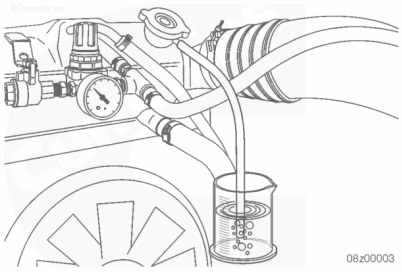
Bubbles should start to form at a pressure within 14 kPa [2 psi] of the value printed on the radiator pressure cap, or it **must** be replaced.

Note : An incorrect or malfunctioning radiator pressure cap can result in the loss of coolant and the engine operating above engine temperature guidelines.



⚠ CAUTION ⚠

Do not apply more than 140 kPa [20 psi] air pressure to the cooling system. The water pump seal can be damaged.

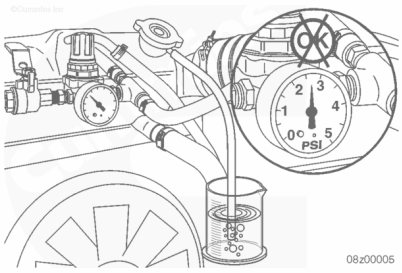


Slowly reduce the cooling system pressure.

BAHADLI ISUZU PARTS

If bubbles continue to form at a pressure within 14 kPa [2 psi] of the value printed on the radiator pressure cap, it **must** be replaced.

Note : An incorrect or malfunctioning radiator pressure cap can result in the loss of coolant and the engine operating above engine temperature guidelines.



For those installations where it is **not** possible to test the radiator pressure cap on-vehicle, use a radiator pressure cap test kit.

See equipment manufacturer service information for guidelines and instructions for this check, or see the steps below.



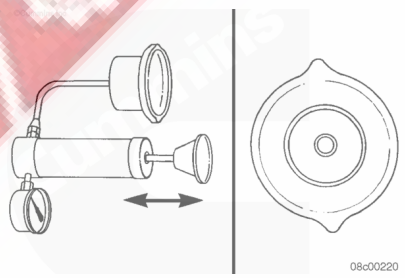
Pressure-test the radiator pressure cap.

The radiator pressure cap **must** seal within 14 kPa [2 psi] of the value printed on the cap, or it **must** be replaced.

Use the following procedure for cooling system specifications.

Refer to Procedure 018-018 in Section V. (/qs3/pubsys2/xml/en/procedures/425/425-018-018.html)

Note : An incorrect or malfunctioning radiator pressure cap can result in the loss of coolant and the engine operating above engine temperature guidelines.



ANADOLU ISUZU PARTS

Last Modified: 04-Aug-2016

Select Service Tools

Recommended Cummins® Service Tools

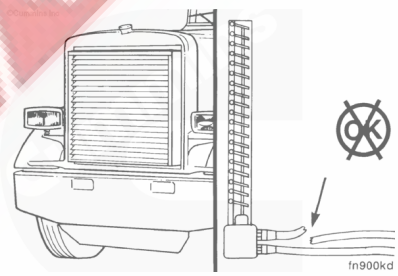
- No Cummins® Service Tools required.

Additional Service Items

- No additional service items required.

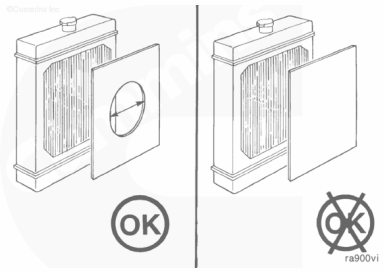
General Information

Shutters are designed to control airflow across the radiator. If the shutters fail to open when needed, the engine can run hot. Failure of the shutters to close can result in too much airflow and the engine running cold.



Note : Make sure the air temperature sensor is functioning correctly. Check the air-operated shutter controls. Check for air leaks. See equipment manufacturer service information.

Winterfronts can be used on a charge air cooled engine, but **must** be designed to cover part of the frontal area of the cooling system. A minimum of 77419 sq mm [120 sq in] of charge air cooled frontal area **must** be left open to airflow.



ANADOLU ISUZU
AFTER SALES

Last Modified: 04-Aug-2016

Select Service Tools

Recommended Cummins® Service Tools

- No Cummins® Service Tools required.

Additional Service Items

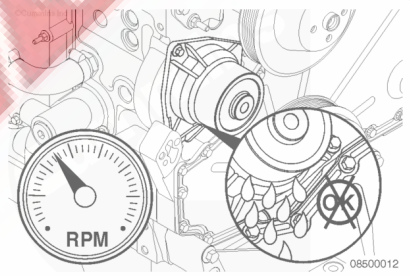
- No additional service items required.

Initial Check

Inspect the water pump impeller and housing for cracks and/or damage.

Note : A streak or chemical buildup or discoloration at the water pump is **not** justification for water pump replacement.

Only replace the water pump if a continuous stream of leakage is observed under operating conditions.



Preparatory Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

⚠ WARNING ⚠

Do not remove the pressure cap from a hot engine. Wait until the coolant temperature is below 50°C [120°F] before removing the pressure cap. Heated coolant spray or steam can cause personal injury.

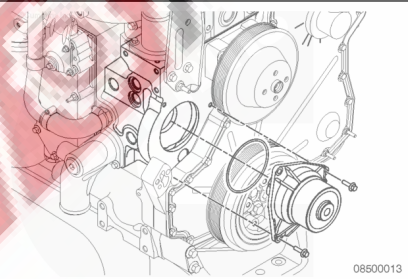
⚠ WARNING ⚠

Coolant is toxic. Keep away from children and pets. If not reused, dispose of in accordance with local environmental regulations.

- Disconnect the batteries. See equipment manufacturer service information.
- Drain the coolant. Refer to Procedure 008-018 in Section 8. (/qs3/pubsys2/xml/en/procedures/425/425-008-018-tr.html)
- Remove the drive belt. Refer to Procedure 008-002 in Section 8. (/qs3/pubsys2/xml/en/procedures/425/425-008-002-tr.html)

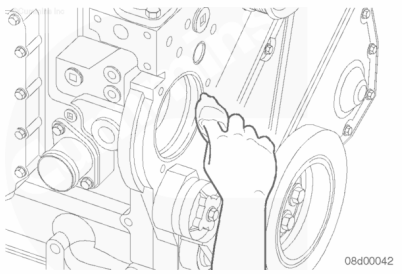
Remove

Remove the water pump capscrews and water pump.



Clean and Inspect for Reuse

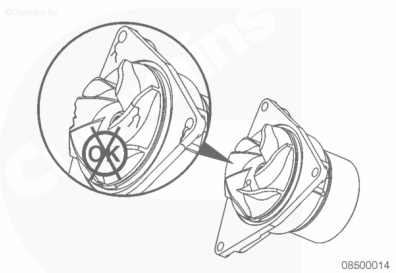
Clean the o-ring sealing surface on the water pump housing and cylinder block.



Inspect the impeller for cracks, missing blades, slippage on the shaft, and other types of damage.

Inspect the water pump housing for damage and cracks.

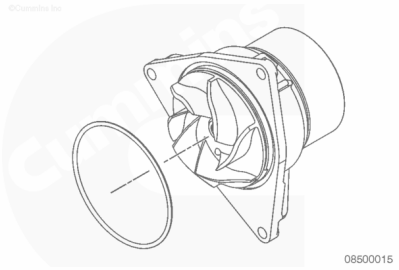
Replace the water pump if any damage is found.



ANADOLU ISUZU AFTER SALES

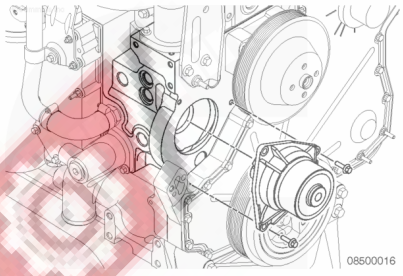
Install

Install a new sealing ring into the groove in the water pump housing.



Install the water pump.

Torque Value: 24 n•m [212 in-lb]



Finishing Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

- Install the drive belt. Refer to Procedure 008-002 in Section 8. (/qs3/pubsys2/xml/en/procedures/425/425-008-002-tr.html)
- Fill the cooling system. Refer to Procedure 008-018 in Section 8. (/qs3/pubsys2/xml/en/procedures/425/425-008-018-tr.html)
- Connect the batteries. See equipment manufacturer service information.
- Operate the engine. Check for leaks.

ANADOLU ISUZU PARTS

Last Modified: 04-Aug-2016


ANADOLU ISUZU
AFTER SALES

Select Service Tools

Recommended Cummins® Service Tools

- Pipe sealant, Part Number 3375066, or equivalent

Additional Service Items

- No additional service items required.

General Information

Note : For engines equipped with optional torque converter cooler.

Conventionally cooled engines with automatic transmissions typically use oil-to-water transmission torque converter coolers plumbed between the radiator and engine water pump.

A torque converter cooling system with a remote bypass allows the torque converter to receive coolant flow when the thermostat is closed (engine cold, no flow through the radiator).

Preparatory Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

⚠ WARNING ⚠

Do not remove the pressure cap from a hot engine. Wait until the coolant temperature is below 50°C [120°F] before removing the pressure cap. Heated coolant spray or steam can cause personal injury.

⚠ WARNING ⚠

Coolant is toxic. Keep away from children and pets. If not reused, dispose of in accordance with local environmental regulations.

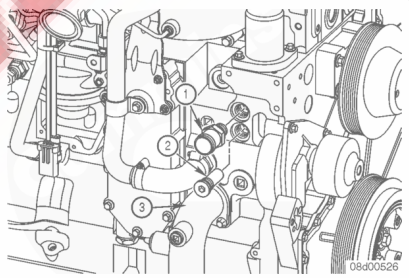
⚠ CAUTION ⚠

Use caution when draining coolant that coolant is not spilled or drained into the bilge area. Do not pump the coolant overboard. If the coolant is not reused, it must be discarded in accordance with local environmental regulations.

- Disconnect the batteries. See equipment manufacturer service information.
- Drain the coolant. Refer to Procedure 008-018 in Section 8. (/qs3/pubsys2/xml/en/procedures/425/425-008-018-tr.html)
- Disconnect the original equipment manufacturer (OEM) torque converter plumbing as required. See equipment manufacturer service information.

Remove

Note : Make sure to note the orientation and location when removing any 90 or 45 degree coolant line fittings.



Remove the M22 x 1.5 fitting and plug from the engine block coolant supply port.

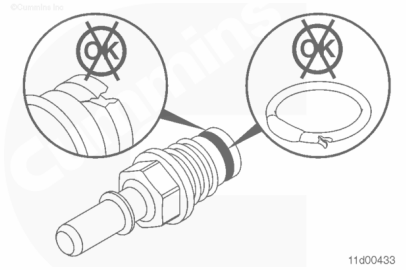
Remove the torque converter coolant return fitting from the water inlet connection or radiator return. Location and size depends on the OEM. See equipment manufacturer service information.

1. M22 x 1.5 fitting (supply port)
2. M22 plug
3. Water inlet connection.

Clean and Inspect for Reuse

⚠ WARNING ⚠

When using solvents, acids, or alkaline materials for cleaning, follow the manufacturer's recommendations for use. Wear goggles and protective clothing to reduce the possibility of personal injury.



⚠ WARNING ⚠

Some solvents are flammable and toxic. Read the manufacturer's instructions before using.

⚠ WARNING ⚠

Wear appropriate eye and face protection when using compressed air. Flying debris and dirt can cause personal injury.

Clean the fittings. Use a cleaning solvent. Dry with compressed air.

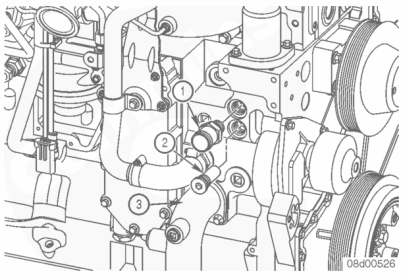
Inspect the fittings for cracks, corrosion, and other damage.

If a component is damaged, it **must** be replaced.

Install

⚠ CAUTION ⚠

The fitting and plug must be installed in the proper locations. The plug blocks off the thermostat bypass. Do not install the plug upstream of the torque converter cooler supply fitting. Doing so blocks off coolant flow to both the thermostat bypass and the torque converter cooler, severe engine damage can occur.



Note : When installing any 90 or 45 degree coolant line fittings, make sure to maintain proper orientation while tightening.

Apply a film of pipe sealant, Part Number 3375066, or equivalent, to the threads of the M22 fitting and plug.

Install the M22 x 1.5 fitting and plug into the engine block coolant supply port

Torque Value: 60 n•m [44 ft-lb]

Apply a film of pipe sealant, Part Number 3375066, or equivalent, to the threads of the torque converter coolant return fitting.

Install the torque converter coolant return fitting into the water inlet connection or radiator return. Location and size depends on the OEM. See equipment manufacturer service information.

Use the following procedure for torque values on various fittings sizes. Refer to Procedure 017-011 in Section 17. (/qs3/pubsys2/xml/en/procedures/100/100-017-011.html)

1. M22 x 1.5 fitting (supply port)
2. M22 plug
3. Water inlet connection.

Finishing Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

⚠ CAUTION ⚠

Always vent the engine during filling to remove air from the coolant system, or overheating can result.

- Connect the OEM torque converter plumbing as required. See equipment manufacturer service information.
- Fill the engine with coolant. Refer to Procedure 008-018 in Section 8. (/qs3/pubsys2/xml/en/procedures/425/425-008-018-tr.html)
- Connect the batteries. See equipment manufacturer service information.
- Operate the engine. Check for leaks.

ANADOLU ISUZU

Last Modified: 04-Aug-2016

Select Service Tools

Recommended Cummins® Service Tools

- Belt tensioner gauge, Part Number ST 1293, or equivalent

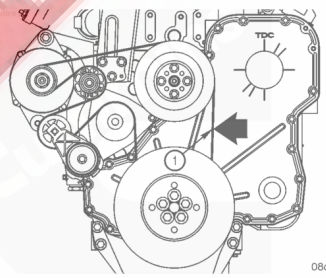
Additional Service Items

- No additional service items required.

Initial Check

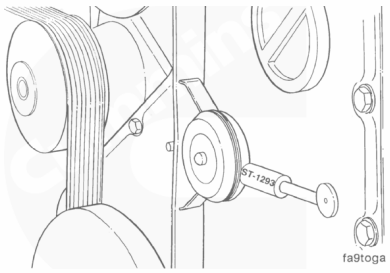
Check the belt deflection at the longest span of the belt. The deflection **must** be checked at the center (1) of the span.

The maximum deflection allowed in the belt is 9.5 to 12.7 mm [3/8 to 1/2 in].



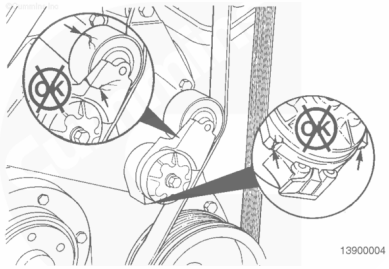
Use belt tensioner gauge, Part Number ST 1293, or equivalent, to measure the tension in the drive belt.

Belt Tension		
n		lbf
356	MIN	80
534	MAX	120



If the measurement is out of the specified range, replace **only** the belt. Perform the tension test again. If the measurement is still outside of the specified rang after the new belt has been installed, replace the belt tensioner.

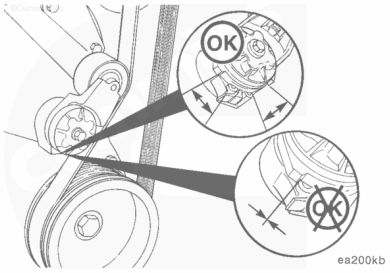
Check the tensioner arm, pulley, and stops for cracks. If any cracks are observed, the tensioner **must** be replaced.



ANADOLU ISUZU SPARE PARTS

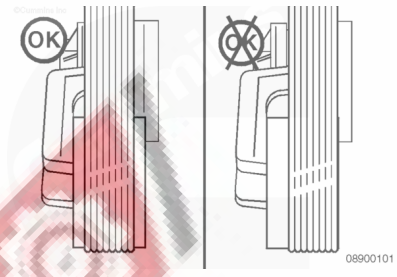
With the belt installed, verify neither tensioner arm stop is in contact with the spring casing stop. If either stop is touching, replace the drive belt. Refer to Procedure 008-002 in Section 8. (/qs3/pubsys2/xml/en/procedures/425/425-008-002-tr.html)

After replacing the belt, if the tensioner arm stops are still in contact with the spring case stop, replace the tensioner.



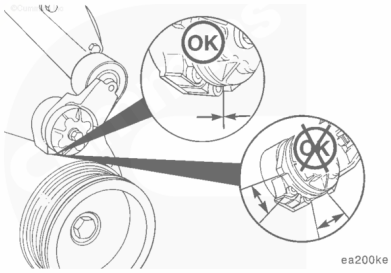
Check the location of the drive belt on the belt tensioner pulley. The belt **must** be centered on, or close to the middle of, the pulley. Misaligned belts, either too far forward or backward, can cause belt wear, belt roll-off failures, or increase uneven tensioner bushing wear.

Belt mis-alignment is **not always** a result of a malfunctioning or faulty belt tensioner. Make sure the adjacent pulleys and mounting brackets are aligned and mounted correctly. Refer to Procedure 008-002 in Section 8. (/qs3/pubsys2/xml/en/procedures/425/425-008-002-tr.html)



Remove the drive belt. Refer to Procedure 008-002 in Section 8. (/qs3/pubsys2/xml/en/procedures/425/425-008-002-tr.html)

With the belt removed, verify the tensioner arm stop is in contact with the spring case stop. If they are **not** touching, the tensioner **must** be replaced.



Preparatory Steps

⚠ WARNING ⚠

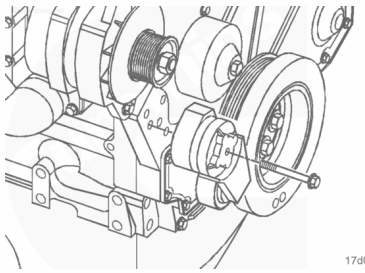
Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

- Disconnect the batteries. See equipment manufacturer service information.
- Remove the drive belt. Refer to Procedure 008-002 in Section 8. (/qs3/pubsys2/xml/en/procedures/425/425-008-002-tr.html)

Remove

Note : Most belt tensioners are mounted to the water inlet connection. Some belt tensioners are mounted to a separate mounting bracket and use internal fasteners for clearance.

Remove the capscrew and belt tensioner from the bracket.



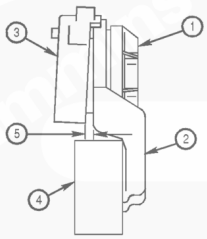
Inspect for Reuse

Inspect the cooling fan drive belt for reuse. Refer to Procedure 008-002 in Section 8. (/qs3/pubsys2/xml/en/procedures/425/425-008-002-tr.html)



Measure the clearance between the tensioner spring case and tensioner arm to verify tensioner wear-out and uneven bearing wear. If the clearance at the measurement point 5 exceeds 3 mm [0.12 in], the tensioner is damaged and **must** be replaced as a complete assembly.

Tensioners generally will show a larger clearance gap near the lower portion of the spring case, resulting in the upper portion rubbing against the tensioner arm.

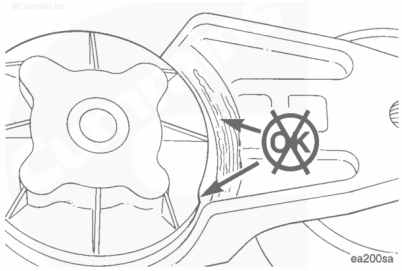


1. Tensioner cap
2. Tensioner arm
3. Spring case
4. Tensioner pulley
5. Clearance gap.

Note : Always replace the belt when a tensioner is replaced. However, it is **not always** necessary to replace a tensioner when a belt is replaced.

ANADOLU ISUZU
ISUZU SALES

Inspect the tensioner for evidence of the tensioner arm contacting the tensioner cap. If there is evidence of the two areas making contact, the pivot tube bushing has malfunctioned and the tensioner **must** be replaced.



Install

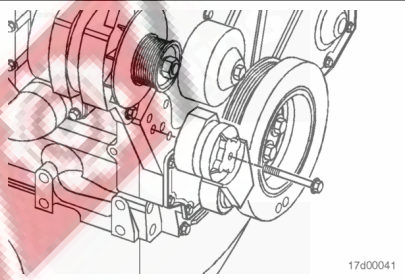
Note : Some belt tensioner mounting brackets use internal fasteners for clearance.

If removed, install the belt tensioner mounting bracket and mounting bracket capscrews.

Torque Value: 24 n•m [212 in-lb]

Install the belt tensioner and capscrew.

Torque Value: 43 n•m [32 ft-lb]



Finishing Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

- Install the drive belt. Refer to Procedure 008-002 in Section 8. (/qs3/pubsys2/xml/en/procedures/425/425-008-002-tr.html)
- Connect the batteries. See equipment manufacturer service information.
- Operate the engine. Check for proper operation.

ANADOLU ISUZU PARTS SALES


ANADOLU ISUZU
AFTER SALES

Select Service Tools

Recommended Cummins® Service Tools

- No Cummins® Service Tools required.

Additional Service Items

- No additional service items required.

Preparatory Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

⚠ WARNING ⚠

Do not remove the pressure cap from a hot engine. Wait until the coolant temperature is below 50°C [120°F] before removing the pressure cap. Heated coolant spray or steam can cause personal injury.

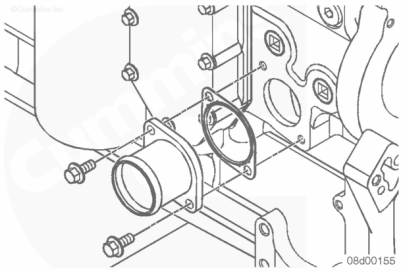
⚠ WARNING ⚠

Coolant is toxic. Keep away from children and pets. If not reused, dispose of in accordance with local environmental regulations.

- Disconnect the batteries. See equipment manufacturer service information.
- Drain the coolant. Refer to Procedure 008-018 in Section 8. (/qs3/pubsys2/xml/en/procedures/425/425-008-018-tr.html)
- Disconnect the water inlet connection. Refer to Procedure 008-082 in Section 8. (/qs3/pubsys2/xml/en/procedures/425/425-008-082.html)

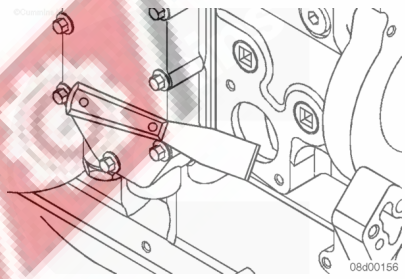
Remove

Remove the water inlet connection capscrews.



Clean and Inspect for Reuse

Clean all the mating surfaces.

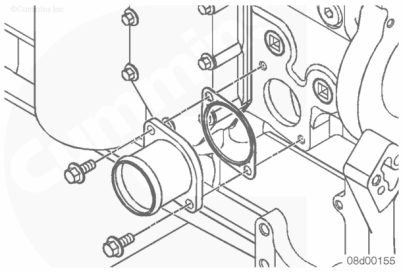


Install

Install a new water inlet connection gasket.

Install the water inlet connection and mounting capscrews.

Torque Value: 24 n•m [212 in-lb]



Finishing Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

ANADOLU ISUZU AFTERSALES

- Connect the water inlet connection. Refer to Procedure 008-082 in Section 8. (/qs3/pubsys2/xml/en/procedures/425/425-008-082.html)
- Fill the engine with coolant. Refer to Procedure 008-018 in Section 8. (/qs3/pubsys2/xml/en/procedures/425/425-008-018-tr.html)
- Connect the batteries. See equipment manufacturer service information.
- Operate the engine. Check for leaks.

Last Modified: 04-Aug-2016

ANADOLU ISUZU AFTER SALES

Select Service Tools

Recommended Cummins® Service Tools

- Pipe sealant, Part Number 3375066, or equivalent

Additional Service Items

- No additional service items required.

General Information

The purpose of this procedure is to explain how to install and remove the selective catalytic reduction (SCR) coolant fittings that connect to the engine block.

The location and size of these fittings could possibly vary from original equipment manufacturer (OEM) to OEM. See equipment manufacturer service information for detailed information.

Generally, the SCR coolant supply port is located at the rear of the engine block on the exhaust side and the SCR coolant return port is located at the water inlet connection.

Preparatory Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

⚠ WARNING ⚠

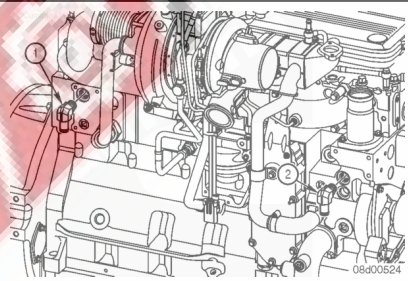
Do not remove the pressure cap from a hot engine. Wait until the coolant temperature is below 50°C [120°F] before removing the pressure cap. Heated coolant spray or steam can cause personal injury.

⚠ WARNING ⚠

Coolant is toxic. Keep away from children and pets. If not reused, dispose of in accordance with local environmental regulations.

- Disconnect the batteries. See equipment manufacturer service information.
- Drain the cooling system. Refer to Procedure 008-018 in Section 8. (/qs3/pubsys2/xml/en/procedures/425/425-008-018-tr.html)
- Disconnect the OEM SCR coolant plumbing as required. See equipment manufacturer service information.

Remove



Note : This step applies to the removal of SCR coolant plumbing fittings.

Note : Make sure to check proper orientation and location when removing any 90 or 45 degree coolant line fittings.

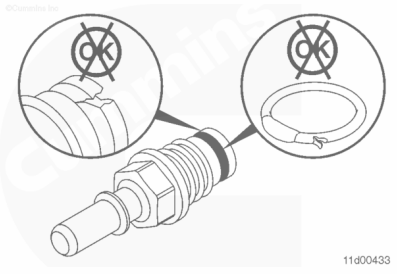
Remove the 3/4 - 14 NPT fitting from the engine block SCR coolant supply port.

Remove the SCR coolant return fitting. The location and size depends on the OEM. See equipment manufacturer service information.

Clean and Inspect for Reuse

⚠ WARNING ⚠

When using solvents, acids, or alkaline materials for cleaning, follow the manufacturer's recommendations for use. Wear goggles and protective clothing to reduce the possibility of personal injury.



⚠ WARNING ⚠

Some solvents are flammable and toxic. Read the manufacturer's instructions before using.

⚠ WARNING ⚠

Wear appropriate eye and face protection when using compressed air. Flying debris and dirt can cause personal injury

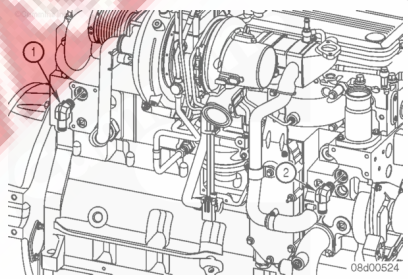
Clean the fittings. Use a cleaning solvent. Dry with compressed air.

Inspect the fittings for cracks, corrosion, or other damage.

If the component is damaged, the component **must** be replaced.

Install

Note : This step applies to the installation of the SCR coolant plumbing fitting.



Note : When installing any 90 or 45 degree coolant line fittings, make sure proper orientation is maintained while tightening.

Apply a film of pipe sealant, Part Number 3375066, or equivalent, to threads of the 3/4 - 14 NPT fitting.

Install the 3/4 - 14 NPT fitting into the engine block SCR coolant supply port.

Torque Value: 75 n•m [55 ft-lb]

Apply a film of pipe sealant, Part Number 3375066, or equivalent, to the threads of the SCR coolant return fitting.

Install the SCR coolant return fitting. Location and size depends on the OEM. See equipment manufacturer service information for detailed information.

Use the following procedure for proper torque values on various fitting sizes. Refer to Procedure 017-007 in Section 17. (/qs3/pubsys2/xml/en/procedures/99/99-017-007.html)

Finishing Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

- Connect the OEM SCR coolant plumbing as required. See equipment manufacturer service information.
- Fill the engine with coolant. Refer to Procedure 008-018 in Section 8. (/qs3/pubsys2/xml/en/procedures/425/425-008-018-tr.html)
- Connect the batteries. See equipment manufacturer service information.
- Operate the engine. Check for leaks.

Last Modified: 04-Aug-2016

ANADOLU ISUZU AFTER SALES

Select Service Tools

Recommended Cummins® Service Tools

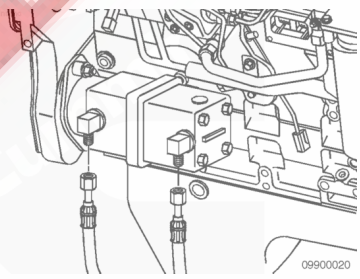
- No Cummins® Service Tools required.

Additional Service Items

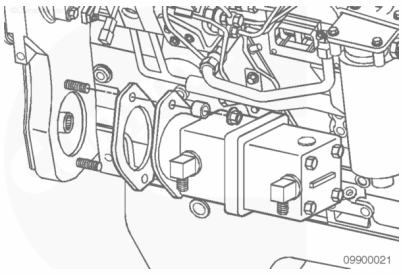
- No additional service items required.

Remove

Disconnect all hydraulic lines from the pump. See equipment manufacturer service information.

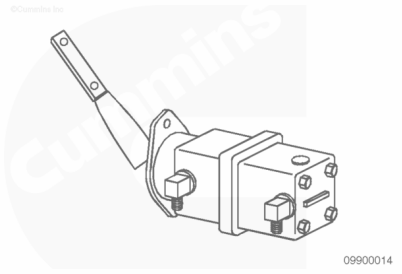


Remove the hydraulic pump and gear assembly. See equipment manufacturer service information.



Clean and Inspect for Reuse

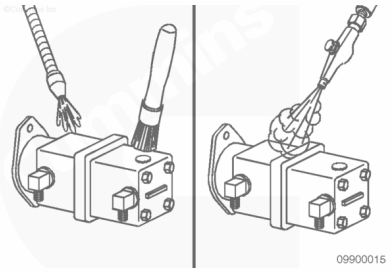
Clean the gasket material from the hydraulic pump.



ANADOLU ISUZU AFTERSALES

⚠ WARNING ⚠

When using solvents, acids, or alkaline materials for cleaning, follow the manufacturer's recommendations for use. Wear goggles and protective clothing to reduce the possibility of personal injury.



⚠ WARNING ⚠

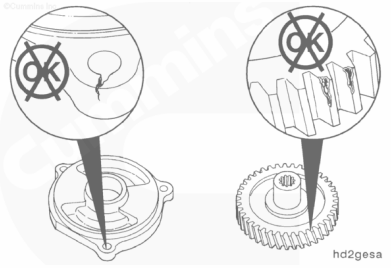
Some solvents are flammable and toxic. Read the manufacturer's instructions before using.

⚠ WARNING ⚠

Wear appropriate eye and face protection when using compressed air. Flying debris and dirt can cause personal injury.

Clean the hydraulic pump gear. Use solvent. Dry with compressed air.

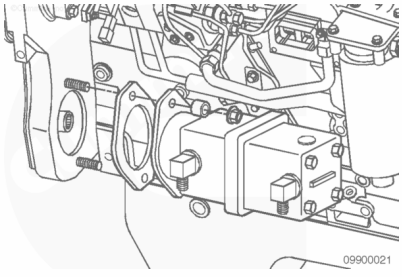
Inspect the hydraulic pump drive gear for damage.



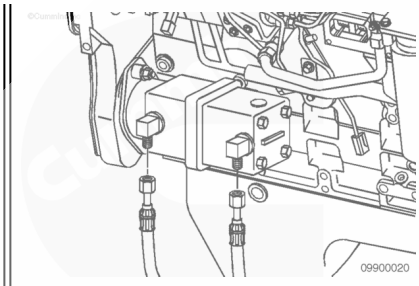
ANADOLU ISUZU AFTER SALES

Install

Use a new gasket and install the hydraulic pump. See equipment manufacturer service information.

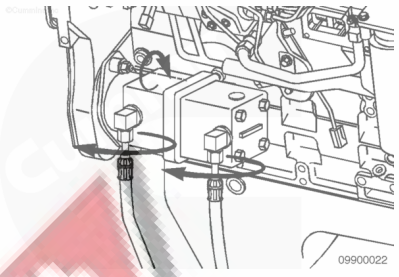


Connect all hydraulic lines to the pump. See equipment manufacturer service information.



Tighten mounting bolts.

Torque Value: 43 n•m [32 ft-lb]



Last Modified: 04-Aug-2016

ANADOLU ISUZU AFTER SALES

Select Service Tools

Recommended Cummins® Service Tools

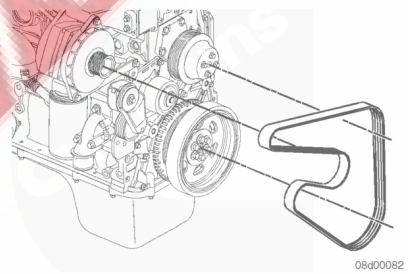
- No Cummins® service tools required.

Additional Service Items

- Belt gauge

General Information

Some refrigerant compressors use the cooling fan drive belt. Use the following procedure for information and instructions on these belts. Refer to Procedure 008-002 in Section 8. (/qs3/pubsys2/xml/en/procedures/425/425-008-002-tr.html)



Preparatory Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

- Disconnect the batteries. See equipment manufacturer service information.

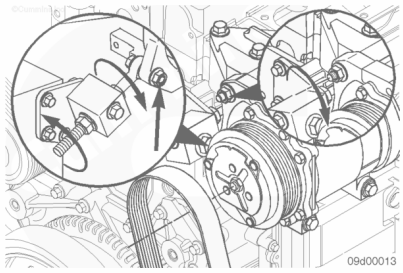
Remove

Loosen the pivot bolt.

Loosen the bolt that attaches the adjusting link to the compressor bracket.

Loosen the adjusting nuts on the adjusting link to remove tension from the belt.

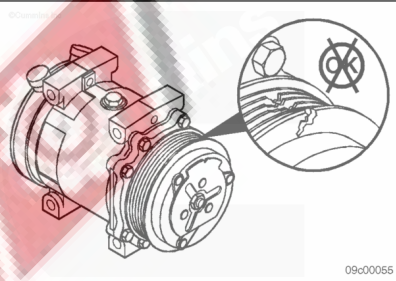
Remove the refrigerant compressor drive belt.



Inspect for Reuse

Inspect the refrigerant compressor pulley for cracks or broken grooves.

Replace the refrigerant compressor, if damaged.



Inspect the belt for cracks, glazing, tears or cuts, and excessive wear.

Replace the belt, if necessary.

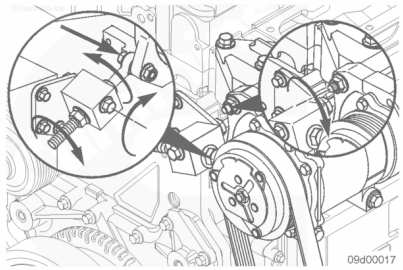


Install

Tighten the pivot bolts and adjusting link bolts finger-tight.

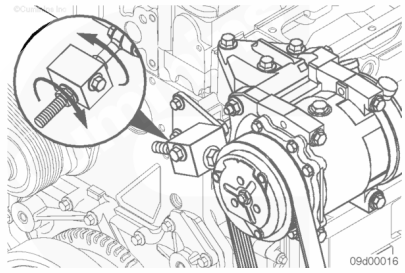
Tighten the bolt that attaches the adjusting link to the compressor bracket finger-tight.

Install the refrigerant compressor drive belt.

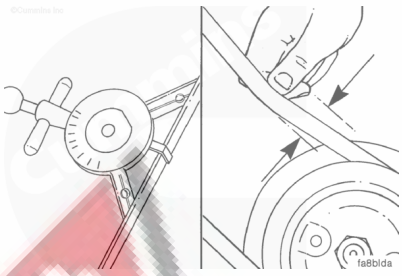


Use the adjusting nuts on the adjusting link to tighten the refrigerant compressor drive belt.

ANADOLU ISUZU AFTER SALES



Use a belt gauge to measure the belt tension. Use the following procedure for the correct gauge and tension value for the belt width used. Refer to Procedure 018-005 in Section V. (/qs3/pubsys2/xml/en/procedures/99/99-018-005.html)

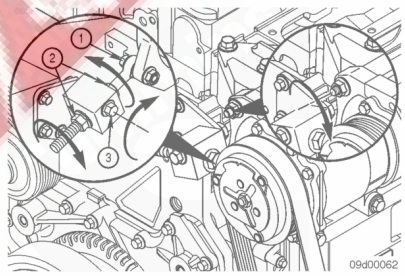


Tighten the pivot bolt, adjusting link bolts, and adjusting link to bracket mounting bolt.

Torque Value:
Pivot Bolt (1) 43 n•m [32 ft-lb]

Torque Value:
Adjusting Link Bolts (2) 77 n•m [57 ft-lb]

Torque Value:
Adjusting Link to Bracket Mounting Bolt (3) 43 n•m [32 ft-lb]



Finishing Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

- Connect the batteries. See equipment manufacturer service information.
- Operate the engine. Check for belt squeal. Excessive belt squeal indicates belt slippage.
- If belt squeal is present, check the belt tension.

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Last Modified: 01-Nov-2016



Select Service Tools

Recommended Cummins® Service Tools

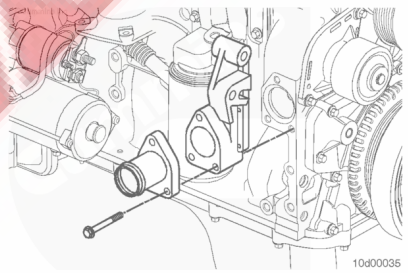
- No Cummins® Service Tools required.

Additional Service Items

- No additional service items required.

General Information

Some refrigerant compressor brackets are integral to the water inlet connection. Use the following procedure for information and instructions on these brackets. Refer to Procedure 008-082 in Section 8 . (/qs3/pubsys2/xml/en/procedures/425/425-008-082.html)



Preparatory Steps

⚠ WARNING ⚠

To protect the environment, liquid refrigerant systems must be properly emptied and filled using equipment that prevents the release of refrigerant gas into the atmosphere. Federal law requires capturing and recycling the refrigerant.

- Remove the refrigerant compressor belt. Refer to Procedure 009-052 in Section 9. (/qs3/pubsys2/xml/en/procedures/425/425-009-052.html)

Remove

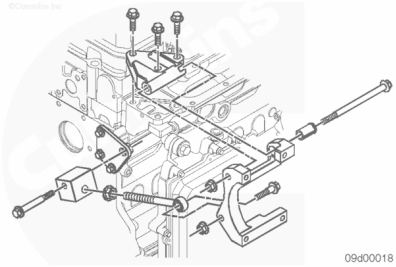
Remove the adjusting link capscrews.

ANADOLU ISUZU AFTER SALES

Remove the adjusting link.

Remove the pivot capscrew and refrigerant compressor support.

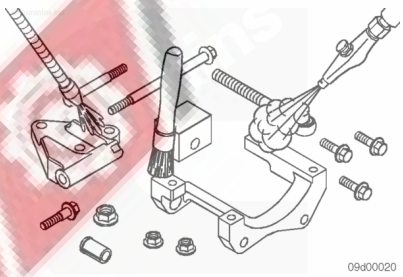
Remove the remaining capscrews and brackets.



Clean and Inspect for Reuse

⚠ WARNING ⚠

When using solvents, acids or alkaline materials for cleaning, follow the manufacturer's recommendations for use. Wear goggles and protective clothing to reduce the possibility of personal injury.



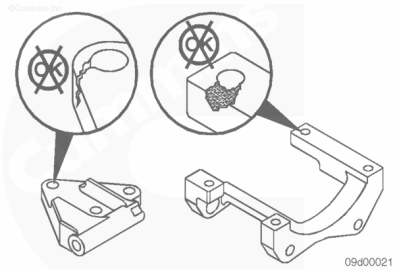
⚠ WARNING ⚠

Wear appropriate eye and face protection when using compressed air. Flying debris and dirt can cause personal injury.

Clean the refrigerant compressor mounting brackets. Use solvent. Dry with compressed air.

Inspect the refrigerant compressor mounting brackets.

Replace the refrigerant compressor mounting bracket if cracked or otherwise damaged.



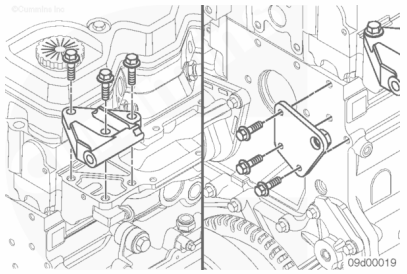
Install

Install the two mounting brackets and capscrews.

Tighten the capscrews.

Torque Value:
M8 23 n•m [204 in-lb]

Torque Value:
M10 43 n•m [32 ft-lb]



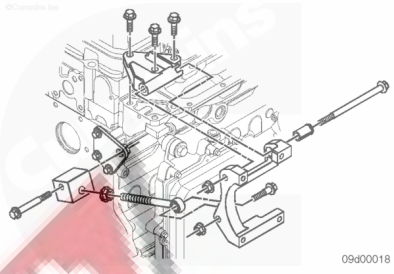
Install the refrigerant compressor support.

Install the pivot capscrew hand-tight.

Install the adjusting link.

Install the adjusting link capscrew hand-tight.

Tighten the adjusting link capscrews and pivot capscrew after the refrigerant compressor is installed and the drive belt has been tensioned. Refer to Procedure 009-052 in Section 9. (/qs3/pubsys2/xml/en/procedures/425/425-009-052.html)

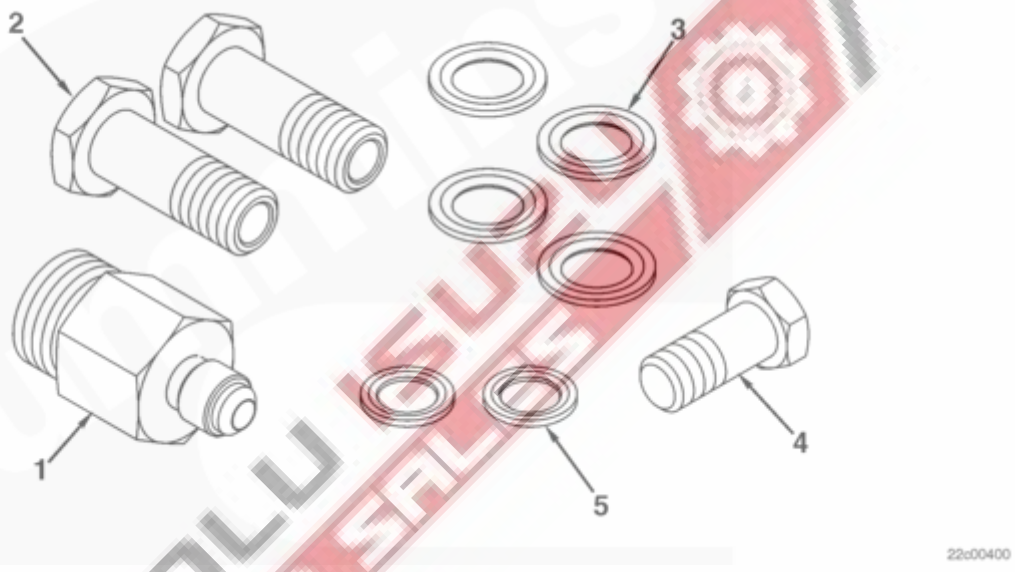


Finishing Steps

- Install the refrigerant compressor belt. Refer to Procedure 009-052 in Section 9. (/qs3/pubsys2/xml/en/procedures/425/425-009-052.html)
- Operate the engine. Check for leaks.

Last Modified: 04-Aug-2016

Air Intake System

Tool Number
2892101
Turbocharger Coolant Leak Test Kit This kit is used with air pressure regulator, Part Number 3164231, or equivalent, to perform a diagnostic leakdown test on the turbocharger coolant passages.


Tool Number
2892320
Black Light (VDC) Used to inspect for oil or fuel leaks.

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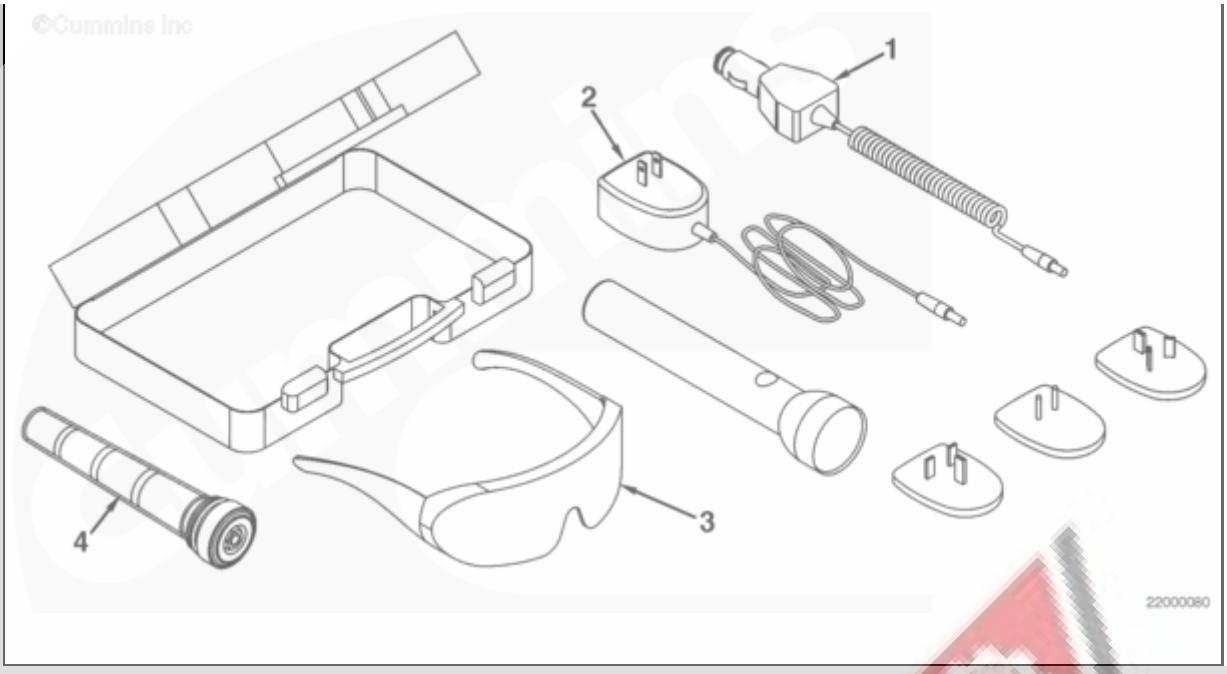
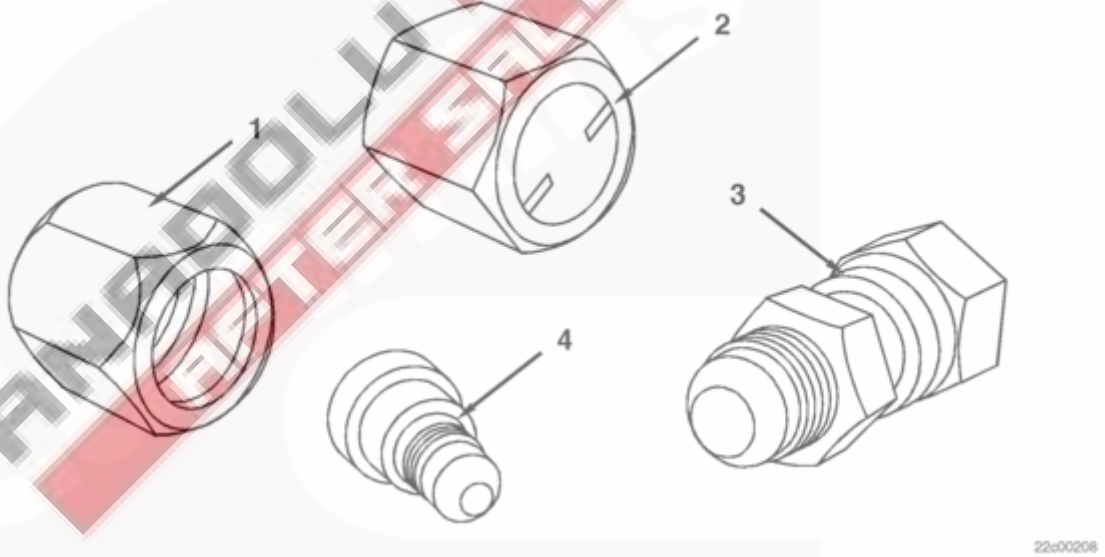


Tool Number

3164231

Air Pressure Regulator

This regulator will allow pressure testing of the water jacket on the new variable geometry turbocharger (VGT).

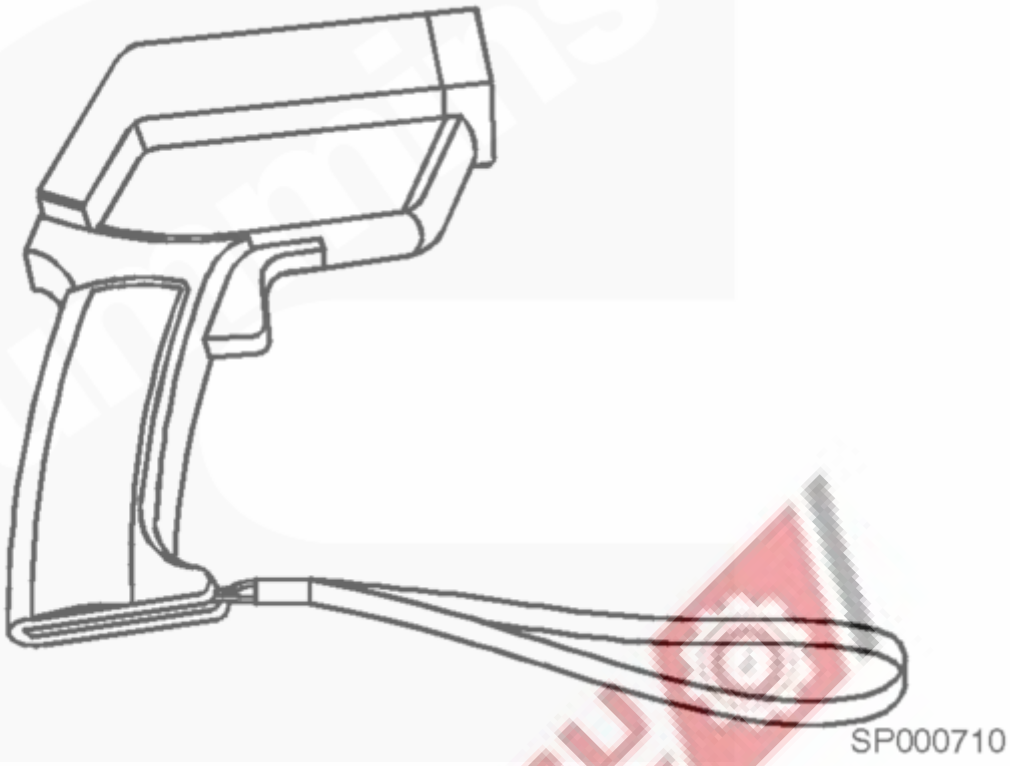


Tool Number

3164487

Infrared Thermometer

This small hand-held infrared digital thermometer is an excellent instrument to measure surface temperatures without actually making physical contact with a temperature probe.



Tool Number

3164488

Digital Multimeter

Used to measure electrical circuits: voltage (volts), resistance (ohms), and current (amperes).



Tool Number

3164489

Digital Multimeter (Standard Meter)

Automotive meter with built in temperature adapter and tachometer.

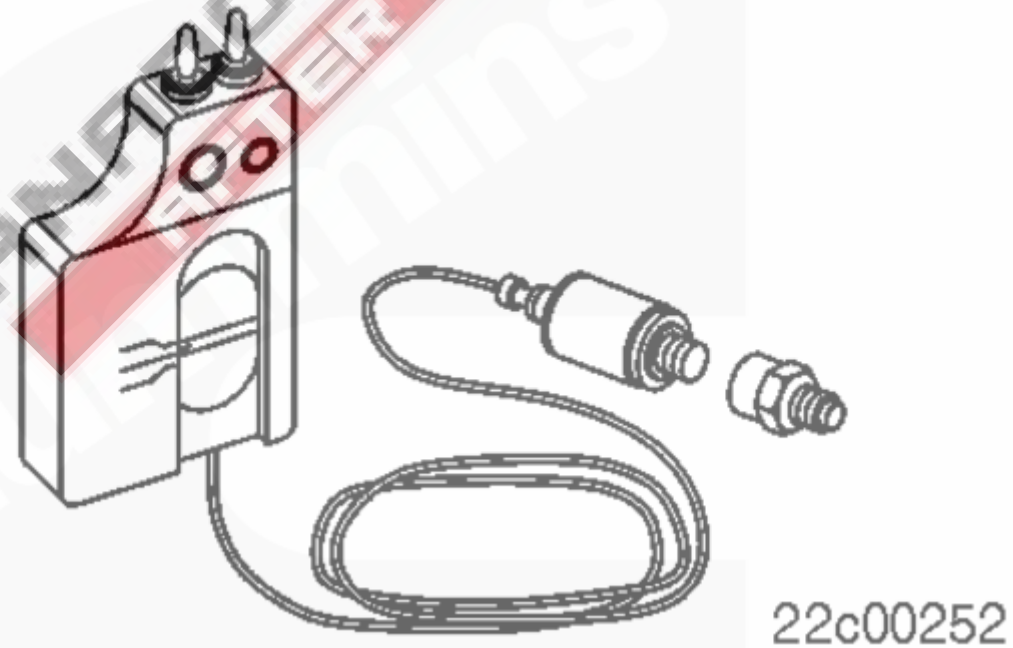


Tool Number

3164491

Pressure and Vacuum Module

Used with multimeter, Part Number 3164488, to measure pressures and vacuums.

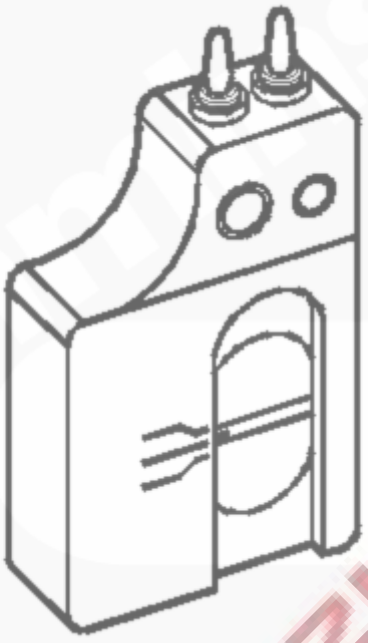


Tool Number

3164499

Digital Thermometer

Used to measure ambient air temperature. Used with digital multimeter, Part Number 3164488.



Tool Number

3375066

Thread Sealant

This product locks and seals threaded fluid fitting. This product resists leakage, vibration loosening, moisture, hydraulic fluids and diesel fuels, and other liquids. It also lubricates the threads for easy assembly and disassembly.



SP000797

Tool Number

3376891

Fluorescent Tracer

Used with black light, Part Number 2892930, to find oil leaks (added to oil).



3376891

Tool Number

3822988

Thermocouple Wire Kit

Used to check temperature. Used with fluke digital multimeter, Part Number 3164488.

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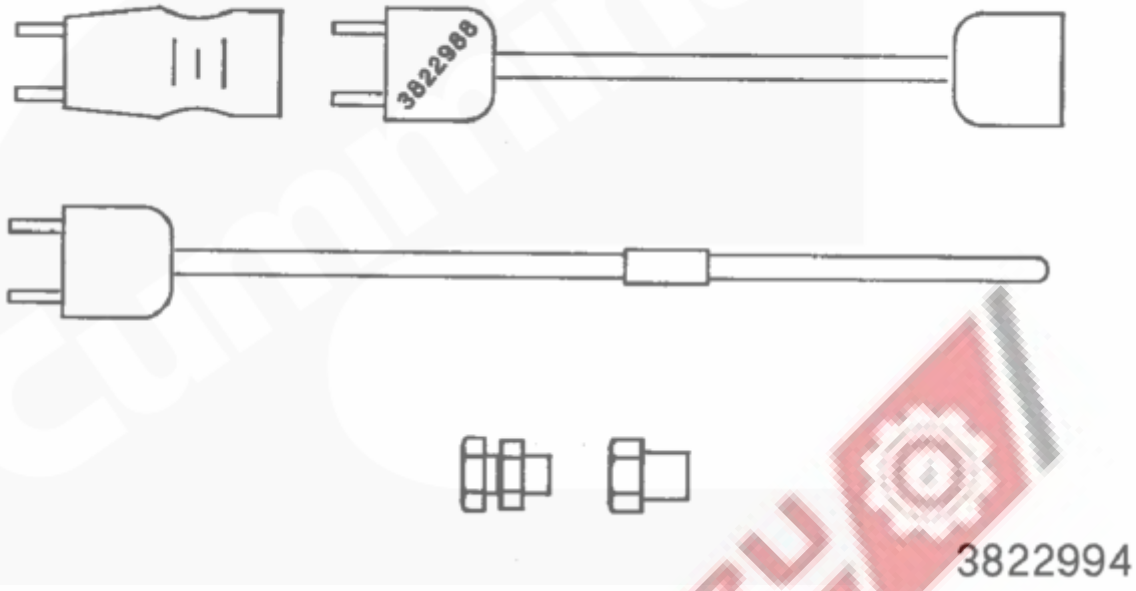

Tool Number

3823205

Pressure Gauge (0 to 60 psi)

This test kit provides a special adapter (2) to fit in place of the rocker housing solenoid to measure oil supply pressure as desired. The gauge (1), hose, and adapter are included in the kit.

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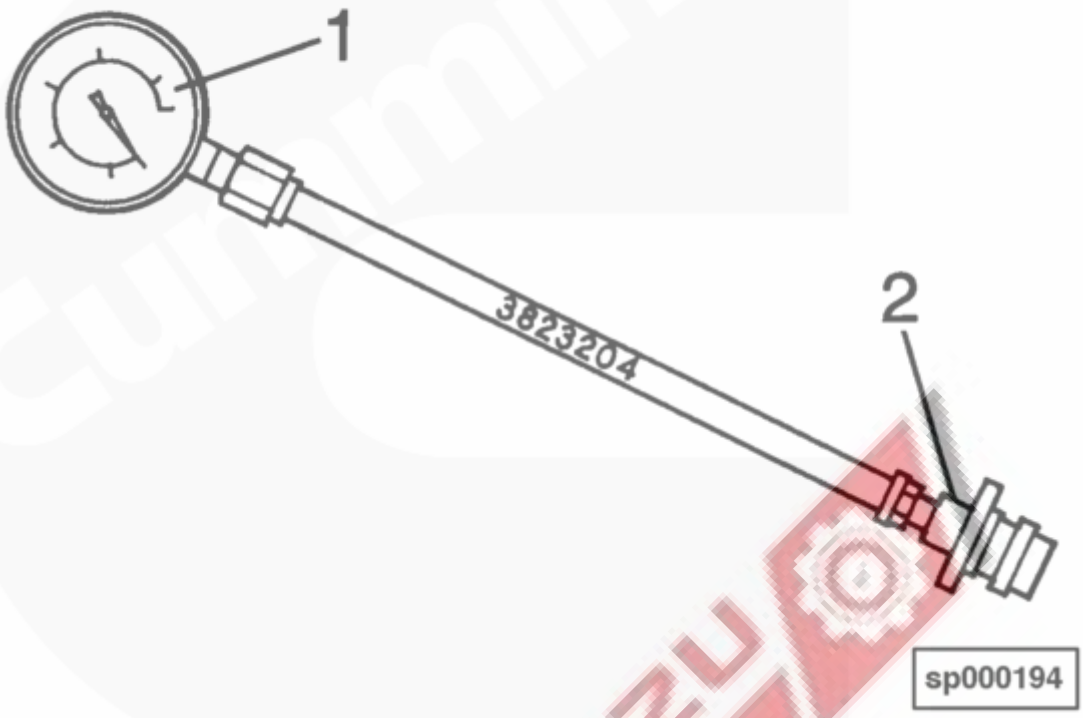

Tool Number

3824041

Thread Sealant

This threadlocker is a general purpose medium strength thread locking compound. It is ideal for all nut and bolt applications. It works especially well for ¼ inch and larger fasteners.

Tool Number

3824732

Anti-Seize Compound

This is a copper compound anti-seize lubricant which protects parts against extreme heat 982°C [1800°F], corrosion, rust, and pitting. It has been approved by Cummins Inc. for use with heated oxygen sensors, studs, capscrews, and other fasteners.

Tool Number

4918921

Turbocharger Actuator Inspection Gauge Kit

Contains the following service tools: Pinout connector tool, Part Number 2892510, test leads (2), Part Number 3164113, Delphi® retainer removal tool, Part Number 4918921. See Service Tool Instruction, Bulletin 3400414, for additional information.

Tool Number
4919085
Charge-Air Cooler Tester Used to pressure test the charge air cooler.

Tool Number
5298776
Air Handling Clean Care Kit Contains a variety of protective caps to prevent contamination of vehicle air handling plumbing during service procedures.

Tool Number
ST 537
Dial Depth Gauge Used to measure turbocharger axial motion.

Tool Number
ST 1111 3
Manometer Used to measure pressure, restriction (0 to 10 in H2O) with more accuracy.

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Last Modified: 10-Aug-2016

Select Service Tools

Recommended Cummins® Service Tools

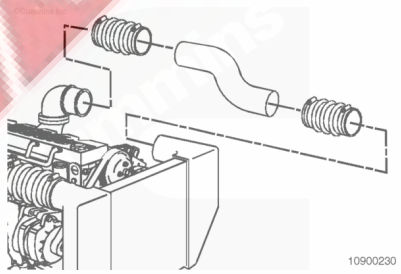
- Air Handling Clean Care Kit, Part Number 5298776

Additional Service Items

- No additional service items required.

Remove

Note : Brush away all loose dirt from around the area of the air handling connections to avoid contamination of the interior of the engine.

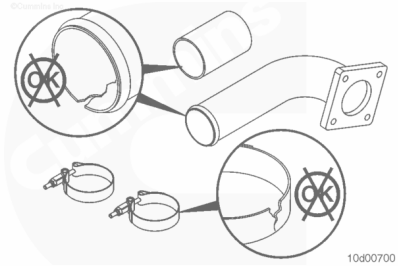


Loosen the hose clamps. Position the crossover tube so it can be removed.

Remove the crossover tube.

Install the protective caps from Air Handling Clean Care Kit, Part Number 5298776, on all open connection points, including inlet to the engine, charge air cooler, and ends of the crossover tube.

Inspect for Reuse



Check the crossover tube for cracks, holes, and worn sections.

Also check for poor sealing between the hose and tube.

Inspect the clamps for wear.

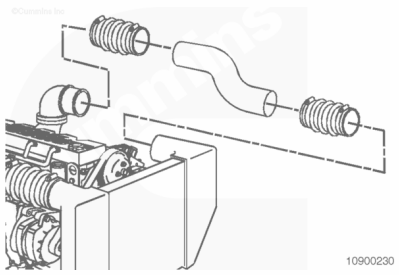
Replace damaged components with a new hose and clamps, if necessary.

Install

Remove all protective caps from the components.

Install the crossover tube and clamps in the reverse order of removal.

Tighten the clamps. See equipment manufacturer service information for the torque specification.



Last Modified: 04-Aug-2016

ANADOLU ISUZU AFTER SALES

Select Service Tools

Recommended Cummins® Service Tools

- Air Handling Clean Care Kit, Part Number 5298776

Additional Service Items

- No additional service items required.

General Information

The air inlet connection connects the turbocharger air inlet to the original equipment manufacturer (OEM) air inlet piping.

Preparatory Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

Note : Brush away all loose dirt from around the area of the air handling connections to avoid contamination of the interior of the engine.

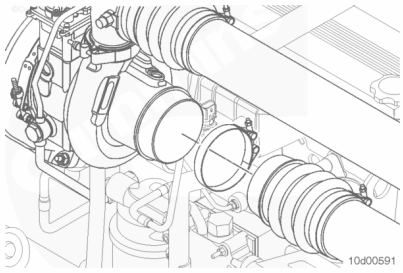
- Disconnect the batteries. See equipment manufacturer service information.
- Remove the air crossover pipe attached to the intake connection. Refer to Procedure 010-019 in Section 10. (/qs3/pubsys2/xml/en/procedures/425/425-010-019.html)

Remove

Loosen the clamps which hold the air inlet connection to the turbocharger air inlet and OEM air inlet piping.

Remove the air inlet connection. Take care **not** to get any dirt or debris inside the turbocharger.

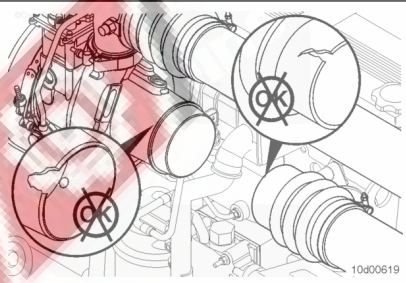
Use protective caps from Air Handling Clean Care Kit, Part Number 5298776, to cover both connection points.



Clean and Inspect for Reuse

⚠ WARNING ⚠

When using solvents, acids, or alkaline materials for cleaning, follow the manufacturer's recommendations for use. Wear goggles and protective clothing to reduce the possibility of personal injury.



⚠ WARNING ⚠

Use skin and eye protection when handling caustic solutions to reduce the possibility of personal injury.

⚠ WARNING ⚠

Wear appropriate eye and face protection when using compressed air. Flying debris and dirt can cause personal injury.

Clean the piping and connections. Use solvent or hot, soapy water. Dry with compressed air.

Check the piping and connections for cracks, holes, and worn sections.

If any damage is found, replace the damaged components.

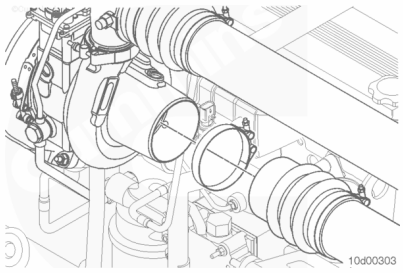
Install

Make sure to remove all protective caps from the components.

Install the air inlet piping and connections.

Tighten the attaching clamps.

See equipment manufacturer service information for correct torque specification.



Finishing Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

- Install the air crossover pipe that is attached to the connection. Refer to Procedure 010-019 in Section 10. (/qs3/pubsys2/xml/en/procedures/425/425-010-019.html)
- Connect the batteries. See equipment manufacturer service information.
- Operate the engine. Check for leaks.

ANADOLU ISUZU AFTER SALES

Last Modified: 25-Apr-2017

Select Service Tools

Recommended Cummins® Service Tools

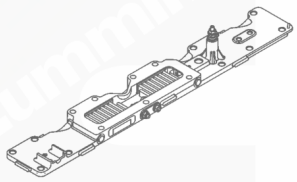
- Thread sealant, Part Number 3824041

Additional Service Items

- Heavy tape
- Gasket scraper

Initial Check

Verify the cold starting aid is functioning properly. Refer to Procedure 010-029 in Section 10. (/qs3/pubsys2/xml/en/procedures/425/425-010-029.html)



Preparatory Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

⚠ WARNING ⚠

When using a steam cleaner, wear safety glasses or a face shield, as well as protective clothing. Hot steam can cause serious personal injury.

⚠ WARNING ⚠

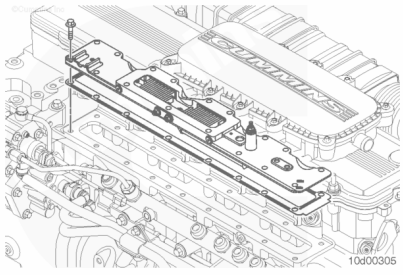
ANADOLU ISUZU AFTERSALES

Wear appropriate eye and face protection when using compressed air. Flying debris and dirt can cause personal injury.

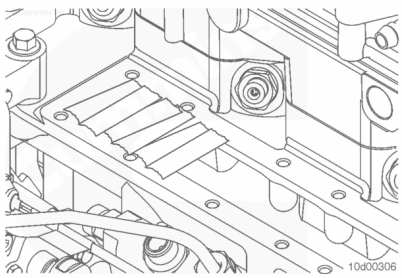
- Disconnect the batteries. See equipment manufacturer service information.
- Steam clean the area around the air intake manifold to remove any loose dirt or debris. Dry with compressed air.
- Disconnect the electrical connection from the cold starting aid. See equipment manufacturer service information.
- Remove the charge air piping from the air intake connection adapter. Refer to Procedure 010-019 in Section 10. (/qs3/pubsys2/xml/en/procedures/425/425-010-019.html)
- Remove the engine intake throttle actuator. Refer to Procedure 010-140 in Section 10. (/qs3/pubsys2/xml/en/procedures/425/425-010-140.html)
- Remove the exhaust gas recirculation (EGR) connection tube. Refer to Procedure 011-025 in Section 11. (/qs3/pubsys2/xml/en/procedures/425/425-011-025.html)
- Remove the EGR valve. Refer to Procedure 011-022 in Section 11. (/qs3/pubsys2/xml/en/procedures/425/425-011-022.html)
- Remove the air intake connection. Refer to Procedure 010-080 in Section 10. (/qs3/pubsys2/xml/en/procedures/425/425-010-080.html)
- Remove the injector supply lines. Refer to Procedure 006-051 in Section 6. (/qs3/pubsys2/xml/en/procedures/425/425-006-051.html)
- Remove the intake manifold pressure/temperature sensor. Refer to Procedure 019-159 in Section 19. (/qs3/pubsys2/xml/en/procedures/425/425-019-159.html)
- Disconnect the injector pass through connectors.

Remove

Remove the remaining capscrews holding the air intake manifold to the cylinder head.



Use heavy tape to cover the intake manifold opening in the cylinder head to prevent debris from entering the engine.



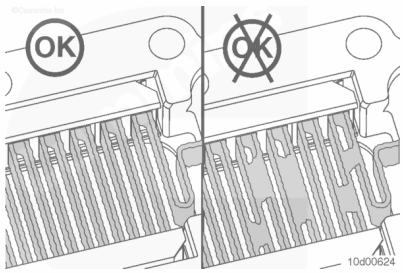
ANADOLU ISUZU PARTS SALES

Clean and Inspect for Reuse

Inspect the air intake manifold heater for plugging and soot buildup.

Soot **only** covering individual elements is acceptable.

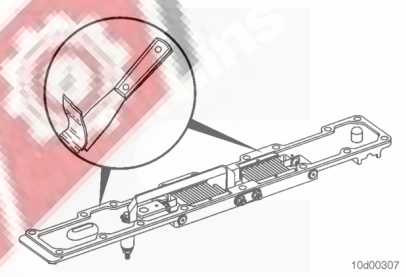
If plugged with soot bridging the heating elements check for the source: turbocharger, air compressor, temperature/pressure sensor, relay, and wiring harness. Replace the air intake manifold heater if necessary.



Note : The cold starting aid and air intake manifold will be coated with a layer of carbon. This carbon coating is normal.

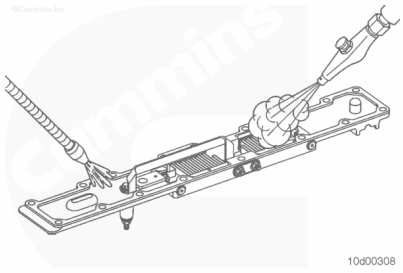
Note : The air intake manifold can have a corrosion-resistant coating on the inside. Take care **not** to scratch or otherwise damage this coating.

Scrape the gasket surfaces with a gasket scraper on both the intake manifold and cylinder head. Take care **not** to drop any gasket material into the cylinder head.



⚠ WARNING ⚠

When using solvents, acids, or alkaline materials for cleaning, follow the manufacturer's recommendations for use. Wear goggles and protective clothing to reduce the possibility of personal injury.



⚠ WARNING ⚠

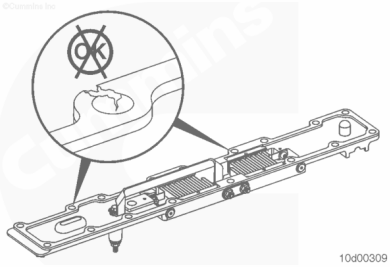
Wear appropriate eye and face protection when using compressed air. Flying debris and dirt can cause personal injury.

Clean the intake manifold and cold starting aid. Use solvent. Dry with compressed air.

Inspect the air intake manifold for cracks, warping, or other damage. Replace, if necessary.

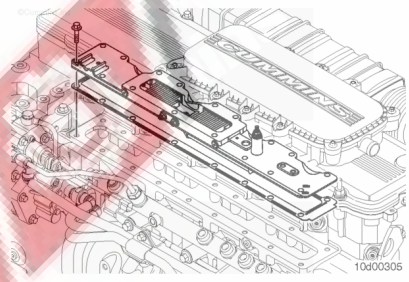
Note : The air intake manifold and cold starting aid are an integral unit. If the cold starting aid needs to be

replaced, the entire intake manifold **must** be replaced.



Install

If previously taped off, remove the tape from the cylinder head prior to installing the intake manifold.



If a new air intake manifold is being installed, verify the correct voltage manifold is being installed. Both 12 VDC and 24 VDC versions exist.

Install the air intake manifold to the cylinder head with a new gasket.

Lightly coat the threads of the capscrews with thread sealant, Part Number 3824041, to prevent boost leaks. This is **only** necessary if reusing the capscrews.

Tighten the capscrews in a crisscross pattern, starting from the middle of the manifold.

Torque Value: 24 n•m [212 in-lb]

Finishing Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

- Install the injector supply lines. Refer to Procedure 006-051 in Section 6. (/qs3/pubsys2/xml/en/procedures/425/425-006-051.html)
- Connect the injector pass through connectors.
- Install the intake manifold pressure/temperature sensor. Refer to Procedure 019-159 in Section 19. (/qs3/pubsys2/xml/en/procedures/425/425-019-159.html)

ANADOLU ISUZU AFTER SALES

- Install the air intake connection. Refer to Procedure 010-080 in Section 10. (/qs3/pubsys2/xml/en/procedures/425/425-010-080.html)
- Install the EGR valve. Refer to Procedure 011-022 in Section 11. (/qs3/pubsys2/xml/en/procedures/425/425-011-022.html)
- Install the EGR connection tube. Refer to Procedure 011-025 in Section 11. (/qs3/pubsys2/xml/en/procedures/425/425-011-025.html)
- Install the engine intake throttle actuator. Refer to Procedure 010-140 in Section 10. (/qs3/pubsys2/xml/en/procedures/425/425-010-140.html)
- Install the charge air piping to the air intake connection adapter. Refer to Procedure 010-019 in Section 10. (/qs3/pubsys2/xml/en/procedures/425/425-010-019.html)
- Connect the electrical connection to the cold starting aid. See equipment manufacturer service information.
- Connect the batteries. See equipment manufacturer service information.
- Operate the engine. Check for leaks.

Last Modified: 04-Aug-2016

ANADOLU ISUZU AFTER SALES

Select Service Tools

Recommended Cummins® Service Tools

- No Cummins® Service Tools required.

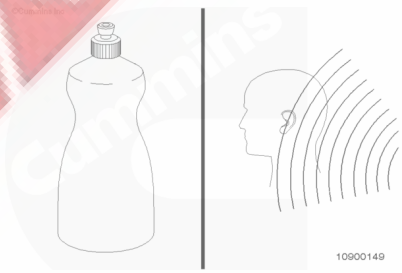
Additional Service Items

- No additional service items required.

Initial Check

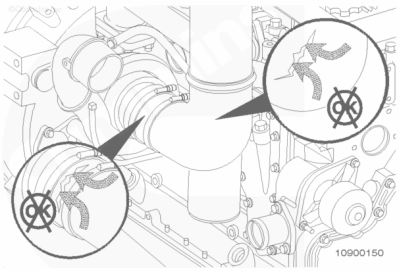
Leaks in the intake air system are most commonly identified by:

1. Inspection of piping for cracked or loose clamps
2. Applying a solution of soapy water in the suspected area and inspecting for bubbles
3. Listening for a high-pitched whining or sucking noise in the suspected area.



⚠ CAUTION ⚠

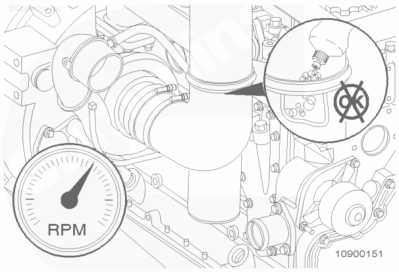
Engine intake air must be filtered to prevent dirt and debris from entering the engine. If intake air piping is damaged or loose, unfiltered air will enter the engine and cause premature wear.



Inspect the inlet air piping for cracked hoses and damaged or loose clamps.

Operate the engine at high idle. Use a solution of soapy water to spot intake air leaks.

If an air leak exists, the soap bubbles will be drawn in with the air.



Replace damaged pipes and tighten loose clamps to make sure the charge air piping and hoses do **not** leak.

Torque Value: 10 n•m [89 in-lb]

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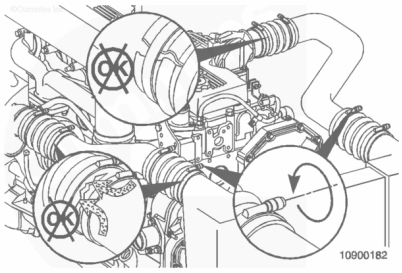
Check for corrosion of the inlet system piping under the clamps and hoses. Corrosion can allow corrosive products and dirt to enter the intake system.

Disassemble and clean, as required.

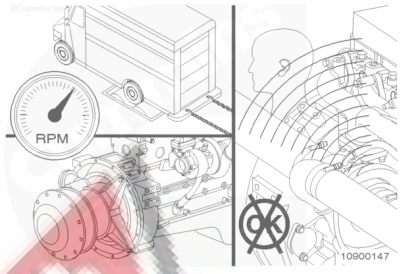


Operate the engine at full throttle and rated rpm with maximum load.

Listen for a high-pitched whistling sound from the turbocharger, nearby piping, and connections.

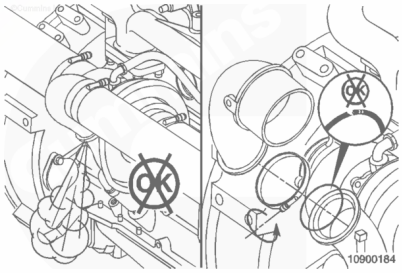
Apply a soapy water solution to sealing surfaces. Inspect for bubbles. Bubbles can be easily detected.

Note : During an active regeneration event, a high-pitched whistling sound emitting from the turbocharger can be present at low engine speeds and light engine loads. This sound is normal and does **not** signify an air leak.



Leaks can also be found at the turbocharger compressor outlet connection.

Inspect for damage, replace the sealing o-ring, and tighten loose clamps. Refer to Procedure 010-033 in Section 10. (/qs3/pubsys2/xml/en/procedures/425/425-010-033.html)

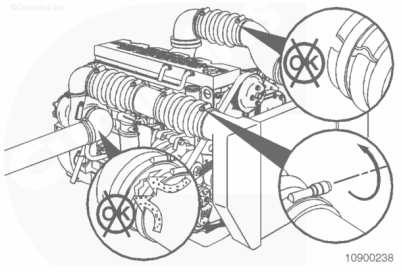


Charge Air Cooler Tubing or Connecting Hoses:

Inspect the hose and tubing for damage. Refer to Procedure 010-019 in Section 10. (/qs3/pubsys2/xml/en/procedures/425/425-010-019.html)

Tighten loose clamps.

See the equipment manufacturer service information for the correct torque value.

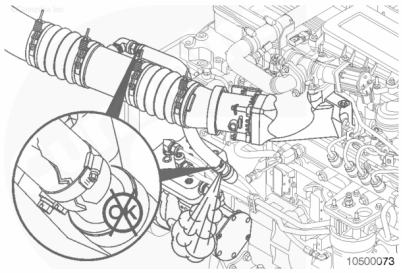


Air Compressor Plumbing:

The air compressor is supplied with turbocharged air **only**.

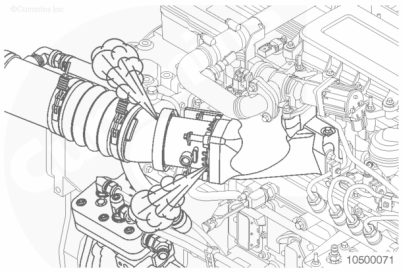
Inspect the original equipment manufacturer (OEM) air supply hose, fittings, and clamps for damage.

Tighten loose clamps and fittings.



Replace the OEM air supply hose, fittings, or clamps, if necessary. See equipment manufacturer service information.

Air Intake Connection, Engine Intake Throttle Actuator, Air Intake Connection Adapter:



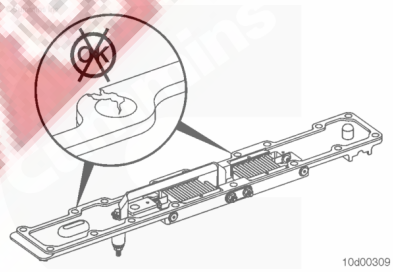
Inspect for damage.

Replace the connection clamp, o-ring, or gasket, if necessary.

Refer to Procedure 010-140 in Section 10. (/qs3/pubsys2/xml/en/procedures/425/425-010-140.html)

Refer to Procedure 010-131 in Section 10. (/qs3/pubsys2/xml/en/procedures/425/425-010-131.html)

Intake Manifold:



Inspect for damage.

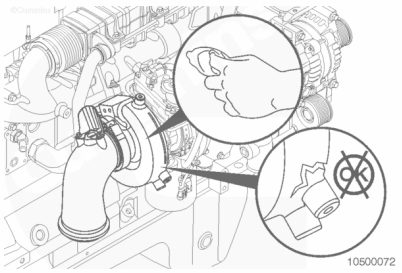
If damage is found, replace the gasket if the engine was originally equipped with a gasket.

Open Crankcase Ventilation System:



Inspect for damage, tighten loose fittings, and replace cracked or leaking hoses and piping.

Compressor Housing:



Clean and inspect for cracks in the compressor housing.

Tighten the clamp, if loose.

Exhaust System:

Leaks in the exhaust system will cause the turbocharger to operate at a lower speed, reducing the amount of air going to the cylinders during engine operation.

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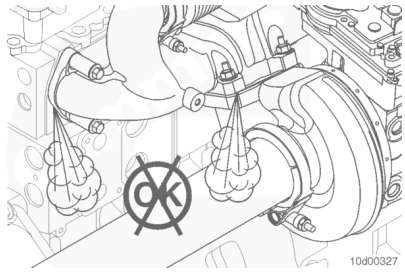
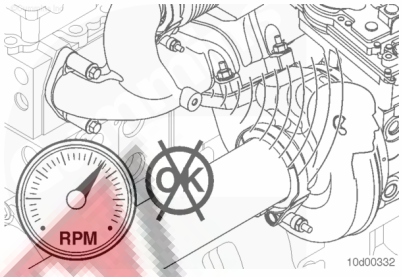


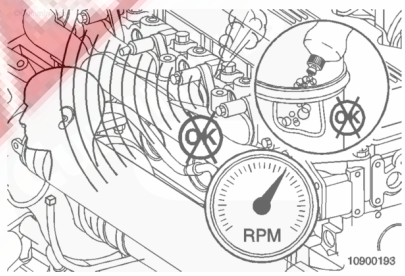
Operate the engine at full throttle and rated rpm with maximum load.

Leaks can be identified by noise, soapy water, or discoloration caused by the escaping hot gases.



Operate the engine at full throttle and rated rpm with maximum load.

Listen and inspect again for leaks.



Leaks can be found at:

- Exhaust manifold gaskets
- Turbocharger mounting gaskets
- Turbine housing sealing surface
- Exhaust gas recirculation (EGR) component gaskets
- EGR cooler inlet gasket
- EGR cooler outlet gasket
- EGR valve inlet gasket
- EGR valve mounting gasket.

ANADOLU ISUZU AFTER SALES


ANADOLU ISUZU
AFTER SALES

Select Service Tools

Recommended Cummins® Service Tools

- Air Handling Clean Care Kit, Part Number 5298776
- Charge air cooler tester, Part Number 4919085
- Pressure gauge, Part Number 3823205 - Quantity 2
- Thermocouple bead probe, Part Number 3164498
- Digital multimeter, Part Number 3164488
- Temperature adapter, Part Number 3164499
- Air Handling Clean Care Kit, Part Number 4919508

Additional Service Items

- Spray bottle of soapy water
- Rubber mallet

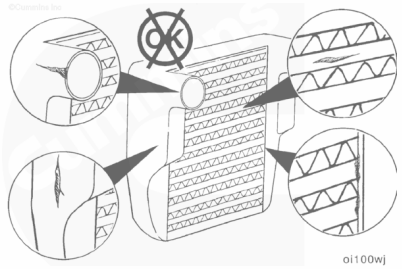
Initial Check

Inspect the charge air cooler for cracks, holes, and other damage.

Inspect the tubes, fins, and welds for tears, breaks, or other damage.

If any damage causes the charge air cooler to fail the air leak check, the charge air cooler **must** be replaced.

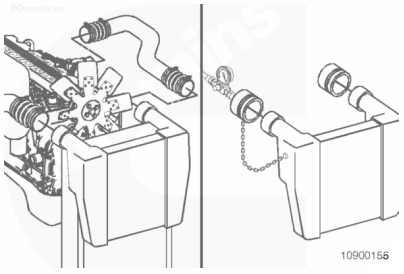
Inspect the charge air cooler plumbing for cracks and other damage.



Leak Test

⚠ WARNING ⚠

To prevent possible injury if either plug blows off during the test, secure safety chains on the test plugs to any convenient capscrew on the radiator assembly. This test must not be performed without securely fastened safety chains.



ANADOLU ISUZU AFTER SALES

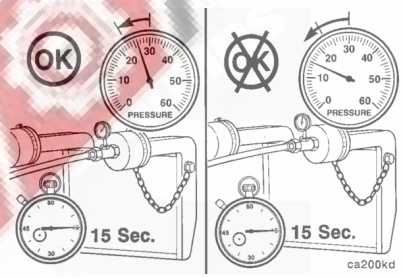
To check the charge air cooler for cracked tubes or header, remove the inlet and outlet hoses from the cooler. The charge air cooler does **not** have to be removed from the chassis.

Use protective caps from Air Handling Clean Care Kit, Part Number 5298776, to cover open points on the plumbing, engine, and charge air cooler.

Install a plug or cap over the outlet side of the cooler. Install a pressure gauge and a regulated shop air supply line with a shutoff valve to the inlet side of the cooler.

Use charge air cooler tester, Part Number 4919085.

Apply air pressure to the cooler until the pressure gauge reads a steady 207 kPa [30 psi] of air pressure.

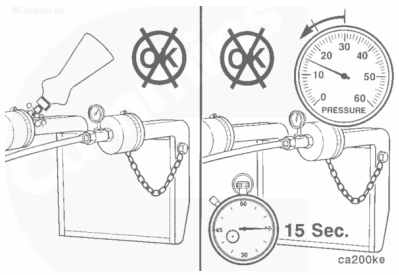


Shut off the air flow to the cooler and start a stopwatch at the same time. Record the leakage at 15 seconds.

If the pressure drop is 48 kPa [7 psi] or less in 15 seconds, the cooler is operational.

If the pressure drop is greater than 48 kPa [7 psi] in 15 seconds, check all connections again.

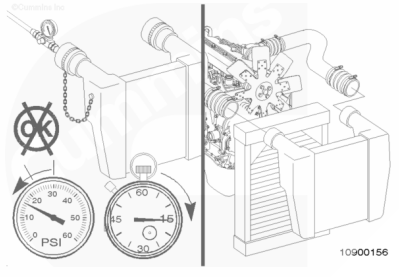
Determine if the pressure drop is caused by a leak in the charge air cooler or by a leaky connection. Use a spray bottle filled with soapy water, applied to all hose connections. Watch for bubbles to appear at the location of the leak.



If the pressure drop is caused by a leaky connection, repair the connection, and repeat the test. If the leak is within the charge air cooler, repeat the test to verify the accuracy of the pressure drop measurement. Similar pressure drop readings **must** be obtained at least three consecutive tests before the reading can be considered accurate.

Note : If a charge air cooler leak causes a pressure drop of more than 48 kPa [7 psi] in 15 seconds, it will appear as a major leak in a leak tank.

If the pressure drop is greater than 48 kPa [7 psi] in 15 seconds, the charge air cooler **must** be replaced.



See equipment manufacturer service information for replacement instructions.

ANADOLU ISUZU PARTS SALES

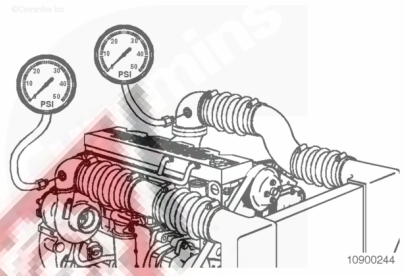
Note : Charge air coolers are **not** designed to be 100 percent leak-free. If the pressure drop is less than 48 kPa [7 psi] in 15 seconds, the charge air cooler does **not** need to be replaced.

Pressure Test

Obtain two pressure gauges, Part Number 3823205. Check both gauges on the same pressure source at 206 kPa [30 psi] to verify consistency.

Install one pressure gauge in the 1/8 inch fitting in the turbocharger compressor outlet elbow. Install the other pressure gauge in the intake manifold.

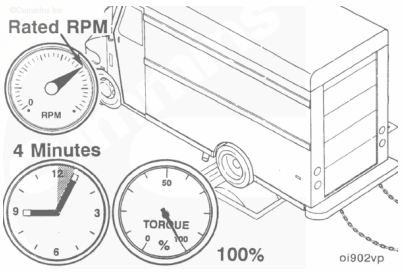
Another alternative to measure the intake manifold pressure is to use the monitor mode on INSITE™ electronic service tool.



Operate the engine at rated rpm and load. Record the readings on the two gauges.

If the differential pressure is greater than 20.6 kPa [3 psi], check the charge air cooler and associated piping for plugging, restrictions, or damage.

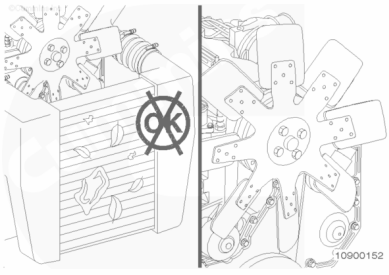
Clean or replace, if necessary.



Temperature Differential Test

Inspect the charge air cooler fins for obstructions to air flow. Remove obstructions such as a winterfront or debris. Manually lock the shutters in the OPEN position, if equipped.

Lock the fan drive in the ON mode to prevent erratic test results. This can be done by installing a jumper wire across the temperature switch.

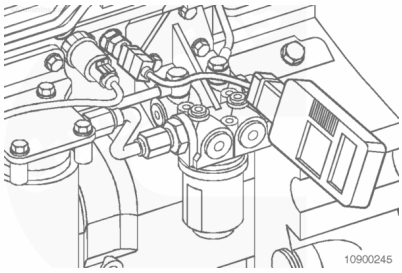


Install thermocouple bead probe, Part Number 3164498.

Connect digital multimeter, Part Number 3164488, and temperature adaptor, Part Number 3164499, to the thermocouple bead probe to read intake air temperature.

Another alternative is to use the monitor mode on the INSITE™ electronic service tool.

Install another thermocouple at the air cleaner inlet to measure ambient air temperature.



Perform a road test with the engine at peak power and a vehicle speed of 48 kph [30 mph] or greater.

Record the intake manifold temperature and ambient air temperature.

Calculate the differential temperature:

- Intake manifold temperature - ambient air temperature = differential temperature.
- Maximum Differential Temperature: 21°C [38°F].

If the temperature differential is greater than the specifications, check the charge air cooler for dirt and debris on the fins. Clean, as necessary. If the problem still exists, check the charge air cooler for debris in the fins or between the charge air cooler and radiator. Confirm full fan engagement.

ANADOLU ISUZU AFTER SALES

Preparatory Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

⚠ WARNING ⚠

Wear appropriate eye and face protection when using compressed air. Flying debris and dirt can cause personal injury.

- Disconnect the batteries. See equipment manufacturer service information.
- Clean debris from the outside of the charge air cooler. Use compressed air.

- Remove the charge air cooler piping. Refer to Procedure 010-019 in Section 10. (/qs3/pubsys2/xml/en/procedures/425/425-010-019.html)

Remove

Remove the charge air cooler. See equipment manufacturer service information.

Use protective caps from Air Handling Clean Care Kit, Part Number 4919508, to cover open points on the plumbing, engine, and charge air cooler.

Clean

⚠ WARNING ⚠

When using solvents, acids, or alkaline materials for cleaning, follow the manufacturer's recommendations for use. Wear goggles and protective clothing to reduce the possibility of personal injury.

⚠ CAUTION ⚠

Do not use caustic cleaners to clean the charge air cooler. Damage to the charge air cooler will result.

Note : If the engine experiences a turbocharger failure or any other occasion where oil or debris is put into the charge air cooler, the charge air cooler **must** be cleaned.

Flush the charge air cooler internally with solvent in the opposite direction of normal airflow. Shake the charge air cooler, and lightly tap on the end tanks with a rubber mallet to dislodge trapped debris. Continue flushing until all debris or oil is removed (i.e., the water runs clear).

Note : Make sure the tubes are in the upright position when flushing.

If the debris can **not** be totally removed from the charge air cooler, the charge air cooler **must** be replaced.

Install

Install the charge air cooler. See equipment manufacturer service information for instructions.

Finishing Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

- Install the charge air cooler piping. Refer to Procedure 010-019 in Section 10. (/qs3/pubsys2/xml/en/procedures/425/425-010-019.html)
- Connect the batteries. See equipment manufacturer service information.
- Operate the engine. Check for leaks.

ANADOLU KUZEY AFTER SALES

Last Modified: 01-Nov-2016

Select Service Tools

Recommended Cummins® Service Tools

- Voltmeter, Part Number 3164489, or equivalent
- Infrared non-contact thermometer, Part Number 3164457

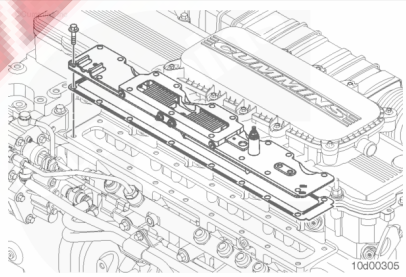
Additional Service Items

- No additional service items required.

General Information

The cold starting aid is **not** a serviceable part.

If the cold starting aid has cracked, broken, or melted elements, the entire air intake manifold **must** be replaced. Refer to Procedure 010-023 in Section 10. (/qs3/pubsys2/xml/en/procedures/425/425-010-023.html)



ISL preheat information:

The cold starting aid **must** be actuated prior to a cold start, which is termed “preheat”. Preheat time is determined as a function of the average of the intake manifold temperature sensor reading and the coolant temperature sensor reading at keyswitch ON, as shown in Figure 1.

ANADOLU ISUZU
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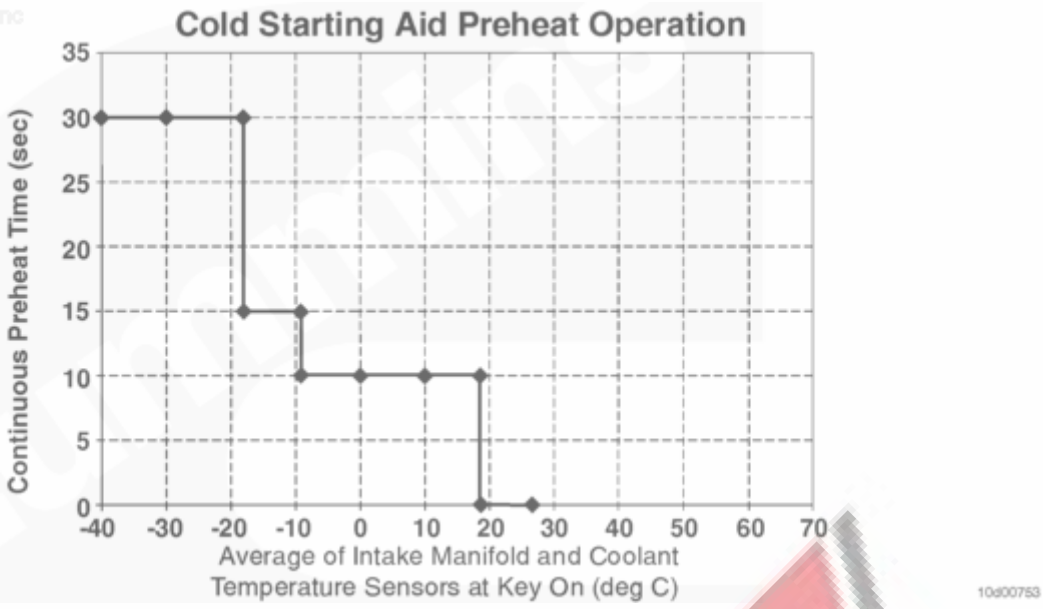
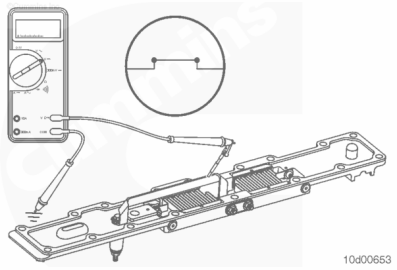


Figure 1: Cold Starting Aid Preheat Cycle

After a cold start, the cold starting aid **must** be activated during warm-up, which is termed “post-heat”. The post-heat schedule is determined by the average of the intake manifold temperature sensor reading and the coolant temperature sensor reading at key ON. Post-heat is deactivated at speeds greater than 30 kph [18.6 mph] if equipped with a vehicle speed sensor. The cold starting aid post-heat operates for minimum of 30 seconds if the average of the intake manifold temperature sensor and the coolant temperature sensor is below 49°C [120°F]. The post-heat operation is turned OFF if the temperature is above this threshold. The actual duration is calculated by the ECM and is a function of engine speed and the average of the intake manifold temperature sensor and the coolant temperture sensor.

Test

Verify cold starting aid operation.



Use voltmeter, Part Number 3164489, or equivalent, and connect the negative test lead to the block ground.

Connect the positive test lead to the electrical connector of the cold starting aid.

Connect INSITE™ electronic service tool. From the list of "Diagnostic Tests" select "Grid Heater Override".

Turn ON the cold starting aid for a few seconds, and note the voltage read by the voltmeter, then turn it OFF again. The voltmeter **must** read within 1 VDC of battery voltage. If it does **not**, there is problem with the wiring or the power jumper in the manifold.

Check the cold starting aid relay circuit. Refer to Procedure 019-408 in Section 19. (/qs3/pubsys2/xml/en/procedures/99/99-019-408.html)

Check the original equipment manufacturer (OEM) wiring and cold starting aid relay functionality. See equipment manufacturer service information for instructions.

Repair the wiring as necessary.

If the electrical connection reads close to battery voltage, turn ON the cold starting aid using the "Grid Heater Override" test. To check if the cold starting aid is heating, use infrared non-contact thermometer, Part Number 3164457. If the air intake manifold does **not** heat, it **must** be replaced.

Last Modified: 04-Aug-2016

ANADOLU ISUZU AFTER SALES

Select Service Tools

Recommended Cummins® Service Tools

- No Cummins® Service Tools required.

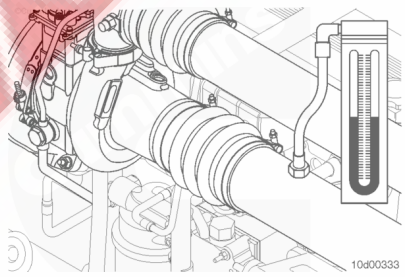
Additional Service Items

- Vacuum gauge or water manometer

Measure

Install a vacuum gauge or water manometer in the intake air piping.

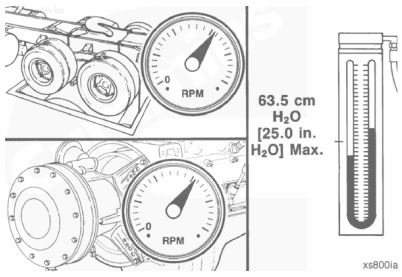
The gauge adapter **must** be installed at a 90 degree angle to the airflow in a straight section of pipe, one pipe diameter before the turbocharger.



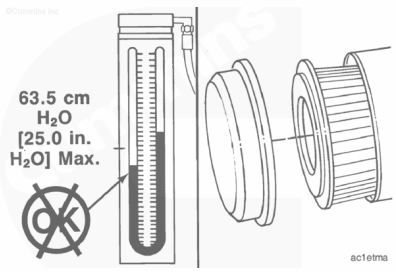
Operate the engine at full throttle and rated rpm with maximum load.

Record the data on the gauge or manometer.

Inlet Air Restriction		
cm H_2O		**in H_2O**
63.5	MAX	25.0

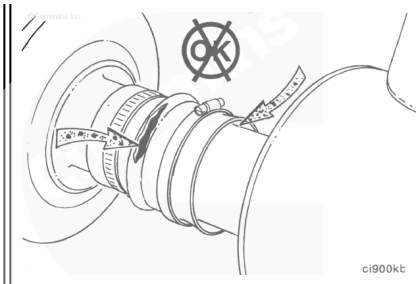


If restriction exceeds specifications, replace or clean the air filter element. See equipment manufacturer service information.



Inspect the intake piping for damage. See equipment manufacturer service information.

Remove the test equipment.



Last Modified: 04-Aug-2016

ANADOLU ISUZU
AFTER SALES

Select Service Tools

Recommended Cummins® Service Tools

- Air Handling Clean Care Kit, Part Number 5298776
- Turbocharger Coolant Leak Test Kit, Part Number 2892101
- Air Pressure Regulator Kit, Part Number 3164231
- Dial depth gauge, Part Number ST 537

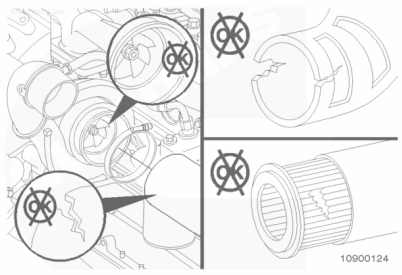
Additional Service Items

- Anti-seize compound

Initial Check

⚠ CAUTION ⚠

Do not operate the engine with the charge air piping removed. The lack of boost pressure on the outlet side of the compressor outlet can cause progressive damage to the turbocharger.



Remove the intake pipe from the turbocharger. See the Remove section in this procedure.

Install protective caps from Air Handling Clean Care Kit, Part Number 5298776, on all open connection points.

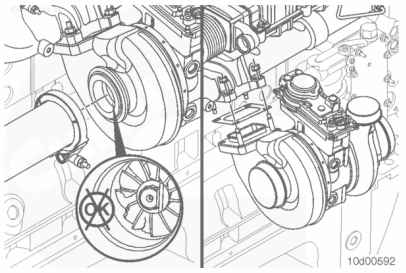
Inspect the turbocharger compressor impeller blades for damage.

Replace the turbocharger if damage is found. See the Remove and Install sections in this procedure.

If the turbocharger compressor impeller is damaged, do the following:

- Inspect the intake piping and filter element for damage.
- Repair any damaged parts before operating the engine.
- See High Blowby and Lubricating Oil Consumption Caused by Dirt and Dust Ingestion, Service Bulletin 5613318 (/qs3/pubsys2/xml/en/bulletin/5613318.html).

Remove the exhaust pipe from the turbocharger. See the Remove section in this procedure.



Install protective caps from Air Handling Clean Care Kit, Part Number 5298776, on all open connection points.

Inspect the turbine wheel for damage.

Replace the turbocharger if damage is found.

If turbine wheel is damaged, see Prevention of Turbocharger Damage After Engine Mechanical Issue, Service Bulletin 4326040 (/qs3/pubsys2/xml/en/bulletin/4326040.html).

Lubricating oil leaks from the compressor (cold-side) or turbine (hot-side) seals can be symptoms of air restrictions, leaks, or a restricted turbocharger oil drain line.



If a turbocharger is leaking oil, see Turbocharger Lubricating Oil Leak Troubleshooting, Service Bulletin 5504213 (/qs3/pubsys2/xml/en/bulletin/5504213.html).

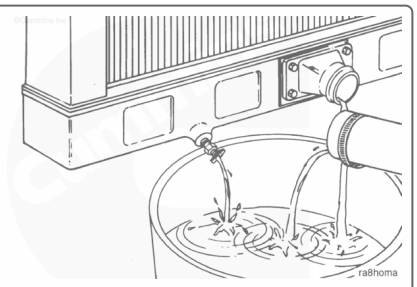
After review of the above service bulletin, reference the following troubleshooting symptom trees in Section TS, if necessary.

- Turbocharger - Compressor Seal Oil Leak troubleshooting symptom tree
- Turbocharger - Turbine Seal Oil Leak troubleshooting symptom tree.

Leak Test

⚠ WARNING ⚠

Do not remove the pressure cap from a hot engine. Wait until the coolant temperature is below 50°C [120°F] before removing the pressure cap. Heated coolant spray or steam can cause personal injury.



⚠ WARNING ⚠

Coolant is toxic. Keep away from children and pets. If not reused, dispose of in accordance with local environmental regulations.

ANADOLU ISUZU AFTER SALES

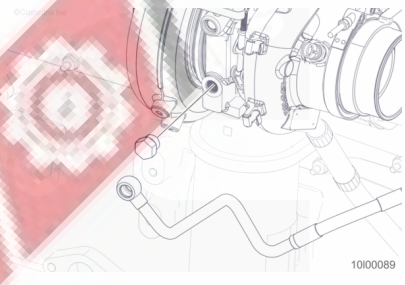
This test **only** needs to be performed if troubleshooting for coolant loss, or if an internal leak is suspected.

Note : The engine **must** be within 3°C or 5°F of ambient temperature to perform the test.

If a turbocharger internal coolant leak is suspected, use the Turbocharger Coolant Leak Test Kit, Part Number 5299505, or equivalent, along with Air Pressure Regulator Kit, Part Number 3164231, or equivalent, to check for a leak.

- Drain the cooling system. Refer to Procedure 008-018 in Section 8. (/qs3/pubsys2/xml/en/procedures/425/425-008-018-tr.html)

To test for either a turbocharger bearing housing internal coolant leak or a leaking variable geometry turbocharger (VGT) actuator, disconnect the coolant inlet line to the bearing housing and install the M16 banjo block-off fitting from the Turbocharger Coolant Leak Test Kit, Part Number 5299505, or equivalent.

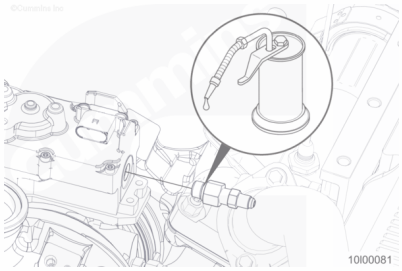


Lubricate the o-ring with clean engine oil before installation.

Torque Value: 27 n•m [239 in-lb]

Disconnect the turbocharger coolant return line at the VGT and install the adapter fitting for the pressure regulator supplied with Turbocharger Coolant Leak Test Kit, Part Number 5299505.

Disconnect the turbocharger actuator coolant return line at the turbocharger actuator and install the plug supplied with Turbocharger Coolant Leak Test Kit, Part Number 5299740, to block off the turbocharger actuator coolant outlet port.

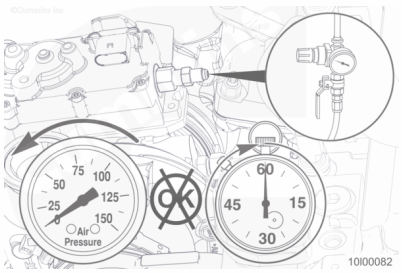


Lubricate the o-ring with clean engine oil before installation.

Torque Value: 27 n•m [239 in-lb]

⚠ WARNING ⚠

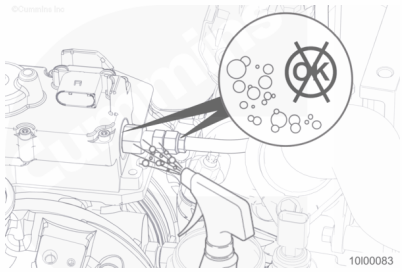
Wear appropriate eye and face protection when using compressed air. Flying debris and dirt can cause personal injury.



- Use compressed air supply to pressurize the VGT to 276 kPa [40 psi].
- Close the air pressure regulator.

- Watch for the pressure to decrease. The pressure **must not** decrease more than 34 kPa [5 psi] in 1 minute.

- If the pressure decreases, use a spray bottle of soapy water to wet the coolant leak test connections and threaded joints. Bubbles will appear if the connections or threaded joints are leaking
- If the pressure decreases and the hose connections or threaded joints are **not** leaking, continue to the next step.
- If the pressure does **not** decrease, no leaks have been detected in the VGT. Proceed to the next steps for testing the actuator for coolant leaks.



Remove the electric VGT actuator. Refer to Procedure 010-134 in Section 10. (/qs3/pubsys2/xml/en/procedures/425/425-010-134.html)

Inspect the pressure testing plate o-ring. Replace the o-ring if damage is found.

Install the pressure testing plate onto the turbocharger bearing housing with the o-ring facing the turbocharger bearing housing.

Tighten the capscrews.

Torque Value: 11 n•m [97 in-lb]

Use compressed air supply to pressurize the turbocharger bearing housing to 276 kPa [40 psi].

Close the air pressure regulator.

Watch for the pressure to decrease. The pressure **must not** decrease more than 34 kPa [5 psi] in 1 minute.

If the pressure decreases, use a spray bottle of soapy water to wet all hose connections. Bubbles will appear if the connections are leaking.

If the pressure decreases and the hose connections are **not** leaking, replace the turbocharger.

If no external leak source is detected, the coolant leak is internal to the electric VGT actuator. Replace the electric VGT actuator. Refer to Procedure 010-134 in Section 10. (/qs3/pubsys2/xml/en/procedures/425/425-010-134.html)

ANADOLU ISUZU AFTER SALES

Preparatory Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

⚠ WARNING ⚠

Do not remove the pressure cap from a hot engine. Wait until the coolant temperature is below 50°C [120°F] before removing the pressure cap. Heated coolant spray or steam can cause personal injury.

⚠ WARNING ⚠

Coolant is toxic. Keep away from children and pets. If not reused, dispose of in accordance with local environmental regulations.

⚠ WARNING ⚠

Some state and federal agencies have determined that used engine oilcan be carcinogenic and cause reproductive toxicity. Avoid inhalation of vapors, ingestion, and prolonged contact with used engine oil. If not reused, dispose of in accordance with local environmental regulations.

Note : Brush away all loose dirt from the around the area of the air handling connections to avoid contamination of the interior of the engine.

Note : For front-out exhaust configurations, the turbocharger will need to be removed with both coolant return and oil supply lines installed to the bearing housing.

Note : Take note of oil and coolant line orientation prior to removal and install in the same manner. Do **not** lift the turbocharger by the coolant return lines.

- Disconnect the batteries. See equipment manufacturer service information.
- Drain the cooling system. Refer to Procedure 008-018 in Section 8. (/qs3/pubsys2/xml/en/procedures/425/425-008-018-tr.html)
- Remove the oil supply line from the turbocharger. Refer to Procedure 010-046 in Section 10. (/qs3/pubsys2/xml/en/procedures/425/425-010-046.html)
- Remove the oil drain line from the turbocharger. Refer to Procedure 010-045 in Section 10. (/qs3/pubsys2/xml/en/procedures/425/425-010-045.html)

- Remove the turbocharger coolant lines. Refer to Procedure 010-041 in Section 10. (/qs3/pubsys2/xml/en/procedures/425/425-010-041.html)
- Disconnect the turbocharger actuator wiring harness by unlocking the tang and pressing down to release the tab.
- Disconnect the turbocharger speed sensor. Refer to Procedure 019-390 in Section 19. (/qs3/pubsys2/xml/en/procedures/425/425-019-390.html)
- Remove the exhaust piping. See equipment manufacturer service information.
- Remove the turbocharger outlet connection. Refer to Procedure 010-132 in Section 10. (/qs3/pubsys2/xml/en/procedures/425/425-010-132.html)
- Remove the turbocharger compressor air inlet connections. Refer to Procedure 010-132 in Section 10. (/qs3/pubsys2/xml/en/procedures/425/425-010-132.html)

Remove

⚠ WARNING ⚠

This component or assembly weighs greater than 23kg [50 lb]. To prevent serious personal injury, be sure to have assistance or use appropriate lifting equipment to lift the component or assembly.

Care **must** be taken **not** to damage the turbocharger sensors or the turbocharger actuator coolant lines when removing the turbocharger from the engine.

Remove the four turbocharger mounting nuts.

Remove the turbocharger and discard the gaskets.

Cover the turbocharger exhaust inlet port with a cap from Air Handling Clean Care Kit, Part Number 5298776. Cover the openings on the exhaust manifold with heavy tape.

If required, remove the turbocharger actuator. Refer to Procedure 010-134 in Section 10. (/qs3/pubsys2/xml/en/procedures/425/425-010-134.html)

Clean and Inspect for Reuse

Clean the turbocharger and exhaust manifold gasket surfaces.

Inspect the turbocharger and exhaust manifold gasket surfaces, and the mounting studs for cracks or other damage.

Cracking of the turbine housing inlet flange may require turbocharger replacement.

Acceptance and rejection guidelines are shown in this illustration. If the exhaust gasket is available, always make sure any cracks lie within its sealing area.

Acceptable cracks **must**:

- be 10 mm [0.39 in] or less in length
- be separated from each other by no less than 10 mm [0.39 in]
- **not** extend to the edge of the flange.

Replace the exhaust manifold if any cracks or other damage is found in the mounting flange surfaces. Refer to Procedure 011-007 in Section 11. (/qs3/pubsys2/xml/en/procedures/425/425-011-007.html)

⚠ WARNING ⚠

When using solvents, acids, or alkaline materials for cleaning, follow the manufacturer's recommendations for use. Wear goggles and protective clothing to reduce the possibility of personal injury.

⚠ WARNING ⚠

When using a steam cleaner, wear safety glasses or a face shield, as well as protective clothing. Hot steam can cause serious personal injury.

⚠ WARNING ⚠

Wear appropriate eye and face protection when using compressed air. Flying debris and dirt can cause personal injury.

Remove all carbon deposits and gasket material from surfaces.

Clean the exterior of the turbocharger. Use solvent or steam. Dry with compressed air.

Inspect the turbine and compressor housings.

If cracks through the outer walls are found, the turbocharger **must** be replaced.

Axial Clearance Check

- Use dial depth gauge, Part Number ST 537.
- Push the rotor assembly away from the gauge.
- Set the gauge on zero.
- Push the rotor assembly toward the gauge. Record the reading.

Axial Clearance (HE300 Variable Geometry)		
mm		in
0.025	MIN	0.001
0.127	MAX	0.005

Replace the turbocharger if the clearance does **not** meet the specifications. See the Remove and Install sections in this procedure.

Radial Clearance Check:

- Check the radial movement of the rotor system by pushing the turbocharger compressor wheel toward the wall of the compressor cover with light finger pressure.
- The turbocharger passes inspection if the wheel does **not** contact the compressor cover wall.
- Repeat the procedure on the turbocharger turbine wheel.

Replace the turbocharger if there is contact between the turbine wheel and turbine housing or compressor wheel and compressor housing. Reference the Remove and Install sections in this procedure.

⚠ WARNING ⚠

When using solvents, acids, or alkaline materials for cleaning, follow the manufacturer's recommendations for use. Wear goggles and protective clothing to reduce the possibility of personal injury.

⚠ CAUTION ⚠

Do not use caustic cleaners to clean the charge air cooler. Damage to the charge air cooler will result.

Make sure all system level causes of oil leaks have been addressed before proceeding. Reference the following troubleshooting symptom trees in Section TS:

- Turbocharger - Compressor Side Oil Leak troubleshooting symptom tree
- Turbocharger - Turbine Side Oil Leak troubleshooting symptom tree.

Clean turbocharger outlets with a non-reactive oil cleaning spray or solution, Part Number 3824421, or equivalent, and a lint-free towel.

Note : If the engine experiences a turbocharger malfunction or any other occasion in which oil or debris is put into the charge air system, the charge air system **must** be inspected and cleaned. Refer to Procedure 010-027 in Section 10. (/qs3/pubsys2/xml/en/procedures/425/425-010-027.html)

Note : If the engine experiences a turbocharger malfunction that resulted in coolant or oil entering the intake, the charge air cooler system, as well as the exhaust gas recirculation (EGR) differential pressure cross drillings should be inspected and cleaned. Refer to Procedure 010-027 in Section 10. (/qs3/pubsys2/xml/en/procedures/425/425-010-027.html) Refer to Procedure 010-080 in Section 10. (/qs3/pubsys2/xml/en/procedures/425/425-010-080.html)

Note : If the engine experiences a turbocharger malfunction or any other occasion where oil is put into the exhaust, the aftertreatment components **must** be inspected. Inspect the aftertreatment diesel oxidation catalyst. Refer to Procedure 011-049 in Section 11. (/qs3/pubsys2/xml/en/procedures/425/425-011-049.html) Inspect the aftertreatment diesel particulate filter. Refer to Procedure 011-041 in Section 11. (/qs3/pubsys2/xml/en/procedures/425/425-011-041-tr.html)

Note : If a malfunction resulted in oil, excessive fuel, or excessive black smoke entering the exhaust system, the aftertreatment system **must** be inspected. Refer to the Aftertreatment Diesel Oxidation Catalyst and Aftertreatment Diesel Particulate Filter Reuse Guidelines, Bulletin 4021600. (/qs3/pubsys2/xml/en/bulletin/4021600.html)

Note : If a malfunction resulted in coolant entering the exhaust system, the aftertreatment system can be recovered. Refer to Procedure 014-016 in Section 14.

(/qs3/pubsys2/xml/en/procedures/425/425-014-016.html)

Install

⚠ WARNING ⚠

This component or assembly weighs greater than 23kg [50 lb]. To prevent serious personal injury, be sure to have assistance or use appropriate lifting equipment to lift the component or assembly.

Note : For front-out exhaust configurations, the turbocharger will need to be installed into the chassis with both coolant return and oil supply lines installed and tightened to specification onto the bearing housing.

Torque Value:
Banjo Fitting 24 n•m [212 in-lb]

Torque Value:
Swivel Nuts 35 n•m [26 ft-lb]

Note : Make sure to install the lines in the proper orientation.

Note : If installing a new turbocharger, orient the compressor housing to the same position as the turbocharger that was removed. Orient the housing by loosening the V-band clamp and then positioning the housing in the correct location. Do **not** orient the turbine housing.

Torque Value: 8 n•m [71 in-lb]

Only remove clean care caps as the connections are being made.

Apply a film of high-temperature anti-seize compound to the turbocharger mounting studs.

Install a new gasket and install the turbocharger.

Install and tighten the four mounting nuts.

Note : The torque values have been established with anti-seize compound as a lubricant.

Torque Value: 55 n•m [41 ft-lb]

ANADOLU ISUZU GLOBAL SALES

If required, install the turbocharger actuator. Refer to Procedure 010-134 in Section 10. (/qs3/pubsys2/xml/en/procedures/425/425-010-134.html)

Prime

Install the turbocharger oil drain line. Refer to Procedure 010-045 in Section 10. (/qs3/pubsys2/xml/en/procedures/425/425-010-045.html)

Lubricate the bearings by pouring 59 to 89 ml [2 to 3 oz] of clean engine oil into the turbocharger oil supply line fitting. Rotate the turbine wheel to allow the oil to enter the bearing housing.

Rotate the turbine wheel to allow the oil to enter the bearing housing.

Note : If too much oil is poured into the bearing housing, the oil can leak past the seals. This is **not** regarded as a malfunction, since the seals are **not** dynamic and rely on exhaust gas and boost pressure to provide a proper seal.

Finishing Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

Note : If a stationary aftertreatment regeneration is needed to complete repair, make sure the engine is brought up to operating temperature before the regeneration is started.

- Install the turbocharger compressor air inlet connection. Refer to Procedure 010-132 in Section 10. (/qs3/pubsys2/xml/en/procedures/425/425-010-132.html)
- Install the turbocharger compressor outlet connection. Refer to Procedure 010-132 in Section 10. (/qs3/pubsys2/xml/en/procedures/425/425-010-132.html)
- Install the exhaust piping. See equipment manufacturer service information.

- Connect the turbocharger speed sensor. Refer to Procedure 019-390 in Section 19. (/qs3/pubsys2/xml/en/procedures/425/425-019-390.html)
- Connect the turbocharger actuator wiring harness. Make sure the tab locks and the locking tang slides into place.
- Connect the turbocharger coolant lines. Refer to Procedure 010-041 in Section 10. (/qs3/pubsys2/xml/en/procedures/425/425-010-041.html)
- Install the turbocharger oil supply line. Refer to Procedure 010-046 in Section 10. (/qs3/pubsys2/xml/en/procedures/425/425-010-046.html)
- Fill the cooling system. Refer to Procedure 008-018 in Section 8. (/qs3/pubsys2/xml/en/procedures/425/425-008-018-tr.html)
- Connect the batteries. See equipment manufacturer service information.
- Operate the engine. Check for leaks.

Last Modified: 04-Feb-2020

ANADOLU ISUZU AFTER SALES

Select Service Tools

Recommended Cummins® Service Tools

- No Cummins® Service Tools required.

Additional Service Items

- No additional service items required.

Preparatory Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

⚠ WARNING ⚠

Do not remove the pressure cap from a hot engine. Wait until the coolant temperature is below 50°C [120°F] before removing the pressure cap. Heated coolant spray or steam can cause personal injury.

⚠ WARNING ⚠

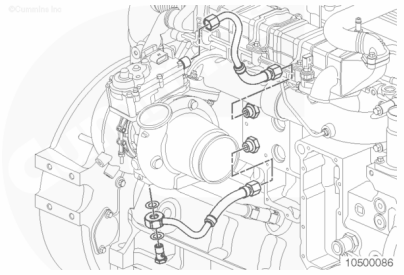
Coolant is toxic. Keep away from children and pets. If not reused, dispose of in accordance with local environmental regulations.

- Disconnect the batteries. See equipment manufacturer service information.
- Drain the coolant. Refer to Procedure 008-018 in Section 8. (/qs3/pubsys2/xml/en/procedures/425/425-008-018-tr.html)

Remove

Remove the turbocharger coolant drain and supply lines.

Note : Use a second wrench to hold the coolant connection fittings at the cylinder block and turbocharger bearing housing to prevent accidental loosening of the fittings. Hold the turbocharger coolant supply line while loosening to prevent kinking the line.

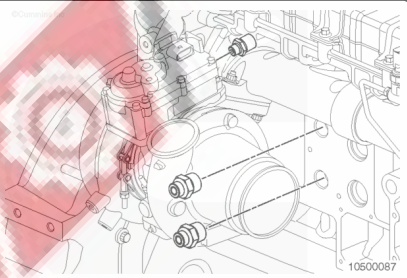


Disassemble

Remove the coolant return and supply line block fittings from the engine block.

Remove the coolant return line fitting from the turbocharger actuator.

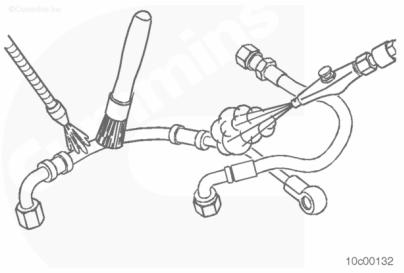
Remove the coolant supply line fitting from the turbocharger bearing housing, if applicable.



Clean and Inspect for Reuse

⚠ WARNING ⚠

When using solvents, acids, or alkaline materials for cleaning, follow the manufacturer's recommendations for use. Wear goggles and protective clothing to reduce the possibility of personal injury.



⚠ WARNING ⚠

Some solvents are flammable and toxic. Read the manufacturer's instructions before using.

⚠ WARNING ⚠

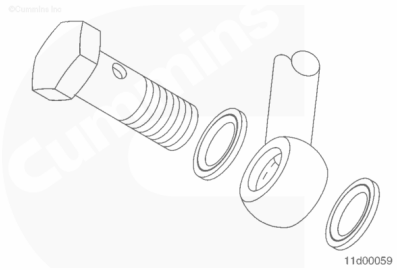
Wear appropriate eye and face protection when using compressed air. Flying debris and dirt can cause personal injury.

Clean the turbocharger coolant hoses. Use solvent. Dry with compressed air.

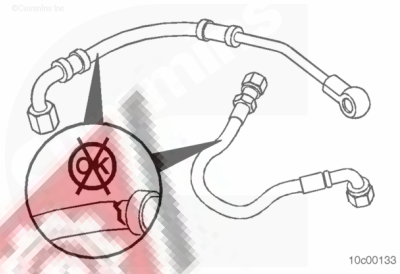
Note : New sealing washer **must** be used when installing the banjo fitting.

Inspect the banjo fittings for dirt, debris, and burrs. Replace as necessary.

A sealing washer is used on both sides of a banjo fitting.



Inspect the coolant hoses for cuts, leaks, cracks, or other damage. Replace as necessary.



Assemble

Install the coolant return and supply line block fittings from the engine block.

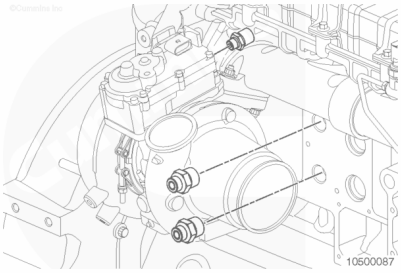
Torque Value: 65 n•m [48 ft-lb]

Install the coolant return line fitting from the turbocharger actuator.

Torque Value: 25 n•m [18 in-lb]

Install the coolant supply line fitting from the turbocharger bearing housing, if applicable.

Torque Value: 35 n•m [26 ft-lb]



Install

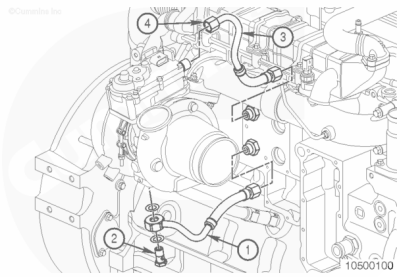
Install the turbocharger coolant supply line.

Torque value at block fitting (1):

Torque Value: 35 n•m [26 ft-lb]

Torque value at turbocharger bearing housing (2):

Torque Value: 35 n•m [26 ft-lb]



ANADOLU ISUZU
UNIVERSALES

Install the turbocharger coolant return line.

Torque value at block fitting (3):

Torque Value: 35 n•m [26 ft-lb]

Torque value at turbocharger actuator (4):

Torque Value: 40 n•m [30 ft-lb]

Finishing Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

- Fill the engine with coolant. Refer to Procedure 008-018 in Section 8. (/qs3/pubsys2/xml/en/procedures/425/425-008-018-tr.html)
- Connect the batteries. See equipment manufacturer service information.
- Operate the engine. Check for leaks.

ANADOLU ISUZU AFTER SALES

Last Modified: 04-Aug-2016

Select Service Tools

Recommended Cummins® Service Tools

- No Cummins® Service Tools required.

Additional Service Items

- No additional service items required.

Preparatory Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

- Disconnect the batteries. See equipment manufacturer service information.

Remove

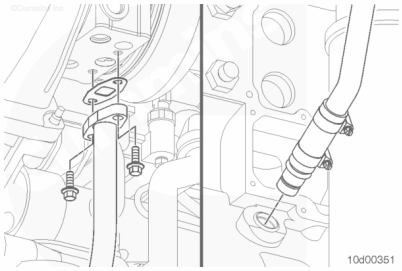
Clean around the area where the oil drain line inserts into the cylinder block. Use a clean cloth.

Loosen the hose clamps that hold the upper oil drain tube to the oil drain hose.

Remove the two capscrews that hold the upper oil drain tube to the turbocharger. Discard the gasket.

Remove the upper oil drain tube from the turbocharger and oil drain hose.

Pull the oil drain hose and lower drain tube out of the cylinder block.

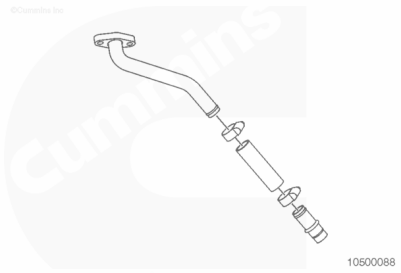


ANADOLU ISUZU
AFTER SALES

Disassemble

Remove the oil drain hose from the lower oil drain tube.

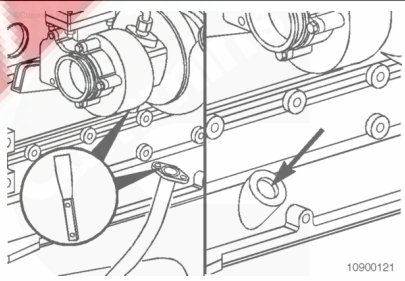
Soap and warm water may be required.



Clean and Inspect for Reuse

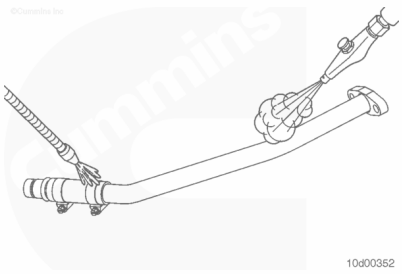
Clean the gasket sealing surfaces on the oil drain line and turbocharger.

Clean the o-ring sealing bore in the cylinder block, taking care **not** to drop any dirt or debris into the cylinder block.



⚠ WARNING ⚠

When using solvents, acids, or alkaline materials for cleaning, follow the manufacturer's recommendations for use. Wear goggles and protective clothing to reduce the possibility of personal injury.



⚠ WARNING ⚠

Some solvents are flammable and toxic. Read the manufacturer's instructions before using.

⚠ WARNING ⚠

Wear appropriate eye and face protection when using compressed air. Flying debris and dirt can cause personal injury.

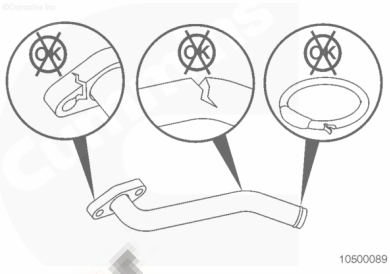
Clean the turbocharger oil drain line. Use solvent. Dry with compressed air.

Inspect the oil drain line for any signs of oil coking or restriction.

Clean the inside of the oil drain line if it shows signs of oil coking or restriction.

Inspect the oil drain tubes and hose for signs of cracks, wear, leaks, or other damage. Replace as necessary.

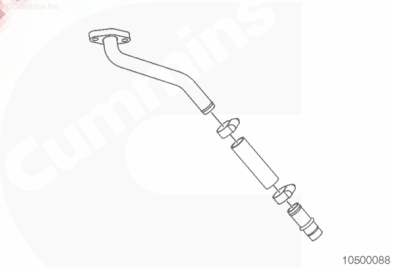
Inspect the oil drain sealing o-rings for signs of cracks, wear, or fretting. Replace as necessary.



Assemble

Assemble the oil drain hose onto the bottom oil drain tube.

Soap and warm water may be required.



Install

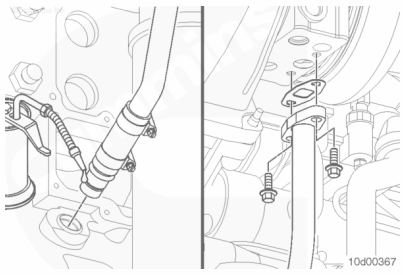
Apply a thin film of clean engine oil to the drain line o-rings.

Push the assembled oil drain hose and lower oil drain tube into the cylinder block. Make sure both o-rings are completed seated in the bore.

Install a new gasket to the upper oil drain tube.

Insert the upper oil drain tube into the oil drain hose. Align to the turbocharger oil drain.

Install and tighten the upper drain tube capscrews.



Torque Value: 23 n•m [204 in-lb]

Tighten the hose clamps.

Torque Value: 5 n•m [44 in-lb]

ANADOLU ISUZU AFTER SALES

Finishing Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

- Connect the batteries. See equipment manufacturer service information.
- Operate the engine. Check for leaks.

ANADOLU ISUZU AFTER SALES

Last Modified: 04-Aug-2016

Select Service Tools

Recommended Cummins® Service Tools

- No Cummins® Service Tools required.

Additional Service Items

- Wrench

Preparatory Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

⚠ CAUTION ⚠

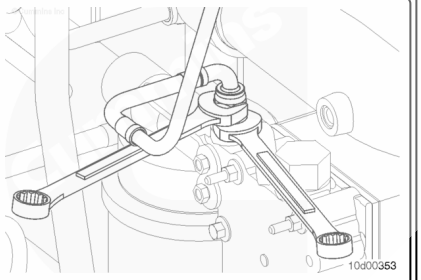
When handling the oil supply line, avoid bending the flexible portion into a tight bend, as this will cause damage to the flexible material. It is advisable to remove the line from the engine, when servicing the engine, to avoid accidentally overbending the flexible material.

- Disconnect the batteries. See equipment manufacturer service information.
- Clean around the oil supply line fittings. Use a clean cloth.

Remove

⚠ CAUTION ⚠

When handling the oil supply line, avoid bending the flexible portion into a tight bend, as this will cause damage to the flexible material. It is advisable to



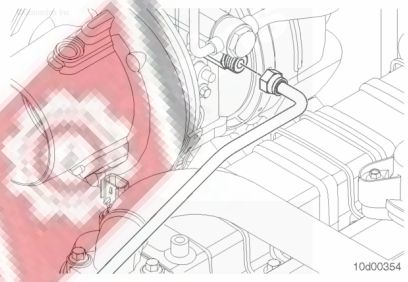
remove the line from the engine, when servicing the engine, to avoid accidentally overbending the flexible material.

Note : Use a wrench to hold the fittings below the oil supply line on both the turbocharger bearing housing and oil filter head. This will prevent the fittings from loosening.

Remove the oil supply line from the fitting in the oil filter head.

Remove the oil supply line from the turbocharger bearing housing fitting.

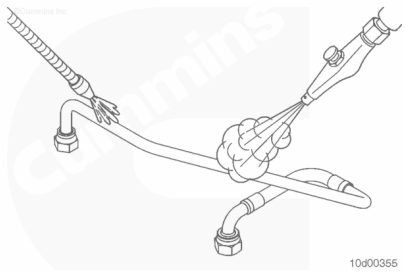
Discard the old o-ring seals.



Clean and Inspect for Reuse

⚠ WARNING ⚠

When using solvents, acids, or alkaline materials for cleaning, follow the manufacturer's recommendations for use. Wear goggles and protective clothing to reduce the possibility of personal injury.



⚠ WARNING ⚠

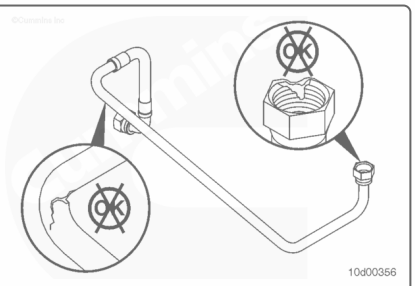
Wear appropriate eye and face protection when using compressed air. Flying debris and dirt can cause personal injury.

⚠ CAUTION ⚠

When handling the oil supply line, avoid bending the flexible portion into a tight bend, as this will cause damage to the flexible material. It is advisable to remove the line from the engine, when servicing the engine, to avoid accidentally overbending the flexible material.

Clean the oil supply line. Use solvent. Dry with compressed air.

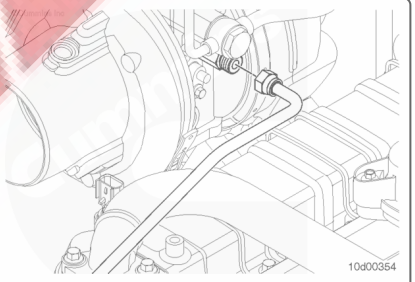
Inspect the oil supply line for cracks, wear, kinks, burns, and other damage that can cause an oil leak.



Install

⚠ CAUTION ⚠

When handling the oil supply line, avoid bending the flexible portion into a tight bend, as this will cause damage to the flexible material. It is advisable to remove the line from the engine, when servicing the engine, to avoid accidentally overbending the flexible material.



Apply a thin film of clean engine oil to the oil supply line o-ring seals.

Install the oil supply line to the turbocharger and to the oil filter head. Use new o-ring seals. Hand tighten.

Note : Use a wrench to hold the fitting below the oil supply line on the turbocharger bearing housing. This will prevent the fitting from being overtightened.

Install the oil supply line to the turbocharger and to the oil filter head. Hand tighten.

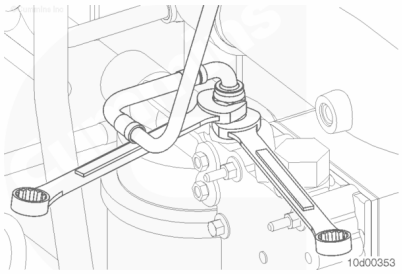
Tighten the oil supply line at the turbocharger bearing housing.

Torque Value: 24 n•m [212 in-lb]

⚠ CAUTION ⚠

Maintain at least 10 mm [0.40 in] clearance between the turbocharger oil supply line and the turbocharger turbine housing and exhaust manifold.

Note : Use a wrench to hold the fitting below the oil supply line on the oil filter head. This will prevent the fitting from being overtightened.



Tighten the oil supply line at the oil filter head fitting.

Torque Value: 24 n•m [212 in-lb]

Finishing Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

- Connect the batteries. See equipment manufacturer service information.
- Operate the engine. Check for leaks.

ANADOLU ISUZU AFTER SALES

Last Modified: 04-Aug-2016

Select Service Tools

Recommended Cummins® Service Tools

- Anti-seize compound, Part Number 3824732, or equivalent

Additional Service Items

- No additional service items required.

General Information

⚠ WARNING ⚠

The exhaust and exhaust components can remain hot after the engine has been shut down or secured. To avoid the risk of fire, property damage, burns or other serious personal injury, allow the exhaust system to cool before beginning this procedure or repair and make sure that no combustible materials are located where they might come in contact with hot exhaust or exhaust components.

⚠ WARNING ⚠

Improper practices, carelessness, or ignoring the warnings can cause burns, cuts, mutilation, asphyxiation, or other personal injury or death.

There are several turbocharger turbine housing mounted heat shield designs. The heat shield reduces heat exposure to chassis components from the turbocharger turbine housing.

Due to the number of turbocharger mounting configurations and heat shield designs, this procedure has been written to be generic. the Remove and Install sections are common regardless of the style of the heat shield used.

Preparatory Steps

⚠ WARNING ⚠

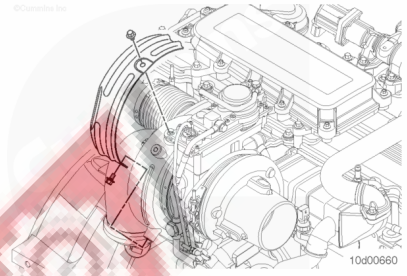
Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery

cable last.

- Disconnect the batteries. See equipment manufacturer service information.

Remove

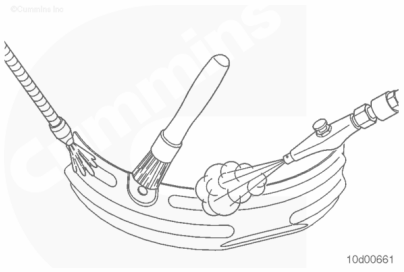
Remove the capscrews securing the turbocharger heat shield to the turbocharger turbine housing.



Clean and Inspect for Reuse

⚠ WARNING ⚠

When using solvents, acids, or alkaline materials for cleaning, follow the manufacturer's recommendations for use. Wear goggles and protective clothing to reduce the possibility of personal injury.



⚠ WARNING ⚠

Some solvents are flammable and toxic. Read the manufacturer's instructions before using.

⚠ WARNING ⚠

When using a steam cleaner, wear safety glasses or a face shield, as well as protective clothing. Hot steam can cause serious personal injury.

⚠ WARNING ⚠

Wear appropriate eye and face protection when using compressed air. Flying debris and dirt can cause personal injury.

Clean the turbocharger heat shield. Use solvent or steam.
Dry with compressed air.

Inspect the turbocharger heat shield.

If cracks or other damage is found, replace the turbocharger heat shield.



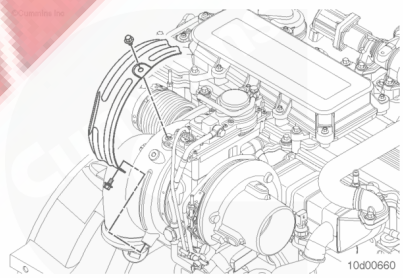
Install

Place a light coating of high-temperature anti-seize compound, Part Number 3824732, or equivalent, on the retaining capscrews prior to installation.

Install the turbocharger heat shield.

Tighten the capscrews.

Torque Value: 25 n•m [221 in-lb]



Finishing Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

- Connect the batteries. See equipment manufacturer service information.
- Operate the engine. Check for loose components.

ANADOLU ISUZU AFTER SALES


ANADOLU ISUZU
AFTER SALES

Select Service Tools

Recommended Cummins® Service Tools

- Anti-seize compound, Part Number 3824732, or equivalent

Additional Service Items

- No additional service items required.

General Information

⚠ WARNING ⚠

The exhaust and exhaust components can remain hot after the engine has been shut down or secured. To avoid the risk of fire, property damage, burns or other serious personal injury, allow the exhaust system to cool before beginning this procedure or repair and make sure that no combustible materials are located where they might come in contact with hot exhaust or exhaust components.

⚠ WARNING ⚠

Improper practices, carelessness, or ignoring the warnings can cause burns, cuts, mutilation, asphyxiation, or other personal injury or death.

There are several turbocharger turbine housing mounted heat shield designs. The heat shield reduces heat exposure to chassis components from the turbocharger turbine housing.

Due to the number of turbocharger mounting configurations and heat shield designs, this procedure has been written to be generic. the Remove and Install sections are common regardless of the style of the heat shield used.

Preparatory Steps

⚠ WARNING ⚠

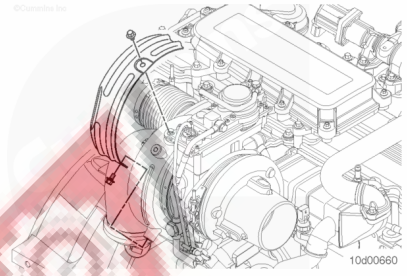
Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery

cable last.

- Disconnect the batteries. See equipment manufacturer service information.

Remove

Remove the capscrews securing the turbocharger heat shield to the turbocharger turbine housing.



Clean and Inspect for Reuse

⚠ WARNING ⚠

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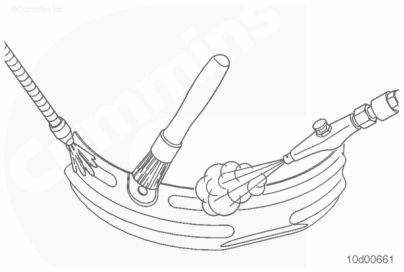

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⚠ WARNING ⚠

When using a steam cleaner, wear safety glasses or a face shield, as well as protective clothing. Hot steam can cause serious personal injury.

⚠ WARNING ⚠

Wear appropriate eye and face protection when using compressed air. Flying debris and dirt can cause personal injury.

Clean the turbocharger heat shield. Use solvent or steam.
Dry with compressed air.

Inspect the turbocharger heat shield.

If cracks or other damage is found, replace the turbocharger heat shield.



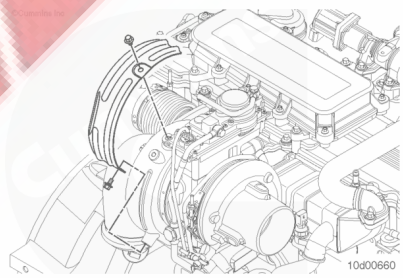
Install

Place a light coating of high-temperature anti-seize compound, Part Number 3824732, or equivalent, on the retaining capscrews prior to installation.

Install the turbocharger heat shield.

Tighten the capscrews.

Torque Value: 25 n•m [221 in-lb]



Finishing Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

- Connect the batteries. See equipment manufacturer service information.
- Operate the engine. Check for loose components.

ANADOLU ISUZU AFTER SALES


ANADOLU ISUZU
AFTER SALES

Select Service Tools

Recommended Cummins® Service Tools

- No Cummins® Service Tools required.

Additional Service Items

- No additional service items required.

General Information

The air intake connection adapter is the part in the air intake system directly downstream of the charge air cooler and directly upstream of the air intake connection. There can be various styles of the air intake connection adapter, and the engine being serviced may **not** have an air intake connection adapter as shown in this procedure, but the procedure steps remain the same, regardless of the style.

Preparatory Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

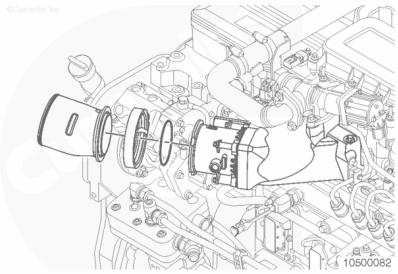
- Disconnect the batteries. See equipment manufacturer service information.
- Remove the charge air piping connected to the air intake connection adapter. Refer to Procedure 010-019 in Section 10. (/qs3/pubsys2/xml/en/procedures/425/425-010-019.html)

Remove

ANADOLU ISUZU AFTER SALES

Remove the V-Band clamp holding the air intake connection adapter to the engine intake throttle actuator.

Remove the air intake connection adapter.



Clean and Inspect for Reuse

⚠ WARNING ⚠

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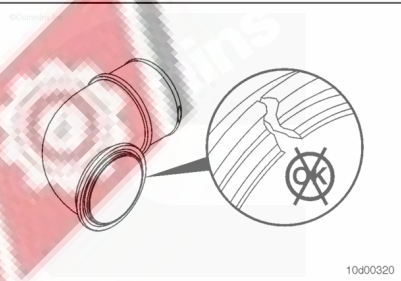


⚠ WARNING ⚠

Some solvents are flammable and toxic. Read the manufacturer's instructions before using.

⚠ WARNING ⚠

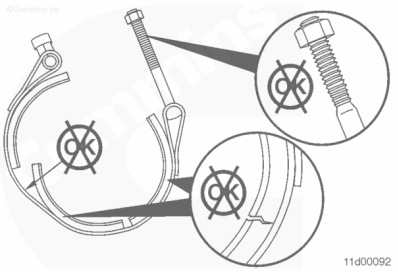
Wear appropriate eye and face protection when using compressed air. Flying debris and dirt can cause personal injury.

Clean the air intake connection adapter. Use solvent. Dry with compressed air.

Inspect the air intake connection adapter for cracks, chips, or other damage.

Inspect the V-Band clamp for signs of stretching or damaged threads. Replace as necessary.

If the air intake connection adapter will **not** seal to the air intake connection or to the charge air piping, replace it.



ANADOLU ISUZU PARTS SALES

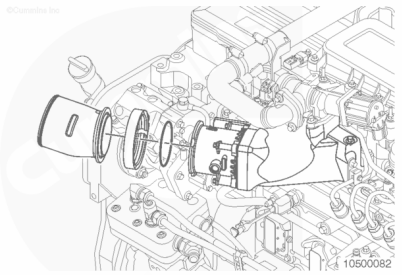
Install

The sealing o-ring **must not** be reused.

Install the air intake connection adapter, sealing o-ring, and V-Band clamp to the air intake connection.

Tighten the clamp.

Torque Value: 10 n•m [88 in-lb]



Finishing Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.



- Install the charge air piping connecting to the charge air cooler. Tighten the hose clamps. Refer to Procedure 010-019 in Section 10. (/qs3/pubsys2/xml/en/procedures/425/425-010-019.html)
- Connect the batteries. See equipment manufacturer service information.
- Operate the engine. Check for boost leaks.

ANADOLU ISUZU AFTER SALES

Last Modified: 04-Aug-2016

Select Service Tools

Recommended Cummins® Service Tools

- Air Handling Clean Care Kit, Part Number 5298776

Additional Service Items

- No additional service items required.

Preparatory Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

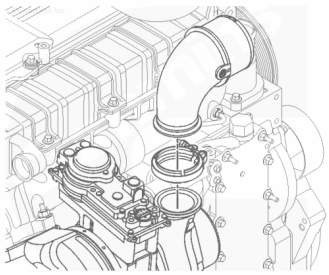
Note : Brush away all loose dirt from around the area of the air handling connections to avoid contamination of the interior of the engne.

- Disconnect the batteries. See equipment manufacturer service information.
- Disconnect the charge air piping. Refer to Procedure 010-019 in Section 10. (/qs3/pubsys2/xml/en/procedures/425/425-010-019.html)

Remove

Remove the turbocharger outlet elbow, V-band clamp, and o-ring from the turbocharger compressor outlet.

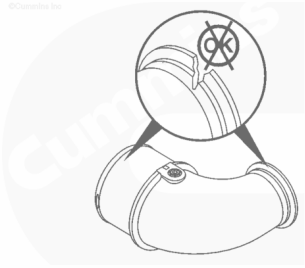
Use protective caps from Air Handling Clean Care Kit, Part Number 5298776, to cover both of the connection points.



Clean and Inspect for Reuse

⚠ WARNING ⚠

Wear appropriate eye and face protection when using compressed air. Flying debris and dirt can cause personal injury.



10d00383

⚠ WARNING ⚠

When using solvents, acids, or alkaline materials for cleaning, follow the manufacturer's recommendations for use. Wear goggles and protective clothing to reduce the possibility of personal injury.

Clean the turbocharger compressor outlet connection. Use solvent. Dry with compressed air.

Inspect the turbocharger compressor outlet connection for cracks abnormal wear, other damage. Replace as necessary.

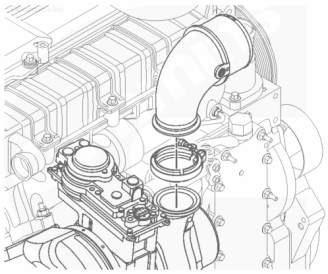
Discard the o-ring seal.

Install

Install the turbocharger compressor outlet elbow, V-band clamp, and new o-ring seal on the turbocharger compressor discharge outlet.

Make sure to remove the protective caps.

Tighten the clamp.


10d00342

Torque Value: 8 n•m [71 in-lb]

Finishing Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

ANADOLU ISUZU AFTER SALES

- Connect the charge air piping. Refer to Procedure 010-019 in Section 10. (/qs3/pubsys2/xml/en/procedures/425/425-010-019.html)
- Disconnect the batteries. See equipment manufacturer service information.
- Operate the engine. Check for leaks.

Last Modified: 04-Aug-2016

ANADOLU ISUZU AFTER SALES

Select Service Tools

Recommended Cummins® Service Tools

- Air Handling Clean Care Kit, Part Number 5298776
- Turbocharger Actuator Inspect Gauge Kit, Part Number 4919281

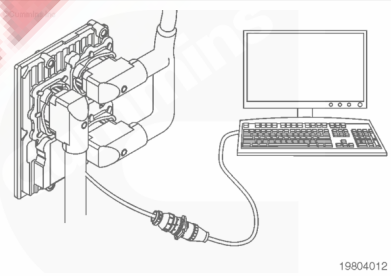
Additional Service Items

- No additional service items required.

General Information

⚠ CAUTION ⚠

The starting motor wiring could electrically interfere with the variable geometry turbocharger (VGT) wiring harness. The starting motor wiring must be at least 300 mm [12 in] away from the actuator and harness.



This procedure provides service information for the electronically controlled variable geometry turbocharger actuator. Take careful note of the procedure steps to avoid improper installation of the turbocharger actuator. Installation or replacement of the actuator requires the use of INSITE™ electronic service tool.

Preparatory Steps

⚠ WARNING ⚠

Wear appropriate eye and face protection when using compressed air. Flying debris and dirt can cause personal injury.

⚠ WARNING ⚠

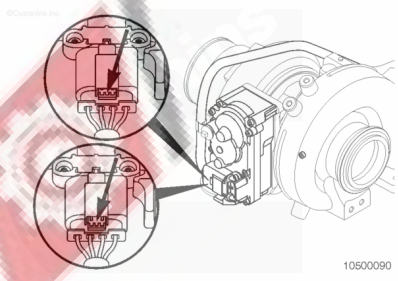
Coolant is toxic. Keep away from children and pets. If not reused, dispose of in accordance with local environmental regulations.

- Clean the area around the turbocharger actuator. Dry with compressed air.
- Drain the coolant. Refer to Procedure 008-018 in Section 8. (/qs3/pubsys2/xml/en/procedures/425/425-008-018-tr.html)
- Remove the turbocharger coolant hoses. Refer to Procedure 010-041 in Section 10. (/qs3/pubsys2/xml/en/procedures/425/425-010-041.html)

Remove

⚠ CAUTION ⚠

Make sure the coolant has been drained before the actuator is removed. If the coolant is not completely drained, the actuator can be damaged.

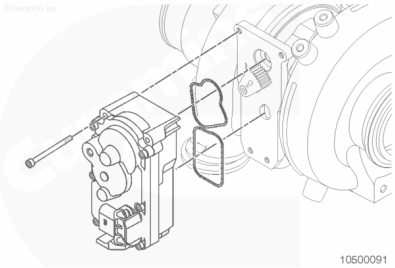


Disconnect the wiring harness from the turbocharger actuator by pushing down and out on the locking tab. The locking tab should click, indicating it is unlocked. Continue to push down and out on the locking tab while pulling the connector to remove it from the turbocharger actuator.

Remove the turbocharger actuator mounting capscrews. Discard the capscrews.

Remove the actuator.

Remove and discard the turbocharger actuator sealing gaskets.

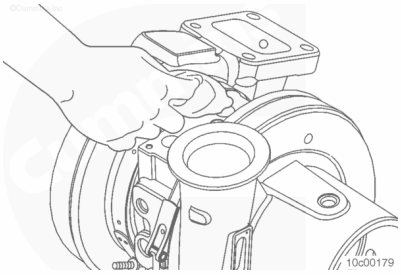


Clean and Inspect for Reuse

Install protective caps from Air Handling Clean Care Kit, Part Number 5298776, on all open connection points.

Use a clean cloth to wipe around the surface where the turbocharger actuator seals to the turbocharger.

Note : Take care **not** to drop any dirt or debris into the turbocharger.



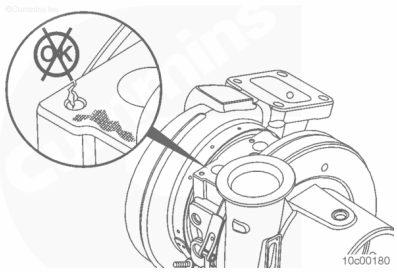
ANADOLU ISUZU AFTER SALES

Inspect the sealing surfaces and rubber sealing gasket for signs of leaks, cracks, or other damage.

If the sealing surface of the turbocharger is damaged and causing a leak, the turbocharger **must** be replaced. Do **not** continue with this procedure. Refer to Procedure 010-033 in Section 10. (/qs3/pubsys2/xml/en/procedures/425/425-010-033.html)

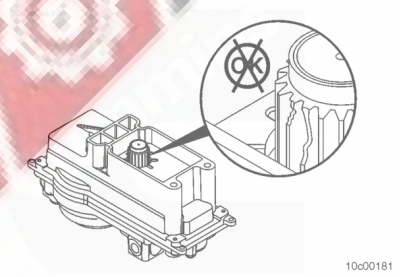
If the sealing surface of the actuator is causing a leak, replace **only** the actuator.

Note : It can be common to see oil leaking from around the sector gear shaft. This is **not** considered a malfunction or damage.



Inspect the pinion gear on the actuator for excessive wear or damaged teeth.

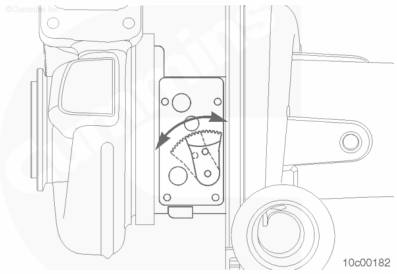
Replace the actuator if the pinion gear teeth are worn or damaged.



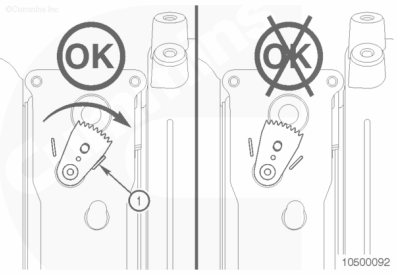
Inspect the sector gear on the turbocharger for excessive wear, damaged teeth, or a broken shaft.

Grasp the sector gear by hand. Move it through its operational range.

Note : It can take considerable force to move the sector gear. If it can be moved by hand, this is considered acceptable. Do **not** use any hand tools.

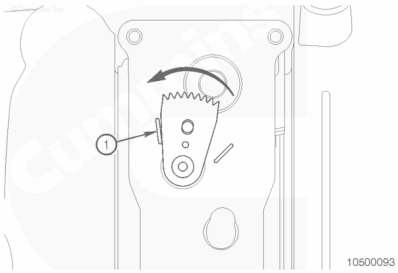


Rotate the sector gear **clockwise** (1) toward the turbocharger turbine housing. The edge of the sector gear **must** touch the engraved bearing housing hash mark.

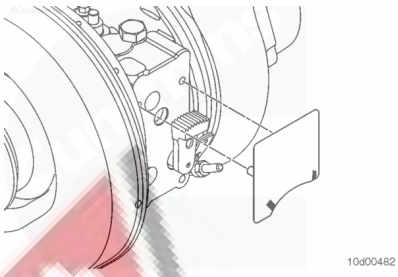


Rotate the sector gear **counterclockwise** (1) toward the turbocharger compressor housing. The edge of the sector gear **must** touch the engraved bearing housing hash mark.

If the sector gear does **not** go through its entire range of motion, or if the sector gear is seized, it is necessary to replace the entire turbocharger assembly. Do **not** continue with this procedure. Refer to Procedure 010-033 in Section 10. (/qs3/pubsys2/xml/en/procedures/425/425-010-033.html)



Alternately, the HE300Ve sector gear travel gauge from Turbocharger Actuator Inspection Gauge Kit, Part Number 4919281, can be used to check the sector gear for range of motion. To install the sector gear travel gauge, carefully bend the gauge and slide the thin section under the sector gear. If necessary, pull the sector gear out by hand to allow more clearance for the gauge. Verify the three alignment bosses are fully engaged in the bearing housing.



Install

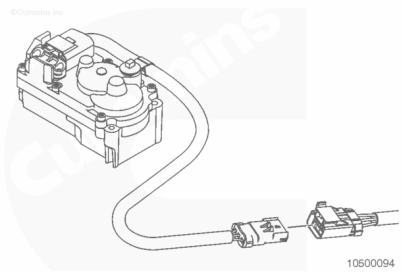
Note : New turbocharger actuators are sold with a calibration code installed. Downloading a new calibration code into the turbocharger actuator should **only** be required if Fault Code 4956 or 4957 is active after installing a new turbocharger actuator, or if directed by a Campaign, Temporary Repair Practice, or warrantable repair.

If the turbocharger actuator requires a calibration code to be downloaded, use the following procedure. Refer to Procedure 010-150 in Section 10. (/qs3/pubsys2/xml/en/procedures/425/425-010-150.html)



Note : Following these installation instructions in order is very important.

- Continue through the entire turbocharger actuator installation procedure before attempting to troubleshoot any other fault codes.
- Verify the turbocharger actuator is removed from the turbocharger bearing housing.
- Verify the turbocharger actuator electrical connector is disconnected from the engine wiring harness.
- Turn the keyswitch ON. Connect INSITE™ electronic service tool. Wait 60 seconds.



Note : It is important the keyswitch remain in the ON position throughout both the Install and Calibrate procedures unless otherwise directed.

- Connect the turbocharger actuator electrical connector to the engine wiring harness.

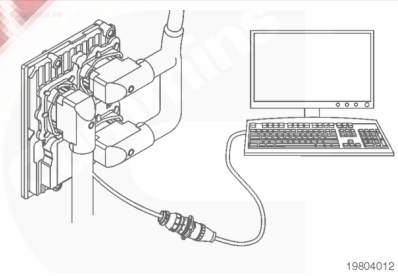
If Fault Code 2634 becomes active, disconnect the turbocharger actuator connector from the engine wiring harness with the keyswitch ON. Connect the turbocharger actuator electrical connector. Fault Code 2634 will go inactive.

It is normal and expected to have Fault Code 2449 active when a new turbocharger actuator is connected to the engine, because it is **not** calibrated to the turbocharger.

Continue through the engine turbocharger actuator installation procedure before attempting to troubleshoot any other fault codes.

In INSITE™ electronic service tool, go to the engine control module (ECM) Diagnostic Tests screen.

From the list, select VGT Electronic Actuator Installation and Calibration, and click on the “next” button.



Note : The VGT Electronic Actuator Installation and Calibration is **not** a diagnostic test. It is the procedure to properly install and calibrate the turbocharger actuator. Running this procedure improperly can result in additional fault codes and/or damage to the turbocharger or actuator.

INSITE™ electronic service tool “INSTALL ACTUATOR” command **must only** be run with the actuator **not** mounted to the turbocharger.

Locate the column labeled “Value” and left click on the down arrow. Select INSTALL ACTUATOR and select START.

Note : The pinion gear on the turbocharger actuator will **not** move during this step.

INSITE™ electronic service tool will indicate when this step is complete.

Fault Code 2449 will be active at this point in the procedure. Continue through the turbocharger actuator procedure before troubleshooting any fault codes.

If at any point, INSITE™ electronic service tool status message indicates the procedure was stopped or failed, leave the key ON and cycle the power to the actuator by

disconnecting it from the harness and reconnecting.

If cycling power to the actuator does **not** work, unplug the actuator, turn the keyswitch OFF for 30 seconds, and restart INSITE™ electronic service tool. Then start over, beginning with the actuator “INSTALL” step.

Rotate the sector gear **clockwise** by hand toward the turbocharger turbine housing. Make sure the edge of the sector gear is rotated all the way toward the hash mark on the bearing housing. Do **not** move the sector gear after this point.

Coat the teeth on the sector gear with the high-temperature grease packet supplied in the installation kit.

Note : It is critical for smooth reliable operation of the actuator to use the full amount of the Holset® supplied high-temperature grease.

⚠ CAUTION ⚠

Do not attempt to force the actuator onto the bearing housing by using the capscrews. Misalignment can cause damage to the actuator or turbocharger.

Install two new sealing o-rings on the turbocharger actuator. Make sure to use the new capscrews available in the Turbocharger Actuator Mounting Kit.

Insert the threaded guide pins into the diagonally opposite fastener holes in the bearing housing. Locate the actuator onto the guide pins. Slide the actuator into position, making sure the gear spigot and shroud locate into the mating holes in the bearing housing face. Insert the long and short actuator socket head capscrews in the remaining fastener holes. Hand tighten.

The actuator pinion gear and turbocharger sector gear **must** engage smoothly. If they do **not** engage smoothly, verify the sector gear through-hole and bearing housing blind hole are aligned.

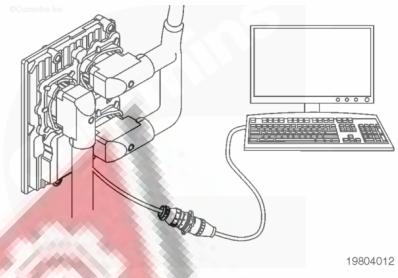
With the actuator aligned on the bearing housing, replace the guide pins with the actuator capscrews. Install the remaining two capscrews.

Tighten the four capscrews in a criss-cross pattern in two steps.

Torque Value:

1. 3 n•m [27 in-lb]
2. 11 n•m [97 in-lb]

Calibrate



The turbocharger actuator **must** be calibrated to the turbocharger. This step **must** be performed to make sure of proper turbocharger operation.

In INSITE™ electronic service tool screen labeled “VGT Electric Actuator Install and Calibrate”, locate the column labeled “Value” and left click on the down arrow. Select “CALIBRATE ACTUATOR”.

The INSITE™ electronic service tool “CALIBRATE ACTUATOR” command **must only** be run with the actuator mounted to the turbocharger.

Follow the instructions on the screen to calibrate the turbocharger actuator to the turbocharger. INSITE™ electronic service tool will indicate when this step is complete.

If INSITE™ electronic service tool status message indicates the procedure was stopped or failed, turn the keyswitch OFF for 30 seconds, then turn the keyswitch ON. Then start over, beginning with the “INSTALL ACTUATOR” instructions.

If the “CALIBRATE ACTUATOR” step does **not** pass, restart with the Install section.

It is normal to have an active Fault Code 2387 at this point.

Turn the keyswitch to the OFF position for 30 seconds. Turn the keyswitch ON. Refresh the fault code screen. All turbocharger actuator fault codes should be inactive. Use INSITE™ electronic service tool to clear all fault codes.

Make sure all turbocharger fault codes are inactive and cleared before adding coolant to the engine.

Finishing Steps

⚠ WARNING ⚠

Coolant is toxic. Keep away from children and pets. If not reused, dispose of in accordance with local environmental regulations.

- Install the turbocharger coolant hoses. Refer to Procedure 010-041 in Section 10. (/qs3/pubsys2/xml/en/procedures/425/425-010-041.html)
- Fill the cooling system. Refer to Procedure 008-018 in Section 8. (/qs3/pubsys2/xml/en/procedures/425/425-008-018-tr.html)
- If a malfunction resulted in coolant, oil, excessive fuel, or excessive black smoke entering the exhaust system, the aftertreatment system **must** be inspected. Refer to Procedure 014-015 in Section 14. (/qs3/pubsys2/xml/en/procedures/425/425-014-015.html)
- Operate the engine to make sure the turbocharger actuator operates correctly and all turbocharger actuator fault codes are inactive.
- Check the engine for leaks.

⚠ CAUTION ⚠

The starting motor wiring can electrically interfere with the VGT pigtail and wiring harness. The starting motor wiring must be at least 300 mm [12 in] away from the actuator and harness.

If zip ties were removed, zip tie the turbocharger actuator and turbocharger speed sensor harnesses to the the oil drain line. The harnesses **must** route over the top of the compressor cover in between the bearing housing and compressor cover.

ANADOLU ISUZU PARTS SALES

Last Modified: 16-Jul-2018

Select Service Tools

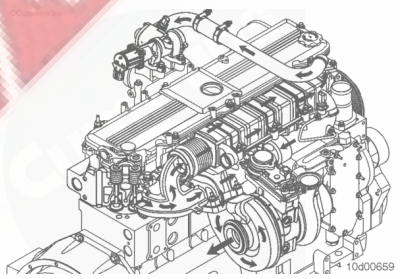
Recommended Cummins® Service Tools

- No Cummins® Service Tools required.

Additional Service Items

- No additional service items required.

General Information



This engine uses exhaust gas recirculation (EGR) in the intake air system. Every component of the EGR system (EGR cooler, air transfer tube, etc.) up to the EGR connection is considered part of the exhaust system. Use the following procedure for exhaust system diagnostics. Refer to Procedure 011-056 in Section 11. (/qs3/pubsys2/xml/en/procedures/425/425-011-056.html)

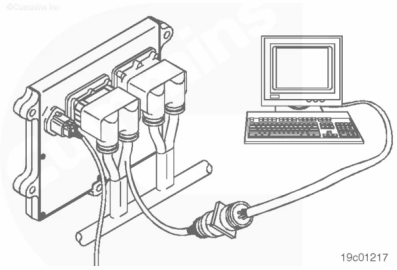
Before diagnostics of the air intake system begins, there are a few items that should be checked:

- Check for fault codes. See the appropriate troubleshooting trees.
- Make sure all intake pipe couplers are connected properly.
- Inspect the intake piping for any physical damage or cracks.
- Inspect the engine air filter for inlet restriction, contamination, or other damage. See equipment manufacturer service information.

This procedure lists various symptoms and respective components to check, listed in the order of easy to difficult to inspect. If the are no clear symptoms, or more than one, follow the diagnostics, in order, until the complaint has been resolved.

Note : The exhaust system components are covered in the Exhaust Systems - Overview. Refer to Procedure 011-999 in Section F. (/qs3/pubsys2/xml/en/procedures/425/425-011-999.html)

Make sure the turbocharger compressor intake and intake manifold temperature and pressure sensors are working properly. Use the following procedures for functionality checks for the intake manifold pressure/temperature sensor. Refer to Procedure 019-159 in Section 19 (/qs3/pubsys2/xml/en/procedures/425/425-019-159.html)



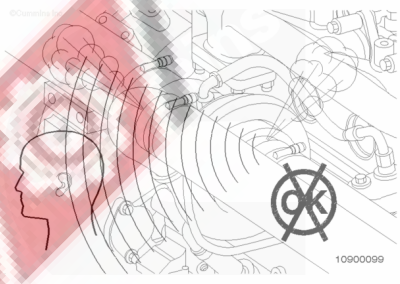
Use the following procedures for functionality checks for the turbocharger compressor intake pressure/temperature sensor. Refer to Procedure 019-466 in Section 19. (/qs3/pubsys2/xml/en/procedures/425/425-019-466.html)

Leaks in the air system intake and/or exhaust components can produce excessive engine noise.

A leaking noise usually sounds like a high-pitched whining or sucking.

Check for leaks in the intake and exhaust system.

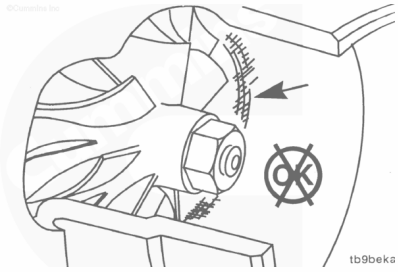
Check to make sure all hose clamps are tight. Refer to Procedure 010-024 in Section 10. (/qs3/pubsys2/xml/en/procedures/425/425-010-024.html)



Malfunctioning Turbocharger

⚠ WARNING ⚠

When using solvents, acids, or alkaline materials for cleaning, follow the manufacturer's recommendations for use. Wear goggles and protective clothing to reduce the possibility of personal injury.



⚠ WARNING ⚠

Some solvents are flammable and toxic. Read the manufacturer’s instructions before using.

⚠ WARNING ⚠

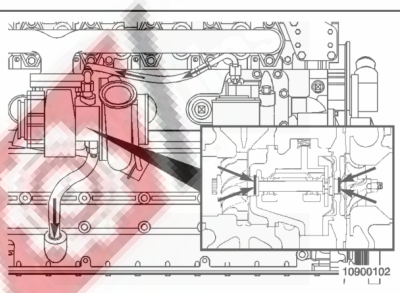
Use skin and eye protection when handling caustic solutions to reduce the possibility of personal injury.

The malfunction of the internal components of the turbocharger can reduce its effectiveness. A bearing malfunction can produce friction, which will slow the speed of

the rotor assembly. Worn bearings can also allow the blades of the rotor assembly to rub the housing, reducing the rotor assembly speed.

Lower pitched sounds or rattles, at slower engine speeds, can indicate debris is in the system or the rotor assembly is touching the housings. If there is a complaint for noise, low power, engine response, or oil consumption, verify the conditions under which the complaint occurred. Refer to Procedure 010-033 in Section 10. (/qs3/pubsys2/xml/en/procedures/425/425-010-033.html)

Seal rings are used on each end of the rotor assembly. The primary function of the seals is to prevent exhaust gases and compressed air from entering the turbocharger housing. Lubricating oil leakage from the seals is rare, but it can occur.

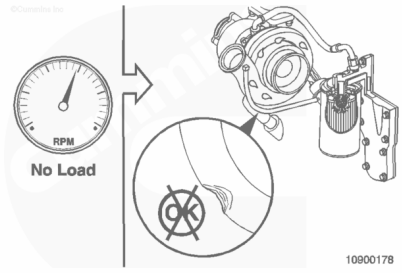


Note : Excessive crankcase pressure will **not** allow the oil to drain from the turbocharger. This will load the bearing housing and allow lubricating oil to leak past the seal rings and into the intake and exhaust of the engine.

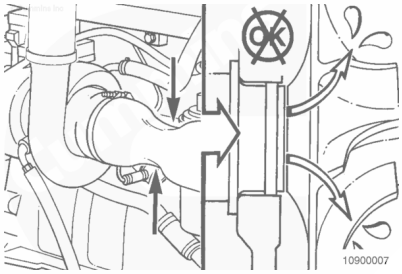
If turbine seal leakage into the exhaust occurs on engines with an aftertreatment system, the aftertreatement system **must** be inspected for reuse.

Note : If the engine experiences a turbocharger malfunction or any other occasion in which oil or debris is put into the charge air system, the EGR differential pressure sensor flow ports **must** be cleaned.

A restricted or damaged lubricating oil return line will cause the turbocharger housing to be pressurized, causing lubricating oil to migrate past the seal rings on both the intake and exhaust side of the turbocharger.



Additionally, high intake or exhaust restrictions can cause a vacuum between the compressor and turbocharger housing, resulting in lubricating oil leaking past the seal rings at the compressor (intake) side.



Note : If this occurs, it is necessary to flush the charge air cooler to clean the oil from the intake system. Refer to Procedure 010-023 in Section 10.

(/qs3/pubsys2/xml/en/procedures/425/425-010-023.html) Refer to Procedure 010-027 in Section 10. (/qs3/pubsys2/xml/en/procedures/425/425-010-027.html)

Note : The EGR differential pressure sensor flow ports **must** be cleaned. Refer to Procedure 010-080 in Section 10. (/qs3/pubsys2/xml/en/procedures/425/425-010-080.html)

Turbocharger Noise

It is normal for the turbocharger to emit a whining sound that varies in intensity, depending on turbine wheel speed.

The sound is caused by the very high rotational speed of the rotor assembly and the method used to balance the rotor assembly during manufacturing.

Because the engine uses a variable geometry turbocharger, which allows for control of the turbine wheel speed independent of engine load and speed, the sound may **not** be the loudest at rated engine speed and load.

Depending on engine and aftertreatment requirements for exhaust temperatures and exhaust pressure, the sound can be most noticeable around idle speed conditions or slightly above.

Charge Air Cooled Engines

The charge air cooler makes sure the proper intake air density is achieved. External damage to the fins or excessive restriction or pressure losses can affect its performance and reduce engine performance.

Use the following procedure for inspection of the charge air cooler. Refer to Procedure 010-027 in Section 10. (/qs3/pubsys2/xml/en/procedures/425/425-010-027.html)

Note : The long-term integrity of the charge air cooling system is the responsibility of the vehicle and component manufacturers.

Air Intake System

On equipped engines, the intake throttle actuator facilitates EGR flow through an electronically actuated valve. It is attached forward of the air intake manifold.

Inspect the intake throttle actuator. Refer to Procedure 010-139 in Section 10. (/qs3/pubsys2/xml/en/procedures/425/425-010-139.html)

Note : The style of the air intake connection (1) can vary, depending on the application. Although the air intake connection can appear different, the function is the same.

The air intake connection is a critical component in combining the EGR flow and fresh intake air of the engine.

The EGR valve (2) is mounted to the top of the air intake connection.

The purpose of the EGR valve is to control the amount of EGR flow into the air intake connection.

The amount of EGR flow is calculated by measuring the pressure differential across the exhaust gas entrance port in the air intake connection, just below the EGR valve outlet. A pressure differential sensor (3) mounted on top of the intake connection, reads the pressure on each side of the exhaust gas entrance port through internal drillings in the air intake connection.

Soot in the exhaust gas entrance ports can affect the pressure readings which, in turn, will affect the calculated EGR flow and can result in an improper commanded EGR valve position. The air intake connection also acts as the intake air source for engines equipped with turbocharged air compressors. An air compressor inlet tube connects the air compressor to the air intake connection.

Inspect and clean the intake air connection if necessary. Refer to Procedure 010-080 in Section 10. (/qs3/pubsys2/xml/en/procedures/425/425-010-080.html)

Use the following procedure for troubleshooting the exhaust system diagnostics related to the EGR system. Refer to Procedure 011-056 in Section 11. (/qs3/pubsys2/xml/en/procedures/425/425-011-056.html)

Air Intake Manifold/Cold Starting Aid

The ON/OFF operation of the intake air heater is controlled by the engine control module (ECM).

The ECM controls a single original equipment manufacturer (OEM) supplied relay which provides power for the intake air heater when commanded. A symptom of a malfunctioning cold starting aid is a hard start in cold ambient temperatures and/or white smoke on engine startup. A plugged intake air heater element can also result in low power.

Use the following procedure for verifying the cold starting aid function. Refer to Procedure 010-029 in Section 10. (/qs3/pubsys2/xml/en/procedures/425/425-010-029.html)

Note : The cold starting aid is **not** a serviceable part. If the cold starting aid has cracked, broken, or melted elements, the engine air intake manifold **must** be replaced. Refer to Procedure 010-023 in Section 10. (/qs3/pubsys2/xml/en/procedures/425/425-010-023.html)

ANADOLU ISUZU AFTER SALES

Last Modified: 04-Aug-2016

Select Service Tools

Recommended Cummins® Service Tools

- No Cummins® Service Tools required.

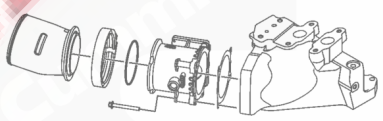
Additional Service Items

- No additional service items required.

General Information

The engine intake throttle actuator connects in between the following components:

- Air intake connection adapter by a o-ring and V-band clamp
- Intake connection by four capscrews and a gasket.



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An electronic actuator controls the movement of the throttle plate. The position of the engine intake throttle actuator moves between fully open (100 percent) and fully closed (0 percent). When the engine is keyed OFF (power OFF) or keyed ON with zero engine rpm, the engine intake throttle actuator will be fully open. When the engine is started, the engine intake throttle actuator will move to 90 percent open. While the engine is running, the engine intake throttle actuator should never be fully open (100 percent). This can be confirmed using INSITE™ electronic service tool.

Preparatory Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

⚠ CAUTION ⚠

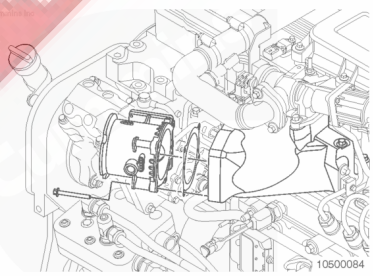
Electrical operation of the throttle actuator is only permitted via the engine control module. The application of a DC voltage directly to the engine intake throttle actuator will result in serious damage to the actuator.

- Disconnect the batteries. See equipment manufacturer service information.
- Remove the charge air piping from the air intake connection adapter. Refer to Procedure 010-019 in Section 10. (/qs3/pubsys2/xml/en/procedures/425/425-010-019.html)
- Remove the air intake connection adapter. Refer to Procedure 010-131 in Section 10. (/qs3/pubsys2/xml/en/procedures/425/425-010-131.html)

Remove

Disconnect the electrical connector at the engine intake throttle actuator.

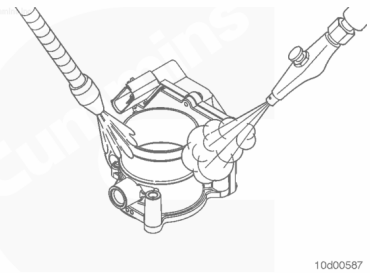
Remove the capscrews that secure the engine intake throttle actuator to the air intake connection.



Clean and Inspect for Reuse

⚠ WARNING ⚠

When using solvents, acids, or alkaline materials for cleaning, follow the manufacturer's recommendations for use. Wear goggles and protective clothing to reduce the possibility of personal injury.



⚠ WARNING ⚠

Wear appropriate eye and face protection when using compressed air. Flying debris and dirt can cause personal injury.

⚠ CAUTION ⚠

Quick or forceful movements of the throttle plate by hand can result in damage to the mechanism.

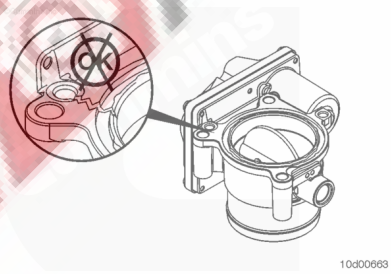
Note : The engine intake throttle actuator is **not** repairable and should **not** be disassembled.

Carefully clean the air intake connector adapter and engine intake throttle actuator. Use warm, soapy water or an acetone free solvent. Do **not** immerse.

Carefully dry with compressed air.

Note : Solvents containing acetone can damage the seals in the engine intake throttle actuator. Avoid these types of solvents.

Inspect the engine intake throttle actuator connection sealing surfaces for cracks and other damage.



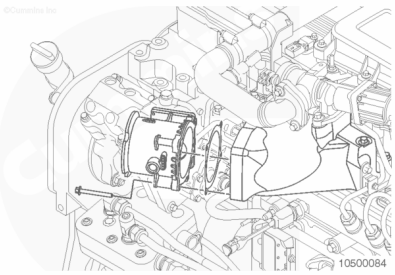
Install

Note : The face of the engine intake throttle actuator gasket can be installed in either direction.

Replace the gasket. Install the engine intake throttle actuator to the air intake connection. Use a crisscross pattern when tightening the capscrews.

Torque Value: 10 n•m [89 in-lb]

Connect the electrical connector at the engine intake throttle actuator.



Finishing Steps

⚠ WARNING ⚠

ANADOLU ISUZU
DEALER SALES

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

- Install the air intake connection adapter. Refer to Procedure 010-131 in Section 10. (/qs3/pubsys2/xml/en/procedures/425/425-010-131.html)
- Install the charge air piping to the air intake connection adapter. Refer to Procedure 010-019 in Section 10. (/qs3/pubsys2/xml/en/procedures/425/425-010-019.html)
- Connect the batteries. See equipment manufacturer service information.
- Operate the engine. Check for leaks.

Last Modified: 04-Aug-2016

ANADOLU ISUZU AFTER SALES

Select Service Tools

Recommended Cummins® Service Tools

- Air Handling Clean Care Kit, Part Number 5298776

Additional Service Items

- No additional service items required.

General Information

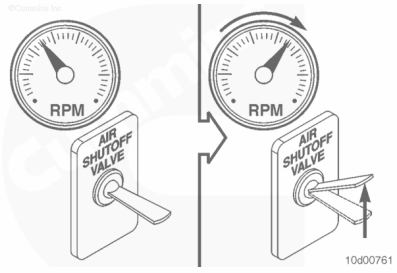
The air shutoff valve activates when excessive engine speed is detected. It results in immediate engine shutdown. This feature was specifically developed for engines that operate in environments where combustible gases can be present in the intake air. In such environments, stopping the flow of fuel to the engine does **not** guarantee the engine will stop. The intake air shutoff valve will stop the engine when necessary.

The air shutoff valve can also be actuated by the test switch or manual switch. The air shutoff lamp will illuminate when the valve is actuated.

Preparatory Steps

⚠ WARNING ⚠

Make sure the valve is in the closed position before removal to reduce the possibility of personal injury.



Note : Activate the air shutoff valve before service to make sure it is in the closed position.

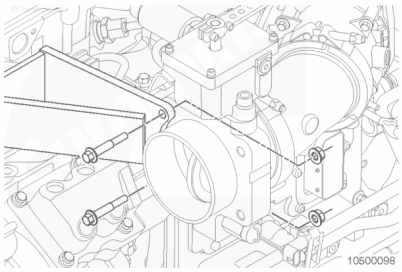
- Disconnect the charge air piping connected to the air shutoff valve. See equipment manufacturer service information.

Remove

Verify the keyswitch is in the OFF position.

Disconnect the solenoid and position switch electrical connectors from the air shutoff valve.

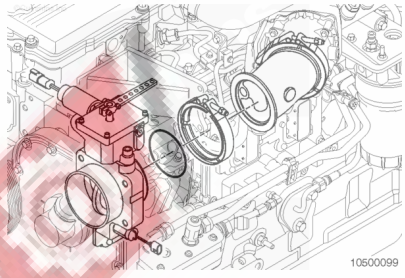
Remove the air shutoff valve support bracket from the shutoff valve, if applicable.



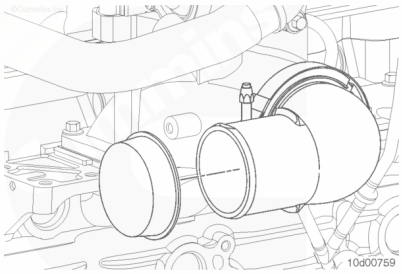
Make sure to completely loosen the V-band clamp from the charge air piping. Make sure to support the valve while loosening.

Remove the clamp, o-ring, and shutoff valve from the air intake connection adapter pipe.

The sealing o-ring **must not** be reused. Discard the sealing o-ring.



Cover the intake connection adapter pipe. Use Air Handling Clean Care Kit, Part Number 5298776.



Inspect for Reuse

Inspect the air shutoff valve for cracks or other damage.

Replace the air shutoff valve, if necessary.

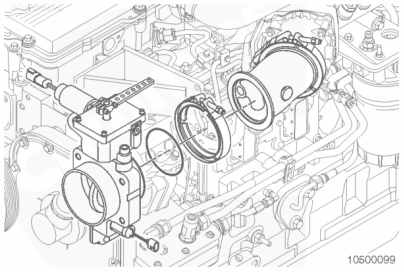
Inspect the seal around the disc valve for cracks or other damage. If the seal is **not** within the groove in the disc valve or other damage is found the air shutoff valve **must** be replaced.

Note : The air shutoff valve is **not** repairable and should **not** be disassembled.

ANADOLU ISUZU AFTER SALES

Install

Install the air shutoff valve and new o-ring onto the intake connection adpater pipe. Orient the valve with the reset lever toward the rear of the engine.

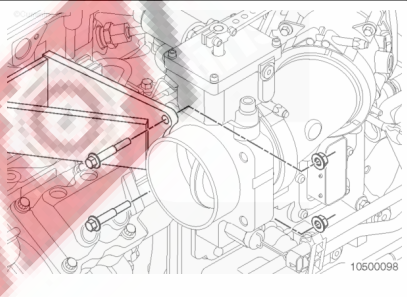


Connect the charge air piping onto the shutoff valve. Make sure to support the valve and align it as such that the valve will **not** contact any original equipment manufacturer (OEM) components.

Tighten the V-Band clamps.

Torque Value: 10 n•m [89 in-lb]

Install the air shutoff valve support bracket, if applicable.



Torque Value:
Support Bracket Capscrew 47 n•m [35 ft-lb]

Torque Value:
Support Bracket Nut 20 n•m [177 in-lb]

Connect the solenoid and position switch electrical connectors to the air shutoff valve.

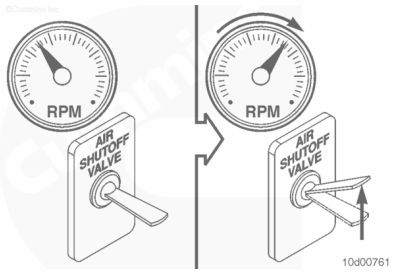
ANADOLU ISUZU AFTER SALES

Finishing Steps

- Install the charge air piping to the air shutoff valve. See equipment manufacturer service information.
- Reset the air shutoff valve.
- Operate the engine to check for leaks.

Test

Note : The starter will be locked out while the valve is actuated. The air shutoff valve **must** be reset to unlock the starter.



Move and hold the air shutoff valve test switch to the active position and apply the throttle to raise the engine rpm. The test switch must be held for the entire test.

The air shutoff valve is functioning properly if the engine shuts down.After the air shutoff valve activates, turn the keyswitch to the OFF position. Manually push the reset lever by hand to reset the valve. **Only** hand pressure should be used to reset the valve.

Last Modified: 04-Aug-2016

ANADOLU ISUZU AFTER SALES

Select Service Tools

Recommended Cummins® Service Tools

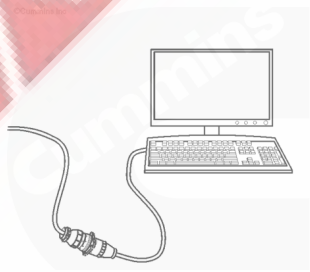
- No Cummins® Service Tools required.

Additional Service Items

- No additional service items required.

General Information

Note : Downloading a calibration code into the turbocharger actuator is **only** required if directed by a Campaign, Temporary Repair Practice, or warrantable repair.



Turbocharger actuator calibration code downloads can be performed with INSITE™ electronic service tool.

INSITE™ electronic service tool connects to the turbocharger actuator through the engine control module (ECM) by using the J1939 data link.

The turbocharger actuator calibration code download can be performed with the actuator installed or removed from the turbocharger when installing a new actuator. If performing a calibration code download into an existing actuator, do **not** remove the actuator.

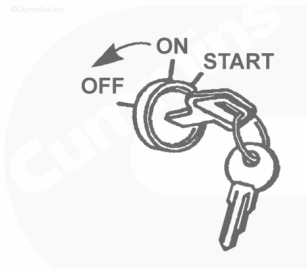
The "Install" and "Calibrate" sections **must** be performed after the calibration code download process if the actuator is not yet installed onto the turbocharger. Refer to Procedure 010-134 in Section 10. (/qs3/pubsys2/xml/en/procedures/425/425-010-134.html)

If the turbocharger actuator is **not** removed during the calibration code download, no further steps are required.

Initial Check

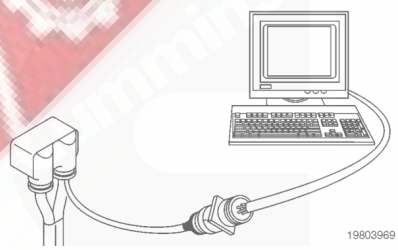
The turbocharger actuator calibration code download process occurs with the keyswitch turned ON. **Always** follow the instructions on the service tool screens.

Note : If the tool will **not** communicate with the keyswitch in the ON position, cycle the keyswitch and try again.



Install

Note : Although either the engine-mounted service tool connector or the vehicle-mounted service tool connector can be used for the software installation, Cummins Inc. recommends the engine-mounted service tool connector be used for the software installation process whenever possible.



- Connect INSITE™ electronic service tool.
- Select Advanced ECM Data, select Turbocharger Actuator Compatibility; locate and record turbocharger actuator software part number and hardware part numbers.
- Disconnect INSITE™ electronic service tool.
- Within Calibration Selection menu, use ECM/PDD Code search, enter software part number without first 0000 (four digits if 0).
- Download turbocharger actuator calibration code to Calibration Workspace.
- Connect INSITE™ electronic service tool.
- Select ECM/PDD calibration tab; select Calibration Workspace, select PDD folder, select turbocharger actuator controller, locate recorded device part number for installed variable geometry turbocharger (VGT).
- Install recorded turbocharger actuator calibration software part number.
- During install process INSITE™ electronic service tool automatically disconnects from ECM.
- When complete, INSITE™ electronic service tool will automatically reconnect.
- New actuator calibration code is **not** stored until a key off event occurs.
- Turn keyswitch to Off position to power down ECM.

If the turbocharger actuator is removed from the engine during the calibration code download, the “Install” and “Calibrate Turbocharger Actuator to Turbocharger” steps **must** be performed.

Refer to Procedure 010-134 in Section 10 (/qs3/pubsys2/xml/en/procedures/425/425-010-134.html). If the turbocharger actuator is **not** removed during the calibration code download, no further steps are required.

Finishing Steps

Note : If the connection is lost during the download process, it can result in Fault Code 2636. If this occurs, the turbocharger actuator calibration process **must** be performed a second time to clear Fault Code 2636.

- See the Help Section of INSITE™ electronic service tool for detailed turbocharger actuator calibration code download procedures.
- If necessary, complete the (VGT) actuator installation. Refer to Procedure 010-134 in Section 10. (/qs3/pubsys2/xml/en/procedures/425/425-010-134.html)
- Use INSITE™ electronic service tool to clear all inactive fault codes.

ANADOLU ISUZU AFTER SALES

Last Modified: 06-Aug-2018

Select Service Tools

Recommended Cummins® Service Tools

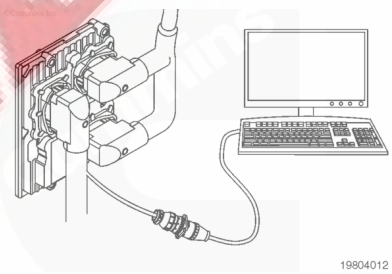
- No Cummins® Service Tools required.

Additional Service Items

- No additional service items required.

General Information

Conditions necessary to perform the Variable Geometry Turbocharger Hysteresis Test:



- Engine OFF
- Keyswitch ON
- Turbocharger and actuator installed on engine
- Coolant temperature greater than 10°C [50°F]
- Battery voltage greater than 11.5 VDC
- No active turbocharger fault codes
- INSITE™ electronic service tool connected
- Compare the engine control module (ECM) code and revision number in the ECM to the calibration revision listed in the ECM calibration revision history for applicable changes related to the “Variable Geometry Turbocharger Hysteresis Test”. If the ECM does **not** contain this revision or higher, calibrate the ECM. Refer to Procedure 019-032 in Section 19. (/qs3/pubsys2/xml/en/procedures/105/105-019-032.html)

The INSITE™ electronic service tool “Variable Geometry Turbocharger Hysteresis Test” **must only** be performed with the actuator mounted to the turbocharger.

In INSITE™ electronic service tool screen labeled “Variable Geometry Turbocharger Hysteresis Test”, locate the button labeled “Start”.

Follow the instructions on the screen to test the turbocharger. INSITE™ electronic service tool will indicate when the test has completed.

If INSITE™ electronic service tool status message indicates the procedure was stopped or had an error, turn the keyswitch OFF for 30 seconds, then turn the keyswitch ON. Verify that all conditions above are met. Perform the test again.

If the “Variable Geometry Turbocharger Hysteresis Test” results in an output of “Fail”, the turbocharger is **not** reusable. Refer to Procedure 010-033 in Section 10. (/qs3/pubsys2/xml/en/procedures/425/425-010-033.html)

Rerun the “Variable Geometry Turbocharger Hysteresis Test” after replacing the turbocharger to confirm the root cause of the issue.

If the “Variable Geometry Turbocharger Hysteresis Test” results in an output of “Fail”, the actuator is **not** reusable. Refer to Procedure 010-134 (/qs3/pubsys2/xml/en/procedures/425/425-010-134.html) in Section 10.

If the “Variable Geometry Turbocharger Hysteresis Test” results in an output of “Pass”, this indicates the sector gear movement is acceptable and the actuator should **not** be removed.

ANADOLU ISUZU AFTER SALES

Last Modified: 06-Jan-2020

Select Service Tools

Recommended Cummins® Service Tools

- No Cummins® service tools required.

Additional Service Items

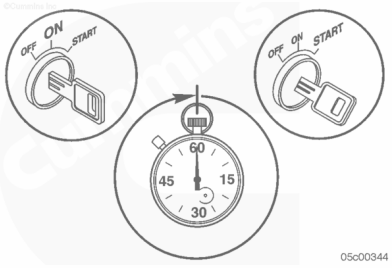
- No additional service items required.

General Information

If the aftertreatment diesel exhaust fluid (DEF) dosing system has been serviced or repaired, it will be necessary to prime the DEF dosing system, in order to check for proper operation.

Setup

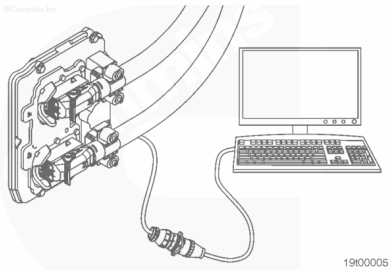
Note : It can be necessary to allow the aftertreatment system time to cool, to allow for accessibility to check for leaking components.



- Make sure the DEF tank is full of DEF. See equipment manufacturer service information.
- Make sure the DEF is **not** frozen. If the DEF is frozen, it will be necessary to run the engine to allow the system to thaw.
- Make sure all DEF dosing system lines are properly connected to the DEF tank, DEF dosing unit, and DEF dosing valve. See equipment manufacturer service information.
- Connect INSITE™ electronic service tool.

Prime

With the keyswitch ON and the engine **not** running, select the Aftertreatment Diesel Exhaust Fluid System Leak Test found under the ECM diagnostics test menu in INSITE™ electronic service tool.



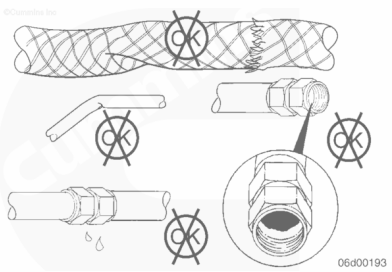
This test will cause the DEF dosing unit to draw DEF from the tank and pressurize it in the DEF dosing valve supply line. During this test, the dosing unit will continuously run and all unused DEF will return to the tank. An audible pumping noise will be noticeable during the test.

During the initialization of this test, a note will pop up on the screen, indicating the system has reached a prime state.

When the test is started, the dosing system will prime. During this process the aftertreatment DEF dosing valve will be held in the closed position. As a result, DEF droplets can potentially be observed exiting the tip of the dosing valve. This is a normal operating characteristic. Do **not** remove the injector.

Inspect

Note : If the system is unable to prime due to leaks, it will be necessary to turn the keyswitch OFF in order to stop the dosing unit. The dosing unit can **not** be stopped using INSITE™ electronic service tool.

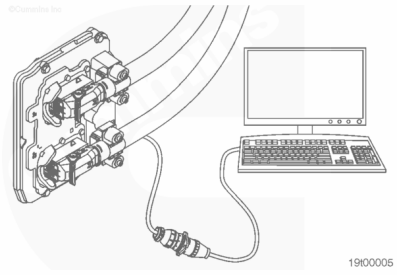


While the test is running, inspect all DEF lines, fittings, and connections for external leaks. Refer to Procedure 011-058 in Section 11. (/qs3/pubsys2/xml/en/procedures/425/425-011-058.html) Refer to Procedure 011-059 in Section 11 (/qs3/pubsys2/xml/en/procedures/425/425-011-059.html). See equipment manufacturer service information.

Repair and replace any leaking component(s). Refer to Procedure 011-058 in Section 11. (/qs3/pubsys2/xml/en/procedures/425/425-011-058.html) Refer to Procedure 011-059 in Section 11 (/qs3/pubsys2/xml/en/procedures/425/425-011-059.html). See equipment manufacturer service information.

Note : If the system fails to prime, a key cycle will be required before attempting to run the aftertreatment DEF system leak test again.

Note : The aftertreatment DEF system leak test can **only** be attempted twice consecutively. A key cycle will be required before attempting to run the aftertreatment DEF system leak test again after two attempts.



If the system is able to successfully prime, a pop-up message will appear in INSITE™ electronic service tool to notify the technician.

Upon completion of inspecting the lines, fittings, and connections for leaks, press the STOP button in INSITE™ electronic service tool. The dosing unit will then purge the system of DEF. An audible purging noise will be noticeable.

If the test is **not** STOPPED using INSITE™ electronic service tool, it will continue to pump for 20 minutes and then automatically purge the system of DEF.

If the system can **not** build pressure, it will attempt to prime multiple times before flagging a fault code.

If any fault codes occur while running this test, see the appropriate fault code troubleshooting tree.

Finishing Steps

- During the test, a small quantity of DEF is sprayed into the aftertreatment decomposition tube. After completion of the test, it is necessary to run the engine at high idle for 5 minutes in order to prevent DEF deposits from forming in the aftertreatment decomposition tube.
- Check for fault codes.

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PARTS SALES

Last Modified: 13-Jun-2019

Select Service Tools

Recommended Cummins® Service Tools

- Seal installer, Part Number 4918709
- Anti-seize compound, Part 3824732, or equivalent

Additional Service Items

- Fine grit emery cloth
- Heavy tape
- Vise
- Gasket scraper or wire brush
- Feeler gauge

General Information

The exhaust manifold contains a seal in the slip joint between the two pieces of the exhaust manifold. If the exhaust manifold slip joint does **not** appear to be leaking, there is no need to inspect the seal or separate the exhaust manifold. The exhaust manifold seal requires a special tool in the event of replacement. The seal is reusable if it passes the inspection criteria.

Preparatory Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

⚠ WARNING ⚠

Do not remove the pressure cap from a hot engine. Wait until the coolant temperature is below 50°C [120°F] before removing the pressure cap. Heated coolant spray or steam can cause personal injury.

⚠ WARNING ⚠

Coolant is toxic. Keep away from children and pets. If not reused, dispose of in accordance with local environmental regulations.

Note : Brush away all dirt from around the area of the air handling connections to avoid contamination of the interior of the engine.

- Disconnect the batteries. See equipment manufacturer service information.
- Drain the coolant. Refer to Procedure 008-018 in Section 8. (/qs3/pubsys2/xml/en/procedures/425/425-008-018-tr.html)
- Remove the air crossover tube and charge-air cooler hose. Refer to Procedure 010-019 in Section 10. (/qs3/pubsys2/xml/en/procedures/425/425-010-019.html)
- Remove the exhaust gas recirculation (EGR) cooler vent line. Refer to Procedure 008-017 in Section 8. (/qs3/pubsys2/xml/en/procedures/425/425-008-017.html)
- Remove the turbocharger, if used. Refer to Procedure 010-033 in Section 10. (/qs3/pubsys2/xml/en/procedures/425/425-010-033.html)
- Remove the EGR cooler coolant lines. Refer to Procedure 011-031 in Section 11. (/qs3/pubsys2/xml/en/procedures/425/425-011-031.html)
- Remove the exhaust gas pressure sensor tube. Refer to Procedure 011-027 in Section 11. (/qs3/pubsys2/xml/en/procedures/425/425-011-027.html)
- Remove the EGR connection tubes. Refer to Procedure 011-025 in Section 11. (/qs3/pubsys2/xml/en/procedures/425/425-011-025.html)
- Remove the EGR cooler. Refer to Procedure 011-019 in Section 11. (/qs3/pubsys2/xml/en/procedures/425/425-011-019.html)

Remove

GRAPHIC NOT FOUND

Note : The two sections of the exhaust manifold are sealed by an exhaust manifold seal. If preliminary inspection shows the seal is **not** leaking, it is **not** necessary to separate the two parts of the exhaust manifold.

Remove the twelve capscrews from the exhaust manifold. Remove the exhaust manifold.

Remove the gasket from the exhaust manifold to the EGR cooler inlet connection.

Use heavy tape to cover open points in the exhaust manifold and cylinder head.

Disassemble

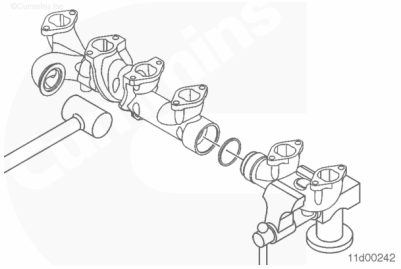
Use a vise to clamp on the two-port section of the exhaust manifold.

Do **not** allow the jaws of the vise to contact the exhaust manifold sealing surfaces.

Use a soft-faced mallet to lightly tap on the four-port section of the exhaust manifold to separate it from the two-port section of the exhaust manifold.

Use heavy tape to cover open points in the exhaust manifold and cylinder head.

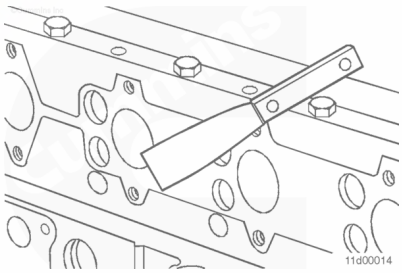
Note : If the exhaust manifold will **not** separate, it can be necessary to heat the manifold in the slip joint area to allow for separation of the manifold.



Clean and Inspect for Reuse

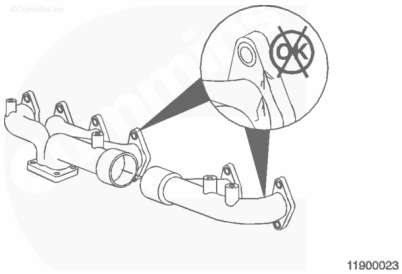
Clean the sealing surfaces of the cylinder head and the exhaust manifold. Use a gasket scraper or a wire brush.

Take caution to keep debris out of the cylinder head.



⚠ WARNING ⚠

Wear appropriate eye and face protection when using compressed air. Flying debris and dirt can cause personal injury.



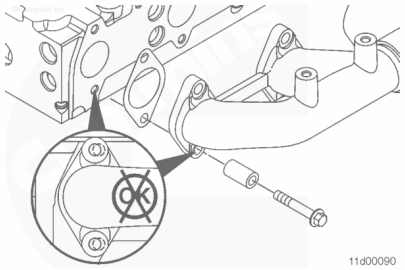
⚠ WARNING ⚠

When using a steam cleaner, wear safety glasses or a face shield, as well as protective clothing. Hot steam can cause serious personal injury.

Clean the exhaust manifold. Use steam. Dry with compressed air.

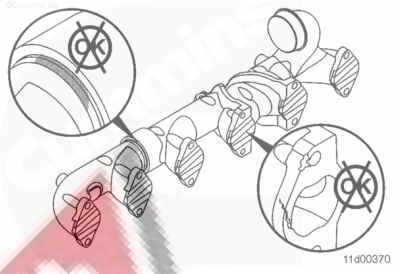
ANADOLU ISUZU DEALER SALES

If a missing or broken capscrew is found check the manifold to cylinder head fit. Perform this inspection on the larger four port section of the manifold. If the manifold mounting capscrew holes do **not** line up with the tapped holes in the cylinder head, replace both pieces of the exhaust manifold.



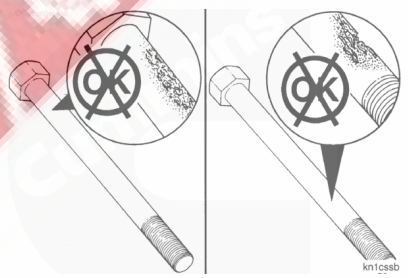
Inspect the exhaust manifold for cracks, soot streaking, leaks, and burnout.

Inspect the cylinder head bosses and turbocharger mounting studs for damage. Repair or replace, as necessary.



Inspect the exhaust manifold capscrews for corrosion.

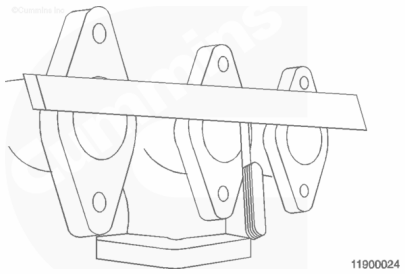
Replace the capscrews if corrosion is found.



Measure the manifold surface for flatness. Place a ruler over all exhaust ports in the manifold. Measure the gap between the port surface and the ruler. Use a feeler gauge.

Exhaust Manifold Flatness		
mm		in
0.20	MAX	0.008

If any port measures out of specification, replace the manifold.



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Exhaust Manifold Flatness		
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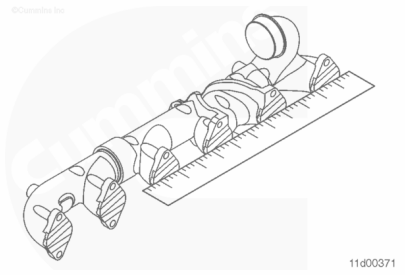


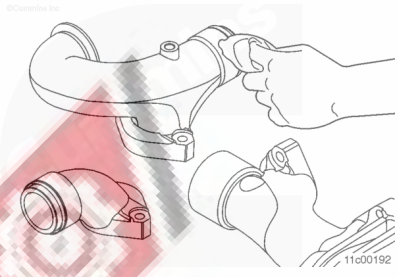
ANADOLU ISUZU GENUINE PARTS

Note : For multi-piece manifolds, each section **must** be verified to be flat, independently. If either section is found to be out of specification, replace both sections of the manifold.

The assembled two-piece manifold is **not** required to meet the flatness specification of the one piece manifold, as some misalignment is allowed for in the design of the manifold. Some misalignment will be eliminated when the manifold capscrews are tightened to specification during installation.

⚠ WARNING ⚠

Wear appropriate eye and face protection when using compressed air. Flying debris and dirt can cause personal injury.

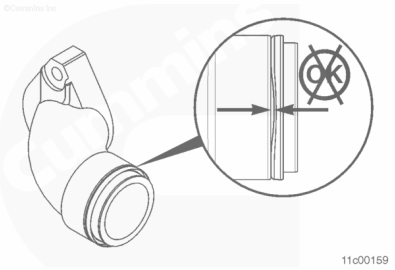


Clean the carbon from the exhaust manifold seal surfaces. Use a fine grit emery cloth.

Blow all debris from the exhaust manifold. Use compressed air.

Check that the exhaust seal ring is fully seated against the shoulder of the exhaust manifold male end section.

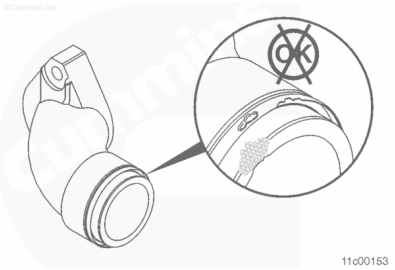
If the exhaust seal ring is **not** fully seated against the shoulder, the exhaust seal ring **must** be replaced.



Inspect the exhaust manifold seal bore for wear.

Inspect the exhaust seal ring for signs of damage or excessive wear.

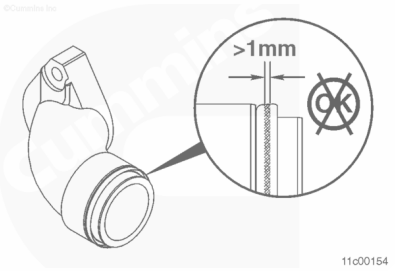
The exhaust seal ring **must not** show signs of denting or any other damage.



Measure the wear width on the exhaust seal ring.

The wear width **must not** be more than 1 mm [0.04 in] wide anywhere on the seal.

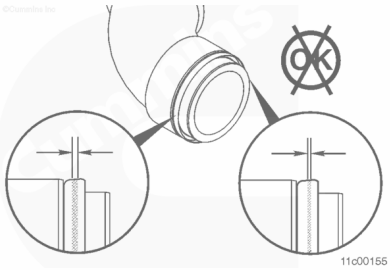
If the wear width is more than 1 mm [0.04 in] wide anywhere on the exhaust seal ring, it **must** be replaced.



ANADOLU ISUZU AFTER SALES

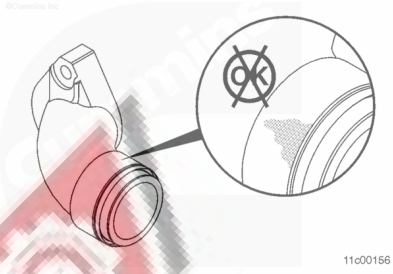
The wear width **must** be uniform around the seal ring.

If one side of the exhaust seal ring is worn more than the other, the exhaust seal ring **must** be replaced.



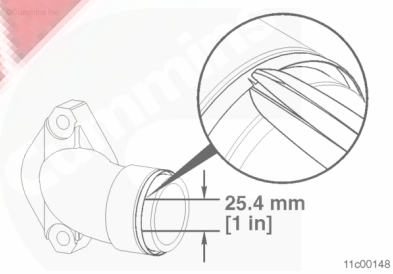
Inspect the exhaust manifold slip joint for signs of soot leakage.

If there is no evidence of an exhaust leak from the slip joint, and there are no visible cracks or other damage, do **not** remove the exhaust seal ring.



If there is damage, remove the exhaust seal ring by cutting it with a pair of snips and pulling it off with a pair of pliers.

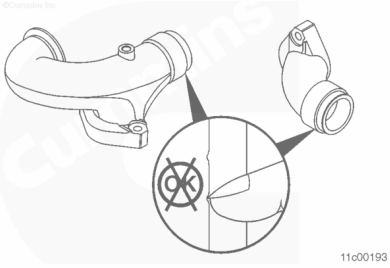
Discard the seal ring after removal.



Inspect the exhaust seal ring mating surfaces of the exhaust manifold.

If scratches or nicks can be felt with a fingernail on the exhaust seal ring mating surfaces, the exhaust manifold section **must** be replaced.

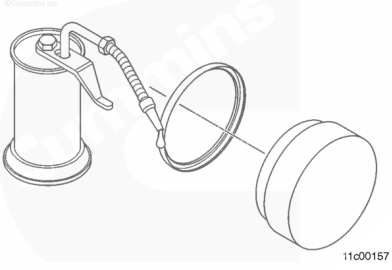
After completing inspection, recover the open points with heavy tape.



Assemble

Insert a new exhaust seal ring into seal installer, Part Number 4918709.

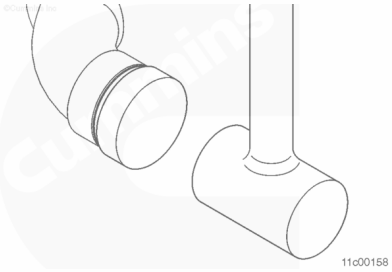
The seal is directional.



ANADOLU ISUZU PARTS SALES

Use a light coat of grease or clean engine oil to lubricate the exhaust seal ring during assembly onto the sections of the exhaust manifold.

With the two-port section of the exhaust manifold secured in a vise, lightly tap on the face of the service tool with a hammer until the exhaust seal ring is bottomed out against the shoulder of the joint.

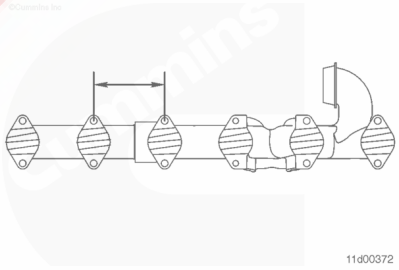


Check the seal to make sure it was **not** damaged during the installation process.

If the seal has bent edges, nicks, cuts, or other damage, remove it and start over.

Install

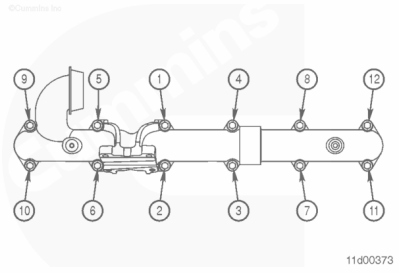
Measure the distance between the center of the mounting holes on ports 4 and 5 of the manifold.



If the distance is **not** within specification, put the manifold on a flat surface with the ports face down and lightly tap the manifold with a soft-faced mallet until the measurements are within specification.

Manifold Section Distance		
mm		in
136	MIN	5.35
138	MAX	5.43

Install the exhaust manifold to the cylinder head and EGR cooler inlet. Install new gaskets.



Lubricate the capscrews with high temperature anti-seize compound, Part Number 3824732, or equivalent, prior to installation.

Torque Value: 53 n•m [39 ft-lb]

Follow the tightening sequence as shown in the illustration.

Note : Using high temperature anti-seize compound is highly recommended. This provides consistent torque and pre-load and is a preventative measure against capscrew ceasing.

ANADOLU ISUZU PARTS

Finishing Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

- Install the EGR cooler. Refer to Procedure 011-019 in Section 11. (/qs3/pubsys2/xml/en/procedures/425/425-011-019.html)
- Install the EGR connection tubes. Refer to Procedure 011-025 in Section 11. (/qs3/pubsys2/xml/en/procedures/425/425-011-025.html)
- Install the exhaust gas pressure sensor tube. Refer to Procedure 011-027 in Section 11. (/qs3/pubsys2/xml/en/procedures/425/425-011-027.html)
- Install the EGR cooler coolant lines. Refer to Procedure 011-031 in Section 11. (/qs3/pubsys2/xml/en/procedures/425/425-011-031.html)
- Install the turbocharger. Refer to Procedure 010-033 in Section 10. (/qs3/pubsys2/xml/en/procedures/425/425-010-033.html)
- Install the EGR cooler vent line. Refer to Procedure 008-017 in Section 8. (/qs3/pubsys2/xml/en/procedures/425/425-008-017.html)
- Connect the charge air cooler hose and crossover tube. Refer to Procedure 010-019 in Section 10. (/qs3/pubsys2/xml/en/procedures/425/425-010-019.html)
- Connect the batteries. See equipment manufacturer service information.
- Operate the engine. Check for leaks.

ANADOLU FUEL

Select Service Tools

Recommended Cummins® Service Tools

- Pressure/vacuum adapter, Part Number 3164491
- Digital multimeter, Part Number 3164488, or deluxe digital multimeter, Part Number 3164489, or equivalent
- Adapter fitting, Part Number 4918576, or equivalent

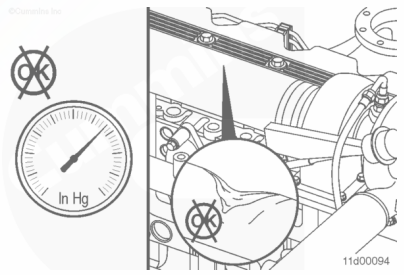
Additional Service Items

- No additional service items required.

General Information

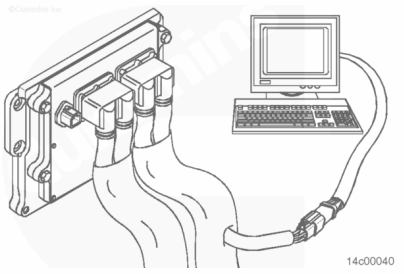
When measuring exhaust restriction, it is preferred the measurement point be within one pipe diameter of the turbocharger outlet.

If this requirement can **not** be met, make sure to inspect the exhaust outlet tubing between the turbocharger outlet and exhaust pressure tap location for damage to the exhaust piping.



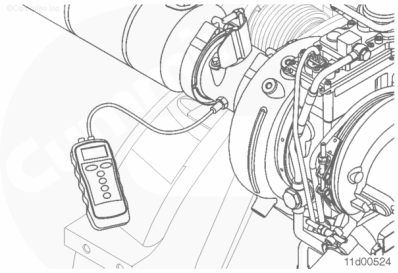
Initial Check

Use INSITE™ electronic service tool to check for fault codes. If any are present, follow the troubleshooting steps as outlined in the corresponding fault code troubleshooting procedure.



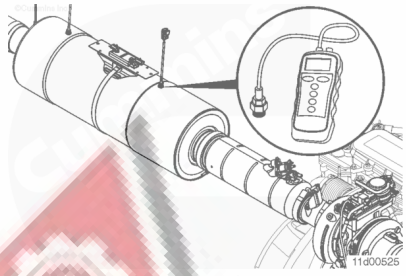
Measure

If equipped, remove the pipe plug from the pressure tap located in the turbocharger exhaust outlet tubing or the inlet of the aftertreament system.



Install pressure/vacuum adapter, Part Number 3164491, used with digital multimeter, Part Number 3164488, or deluxe digital multimeter, Part Number 3164489, or equivalent, into the pressure tap location.

If the exhaust outlet tubing or the inlet of the aftertreatment system is **not** equipped with a pressure taplocation, remove the first exhaust temperature sensor located in the aftertreatment system. Refer to Procedure 019-449 in Section 19. (/qs3/pubsys2/xml/en/procedures/425/425-019-449.html)



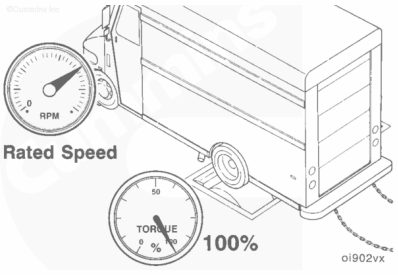
Install adapter fitting, Part Number 4918576, or equivalent, in the temperature sensor port. This will adapt the temperature sensor port to 1/8 inch NPT pipe threads.

Install pressure/vacuum adapter, Part Number 3164491, or equivalent, into the pressure tap location.

Use digital multimeter, Part Number 3164488, or deluxe digital multimeter, Part Number 3164489, or equivalent, to obtain the exhaust restriction measurement.

Note : Install at least 12 inches of metal tubing between the exhaust pipe pressure tap and pressure gauge to prevent exhaust from damaging the gauge and giving an inaccurate reading.

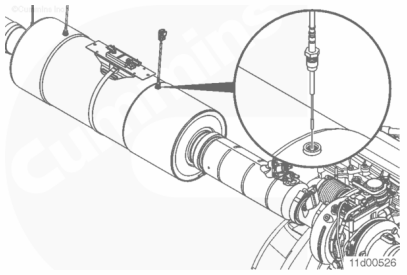
Operate the engine at rated speed and load and record the exhaust restriction. Refer to Procedure 018-020 in Section V. (/qs3/pubsys2/xml/en/procedures/425/425-018-020.html)



If the exhaust restriction exceeds the specification:

1. Inspect the exhaust piping for damage. See equipment manufacturer service information.
2. Check for any fault codes related to the aftertreatment diesel particulate filter indicating a possible damaged or plugged aftertreatment system.
3. Check for a damaged or restricted selective catalyst recirculation (SCR) decomposition tube. Refer to Procedure 011-062 in Section 11. (/qs3/pubsys2/xml/en/procedures/425/425-011-062.html)

If equipped with an exhaust pressure tap, remove the test equipment and install the pipe plug. Coat the threads of the plug with high-temperature multi-purpose anti-seize compound prior to installation.



If an aftertreatment exhaust temperature sensor port was used, remove the test equipment and install the exhaust temperature sensor. Refer to Procedure 019-449 in Section 19. (/qs3/pubsys2/xml/en/procedures/425/425-019-449.html)

Note : Clear any inactive fault codes with INSITE™ electronic service tool once the testing is completed.

Last Modified: 05-Aug-2016

ANADOLU ISUZU AFTER SALES

Select Service Tools

Recommended Cummins® Service Tools

- No Cummins® Service Tools required.

Additional Service Items

- Ai-seize compound

General Information

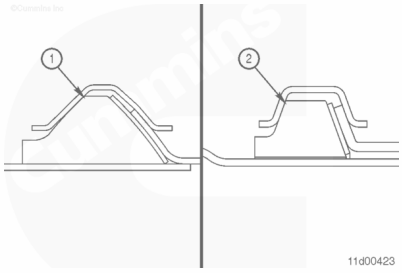
⚠ WARNING ⚠

The exhaust and exhaust components can remain hot after the engine has been shut down or secured. To avoid the risk of fire, property damage, burns or other serious personal injury, allow the exhaust system to cool before beginning this procedure or repair and make sure that no combustible materials are located where they might come in contact with hot exhaust or exhaust components.



The exhaust outlet connection is attached to the outlet of the turbocharger that houses the inlet NOx sensor. Due to the number of various exhaust aftertreatment applications, this procedure has been written to be generic. **Not** all illustrations within this procedure will represent the application being serviced. The remove and install procedures are common regardless of the exhaust outlet connection configuration.

A variation in vehicle aftertreatment configuration will drive the aftertreatment to have different flanges. The clamps and gaskets on either end of the exhaust outlet connection can be different from one another. There are two types of flanged joints, spherical Marman® and full Marman®.



The spherical Marman® (1) joints allow a small amount of misalignment and have a rounded cross section. The full Marman® (2) joints are completely rigid and have a more edgy profile.

Preparatory Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

⚠ WARNING ⚠

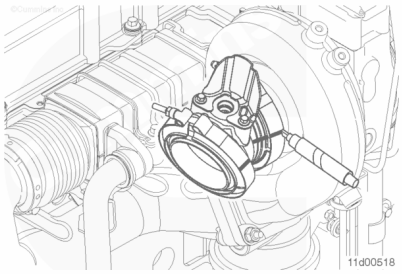
During regeneration, exhaust gas temperature can reach 800 °C [1500°F], and exhaust system surface temperature can exceed 700 °C [1300°F], which is hot enough to ignite or melt common materials, and to burn people. The exhaust and exhaust components can remain hot after the vehicle has stopped moving. To avoid the risk of fire, property damage, burns or other serious personal injury, allow the exhaust system to cool before beginning this procedure or repair and make sure that no combustible materials are located where they are likely to come in contact with hot exhaust or exhaust components.

⚠ WARNING ⚠

Wear appropriate eye and face protection when using compressed air. Flying debris and dirt can cause personal injury.

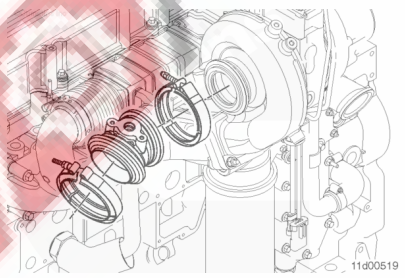
- Disconnect the batteries. See equipment manufacturer service information.
- Use compressed air to remove any loose debris.
- Remove the aftertreatment intake NOx sensor heat shield. Refer to Procedure 011-032 in Section 11. (/qs3/pubsys2/xml/en/procedures/425/425-011-032.html)
- Remove the aftertreatment intake NOx sensor. Refer to Procedure 019-463 in Section 19. (/qs3/pubsys2/xml/en/procedures/425/425-019-463.html)

- Draw an orientation reference line across each of the V-band clamps on either end of the exhaust outlet connection. This will aid in lining up the clamps and outlet to their original orientation during installation.



Remove

Remove the V-band clamps on either end of the exhaust outlet connection.



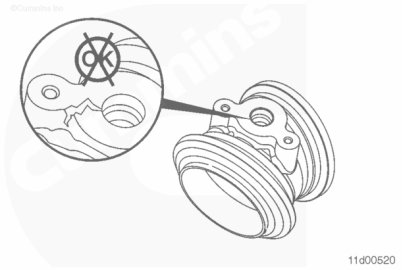
Depending on original equipment manufacturer (OEM) design, it can be necessary to loosen any supports to the down pipe attached to the exhaust outlet connection. See equipment manufacturer service information. This will provide enough space to remove the exhaust outlet connection.

Remove the exhaust outlet connection.

If applicable, discard the gasket.

Clean and Inspect for Reuse

Inspect the outlet connection for corrosion or structural damage.



Observe the outlet connection for oil spray on the inside walls of the tube. Use the following procedure if oil is on the inside of the walls of the tube. Refer to Procedure 010-033 in Section 10. (/qs3/pubsys2/xml/en/procedures/425/425-010-033.html)

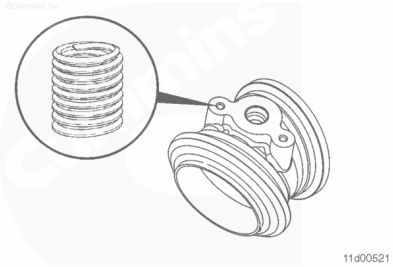
Inspect the aftertreatment intake NOx sensor mounting area for damage.

Inspect the threaded bosses of the intake NOx sensor mounting area. If the capscrew holes are damaged the exhaust outlet connection can be repaired.

ANADOLU ISUZU
PARTS SALES

Coiled thread inserts with inner coil threads M20 x 1.5 can be used.

Follow manufacturer recommended guidelines to install the coiled threaded insert.

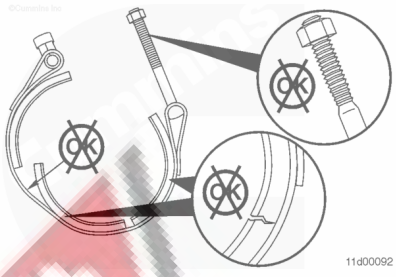


Inspect the V-band clamps and mounting straps for signs of over-extension.

The band **must not** be bent or damaged.

Inspect the V-band clamp and mounting strap threads for damage.

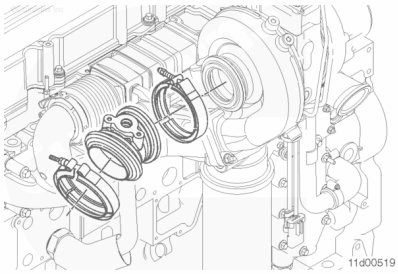
Replace the V-band clamp or mounting strap if damage is found.



Install

⚠ CAUTION ⚠

Do not use an air tool to tighten the V-band clamp(s). An air tool will damage the threads.



Note : The clamps on either end of the exhaust outlet connection may not be the same. See to the General Information section in this procedure. Where applicable, install and tighten the full Marman® clamps before the spherical Marman® clamps, to account for misalignment in the aftertreatment system.

Apply a coat of anti-seize compound on the threads of the V-band clamps.

Install a new gasket if applicable. Initially, do **not** completely tighten the clamp between the turbocharger and \exhaust outlet connection. Rotate the exhaust outlet connection, if necessary, to align with the down pipe and turbocharger using the identification marks made in the preparation step. Once properly aligned, tighten the clamps.

Torque Value: 14 n•m [124 in-lb]

Finishing Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

- Install the aftertreatment intake NOx sensor. Refer to Procedure 019-463 in Section 19. (/qs3/pubsys2/xml/en/procedures/425/425-019-463.html)
- Install the aftertreatment intake NOx sensor heat shield. Refer to Procedure 011-032 in Section 11. (/qs3/pubsys2/xml/en/procedures/425/425-011-032.html)
- Tighten any exhaust hangers loosened in the removal process. See equipment manufacturer service information.
- Connect the batteries. See equipment manufacturer service information.
- Start the engine. Check for exhaust leaks.

ANADOLU ISUZU AFTER SALES

Last Modified: 05-Aug-2016

Note: A video supports the information provided in this procedure. Read the procedure prior to viewing the video.

Select Service Tools

Recommended Cummins® Service Tools

- Exhaust Gas Recirculation (EGR) Cooler Leak Test Kit, Part Number 4919688 or 4918625
- Collar assembly, Part Number 4919691
- Threaded plug, Part Number 3678923
- O-ring seal, Part Number 3678925
- Plug, Part Number 4918627
- Collar, Part Numbers 4919689 and 4919690
- P-80 lubricant, Part Number 3824878
- Plug, Part Number 4918628
- O-ring seal, Part Number 4919208
- Collar, Part Numbers 4918626 and 4918702, or 4919689 and 4919690
- Male connector, Part Number 68138
- Air pressure regulator, Part Number 3164231
- Air Handling Clean Care Kit, Part Number 4919508
- EGR Cooler Leak Test Kit, Part Number 5298810
- Plug, Part Number 5298811
- Plug, Part Number 5928884
- Air Handling Clean Care Kit, Part Number 5298776

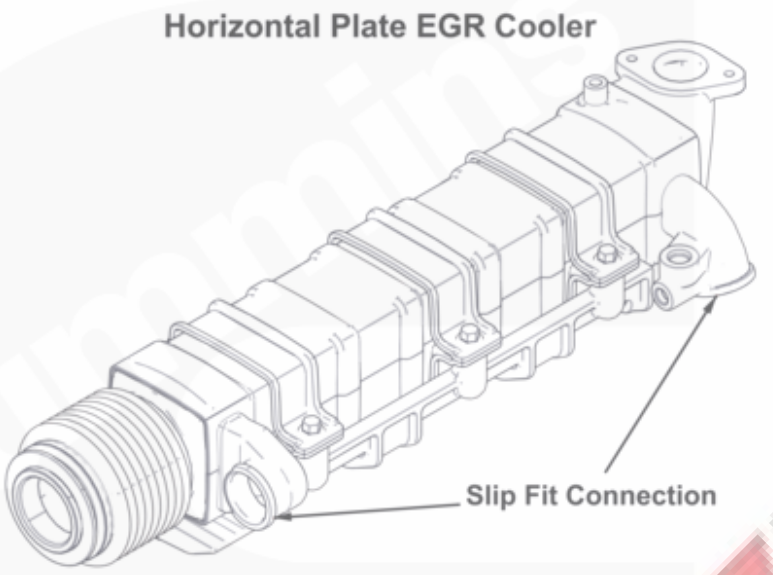
Additional Service Items

- No additional service items required.

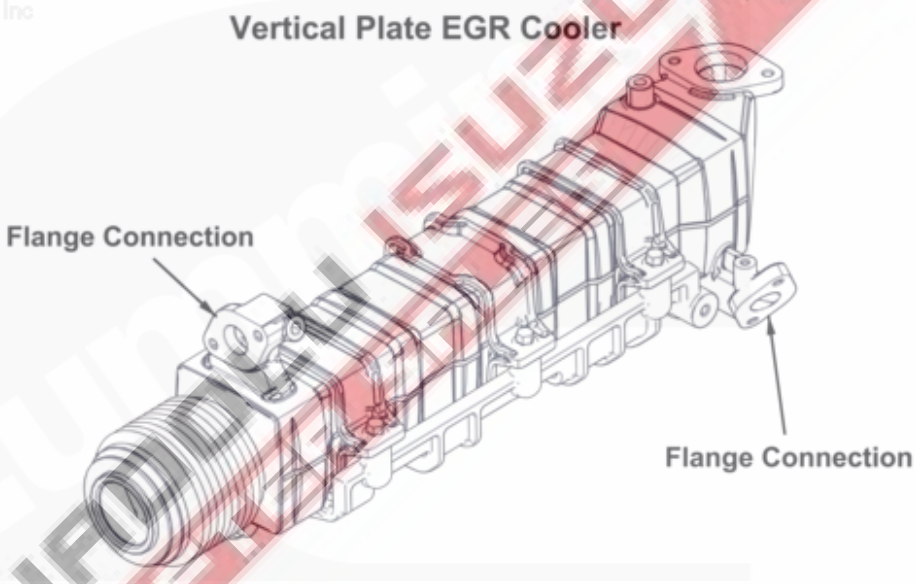
General Information

The illustrations show the horizontal plate EGR cooler and vertical plate EGR cooler. The engine can be equipped with one of the below two EGR coolers.

The horizontal plate EGR cooler is equipped with slip fit connection (without a flange) for the coolant inlet and outlet lines. The vertical plate EGR cooler is equipped with a flange connection for the coolant inlet and outlet lines.



Horizontal Plate EGR Cooler



Vertical Plate EGR Cooler

See the appropriate sections based on the EGR cooler type.

Preparatory Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

⚠ WARNING ⚠

Do not remove the pressure cap from a hot engine. Wait until the coolant temperature is below 50°C [120°F] before removing the pressure cap. Heated coolant spray or steam can cause personal injury.

Note : Brush away all dirt from around the area of the air handling connections to avoid contamination of the interior of the engine.

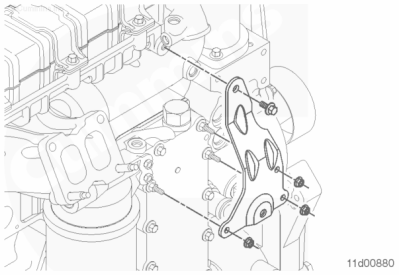
- Disconnect the batteries. See equipment manufacturer service information.
- Drain the coolant. Refer to Procedure 008-018 in Section 8. (/qs3/pubsys2/xml/en/procedures/425/425-008-018-tr.html)
- Remove the EGR connection tube. Refer to Procedure 011-025 in Section 11. (/qs3/pubsys2/xml/en/procedures/425/425-011-025.html)
- Remove the exhaust gas pressure sensor tube. Refer to Procedure 011-027 in Section 11. (/qs3/pubsys2/xml/en/procedures/425/425-011-027.html)
- Remove the exhaust gas pressure sensor. Refer to Procedure 019-376 in Section 19. (/qs3/pubsys2/xml/en/procedures/425/425-019-376.html)
- Remove the EGR cooler coolant lines. Refer to Procedure 011-031 in Section 11. (/qs3/pubsys2/xml/en/procedures/425/425-011-031.html)
- Remove the coolant vent line. Refer to Procedure 008-017 in Section 8. (/qs3/pubsys2/xml/en/procedures/425/425-008-017.html)

Pressure Test

Horizontal Plate

Note : The engine **must** be within 3°C or 5°F of ambient temperature to perform the test. Testing the EGR cooler while hot will give false results.

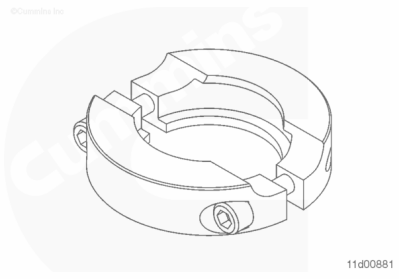
Note : Moisture in the EGR cooler or EGR connection tubes does **not** indicate a malfunctioning EGR cooler. The EGR cooler **must** be pressure tested before being replaced.



Remove the retaining screw and three nuts that hold the EGR cooler bracket in place. Remove the EGR cooler bracket.

Use EGR Cooler Leak Test Kit, Part Number 4919688 or 4918625, to check the EGR cooler for internal leaks.

For EGR Cooler Leak Test Kit, Part Number 4918625, one of the collar sets will have to be replaced with collar assembly Part Number 4919691, to be able to orient the collar with the bolts facing away from the engine on the coolant outlet of the EGR cooler.



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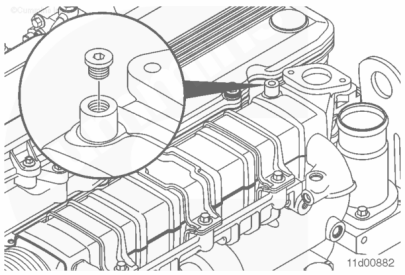
Plug the EGR cooler vent fitting by installing threaded plug, Part Number 3678923.

Inspect the o-ring on plug, Part Number 3678923, for damage prior to use. If the o-ring is damaged, replace it with o-ring seal, Part Number 3678925, to make sure of an airtight seal.

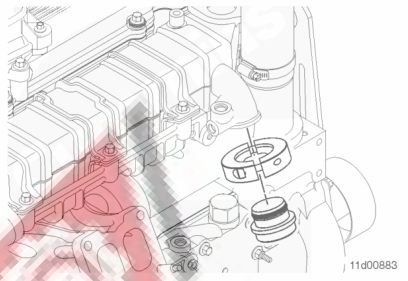


Plug the EGR cooler coolant outlet connection by installing plug, Part Number 4918627, and collar, Part Numbers 4919689 and 4919690.

Note : The collar **must** be installed in the orientation shown in the illustration to provide clearance for the exhaust manifold pressure sensor mounting boss.

Make sure the o-ring is lubricated with P-80 lubricant, Part Number 3824878, to prevent rolling and damaging the o-ring during installation.

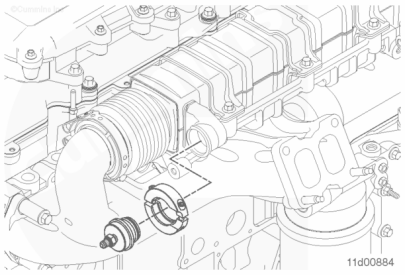
Inspect the o-ring on plug, Part Number 4918628, and plug, Part Number 4918627, for damage prior to use. If the o-ring is damaged, replace it with o-ring seal, Part Number 4919208, to make sure of an airtight seal.



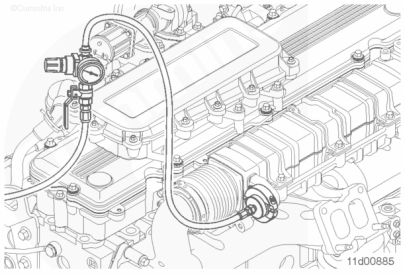
Plug the EGR cooler coolant inlet connection by installing plug, Part Number 4918628, collar, Part Numbers 4918626 and 4918702, or 4919689 and 4919690, and male connector, Part Number 68138.

Note : The collar **must** be installed in the orientation shown in the illustration to provide clearance for the EGR cooler body.

Make sure the o-rings are lubricated with P-80 lubricant, Part Number 3824878, to prevent rolling and damaging the o-ring during installation.

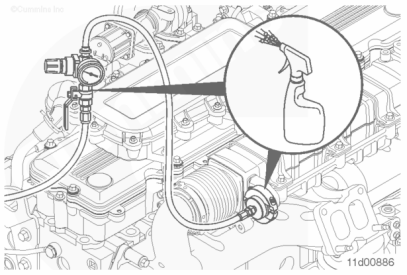


Connect air pressure regulator, Part Number 3164231, to the air fitting on plug, Part Number 4918628. Connect shop air to the inlet of the air pressure regulator.



⚠ WARNING ⚠

Wear appropriate eye and face protection when using compressed air. Flying debris and dirt can cause personal injury.



- Apply 483 kPa [70 psi] of air pressure to the cooler.
- Inspect for air escaping the EGR cooler assembly as a result of loose lines and fittings by spraying a mixture of mild soap and water at the fitting and line connections. Air leaks at these locations will **not** give accurate test results, and will lead to EGR coolers being replaced when they are **not** malfunctioning.
- Shut the air supply OFF to the regulator by using the ball valve. Disconnect the compressed air supply.
- Record the time the air supply was shut OFF and the air pressure shown on the air pressure regulator gauge.
- Periodically check the fittings for air leaks using the mixture of soap and water. If there are any air leaks found during the test, fix the leak and start the test over.
- Measure and record the air pressure after 20 minutes. If there is no pressure drop, the EGR cooler is reusable.
- If the measured pressure drop is greater than 138 kPa [20 psi], replace the EGR cooler.
- If the measured pressure drop is 138 kPa [20 psi] or less, check all of the fittings for air leaks. Correct any leaks found and test again.
- If any detectable pressure drop is seen on the second test and no air leaks are found on the test equipment, replace the EGR cooler.

Note : Open the ball valve to release any pressure in the EGR cooler before removing the test fittings.

Once the parts are cleaned and tested, cover open points with protective caps from Air Handling Clean Care Kit, Part Number 4919508.

If the EGR cooler is **not** usable, check the following items:

- Pressure check the cooling system for leaks. Leaks can be in original equipment manufacturer (OEM) coolant plumbing as well as on the engine which can cause EGR cooler malfunctions. Verify there are no other issues with the cooling system (water pump damage, fan drive damage, or similar). Refer to Procedure 008-020 in Section 8. (/qs3/pubsys2/xml/en/procedures/425/425-008-020.html)
- Inspect the turbocharger turbine housing for signs of coolant deposits. Coolant deposits can typically be identified as dried white deposits coating the inside of the

housings. Refer to Procedure 010-033 in Section 10. (/qs3/pubsys2/xml/en/procedures/425/425-010-033.html)
- Inspect the EGR valve inlet for signs of coolant and clean if coolant is found. Refer to Procedure 011-022 in Section 11. (/qs3/pubsys2/xml/en/procedures/425/425-011-022.html)
- Inspect the air intake connection for coolant. Clean if coolant is found. Refer to Procedure 010-080 in Section 10. (/qs3/pubsys2/xml/en/procedures/425/425-010-080.html)
- Replace the crankcase breather element. Refer to Procedure 003-019 in Section 3. (/qs3/pubsys2/xml/en/procedures/425/425-003-019.html)
- If there is coolant contamination in the engine lubricating oil, change the engine lubricating oil. Refer to Procedure 007-013 in Section 7. (/qs3/pubsys2/xml/en/procedures/425/425-007-013-tr.html) Refer to Procedure 007-037 in Section 7. (/qs3/pubsys2/xml/en/procedures/425/425-007-037.html)

Note : If damage resulted in a hydraulic lock and the coolant level reached the intake manifold, it can be necessary to clean the charge air cooler. See equipment manufacturer service information.

Note : If damage resulted in a hydraulic lock and/or the coolant level reached the intake manifold, inspect the air compressor air inlet and outlet tubes for signs of coolant. If coolant is found, clean and inspect the air compressor head. Refer to Procedure 012-007 in Section 12. (/qs3/pubsys2/xml/en/procedures/425/425-012-007.html)

Note : If damage resulted in a hydraulic lock, it can be necessary to remove the injectors and evacuate coolant from the cylinder(s). Refer to Procedure 006-026 in Section 6. (/qs3/pubsys2/xml/en/procedures/425/425-006-026.html)

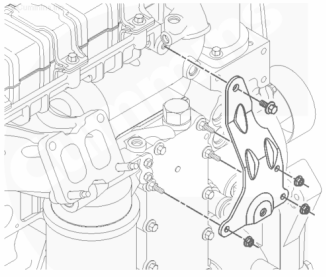
If the EGR cooler is reusable, remove the parts supplied in the service kit, install the EGR cooler bracket in the next step, and proceed to the Inspect for Reuse section of this procedure.

Install the EGR cooler bracket. Install and tighten the capscrews.

Torque Value: 24 n•m [212 in-lb]

Install and tighten the three hex nuts.

Torque Value: 10 n•m [89 in-lb]

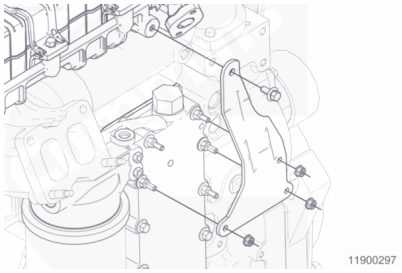


Vertical Plate

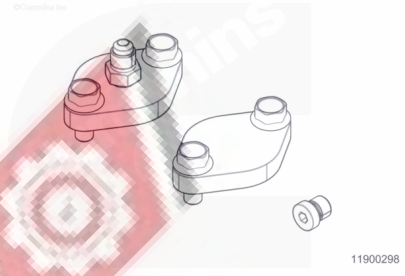
Note : The engine **must** be within 3°C or 5°F of ambient temperature to perform the test.

Note : Moisture in the EGR cooler or EGR connection tubes does **not** indicate a malfunctioning EGR cooler. The EGR cooler **must** be pressure tested before being replaced.

Remove the retaining screw and three nuts that hold the EGR cooler bracket in place. Remove the EGR cooler bracket.

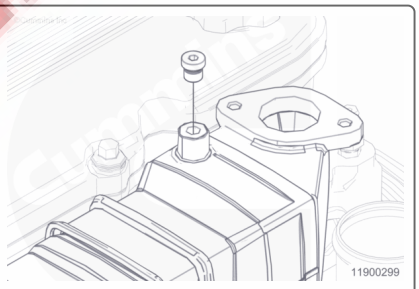

11900297

Use EGR Cooler Leak Test Kit, Part Number 5298810, to check the EGR cooler for internal leaks.

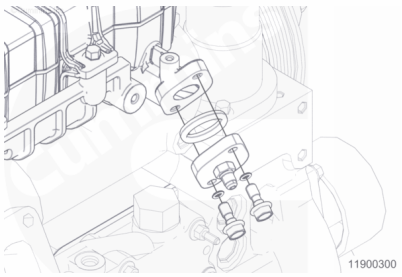

11900298

Plug the EGR cooler vent fitting by installing threaded plug, Part Number 3678923.

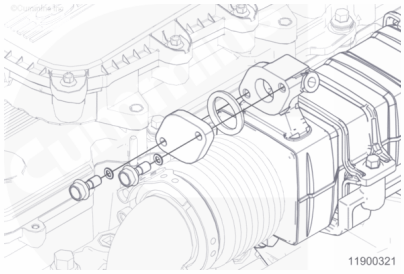
Inspect the o-ring on plug, Part Number 3678923, for damage prior to use. If the o-ring is damaged, replace it with o-ring seal, Part Number 3678925, to make sure of an airtight seal.


11900299

Plug the EGR cooler coolant outlet connection by installing plug, Part Number 5298811.


11900300

Plug the EGR cooler coolant inlet connection by installing plug, Part Number 5298884.


11900321

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Connect air pressure regulator, Part Number 3164231, to the air fitting on plug, Part Number 5298811. Connect shop air to the inlet of the air pressure regulator.

GRAPHIC NOT FOUND

⚠ WARNING ⚠

Wear appropriate eye and face protection when using compressed air. Flying debris and dirt can cause personal injury.

GRAPHIC NOT FOUND

- Apply 483 kPa [70 psi] of air pressure to the cooler.
- Inspect for air escaping the EGR cooler assembly as a result of loose lines and fittings by spraying a mixture of mild soap and water at the fitting and line connections. Air leaks at these locations will **not** give accurate test results, and will lead to EGR coolers being replaced when they are **not** malfunctioning.
- Shut the air supply OFF to the regulator by using the ball valve. Disconnect the compressed air supply.
- Record the time the air supply was shut OFF and the air pressure shown on the air pressure regulator gauge.
- Periodically check the fittings for air leaks using a mixture of soap and water. If there are any air leaks found during the test, fix the leak and start the test over.
- Measure and record the air pressure after 20 minutes. If there is no pressure drop, the EGR cooler is reusable.
- If the measured pressure drop is greater than 138 kPa [20 psi], replace the EGR cooler.
- If the measured pressure drop is 138 kPa [20 psi] or less, check all of the fittings for air leaks. Correct any leaks found and test again.
- If any detectable pressure drop is seen on the second test and no air leaks are found on the test equipment, replace the EGR cooler.

Note : Open the ball valve to release any pressure in the EGR cooler before removing the test fittings.

Once the parts are cleaned and tested, cover open points with protective caps from Air Handling Clean Care Kit, Part Number 4919508.

If the EGR cooler is **not** usable, check the following items:

- Pressure check the cooling system for leaks. Leaks can be in OEM coolant plumbing as well as on the engine which can cause EGR cooler malfunctions. Verify there are no other issues with the cooling system (water pump damage, fan drive damage, or similar). Refer to Procedure

008-020 in Section 8. (/qs3/pubsys2/xml/en/procedures/425/425-008-020.html)

- Inspect the turbocharger turbine housing for signs of coolant deposits. Coolant deposits can typically be identified as dried white deposits coating the inside of the housings. Refer to Procedure 010-033 in Section 10. (/qs3/pubsys2/xml/en/procedures/425/425-010-033.html)
- Inspect the EGR valve inlet for signs of coolant and clean if coolant is found. Refer to Procedure 011-022 in Section 11. (/qs3/pubsys2/xml/en/procedures/425/425-011-022.html)
- Inspect the air intake connection for coolant. Clean if coolant is found. Refer to Procedure 010-080 in Section 10. (/qs3/pubsys2/xml/en/procedures/425/425-010-080.html)
- Replace the crankcase breather element. Refer to Procedure 003-019 in Section 3. (/qs3/pubsys2/xml/en/procedures/425/425-003-019.html)
- If there is coolant contamination in the engine lubricating oil, change engine lubricating oil. Refer to Procedure 007-013 in Section 7. (/qs3/pubsys2/xml/en/procedures/425/425-007-013-tr.html) Refer to Procedure 007-037 in Section 7. (/qs3/pubsys2/xml/en/procedures/425/425-007-037.html)

Note : If damage resulted in a hydraulic lock and the coolant level reached the intake manifold, it can be necessary to clean the charge air cooler. See equipment manufacturer service information.

Note : If damage resulted in a hydraulic lock and/or the coolant level reached the intake manifold, inspect the air compressor air inlet and outlet tubes for signs of coolant. If coolant is found, clean and inspect the air compressor head. Refer to Procedure 012-007 in Section 12. (/qs3/pubsys2/xml/en/procedures/425/425-012-007.html)

Note : If damage resulted in a hydraulic lock, it can be necessary to remove the injectors and evacuate coolant from the cylinder(s). Refer to Procedure 006-026 in Section 6. (/qs3/pubsys2/xml/en/procedures/425/425-006-026.html)

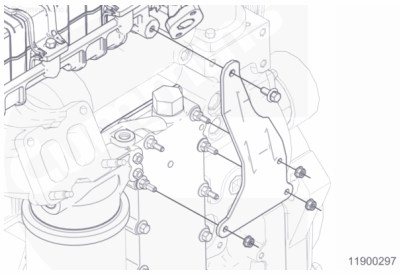
If the EGR cooler is reusable, remove the parts supplied in the service kit, install the EGR cooler bracket in the next step, and proceed to the Inspect for Reuse section of this procedure.

Install the EGR cooler bracket. Install and tighten the capscrews.

Torque Value: 24 n•m [212 in-lb]

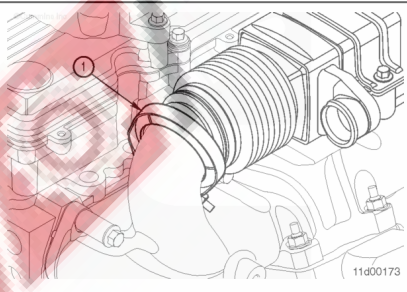
Install and tighten the three hex nuts.

Torque Value: 10 n•m [89 in-lb]



Remove

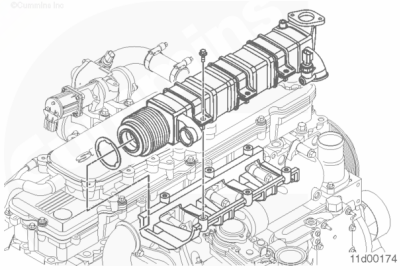
Remove the V-band clamp (1) and gasket from the EGR cooler inlet.



Remove the six capscrews holding the EGR cooler to the EGR cooler bracket.

Remove the EGR cooler.

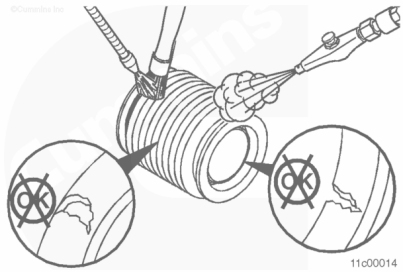
Cover open connections with protective caps from Air Handling Clean Care Kit, Part Number 5298776.



Clean and Inspect for Reuse

Inspect the EGR cooler bellows for cracks or other damage.

Replace the EGR cooler if damage is found.



Inspect the V-band clamp threads for damage.

Replace the V-band clamp if damage is found.

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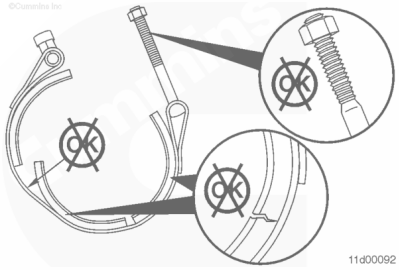
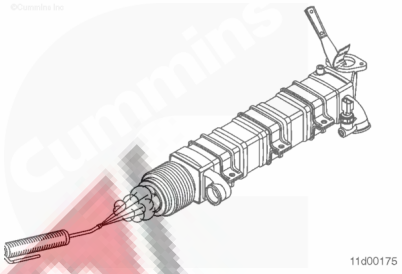


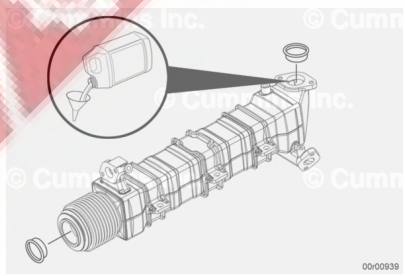
Remove any gasket material from the EGR cooler gas outlet connection.

Inspect the EGR cooler for signs of external leaks or cracks.



⚠ CAUTION ⚠

Do not use chlorinated water to clean or rinse the EGR cooler. Chlorides are very corrosive to the stainless alloys internal and external to the EGR cooler.



Cap the exhaust gas outlet end of the EGR cooler with the plastic caps supplied in the EGR Cooler Leak Check Kit, Part Number 4919688.

Completely fill the EGR cooler with safety solvent.

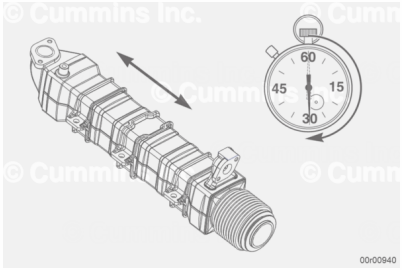
Cap the exhaust gas inlet of the EGR cooler with the plastic cap supplied in the EGR Cooler Leak Check Kit, Part Number 4919688.

Lay the EGR cooler on its side.

Allow the EGR cooler to soak for approximately 20 minutes.

Drain approximately 25 percent of the liquid from the cooler and recap. Dispose of this liquid properly.

Shake the cooler by hand, from end-to-end, for approximately 30 seconds.



⚠ WARNING ⚠

When using solvents, acids, or alkaline materials for cleaning, follow the manufacturer's recommendations for use. Wear goggles and protective clothing to reduce the possibility of personal injury.

⚠ WARNING ⚠

Wear appropriate eye and face protection when using compressed air. Flying debris and dirt can cause personal injury.

Drain the remaining safety solvent from the EGR cooler and properly dispose of it.

Use compressed air to dry the inside of the EGR cooler and remove any loose debris or particles.

Cap the exhaust gas outlet of the EGR cooler with the plastic cap supplied in the EGR Cooler Leak Check Kit, Part Number 4919688.

Completely fill the EGR cooler with water.

Cap the exhaust gas inlet end of the EGR cooler with the plastic cap supplied in the EGR Cooler Leak Check Kit, Part Number 4919688.

Shake the cooler by hand, from end-to-end, for approximately 30 seconds.

Drain the water from the EGR cooler and properly dispose of it.

Use compressed air to dry the inside of the EGR cooler.

Replace the EGR cooler if cracks or other damage is found.

Clean the EGR cooler exhaust gas inlet and outlet with safety solvent.

Dry with compressed air.

Inspect the EGR cooler exhaust gas inlet and outlet for signs of fretting, cracks, or other damage.

Replace the EGR cooler if any damage is found.

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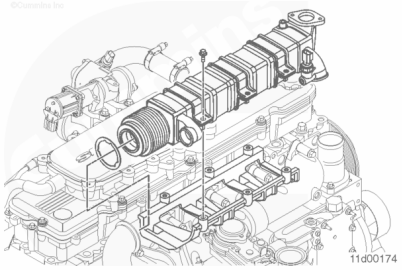
Install

Install the EGR cooler to the EGR cooler bracket. Leave the six capscrews loose to minimize assembly stress on the EGR cooler bellows.

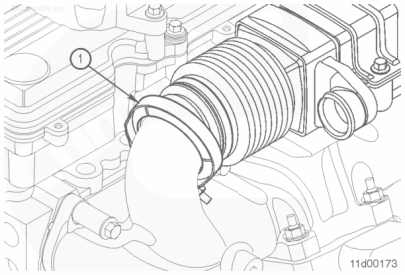


Connect the EGR cooler exhaust gas inlet bellows to the exhaust manifold with a new gasket.

Tighten the clamp.

Torque Value: 17 n•m [150 in-lb]

With the EGR cooler bellows aligned to the exhaust manifold, hand tighten the six capscrews holding the EGR cooler to the EGR cooler bracket.



Tighten the capscrews in an alternating pattern, starting from the center and working toward the outside.

Torque Value: 24 n•m [212 in-lb]

Finishing Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

- Install the coolant vent line. Refer to Procedure 008-017 in Section 8. (/qs3/pubsys2/xml/en/procedures/425/425-008-017.html)
- Install the EGR cooler coolant lines. Refer to Procedure 011-031 in Section 11. (/qs3/pubsys2/xml/en/procedures/425/425-011-031.html)
- Install the exhaust gas pressure sensor. Refer to Procedure 019-376 in Section 19. (/qs3/pubsys2/xml/en/procedures/425/425-019-376.html)
- Install the exhaust gas pressure sensor tube. Refer to Procedure 011-027 in Section 11. (/qs3/pubsys2/xml/en/procedures/425/425-011-027.html)
- Install the EGR connection tube. Refer to Procedure 011-025 in Section 11. (/qs3/pubsys2/xml/en/procedures/425/425-011-025.html)
- Fill the engine with coolant. Refer to Procedure 008-018 in Section 8. (/qs3/pubsys2/xml/en/procedures/425/425-008-018-tr.html)
- Connect the batteries. See equipment manufacturer service information.
- Operate the engine. Check for leaks.

Note : If a malfunction resulted in coolant entering the exhaust system, the aftertreatment system can be recovered. Refer to Procedure 014-015 in Section 14. (/qs3/pubsys2/xml/en/procedures/425/425-014-015.html)



0:00

Last Modified: 15-Dec-2020

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Select Service Tools

Recommended Cummins® Service Tools

- Air Handling Clean Care Kit, Part Number 5298776, or equivalent

Additional Service Items

- Nylon bristle and/or wire brush
- Pick or scraping tool
- 90 degree bent pick

Preparatory Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

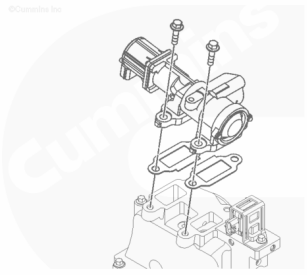
Note : Brush away all dirt from around the area of the air handling connections to avoid contamination of the interior of the engine.

- Disconnect the batteries. See equipment manufacturer service information.
- Disconnect the exhaust gas recirculation (EGR) connection tube from the EGR valve. Refer to Procedure 011-025 in Section 11. (/qs3/pubsys2/xml/en/procedures/425/425-011-025.html)
- Disconnect the electrical connection from the EGR valve.

Remove

Clean the area around the EGR valve with a clean cloth to help prevent debris from entering the air intake system when the EGR valve is removed.

Remove the four capscrews holding the EGR valve to the air intake connection. Remove the EGR valve.



11d00198

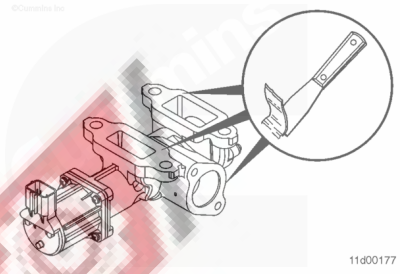
Use protective caps from Air Handling Clean Care Kit, Part Number 5298776, or equivalent, or heavy tape to cover any open connections to prevent debris from entering the system.

Clean and Inspect for Reuse

Clean the EGR valve and air intake connection mounting surfaces of gasket material, taking care to keep any debris out of the air intake system.

A light coating of carbon is common on the inside of the EGR valve and does **not** need to be removed.

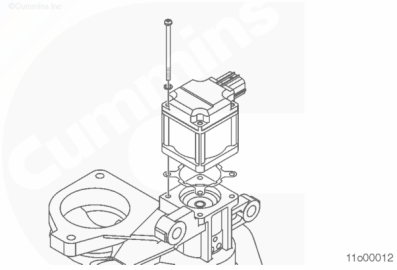
Note : The EGR valve has a green corrosion-resistant coating on its inner surfaces. Do **not** remove this coating.



Remove the four capscrews that hold the EGR valve motor to the EGR valve base.

Remove the EGR valve motor. Take care to keep the shim with the motor.

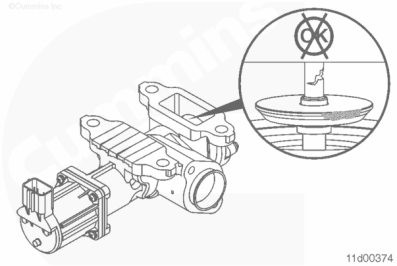
Note : Note the orientation of the electrical connector with respect to the valve body. A witness mark on the outside of the motor case and valve body can be used to document the orientation. This orientation **must** be the same upon reassembly.



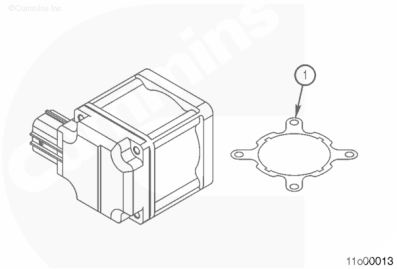
Inspect the EGR valve seats and stem for galling, pitting, cracks, or excessive corrosion.

If the EGR valve shows signs of internal damage, replace the EGR valve.

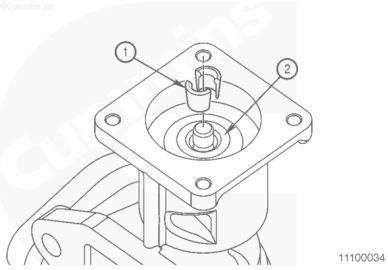
Note : Soot and condensation leaking from the weep hole on the EGR valve is considered normal, and does **not** mean the EGR valve needs to be replaced.



Note : The shim (1) is specific to that valve and can **not** be replaced. If the shim is lost or damaged, replace the EGR valve.

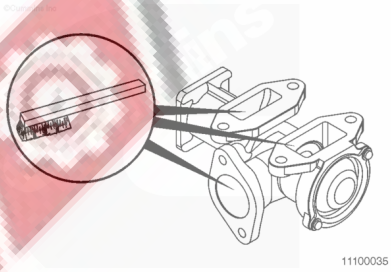


Use two fingers to press down on the valve spring retainer (1) to unlock two valve keepers (2). If valve keepers will **not** release using finger pressure, locate a 5/8" deep socket to the spring retainer (1). Gently tap on the socket with a small hammer to release the keepers. Use two fingers and press for keeper removal.

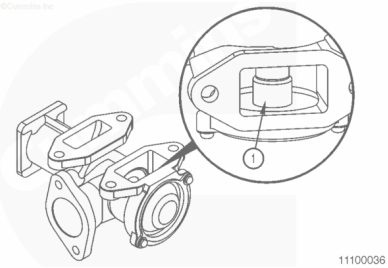


Note : The spring, spring keepers, and spring retainer can **not** be replaced. If the spring, spring keepers, or spring retainer are lost or damaged, replace the EGR valve.

Clean the accumulated soot from the EGR valve inlet port and outlet ports with a nylon bristle and/or wire brush. Some deposits may need to be scraped out with a pick or scraping tool. Remove as much material as possible before applying any cleaner and without damaging the poppet sealing surfaces and anti-corrosion finish inside the EGR valve body.

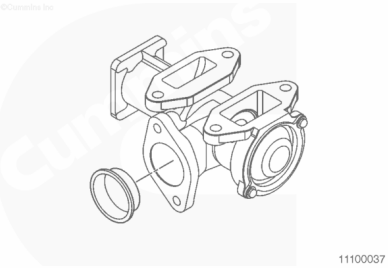


Clear the area around the soot guard (1) in the outlet port with a 90 degree bent pick. Clear any deposit material all the way around the front and the back of the soot guard. Make sure that there is no deposit material on or around the soot guard that could hold the poppet shaft open.



⚠ WARNING ⚠

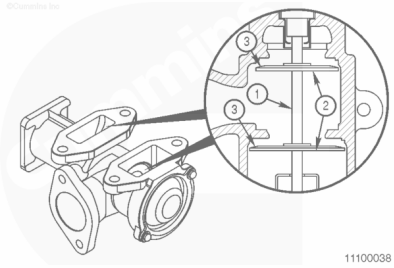
When using solvents, acids, or alkaline materials for cleaning, follow the manufacturer's recomendations for use. Wear goggles and protective clothing to reduce the possibility of personal injury.



Spray carburetor cleaner into the EGR valve outlet ports to soak inner surfaces. Use Clean Care Kit plug, Part Number 4919416, available in ISC/ISL Clean Care Kit, Part Number 5298776, to seal the EGR valve inlet and fill the EGR valve cavity with carburetor cleaner. Soak for 5 minutes. Work the poppet shaft back and forth. Turn it while the poppets are in contact with the valve seats (closed position) to help clean the valve. After 5 minutes, drain and properly dispose of the excess cleaner.

Note : Carburetor cleaner is the most effective solvent for this procedure. Do **not** substitute any other cleaning solvent.

The EGR valve shaft stem (3) is comprised of two valve faces (1) on two valve seats. Using a small nylon or brass wire brush, lightly brush away loose soot from the stem (3), valve seat (2) and also from the valve seat on the EGR valve housing. Take care **not** to damage the poppet sealing surfaces.

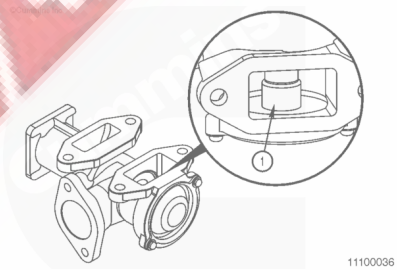


11100038

Spray additional carburetor cleaner, as needed, to clean the sealing surfaces.

Note : Carburetor cleaner is the most effective solvent for this procedure. Do **not** substitute any other cleaning solvent.

The soot guard (1) is comprised of outer and inner cylinders which must be able to close with a small gap at the bottom. Use a small nylon or brass wire brush. Brush away deposits from the soot guard. Deposits can be on the back side of the soot guard causing the valve **not** to close fully.



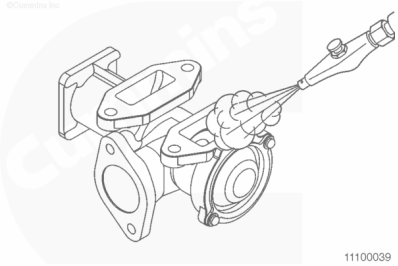
11100036

Spray additional carburetor cleaner, as needed, to clean the sealing surfaces.

Note : Carburetor cleaner is the most effective solvent for this procedure. Do **not** substitute any other cleaning solvent.

⚠ WARNING ⚠

Wear appropriate eye and face protection when using compressed air. Flying debris and dirt can cause personal injury.


11100039

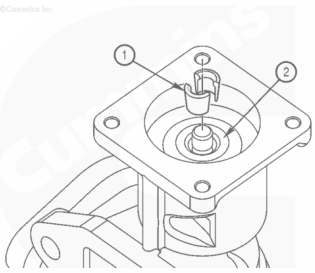
Drain any remaining carburetor cleaner from the EGR valve and properly dispose of the liquid.

Used compressed air to dry the inside of the EGR valve.

Repeat the cleaning steps, if needed.

Note : An effectively cleaned valve will close with a metal sound when the poppet shaft is closed. A soft thud is an indication deposits are still holding the EGR valve partially open.

Install the spring, spring retainer, and spring keepers.

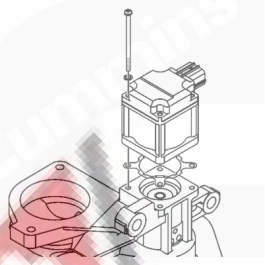


11100034

Install the EGR valve motor, shim, and four capscrews to the base.

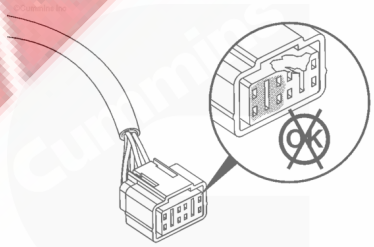
Torque Value:
EGR Motor Capscrews 2.5 n•m [22 in-lb]

Note : EGR valve motor electrical connector **must** be oriented in the same direction as when originally disassembled.


11c00012

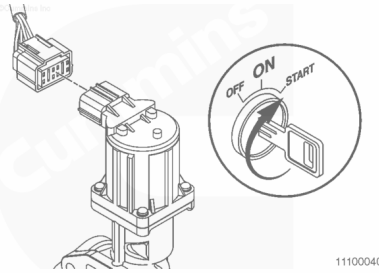
Inspect the engine wiring harness EGR valve actuator connector for corrosion, worn receptacles, or other damage.

Replace the engine wiring harness EGR valve connector if corrosion, worn receptacles, or other damage is found.



11c00175

After cleaning the EGR valve, connect the electrical connector to the EGR valve. Turn the ignition keyswitch ON. Do **not** start the engine. Check for active Fault Code 1896. If Fault Code 1896 persists after cleaning, replace the EGR valve.

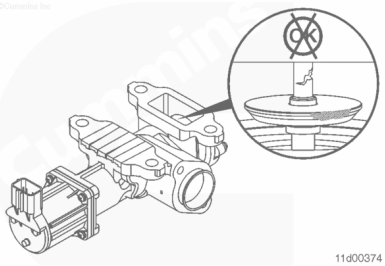


11100040

Inspect the EGR valve seats and stem for galling, pitting, cracks, or excessive corrosion.

If the EGR valve shows signs of internal damage, replace the EGR valve.

Note : Soot and condensation leaking from the weep hole on the EGR valve is considered normal, and does **not** mean the EGR valve needs to be replaced.

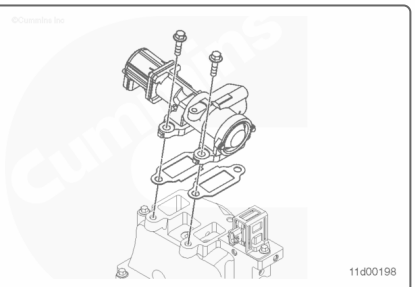


11d00374

ANADOLU ISUZU
PARTS

Install

Note : Remove all protective caps from the component.



Install the EGR valve with new mounting gaskets onto the air intake connection.

Install the four capscrews holding the EGR valve to the air intake connection. Tighten in a crisscross pattern.

Torque Value: 24 n•m [212 in-lb]

Finishing Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

- Connect the electrical connection to the EGR valve.
- Connect the EGR connection tube to the EGR valve. Refer to Procedure 011-025 in Section 11. (/qs3/pubsys2/xml/en/procedures/425/425-011-025.html)
- If a malfunction resulted in coolant, oil, excessive fuel or excessive black smoke entering the exhaust system, the aftertreatment system **must** be inspected. Refer to Procedure 014-017 in Section 14. (/qs3/pubsys2/xml/en/procedures/425/425-014-017.html)
- Connect the batteries. See equipment manufacturer service information.
- Operate the engine. Check for leaks.

ANADOLU ISUZU

Last Modified: 01-Nov-2016

Select Service Tools

Recommended Cummins® Service Tools

- Air Handling Clean Care Kit, Part Number 5298776

Additional Service Items

- No additional service items required.

General Information

The exhaust gas recirculation (EGR) connection tube is the tube which connects the EGR valve to the EGR cooler.

There are three different styles of EGR connection tubes used on this engine: one for engines without compression brakes, one for engines with compression brakes, and one for engines used in transit bus applications.

There are two different styles of EGR connection tubes used on this engine: one for engines without compression brakes and one for engines with compression brakes.

The illustrations in this procedure may **not** exactly match the engine being serviced. The procedure is the same regardless of the style of the EGR connection tube.

Preparatory Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

All configurations:

- Disconnect the batteries. See equipment manufacturer service information.
- Disconnect the EGR temperature sensor. Refer to Procedure 019-378 in Section 19. (/qs3/pubsys2/xml/en/procedures/425/425-019-378.html)

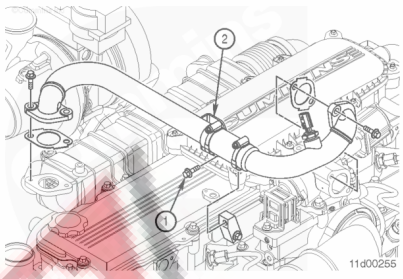
Remove

Clean the area around the flanges of the EGR connection tube. Use a clean cloth.

GRAPHIC NOT FOUND

⚠ CAUTION ⚠

Do not twist or bend the EGR connection tube during removal or installation, or damage to the hose can result.



Remove the capscrew (1) from the support flange of the EGR connection tube (2).

Remove the EGR connection tube by loosening the bolted flanges from both sides of the EGR connection tube.

Use caution to keep debris from falling into the EGR cooler and EGR valve when removing the EGR connection tube.

Cover all open connections with protective caps from Air Handling Clean Care Kit, Part Number 5298776.

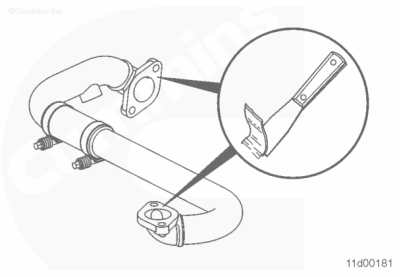
Clean and Inspect for Reuse

Scrape the gasket surfaces of the EGR connection tube, EGR valve, and EGR cooler free of gasket material.

Use caution **not** to drop any foreign material into the EGR cooler or EGR valve.

Note : It is common for the EGR components to have a buildup of carbon on the inside surfaces. This buildup is normal and does **not** have to be removed.

Note : If the EGR connection tube will be off the engine for a prolonged period of time, tape over the openings in the EGR cooler and EGR valve to prevent debris from entering the air intake system.

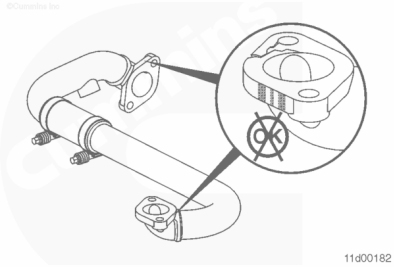


Inspect the EGR connection tube for cracks, distortion, corrosion, or soot streaking on the outside of the connection tube, indicators of an EGR leak.

Inspect for signs of coolant in the EGR connection tube.

If signs of coolant are found in the EGR connection tube, inspect the EGR cooler for leaks. Refer to Procedure 011-019 in Section 11. (/qs3/pubsys2/xml/en/procedures/425/425-011-019.html)

Replace the EGR connection tube if any cracks or other damage is found.

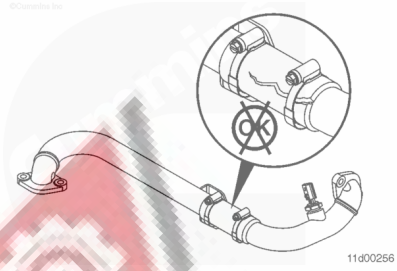


Loosen both hose clamps, then remove the hose if inspection is needed.

Inspect the interior and exterior of the hose connecting the two pieces of the EGR connection tube for damage. Replace if any damage is found.

Tighten the hose clamps.

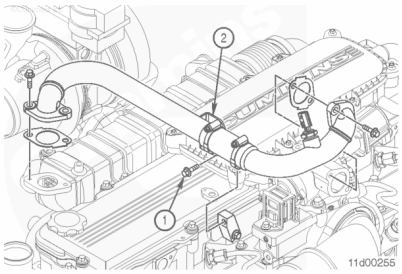
Torque Value: 5 n•m [44 in-lb]



Install

⚠ CAUTION ⚠

Do not twist or bend the EGR connection tube during removal or installation or damage to the hose can result.



Install the EGR connection tube (2). Use new gaskets.

Install the capscrew and mounting capscrew (1) at the EGR cooler outlet, EGR valve inlet, and tube brace hand-tight. Check for correct alignment at all locations. Make sure the EGR crossover tube does **not** contact the rocker lever cover.

Tighten the capscrews and mounting capscrews in the following sequence:

Tighten the brace mounting capscrew.

Torque Value: 24 n•m [212 in-lb]

Tighten the capscrews at the EGR cooler outlet.

Torque Value: 24 n•m [212 in-lb]

Tighten the capscrews at the EGR valve inlet.

Torque Value: 24 n•m [212 in-lb]

Finishing Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

- Connect the EGR temperature sensor. Refer to Procedure 019-378 in Section 19. (/qs3/pubsys2/xml/en/procedures/425/425-019-378.html)
- Connect the batteries. See equipment manufacturer service information.
- Operate the engine. Check for leaks.

ANADOLU ISUZU AFTER SALES

Last Modified: 17-Nov-2016

Select Service Tools

Recommended Cummins® Service Tools

- Anti-seize compound, Part Number 3824732, or equivalent

Additional Service Items

- Pipe cleaner, or equivalent

General Information

For details on the type of exhaust gas recirculation (EGR) coolers (horizontal plate or vertical plate), see the General information section in the EGR cooler procedure.

Preparatory Steps

⚠ WARNING ⚠

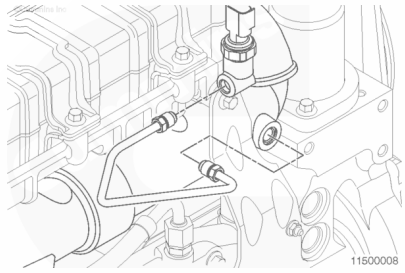
Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

- Disconnect the batteries. See equipment manufacturer service information.
- Remove the exhaust gas pressure sensor. Refer to Procedure 019-376 in Section 19. (/qs3/pubsys2/xml/en/procedures/425/425-019-376.html)

Remove

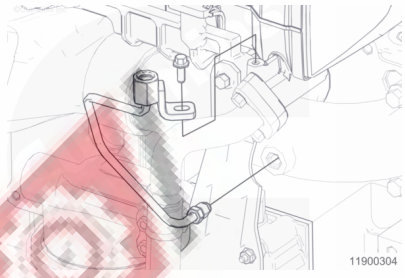
Horizontal Plate

Remove the exhaust gas pressure sensor tube from the exhaust manifold.



Vertical Plate

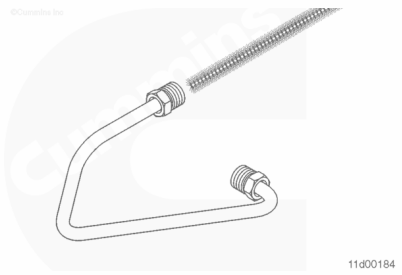
Remove the capscrew mounting the pressure sensor tube to the EGR cooler coolant outlet casting. Remove the pressure sensor tube from the exhaust manifold.



Clean and Inspect for Reuse

⚠ WARNING ⚠

When using solvents, acids, or alkaline materials for cleaning, follow the manufacturer's recommendations for use. Wear goggles and protective clothing to reduce the possibility of personal injury.



⚠ WARNING ⚠

Wear appropriate eye and face protection when using compressed air. Flying debris and dirt can cause personal injury.

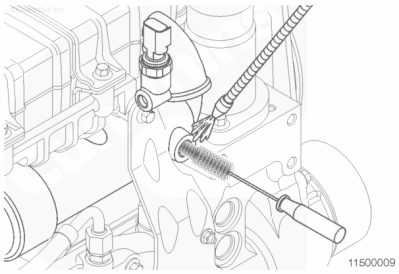
Clean the exhaust gas pressure sensor tube. Use solvent. Dry with compressed air.

Inspect the tube for signs of leakage, damaged sealing areas, or plugging with soot.

If the tube is plugged with soot, use safety solvent and a pipe cleaner or similar device to remove the soot blockages in the tube.

Inspect the port on the exhaust manifold for signs of leaks or damage.

Leaks can be identified by soot streaks.



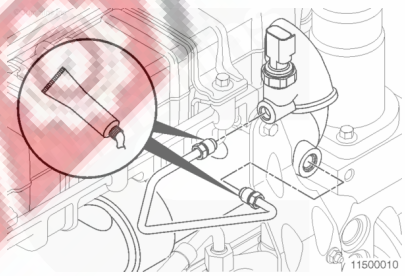
Install

Horizontal Plate

Put a light coating of high-temperature anti-seize compound, Part Number 3824732, or equivalent, on the threads of both fittings of the exhaust pressure sensor tube prior to installation.

Install the exhaust gas pressure sensor tube to the exhaust manifold.

Torque Value: 18 n•m [159 in-lb]



Vertical Plate

Put a light coating of high-temperature anti-seize compound, Part Number 3824732, or equivalent, on the threads of both fitting of the exhaust pressure sensor tube prior to installation.

Install the pressure sensor tube to the exhaust manifold.

Install the pressure sensor tube to EGR cooler coolant outlet casting with a capscrew.

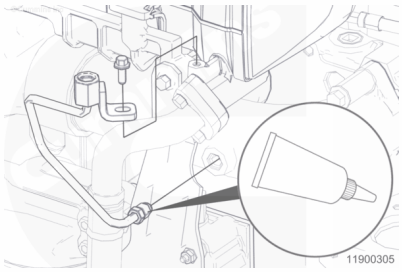
Tighten both the capscrew and exhaust gas pressure sensor tube fitting hand-tight before tightening.

Tighten the fitting.

Torque Value: 18 n•m [159 in-lb]

Tighten the capscrew.

Torque Value: 10 n•m [89 in-lb]



ANADOLU ISUZU PARTS SALES

Finishing Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

- Install the exhaust gas pressure sensor. Refer to Procedure 019-376 in Section 19. (/qs3/pubsys2/xml/en/procedures/425/425-019-376.html)
- Connect the batteries. See equipment manufacturer service information.
- If the malfunction resulted in coolant, oil, excessive fuel or excessive black smoke entering the exhaust system, the aftertreatment system **must** be inspected. Refer to Procedure 014-017 in Section 14. (/qs3/pubsys2/xml/en/procedures/425/425-014-017.html)
- Operate the engine. Check for leaks.

Last Modified: 05-Aug-2016

ANADOLU ISUZU AFTER SALES

Select Service Tools

Recommended Cummins® Service Tools

- No Cummins® Service Tools required.

Additional Service Items

- No additional service items required.

Preparatory Steps

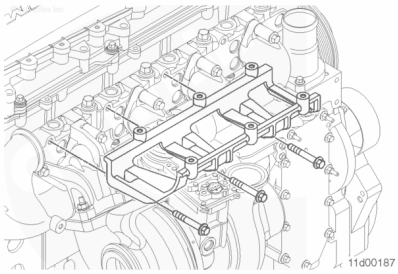
⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

- Disconnect the batteries. See equipment manufacturer service information.
- Drain the coolant. Refer to Procedure 008-018 in Section 8. (/qs3/pubsys2/xml/en/procedures/425/425-008-018-tr.html)
- Remove the exhaust gas recirculation (EGR) connection tube. Refer to Procedure 011-025 in Section 11. (/qs3/pubsys2/xml/en/procedures/425/425-011-025.html)
- Remove the exhaust gas pressure sensor tube. Refer to Procedure 011-027 in Section 11. (/qs3/pubsys2/xml/en/procedures/425/425-011-027.html)
- Remove the EGR cooler coolant lines. Refer to Procedure 011-031 in Section 11. (/qs3/pubsys2/xml/en/procedures/425/425-011-031.html)
- Remove the EGR cooler. Refer to Procedure 011-019 in Section 11. (/qs3/pubsys2/xml/en/procedures/425/425-011-019.html)
- Remove the turbocharger, if necessary. Refer to Procedure 010-033 in Section 10. (/qs3/pubsys2/xml/en/procedures/425/425-010-033.html)
- Remove the exhaust manifold, if necessary. Refer to Procedure 011-007 in Section 11. (/qs3/pubsys2/xml/en/procedures/425/425-011-007.html)

Remove

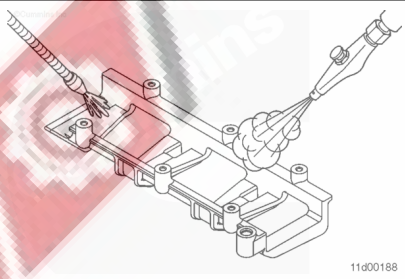
Remove the three capscrews that attach the EGR cooler bracket to the cylinder head. Remove the EGR cooler bracket.



Clean and Inspect for Reuse

⚠ WARNING ⚠

When using solvents, acids, or alkaline materials for cleaning, follow the manufacturer's recommendations for use. Wear goggles and protective clothing to reduce the possibility of personal injury.



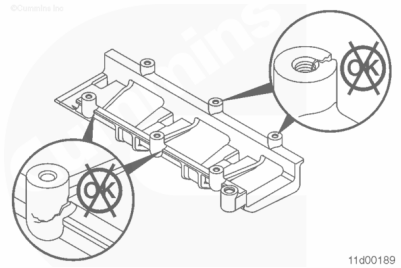
⚠ WARNING ⚠

Wear appropriate eye and face protection when using compressed air. Flying debris and dirt can cause personal injury.

Clean the EGR cooler bracket. Use solvent. Dry with compressed air.

Inspect the EGR cooler bracket for cracks or other damage.

Replace the EGR cooler bracket if it is damaged.



Install

Install the EGR cooler bracket to the cylinder head, leaving capscrews finger-tight.

Tighten the capscrews.

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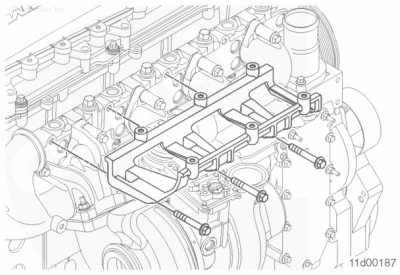
Torque Value: 43 n•m [32 ft-lb]



Finishing Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

- Install the exhaust manifold, if necessary. Refer to Procedure 011-007 in Section 11. (/qs3/pubsys2/xml/en/procedures/425/425-011-007.html)
- Install the turbocharger, if necessary. Refer to Procedure 010-033 in Section 10. (/qs3/pubsys2/xml/en/procedures/425/425-010-033.html)
- Install the EGR cooler. Refer to Procedure 011-019 in Section 11. (/qs3/pubsys2/xml/en/procedures/425/425-011-019.html)
- Install the EGR cooler coolant lines. Refer to Procedure 011-031 in Section 11. (/qs3/pubsys2/xml/en/procedures/425/425-011-031.html)
- Install the exhaust gas pressure sensor tube. Refer to Procedure 011-027 in Section 11. (/qs3/pubsys2/xml/en/procedures/425/425-011-027.html)
- Install the EGR connection tube. Refer to Procedure 011-025 in Section 11. (/qs3/pubsys2/xml/en/procedures/425/425-011-025.html)
- Fill the engine with the coolant. Refer to Procedure 008-018 in Section 8. (/qs3/pubsys2/xml/en/procedures/425/425-008-018-tr.html)
- Connect the batteries. See equipment manufacturer service information.
- Operate the engine. Check for leaks.

PRODUCTION

Last Modified: 05-Aug-2016

Select Service Tools

Recommended Cummins® Service Tools

- Assembly lubricant, Part Number 3163087, or equivalent

Additional Service Items

- Anti-seize compound

General Information

For details on the type of exhaust gas recirculation (EGR) coolers (horizontal plate or vertical plate), see the General information section in the EGR cooler procedure.

Preparatory Steps

⚠ WARNING ⚠

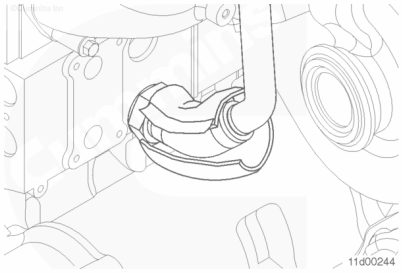
Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

- Disconnect the batteries. See equipment manufacturer service information.
- Drain the coolant. Refer to Procedure 008-018 in Section 8. (/qs3/pubsys2/xml/en/procedures/425/425-008-018-tr.html)
- Disconnect the turbocharger coolant return line from the EGR cooler coolant return line. Refer to Procedure 010-041 in Section 10. (/qs3/pubsys2/xml/en/procedures/425/425-010-041.html)
- Remove the coolant vent lines. Refer to Procedure 008-017 in Section 8. (/qs3/pubsys2/xml/en/procedures/425/425-008-017.html)

Remove

Horizontal Plate

Remove the heat shield from the EGR cooler coolant inlet line hose by peeling up the tape at the seam.



Remove the retaining capscrew and nut holding the EGR cooler coolant lines in place.

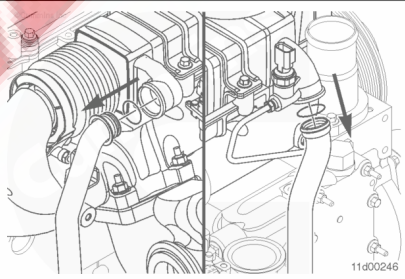
GRAPHIC NOT FOUND

The coolant inlet line is held in place by a capscrew on the EGR cooler bracket.

The coolant outlet line is held in place by a nut on a studded capscrew located on the oil cooler.

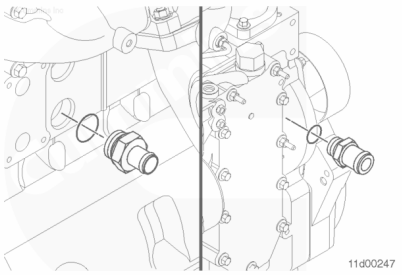
Loosen the hose clamps from the engine block coolant fittings. Pull the hoses off the engine block coolant fittings.

Pull the EGR coolant connections out of the EGR cooler in the directions shown by the arrows in the illustration.



Remove the EGR cooler coolant supply line fitting from the cylinder block (rear of engine).

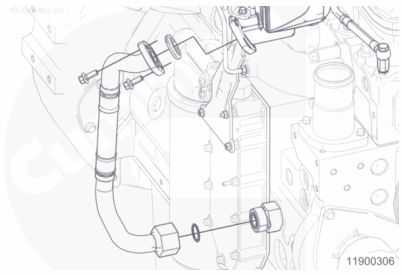
Remove the EGR cooler coolant return line fitting from the cylinder block (front of engine).



Vertical Plate

Remove the coolant return tube swivel-nut from the coupling (front of the block).

Remove the coolant return tube capscrews from the EGR cooler flange (front of engine).



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AFTER SALES

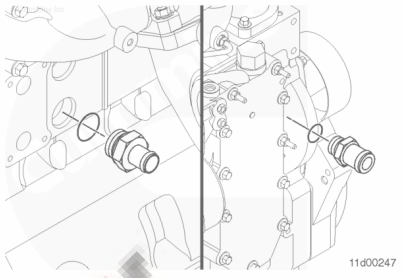
Remove the coolant supply tube swivel-nut from coupling (rear of the block).

GRAPHIC NOT FOUND

Remove the coolant supply tube capscrews from the EGR cooler flange (rear of engine).

Remove the EGR cooler coolant supply line fitting from the cylinder block (rear of engine).

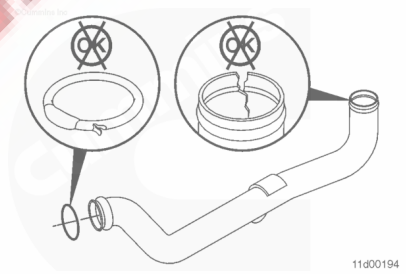
Remove the EGR cooler coolant return line fitting from the cylinder block (front of engine).



Clean and Inspect for Reuse

⚠ WARNING ⚠

When using solvents, acids, or alkaline materials for cleaning, follow the manufacturer's recommendations for use. Wear goggles and protective clothing to reduce the possibility of personal injury.



⚠ WARNING ⚠

Wear appropriate eye and face protection when using compressed air. Flying debris and dirt can cause personal injury.

Clean the tubes. Use solvent. Dry with compressed air.

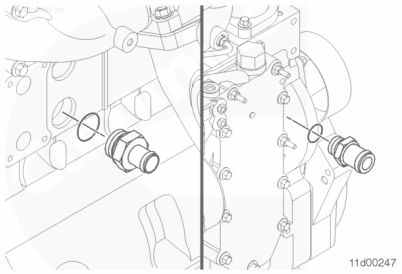
Inspect the tubes for cracks or leaks.

Inspect the sealing o-ring for cracks or distortion. Replace, as necessary.

Install

Horizontal Plate

Note : If replacing a horizontal plate cooler to a vertical plate cooler, see the installation directions in the vertical plate cooler section.



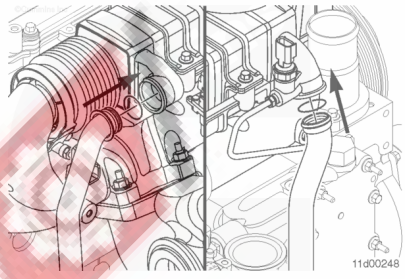
Install the EGR cooler coolant supply line fitting into the cylinder block (rear of engine).

Torque Value: 115 n•m [85 ft-lb]

Install the EGR cooler coolant return line fitting into the cylinder block (front of engine).

Torque Value: 85 n•m [63 ft-lb]

Lubricate the sealing o-rings with assembly lubricant, Part Number 3163087, or equivalent, before installing the EGR cooler coolant lines into the EGR cooler.



Push the EGR cooler coolant lines into the EGR cooler in the directions shown in the illustration.

Push the EGR cooler coolant line hoses onto the coolant fittings in the cylinder block. Tighten the hose clamps.

GRAPHIC NOT FOUND

Torque Value: 5 n•m [44 in-lb]

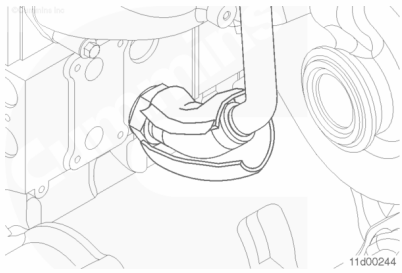
Install the EGR cooler coolant outlet line to the EGR cooler and oil cooler cover. Tighten the mounting nut.

Torque Value: 10 n•m [89 in-lb]

Install the EGR cooler coolant inlet line to the EGR cooler and EGR cooler bracket. Tighten the capscrew.

Torque Value: 24 n•m [212 in-lb]

Install the heat shield to the EGR cooler coolant inlet line hose.



Make sure the edge of the heat shield is snug against the cylinder block coolant inlet fitting and covers the entire length of the hose.

Vertical Plate

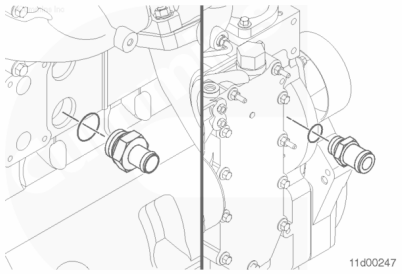
Apply lubricant/anti-seize to both thread of the EGR coolant supply line coupling.

Install the EGR cooler coolant supply line coupling into the cylinder block (rear of engine).

Torque Value: 115 n•m [85 ft-lb]

Apply lubricant/anti-seize to both thread of the EGR coolant return line coupling.

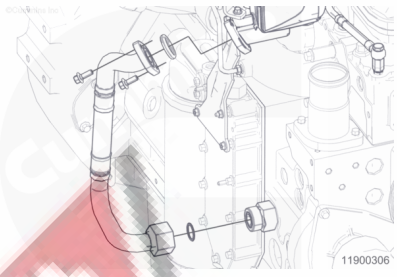
Install the EGR cooler coolant return line coupling into the cylinder block (front of engine).



Torque Value: 85 n•m [63 ft-lb]

Install the coolant return tube swivel-nut (hand-ight) to the coupling at the front of the block. Make sure the o-ring is in place on the coupling.

Tighten the capscrews attaching coolant return tube at the front of the EGR cooler. Make sure the diamond seal is in place.



Torque Value: 24 n•m [212 in-lb]

Tighten the swivel-nut on the coupling at the front of the block.

Torque Value: 85 n•m [63 ft-lb]

Install the coolant supply tube swivel-nut (hand-tight) to the coupling at the rear of the block. Make sure the o-ring is in place on the coupling.

GRAPHIC NOT FOUND

Tighten capscrews attaching coolant supply tube at the rear of the EGR cooler. Make sure the diamond seal is in place.

Torque Value: 24 n•m [212 in-lb]

Tighten the swivel-nut on the coupling at the rear of the block.

Torque Value: 85 n•m [63 ft-lb]

ANADOLU ISUZU USER SALES

Finishing Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

- Install the coolant vent lines. Refer to Procedure 008-017 in Section 8. (/qs3/pubsys2/xml/en/procedures/425/425-008-017.html)

- Connect the turbocharger coolant return line onto the EGR cooler coolant return line. Refer to Procedure 010-041 in Section 10. (/qs3/pubsys2/xml/en/procedures/425/425-010-041.html)
- Fill the engine with coolant. Refer to Procedure 008-018 in Section 8. (/qs3/pubsys2/xml/en/procedures/425/425-008-018-tr.html)
- Connect the batteries. See equipment manufacturer service information.
- Operate the engine. Check for leaks.

Last Modified: 06-Oct-2016

ANADOLU ISUZU AFTER SALES

Select Service Tools

Recommended Cummins® Service Tools

- No Cummins® Service Tools required.

Additional Service Items

- No additional service items required.

General Information

⚠ WARNING ⚠

The exhaust and exhaust components can remain hot after the engine has been shut down or secured. To avoid the risk of fire, property damage, burns, or other serious personal injury, allow the exhaust system to cool before beginning this procedure or repair. Make sure that no combustible materials are located where they might come in contact with hot exhaust or exhaust components.

⚠ WARNING ⚠

Improper practices, carelessness, or ignoring the warnings can cause burns, cuts, mutilation, asphyxiation, or other personal injury or death.

There are heat shields mounted in various locations on the engine and aftertreatment system.

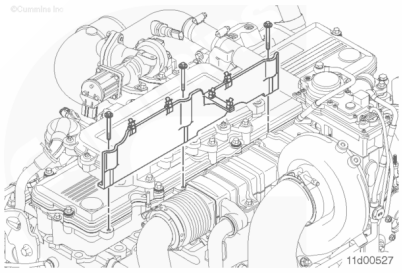
Heat shields reduce heat exposure to various components from the exhaust and exhaust gas recirculation (EGR) components.

In the following information are examples of the different heat shields found on MidRange Cummins® engines.

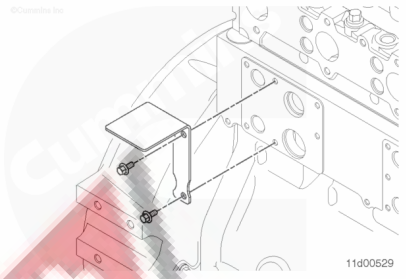
Due to the number of heat shield mounting locations, this procedure has been written to be generic. The Remove and Install procedures are common, regardless of the style of heat shield used.

The NOx sensor module, crankcase breather, and rocker cover heat shield all attach to the rocker housing.

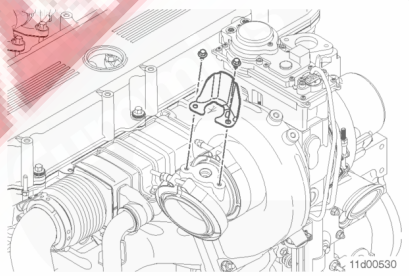
The heat shield also provides attachment points for the NOx sensor wiring.



The selective catalytic reduction (SCR) coolant supply fitting heat shield attaches to the cylinder block.



The aftertreatment intake NOx sensor heat shield is **not** applicable or required for all original equipment manufacturers (OEMs). The aftertreatment intake NOx sensor heat shield typically attaches to the exhaust outlet connection.

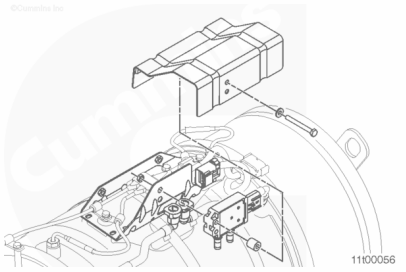


The diesel particulate filter (DPF) sensor table heat shield is **not** applicable or required for all OEMs. The DPF sensor table heat shield mounts to the DPF sensor table.

Note : The DPF sensor table heat shield uses the same mounting bolts as the DPF differential pressure sensor. There is a spacer located between the heat shield and DPF differential pressure sensor. Note the location and orientation of this spacer during removal and installation.

Mounting capscrew torque value:

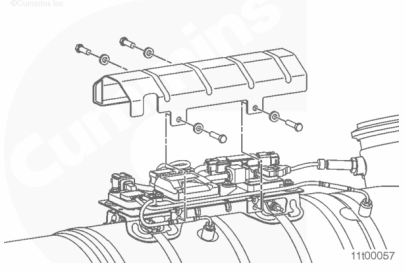
Torque Value: 14 n•m [124 in-lb]



The SCR sensor table heat shield is **not** applicable or required for all OEMs. The SCR sensor table heat shield mounts to the SCR sensor table.

Mounting capscrew torque value:

Torque Value: 14 n•m [124 in-lb]



Preparatory Steps

⚠ WARNING ⚠

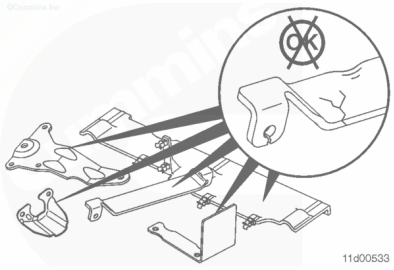
Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

- Disconnect the batteries. See equipment manufacturer service information.
- Remove the heat shield.

Clean and Inspect for Reuse

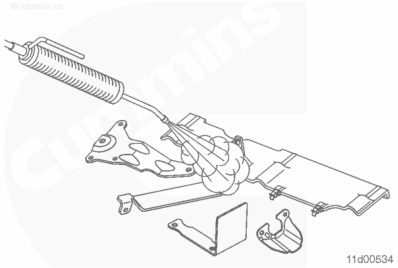
Inspect the heat shield for cracks or other damage.

Replace the heat shield if cracks or other damage is found.



⚠ WARNING ⚠

When using a steam cleaner, wear safety glasses or a face shield, as well as protective clothing. Hot steam can cause serious personal injury.



⚠ WARNING ⚠

Wear appropriate eye and face protection when using compressed air. Flying debris and dirt can cause personal injury.

Wash the heat shield in a hot, soapy water solution or steam clean, if desired.

Dry with compressed air.

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Finishing Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

- Install the heat shield.
- Connect the batteries. See equipment manufacturer service information.
- Operate the engine. Check for loose components.

Last Modified: 05-Aug-2016

ANADOLU ISUZU AFTER SALES

Select Service Tools

Recommended Cummins® Service Tools

- Anti-seize compound, Part Number 3824879, or equivalent

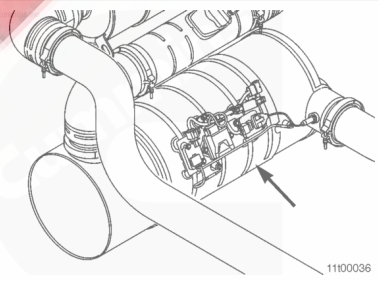
Additional Service Items

- Lowering jack
- Putty knife

General Information

⚠ WARNING ⚠

The exhaust and exhaust components can remain hot after the engine has been shut down or secured. To avoid the risk of fire, property damage, burns, or other serious personal injury, allow the exhaust system to cool before beginning this procedure or repair. Make sure that no combustible materials are located where they might come in contact with hot exhaust or exhaust components.



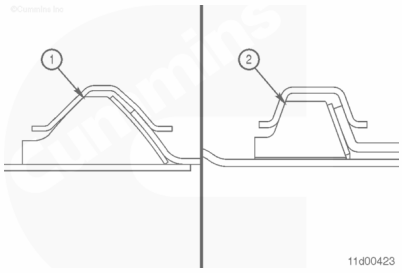
⚠ CAUTION ⚠

The catalyst elements contained in the aftertreatment system are made of brittle material. Do not drop or strike the side of the aftertreatment system, as damage to the catalyst element can result.

Due to the number of varying exhaust aftertreatment applications, this procedure has been written to be generic. **Not** all illustrations within this procedure will represent the application being serviced.

Different vehicles will require different aftertreatment configurations. Some of the aftertreatment selective catalytic reduction (SCR) catalysts can have elbows clamped to them.

A variation in vehicle aftertreatment configuration will cause the aftertreatment SCR catalyst to have different flanges. The clamps and gaskets on either end of the aftertreatment SCR catalyst may be different from one another. There are two types of flanged joints, spherical Marmon® and full Marmon®. The spherical Marmon® (1) joints allow a small amount of misalignment and have a rounded cross section. The full Marmon® (2) joints are completely rigid and have a more edgy profile.



Preparatory Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

⚠ WARNING ⚠

During regeneration, exhaust gas temperature can reach 800 °C [1500°F], and exhaust system surface temperature can exceed 700 °C [1300°F], which is hot enough to ignite or melt common materials, and to burn people. The exhaust and exhaust components can remain hot after the vehicle has stopped moving. To avoid the risk of fire, property damage, burns, or other serious personal injury, allow the exhaust system to cool before beginning this procedure or repair. Make sure that no combustible materials are located where they are likely to come in contact with hot exhaust or exhaust components.

⚠ WARNING ⚠

Wear appropriate eye and face protection when using compressed air. Flying debris and dirt can cause personal injury.

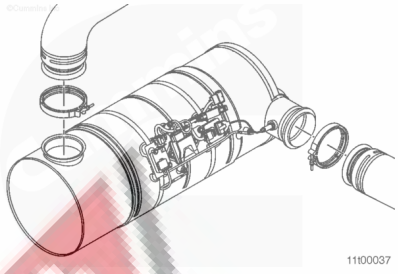
- Disconnect the batteries. See equipment manufacturer service information.
- Clean the area with compressed air to remove any loose debris.
- Draw an orientation reference line across each of the V-band and Torca™ clamps on either end of the aftertreatment SCR canister. This will aid in lining up the clamps and canister to their original orientation during installation.
- Remove the aftertreatment outlet NOx sensor probe. Refer to Procedure 019-451 in Section 19. (/qs3/pubsys2/xml/en/procedures/425/425-019-451.html)

- Disconnect the aftertreatment interface harness from the original equipment manufacturer wiring (OEM) harness connection.

Remove

⚠ WARNING ⚠

This component or assembly weighs greater than 23 kg [50 lb]. To prevent serious personal injury, be sure to have assistance or use appropriate lifting equipment to lift this component or assembly.



Support the aftertreatment decomposition tube to prevent it from being freely suspended after the aftertreatment SCR catalyst is removed. If supporting it is **not** an available option, remove the aftertreatment diesel exhaust fluid (DEF) decomposition tube. Refer to Procedure 011-062 in Section 11. (/qs3/pubsys2/xml/en/procedures/425/425-011-062.html)

Support the aftertreatment SCR catalyst with a lowering jack.

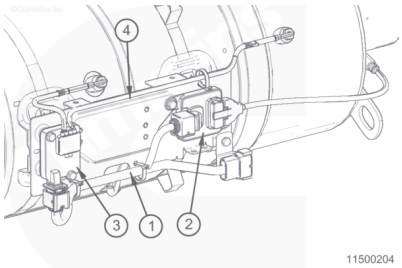
Remove the clamps on either end of the aftertreatment SCR catalyst.

Remove the exhaust hangers that support the aftertreatment SCR catalyst. Slowly remove the canister from the vehicle.

Discard the gasket from the V-band joint.

Disassemble

If the aftertreatment SCR catalyst is being replaced, complete the following procedures to remove the key parts of the aftertreatment SCR catalyst.



Disconnect and remove the aftertreatment interface harness (1). Refer to Procedure 019-477 in Section 19. (/qs3/pubsys2/xml/en/procedures/425/425-019-477.html)

Disconnect and remove the aftertreatment temperature sensor assembly (2). Refer to Procedure 019-449 in Section 19. (/qs3/pubsys2/xml/en/procedures/425/425-019-449.html)

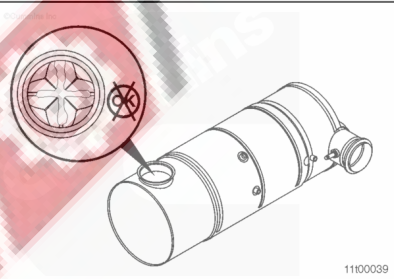
Remove the aftertreatment outlet NOx sensor module and probe assembly (4). Refer to Procedure 019-451 in Section 19. (/qs3/pubsys2/xml/en/procedures/425/425-019-451.html)

Remove the aftertreatment SCR catalyst temperature sensor interface module mounting bracket (5). Refer to Procedure 011-076 in Section 11. (/qs3/pubsys2/xml/en/procedures/425/425-011-076.html)

Clean and Inspect for Reuse

⚠ CAUTION ⚠

Do not use a metallic object to clean the aftertreatment SCR catalyst. This will scratch the surface of the aftertreatment SCR catalyst which can cause future excessive DEF deposits.



Inspect the aftertreatment SCR catalyst for cracks or puncture holes, especially around the weld areas.

Replace the aftertreatment SCR catalyst if damaged.

Inspect the aftertreatment SCR catalyst inlet for DEF deposits.

If buildups are present, carefully scrape the buildup with a non-metallic object to clean the majority of the buildup from the catalyst.

Excessive fuel or oil buildup will damage the exhaust catalyst. If oil from an upstream engine malfunction is visible in the exhaust plumbing, replace the aftertreatment SCR catalyst.

Note : Do **not** use a mechanical device to remove DEF deposits from the aftertreatment. SCR catalyst.

Note : Do **not** use a pressure washer to remove DEF deposits from the aftertreatment SCR catalyst.

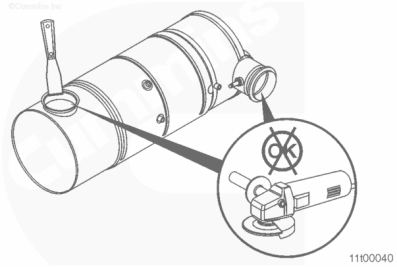
Note : If crystallization buildup was present after installation, complete a stationary regeneration to make sure any of the remaining DEF crystallization has been removed from the aftertreatment SCR catalyst.

Inspect the exhaust flanges for corrosion or other damage.

Use a putty knife to remove any residual gasket material from the flanges on the aftertreatment SCR catalyst.

Avoid dropping fragments of gasket material into the aftertreatment SCR catalyst.

Do **not** grind on the flange surface, as this can damage the flange and cause the connection to leak.

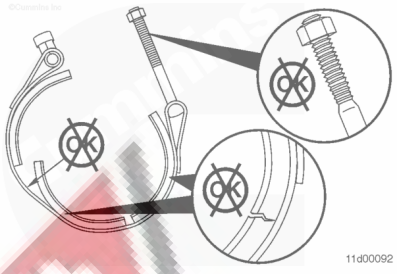


Inspect the V-band clamps and mounting straps for signs of over-extension.

The band **must not** be bent or damaged.

Inspect the V-band clamp and mounting strap threads for damage.

Replace the V-band clamp or mounting strap if damage is found.



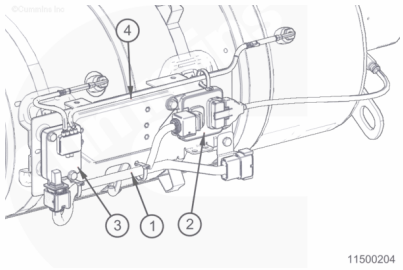
Assemble

Install the aftertreatment SCR catalyst temperature sensor interface module mounting bracket (5). Refer to Procedure 011-076 in Section 19. (/qs3/pubsys2/xml/en/procedures/425/425-011-076.html)

Install the aftertreatment outlet NOx sensor module (4) on the aftertreatment SCR catalyst temperature sensor interface module mounting bracket. Refer to Procedure 019-451 in Section 19. (/qs3/pubsys2/xml/en/procedures/425/425-019-451.html)

Install the aftertreatment temperature sensor assembly (2). Refer to Procedure 019-449 in Section 19. (/qs3/pubsys2/xml/en/procedures/425/425-019-449.html)

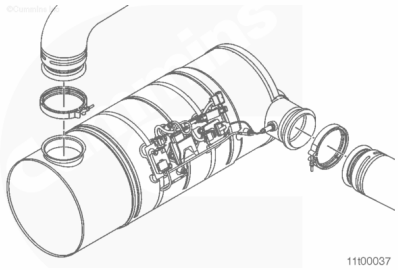
Install and connect the aftertreatment interface harness (1). Refer to Procedure 019-477 in Section 19. (/qs3/pubsys2/xml/en/procedures/425/425-019-477.html)



Install

⚠ WARNING ⚠

This component or assembly weighs greater than 23 kg [50 lb]. To prevent serious personal injury, be sure to have assistance or use appropriate lifting equipment to lift this component or assembly.



⚠ CAUTION ⚠

Do not use an air tool to tighten the V-band clamp. An air tool will damage the threads.

Place the aftertreatment SCR catalyst on the vehicle. Use the exhaust hangers to support the canister.

Align the catalyst in the same orientation as marked previously.

Note : Horizontal aftertreatment SCR catalysts incorporate a water drain hole in the outlet section of the canister. If a new horizontal aftertreatment SCR catalyst is being installed, make sure the drain hole is located toward the bottom of the installation, within ±10 degrees of the vertical axis.

Note : Where applicable install and tighten the full Marmon® clamps before the spherical Marmon® to account for misalignment in the aftertreatment system.

Apply a coat of anti-seize compound, Part Number 3824879, or equivalent, on the threads of the V-band clamp. Put a new gasket on the V-band connection of the aftertreatment SCR catalyst and install opposite of removal. Tighten the V-band and Torca™ clamps.

Tighten the V-Band and Torca™ clamps.

Torque Value:
V-band Clamp 14 n•m [124 in-lb]

Torque Value:
Torca™ Clamp 55 n•m [41 ft-lb]

Connect the OEM wiring to the aftertreatment interface harness.

Install the aftertreatment outlet NOx sensor probe. Refer to Procedure 019-451 in Section 19. (/qs3/pubsys2/xml/en/procedures/425/425-019-451.html)

Tighten the exhaust hangers. See equipment manufacturer service information

Finishing Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

- Connect the batteries. See equipment manufacturer service information.
- Start the engine. Check the system for leaks.
- Use INSITE™ electronic service tool to check for active fault codes.
- If buildups were present, complete a stationary regeneration to make sure any of the remaining DEF crystallization has been removed from the aftertreatment SCR catalyst.
- Continue to monitor for leaks at the exhaust joints.

ANADOLU ISUZU AFTER SALES

Last Modified: 05-Aug-2016

Select Service Tools

Recommended Cummins® Service Tools

- No Cummins® service tools required.

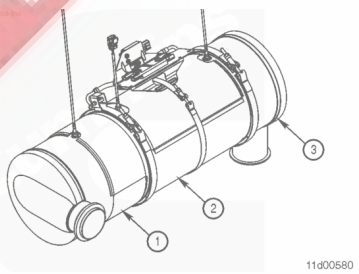
Additional Service Items

- No additional service items required.

General Information

⚠ WARNING ⚠

The material captured in a partial flow diesel particulate filter and/or a diesel particulate filter may contain elevated concentrations of metals. Primarily zinc, molybdenum, and possibly polynuclear aromatic hydrocarbons, that may be regulated. These materials must be characterized, handled, and disposed of according to applicable local regulations. In addition, due to the presence of the above-listed chemicals and other potentially toxic components such as oxides of calcium, zinc, phosphorous, silicon, sulfur, and iron, exhaust filter maintenance must be completed only by appropriately trained personnel.



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⚠ CAUTION ⚠

The aftertreatment diesel oxidation catalyst (DOC) elements contained in the aftertreatment system are made of brittle material. Do not drop or strike the side of the aftertreatment system as damage to the aftertreatment DOC element can result.

Due to the number of exhaust aftertreatment applications, this document has been written to be generic. **Not** all illustrations within this document will represent the application being serviced.

The aftertreatment system is composed of four sections. These sections are:

- Aftertreatment DOC
- Aftertreatment diesel particulate filter (DPF)
- Decomposition reactor tube
- Selective catalytic reduction (SCR).

Note : The aftertreatment DOC is integrated into the inlet of the exhaust aftertreatment system. Use the following procedure for aftertreatment inlet service guidelines. Refer to Procedure 011-049 in Section 11. (/qs3/pubsys2/xml/en/procedures/425/425-011-049.html)

Note : If the aftertreatment DPF is being replaced due to progressive damage from engine oil or fuel, clean the exhaust pipe from the turbocharger outlet to the aftertreatment DOC.

Preparatory Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

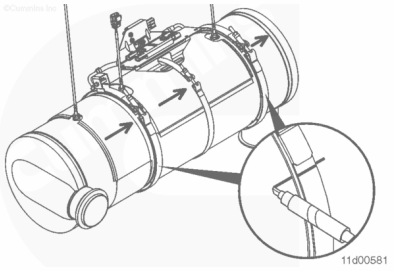
⚠ WARNING ⚠

During regeneration, exhaust gas temperature can reach 800 °C [1500°F], and exhaust system surface temperature can exceed 700 °C [1300°F], which is hot enough to ignite or melt common materials, and to burn people. The exhaust and exhaust components can remain hot after the vehicle has stopped moving. To avoid the risk of fire, property damage, burns, or other serious personal injury, allow the exhaust system to cool before beginning this procedure or repair and make sure that no combustible materials are located where they are likely to come in contact with hot exhaust or exhaust components.

- Disconnect the batteries. See equipment manufacturer service information.
- Disconnect the original equipment manufacturer (OEM) wiring harness from the aftertreatment interface harness. Refer to Procedure 019-477 in Section 19. (/qs3/pubsys2/xml/en/procedures/425/425-019-477.html)

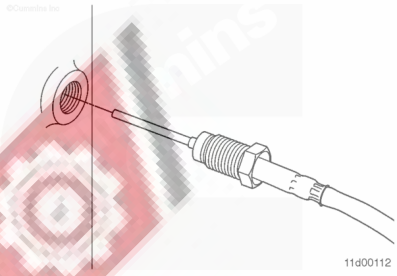
Remove

Draw an orientation reference line across each V-band clamp, aftertreatment canister sections, sensor mounting bracket strap, and connections points to the exhaust pipe. This aids in lining up sections and V-band clamps to their original orientation during installation.



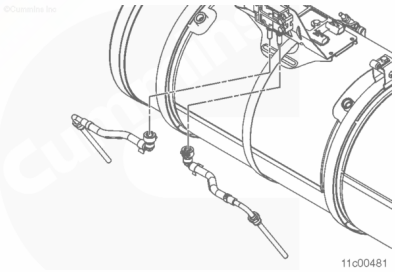
Remove the exhaust gas temperature sensor probes from the aftertreatment DOC and particulate filter. Refer to Procedure 019-449 in Section 19. (/qs3/pubsys2/xml/en/procedures/425/425-019-449.html)

Note : All three aftertreatment exhaust gas temperature sensor probes **must** be removed prior to aftertreatment DOC removal or damage to the sensor wiring and sensor probe will occur.



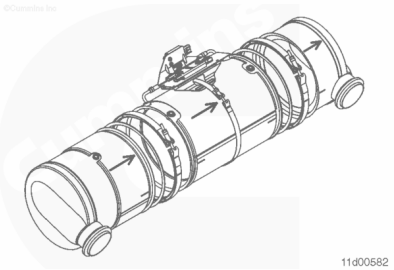
Remove the DPF differential pressure probes from the DPF inlet and outlet. Refer to Procedure 019-443 in Section 19. (/qs3/pubsys2/xml/en/procedures/425/425-019-443.html)

Note : The DPF inlet and outlet differential pressure sensor tubes **must** be removed prior to aftertreatment DOC removal or damage to the sensor tube will occur.



⚠ WARNING ⚠

This component or assembly weighs greater than 23 kg [50 lb]. To prevent serious personal injury, be sure to have assistance or use appropriate lifting equipment to lift this component or assembly.



⚠ CAUTION ⚠

The aftertreatment DOC elements contained in the aftertreatment system are made of brittle material. Do not drop or strike the side of the aftertreatment system as damage to the aftertreatment DOC element can result.

⚠ CAUTION ⚠

Do not use an air tool to remove the V-band clamp nut. An air tool will damage the threads. Apply thread lubricant to the V-band clamp threads prior to nut removal.

⚠ CAUTION ⚠

The DOC and DPF canister sections are an interlock design. The components must be separated by at least 51 mm [2 in] in the axial direction to allow enough clearance for the overlapping canister sections to not come into contact with each other as damage to the insulation and/or body joints can result.

Note : It can be necessary to remove additional mounting hardware to remove the aftertreatment DPF from the vehicle.

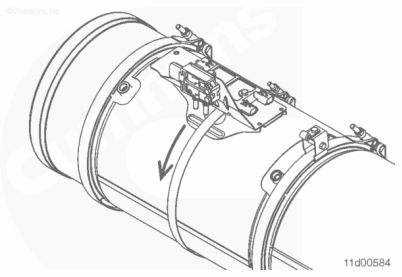
Remove the V-band clamps from the inlet and outlet flanges of the aftertreatment DPF.

Separate the flanges by approximately 45 mm [1.75 in] to allow removal over the gasket retainer rings.

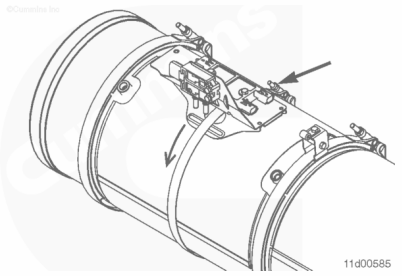
Remove and discard the gaskets.

Disassemble

Mark the direction of the aftertreatment DPF differential pressure sensor ports on the aftertreatment DPF canister. This will aid in installing the aftertreatment DPF differential pressure sensor mounting bracket in the correct orientation.



Remove the aftertreatment DPF sensor mounting bracket from the aftertreatment DPF. Refer to Procedure 011-046 in Section 11. (/qs3/pubsys2/xml/en/procedures/425/425-011-046.html)



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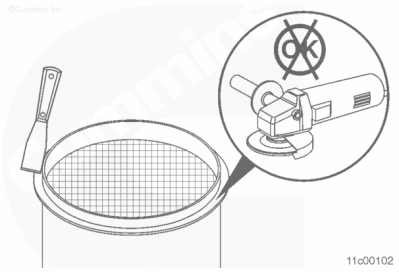
Clean and Inspect for Reuse

⚠ CAUTION ⚠

Do not use a grinder to remove residual gasket material as this can damage the flange and cause the connection to leak.



⚠ CAUTION ⚠

Do not use an open flame to burn off soot accumulation from the face of the aftertreatment DPF.

⚠ CAUTION ⚠

Do not scrape off soot accumulation from the face of the aftertreatment DPF.

Note : The aftertreatment DPF relies on gas flow through the walls to collect soot. To accomplish gas flow through the walls of the aftertreatment DPF, every other cell on the face of the aftertreatment DPF is plugged with a ceramic material. Therefore, it is **not** possible to see light straight through the holes in the aftertreatment DPF.

Note : If the aftertreatment DPF is being replaced due to progressive damage from engine oil or excessive fuel, clean the tailpipe from the turbocharger outlet to the aftertreatment DOC. Refer to Procedure 011-049 in Section 11. (/qs3/pubsys2/xml/en/procedures/425/425-011-049.html)

Remove any residual gasket material from the flanges on the aftertreatment DPF with a scraping tool.

Note : Avoid dropping fragments of gasket material into the aftertreatment DPF.

Refer to Service Bulletin, Aftertreatment Diesel Oxidation Catalyst and Aftertreatment Diesel Particulate Filter Reuse Guidelines, Bulletin 4021600 (/qs3/pubsys2/xml/en/bulletin/4021600.html), to inspect the inlet and outlet faces of the aftertreatment DPF for signs of damage.



Replace the aftertreatment particulate filter if damage is found.

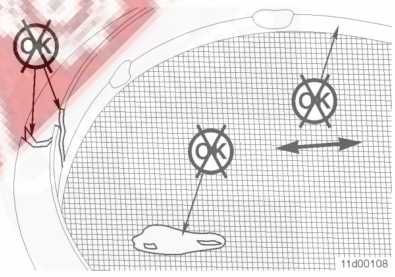
If the aftertreatment DPF has been removed for cleaning and is considered reusable (according to Service Bulletin,Aftertreatment Diesel Oxidation Catalyst and Aftertreatment Diesel Particulate Filter Reuse Guidelines, Bulletin 4021600 (/qs3/pubsys2/xml/en/bulletin/4021600.html)) the aftertreatment DPF can be cleaned with an aftertreatment particulate filter cleaning machine approved by Cummins Inc..

Note : If the aftertreatment DPF was removed due to Fault Code 1922 and is contaminated with coolant, it **must** be replaced with a new filter.

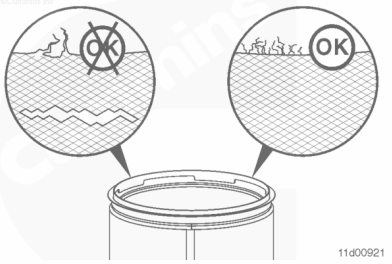
If the aftertreatment DPF has shifted, moved, or is loose inside the canister, replace the aftertreatment DPF.

If the aftertreatment DPF canister is cracked or otherwise damaged, replace the aftertreatment DPF.

Return the aftertreatment DPF section to a Cummins® Authorized Repair Location for cleaning, replacement, or exchange.



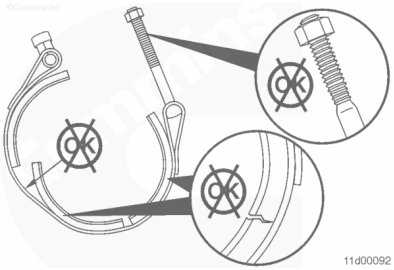
Inspect the DPF body joint insulation for visible wear at the diesel particulate filter inlet and outlet. Replace the DPF if excessive fraying or any cuts are observed.



Inspect the V-band clamps and mounting straps for signs of over-extension. The band **must not** be bent or damaged.

Inspect the V-band clamp and mounting strap threads for damage.

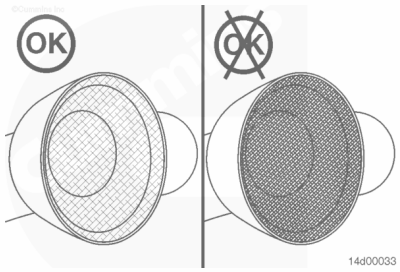
Replace the V-band clamp or strap if damage is found.



Note : The aftertreatment DPF is **not** 100 percent efficient. Some accumulation of exhaust residue/soot is normal and does **not** indicate a malfunctioning aftertreatment DPF.

A heavy buildup of exhaust residue/soot can indicate a malfunction of the aftertreatment DPF.

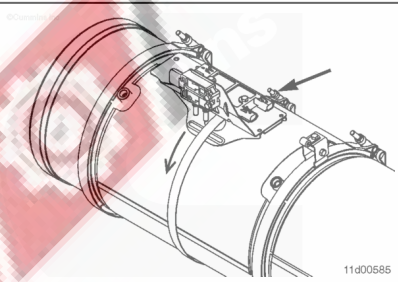
If the aftertreatment DPF is being replaced due to black smoke and the exhaust stack is found to have heavy black soot accumulation, clean the last 152 to 254 mm [6 to 10 in] of the exhaust system outlet.



Assemble

Install the aftertreatment DPF sensor mounting bracket onto the aftertreatment DPF. Refer to Procedure 011-046 in Section 11. (/qs3/pubsys2/xml/en/procedures/425/425-011-046.html)

Note : If equipped with a DPF mounted aftertreatment DPF differential pressure sensor, make sure the aftertreatment system is oriented so the aftertreatment DPF differential pressure sensor is installed in the same orientation noted during disassembly.



Install

⚠ WARNING ⚠

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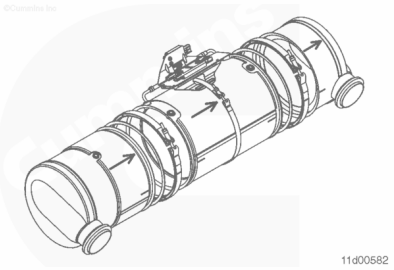

⚠ CAUTION ⚠

Do not use an air tool to tighten the V-band clamp. An air tool will damage the threads.

Install new gaskets on the inlet and outlet of the aftertreatment DPF canister.

Note : In some applications, a locating tab is integrated into the gasket retaining ring. The locating tab prevents the jointed aftertreatment DOC-

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aftertreatment V from being installed backwards and restricts the rotational orientation at which the filter can be installed.

Apply a coat of anti-seize compound to the threads of the V-band clamps.

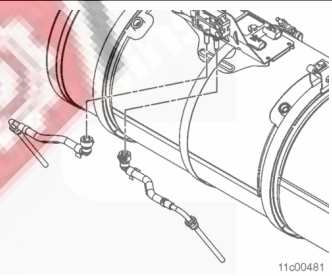
Install the aftertreatment DPF.

Loosely tighten the V-band clamps to allow rotation for final orientation of the differential pressure sensor tubes and exhaust gas temperature sensor probes.

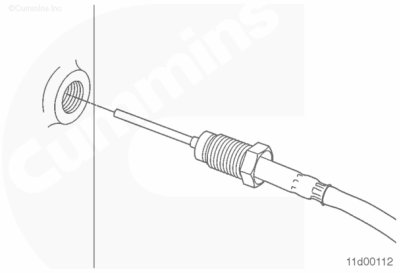
Tighten the V-band clamps.

Torque Value: 20 n•m [177 in-lb]

Install the aftertreatment DPF pressure sensor tubes into the aftertreatment DPF. Refer to Procedure 011-047 in Section 11. (/qs3/pubsys2/xml/en/procedures/425/425-011-047.html)

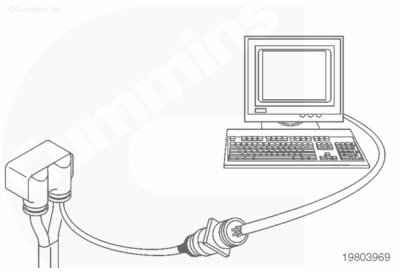


Install the exhaust gas temperature sensor probes into the aftertreatment DOC and particulate filter. Refer to Procedure 019-449 in Section 19. (/qs3/pubsys2/xml/en/procedures/425/425-019-449.html)



Adjust

If the aftertreatment DPF was replaced for high soot loading or plugging, it will be necessary to reset the stored soot load in engine engine control module (ECM).



This can be performed by the following:

- Use INSITE™ electronic service tool to perform the Aftertreatment Maintenance Reset procedure under the ECM Diagnostic Test menu.

If the aftertreatment DPF was cleaned or replaced due to Fault Code 1922, it will be necessary to reset the stored soot load in the engine's ECM.

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This can be performed by the following:

- Use INSITE™ electronic service tool to perform the Aftertreatment Maintenance Reset procedure under the Advanced ECM Data.
- Use INSITE™ electronic service tool or the in cab switch, if equipped, to perform a stationary regeneration. Refer to Procedure 014-016 in Section 14. (/qs3/pubsys2/xml/en/procedures/425/425-014-016.html)

If the aftertreatment DPF is being replaced due to black smoke and the exhaust stack is found to have heavy black soot accumulation, perform a stationary regeneration to verify and finalize the repair. If any fault codes become active during a stationary regeneration, see the Fault Code Troubleshooting Manual.

Aftertreatment DPFs replaced with new filters will require the aftertreatment maintenance installation function in INSITE™ electronic service tool to be reset.

Finishing Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

- Connect the batteries. See equipment manufacturer service information.
- Operate the vehicle on a dynamometer or perform a road test with the engine at rated load for a minimum of 5 minutes to make sure the aftertreatment system is performing properly. Refer to Procedure 014-016 in Section 14. (/qs3/pubsys2/xml/en/procedures/425/425-014-016.html)
- Check for exhaust leaks and proper operation.

ANADOLU ISUZU GENUINE PARTS


ANADOLU ISUZU
AFTER SALES

Select Service Tools

Recommended Cummins® Service Tools

- No Cummins® Service Tools required.

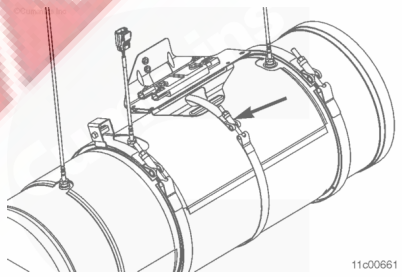
Additional Service Items

- Anti-seize compound

General Information

⚠ CAUTION ⚠

The catalyst elements contained in the aftertreatment system are made of brittle material. Do not drop or strike the side of the aftertreatment system, as damage to the catalyst element can result.



Due to the number of exhaust aftertreatment applications, this procedure is generic. **Not** all illustrations within the procedure will represent all applications.

The exhaust aftertreatment system is composed of three sections:

1. Aftertreatment diesel oxidation catalyst
2. Aftertreatment diesel particulate filter
3. Outlet.

Note : In some applications, the aftertreatment diesel oxidation can be integrated into the inlet of the exhaust aftertreatment system. Use the following procedure for aftertreatment inlet service guidelines. Refer to Procedure 011-049 in Section 11. (/qs3/pubsys2/xml/en/procedures/425/425-011-049.html)

Preparatory Steps

⚠ WARNING ⚠

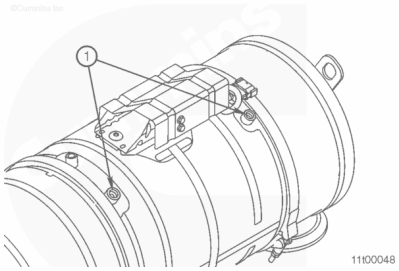
Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

⚠ WARNING ⚠

During regeneration, exhaust gas temperature could reach 800°C [1500°F], and exhaust system surface temperature could exceed 700°C [1300°F], which is hot enough to ignite or melt common materials, and to burn people. The exhaust and exhaust components can remain hot after the vehicle has stopped moving. To avoid the risk of fire, property damage, burns or other serious personal injury, allow the exhaust system to cool before beginning this procedure or repair. Make sure that no combustible materials are located where they are likely to come in contact with hot exhaust or exhaust components.

- Disconnect the batteries. See equipment manufacturer service information.
- Disconnect the original equipment manufacturer (OEM) wiring harness from the aftertreatment interface harness. Refer to Procedure 019-477 in Section 19. (/qs3/pubsys2/xml/en/procedures/425/425-019-477.html)
- Disconnect the aftertreatment interface harness from aftertreatment diesel particulate filter temperature sensor assembly. Refer to Procedure 019-449 in Section 19. (/qs3/pubsys2/xml/en/procedures/425/425-019-449.html)
- Disconnect the aftertreatment interface harness from the aftertreatment diesel particulate filter differential pressure sensor interface module. Refer to Procedure 019-443 in Section 19. (/qs3/pubsys2/xml/en/procedures/425/425-019-443.html)
- Disconnect the aftertreatment diesel particulate filter differential pressure sensor tubes from the aftertreatment differential pressure sensor. Refer to Procedure 011-047 in Section 11. (/qs3/pubsys2/xml/en/procedures/425/425-011-047.html)

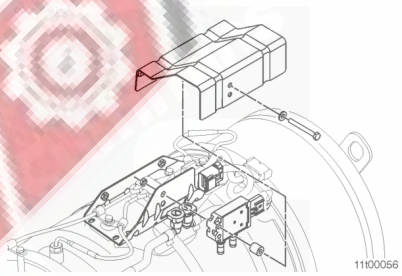
Mark the direction of the aftertreatment diesel particulate filter differential pressure sensor ports (1) on the aftertreatment diesel particulate filter canister.



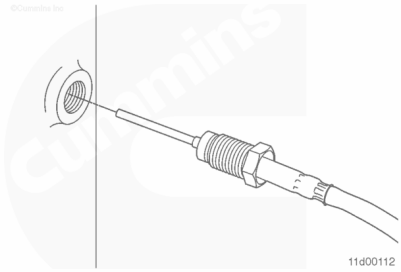
Disassemble

Remove the aftertreatment diesel particulate filter differential pressure sensor and heat shield, if equipped. Refer to Procedure 019-443 in Section 19. (/qs3/pubsys2/xml/en/procedures/425/425-019-443.html)

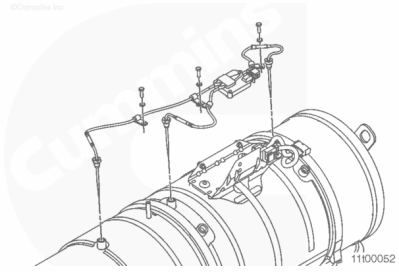
Note : The diesel particulate filter sensor table heat shield uses the same mounting bolts as the diesel particulate filter differential pressure sensor. There is a spacer located between the heat shield and diesel particulate filter differential pressure sensor. Note the location and orientation of this spacer during removal.



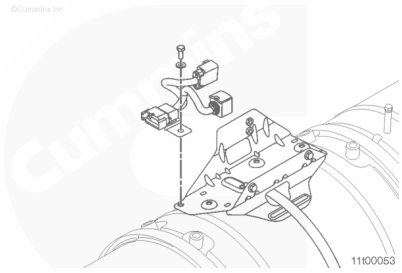
Remove the exhaust gas temperature sensor probes from the aftertreatment diesel oxidation catalyst and particulate filter. Refer to Procedure 019-449 in Section 19. (/qs3/pubsys2/xml/en/procedures/425/425-019-449.html)



Remove the aftertreatment diesel particulate filter temperature sensor assembly. Refer to Procedure 019-449 in Section 19. (/qs3/pubsys2/xml/en/procedures/425/425-019-449.html)



Remove the aftertreatment interface harness. Refer to Procedure 019-477 in Section 19. (/qs3/pubsys2/xml/en/procedures/425/425-019-477.html)



Remove

⚠ CAUTION ⚠

Do not use an air tool to remove the band clamp nut. An air tool will damage the threads. Apply thread lubricant to the band clamp threads prior to nut removal.

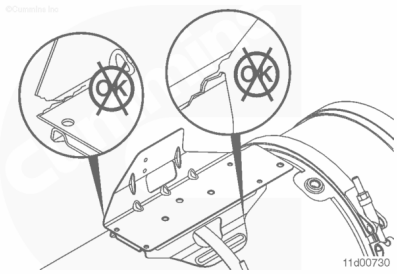
Remove the nut on the aftertreatment diesel particulate filter differential pressure sensor mounting bracket strap.

Remove the aftertreatment diesel particulate filter differential pressure sensor mounting bracket and strap.

Clean and Inspect for Reuse

Inspect the aftertreatment diesel particulate filter differential pressure sensor mounting bracket for cracks, damaged threads, or broken studs.

Replace the aftertreatment diesel particulate filter differential pressure sensor mounting bracket, if damaged.



Inspect the aftertreatment diesel particulate filter differential pressure sensor mounting bracket strap for cracks, damaged threads, or bends.

Replace the aftertreatment diesel particulate filter differential pressure sensor mounting bracket strap, if damaged.

ANADOLU ISUZU PARTS SALES

Install

⚠ CAUTION ⚠

The aftertreatment system must be installed so the aftertreatment diesel particulate filter differential pressure sensor tubes slope downward to drain condensation away from the aftertreatment diesel particulate filter differential pressure sensor.

⚠ CAUTION ⚠

Do not use an air tool to tighten the band clamp. An air tool will damage the threads.

Note : Make sure the aftertreatment system is oriented so the aftertreatment diesel particulate filter differential pressure sensor is installed in the same orientation noted during disassembly.

Install the aftertreatment diesel particulate filter differential pressure sensor mounting bracket and strap.

Apply a coating of anti-seize compound to the threads of the aftertreatment diesel particulate filter differential pressure sensor mounting bracket strap.

Install the nut on the aftertreatment diesel particulate filter differential pressure sensor mounting bracket strap. Do **not** tighten the nut at this time.

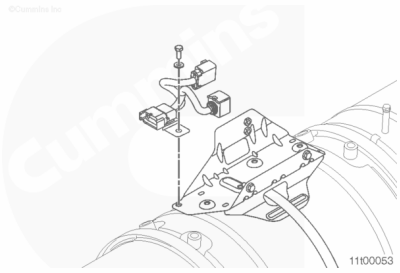
Connect the differential pressure sensor tubes to align the aftertreatment diesel particulate filter differential pressure sensor mounting bracket on the diesel particulate filter canister. Refer to Procedure 011-047 in Section 11. (/qs3/pubsys2/xml/en/procedures/425/425-011-047.html)

Tighten the aftertreatment diesel particulate filter differential pressure sensor mounting bracket strap.

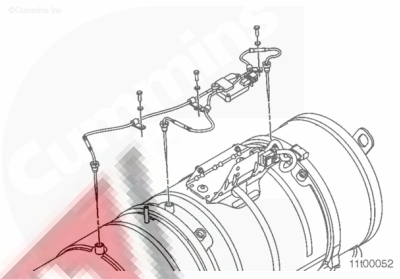
Torque Value: 7 n•m [62 in-lb]

Assemble

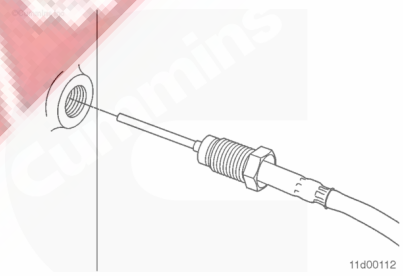
Install the aftertreatment interface harness. Refer to Procedure 019-477 in Section 19. (/qs3/pubsys2/xml/en/procedures/425/425-019-477.html)



Install the aftertreatment diesel particulate filter temperature sensor assembly. Refer to Procedure 019-449 in Section 19. (/qs3/pubsys2/xml/en/procedures/425/425-019-449.html)

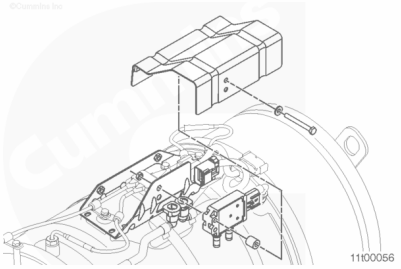


Install the exhaust gas temperature sensor probes to the aftertreatment diesel oxidation catalyst and particulate filter. Refer to Procedure 019-449 in Section 19. (/qs3/pubsys2/xml/en/procedures/425/425-019-449.html)



Install the aftertreatment diesel particulate trap differential pressure sensor and heat shield, if equipped. Refer to Procedure 019-443 in Section 19. (/qs3/pubsys2/xml/en/procedures/425/425-019-443.html)

Note : The diesel particulate filter sensor table heat shield use the same mounting bolts as the diesel particulate filter differential pressure sensor. There is a spacer located between the heat shield and diesel particulate filter differential pressure sensor. Note the location and orientation of this spacer during installation.



Finishing Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery

cable last.

- Connect the aftertreatment diesel particulate filter differential pressure sensor tubes to the aftertreatment differential pressure sensor. Refer to Procedure 011-047 in Section 11. (/qs3/pubsys2/xml/en/procedures/425/425-011-047.html)
- Connect the aftertreatment interface harness to the aftertreatment diesel particulate filter temperature sensor assembly. Refer to Procedure 019-449 in Section 19. (/qs3/pubsys2/xml/en/procedures/425/425-019-449.html)
- Connect the aftertreatment interface harness to the aftertreatment diesel particulate filter differential pressure sensor interface module. Refer to Procedure 019-443 in Section 19. (/qs3/pubsys2/xml/en/procedures/425/425-019-443.html)
- Connect the OEM wiring harness to the aftertreatment interface harness. Refer to Procedure 019-477 in Section 19. (/qs3/pubsys2/xml/en/procedures/425/425-019-477.html)
- Connect the batteries. See equipment manufacturer service information.
- Operate the engine. Check for leaks.

Last Modified: 05-Aug-2016

ANADOLU ISUZU AFTER SALES

Select Service Tools

Recommended Cummins® Service Tools

- Anti-seize compounds 3824397, 3824732, and 3824879, or equivalent

Additional Service Items

- No additional service items required.

General Information

⚠ WARNING ⚠

During regeneration, exhaust gas temperature can reach 800 °C [1500°F], and exhaust system surface temperature can exceed 700 °C [1300°F], which is hot enough to ignite or melt common materials, and to burn people. The exhaust and exhaust components can remain hot after the vehicle has stopped moving. To avoid the risk of fire, property damage, burns, or other serious personal injury, allow the exhaust system to cool before beginning this procedure or repair and make sure that no combustible materials are located where they are likely to come in contact with hot exhaust or exhaust components.

⚠ WARNING ⚠

The material captured in a partial flow diesel particulate filter and/or a diesel particulate filter may contain elevated concentrations of metals. Primarily zinc, molybdenum, and possibly polynuclear aromatic hydrocarbons, that may be regulated. These materials must be characterized, handled, and disposed of according to applicable local regulations. In addition, due to the presence of the above-listed chemicals and other potentially toxic components such as oxides of calcium, zinc, phosphorous, silicon, sulfur, and iron, exhaust filter maintenance must be completed only by appropriately trained personnel.

The aftertreatment diesel particulate filter differential pressure sensor tubes connect the aftertreatment diesel particulate filter differential pressure sensor to the ports on the aftertreatment system. There are two aftertreatment diesel particulate filter differential pressure sensor tubes. One tube connects to the aftertreatment system upstream of the aftertreatment diesel particulate filter and the other connects downstream of the aftertreatment diesel particulate filter.

Due to the number of aftertreatment applications, this procedure is generic. **Not** all illustrations within the procedure will represent all applications.

Excessive carbon deposits inside the aftertreatment diesel particulate filter differential pressure sensor tubes can cause a CHECK ENGINE light.

Preparatory Steps

⚠ WARNING ⚠

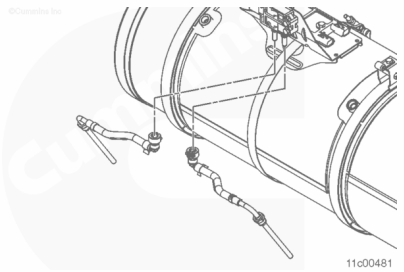
Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

- Disconnect the batteries. See equipment manufacturer service information.
- Remove the heat shield, if equipped. Refer to Procedure 011-032 in Section 11. (/qs3/pubsys2/xml/en/procedures/425/425-011-032.html)
- Remove the differential pressure sensor tubes from the aftertreatment diesel particulate filter differential pressure sensor. Refer to Procedure 019-443 in Section 19. (/qs3/pubsys2/xml/en/procedures/425/425-019-443.html)

Remove

⚠ WARNING ⚠

During regeneration, exhaust gas temperature can reach 800 °C [1500°F], and exhaust system surface temperature can exceed 700 °C [1300°F], which is hot enough to ignite or melt common materials, and to burn people. The exhaust and exhaust components can remain hot after the vehicle has stopped moving. To avoid the risk of fire, property damage, burns, or other serious personal injury, allow the exhaust system to cool before beginning this procedure or repair and make sure that no combustible materials are located where they are likely to come in contact with hot exhaust or exhaust components.



⚠ CAUTION ⚠

The aftertreatment diesel particulate filter differential sensor will not operate properly if the aftertreatment diesel particulate filter differential pressure sensor tubes are not connected to the correct port. Mark the aftertreatment diesel particulate filter differential pressure sensor tube connection port locations before disconnecting.

Note : The mounting location of the aftertreatment diesel particulate filter differential pressure sensor varies with exhaust aftertreatment orientation.

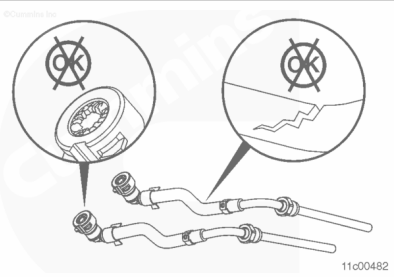
If equipped with a diesel particulate filter mounted aftertreatment differential pressure sensor:

- Loosen the aftertreatment diesel particulate filter differential pressure sensor tube nuts.
- Remove the P-clips or tube clamp mounting capscrews, if necessary.

Clean and Inspect for Reuse

⚠ WARNING ⚠

When using solvents, acids, or alkaline materials for cleaning, follow the manufacturer's recommendations for use. Wear goggles and protective clothing to reduce the possibility of personal injury.



⚠ WARNING ⚠

Wear appropriate eye and face protection when using compressed air. Flying debris and dirt can cause personal injury.

Inspect the inside of the tube.

If the tube is partially clogged, saturate the inside of the tube with a mineral based solvent, or equivalent.

Carefully clean debris from the mouth of the tube, making sure **not** to damage the tube.

If the tube is fully clogged or otherwise unable to be cleaned, the tube **must** be replaced.

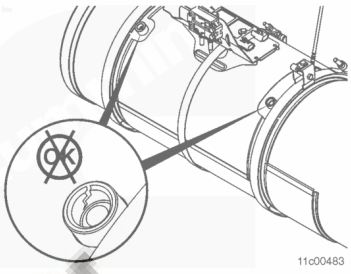
ANADOLU ISUZU PARTS SALES

Clean the tube. Use safety solvent. Dry the tube with compressed air.

Check the tube for cracks and thread damage. Replace the tube if damage is found.

Inspect the inside of the threaded bosses on the aftertreatment canister.

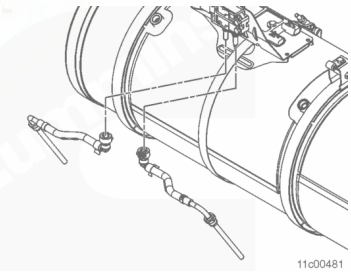
Clean debris from the inside of the threaded bosses, while being careful **not** to damage the threads.



Install

⚠ CAUTION ⚠

The aftertreatment diesel particulate filter differential sensor will not operate properly if the aftertreatment diesel particulate filter aftertreatment diesel particulate filter differential pressure sensor tubes are not connected to the correct port. Install the aftertreatment diesel particulate filter differential pressure sensor tubes as noted during disassembly.



⚠ CAUTION ⚠

The aftertreatment system must be installed so the aftertreatment diesel particulate filter differential pressure sensor tubes slope downward to drain condensation away from the aftertreatment diesel particulate filter differential pressure sensor.

Note : In vertical aftertreatment orientations, an aftertreatment diesel particulate filter differential pressure sensor tube support is present. Make sure the aftertreatment diesel particulate filter differential pressure tube is seated in the support clip.

Apply a coating of anti-seize compounds 3824397, 3824732, and 3824879, or equivalent, to the threads on the aftertreatment diesel particulate filter differential pressure sensor tubes prior to assembly. Do **not** allow Loctite® to

enter the inside of the aftertreatment diesel particulate filter differential pressure sensor tubes. This can cause a blockage.

Minimum Loctite® anti-seize temperature range specifications: 1600°C [870°C].

Install the aftertreatment diesel particulate filter differential pressure sensor tubes on the aftertreatment system.

Note : Make sure the aftertreatment diesel particulate filter differential pressure sensor tubes are **not** making contact with each other or any other vehicle components prior to tightening the aftertreatment diesel particulate filter differential pressure sensor tube nuts.

Tighten the upstream aftertreatment diesel particulate filter differential pressure sensor tube nut.

Torque Value: 31 n•m [23 ft-lb]

Tighten the downstream aftertreatment diesel particulate filter differential pressure sensor tube nut.

Torque Value: 17 n•m [150 in-lb]

If equipped with diesel particulate filter mounted aftertreatment differential pressure sensor:

- Install the P-clip or the tube clamp that holds the aftertreatment diesel particulate filter differential pressure sensor tube on the aftertreatment system, if necessary.

Torque Value: 14 n•m [124 in-lb]

Finishing Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

- Install the quick disconnect fittings, and, if equipped, the aftertreatment diesel particulate filter differential pressure sensor insulation box and differential pressure sensor tubes to the aftertreatment diesel particulate filter differential pressure sensor.

ANADOLU ISUZU AFTER SALES

- Install of the differential pressure sensor tubes to the aftertreatment diesel particulate filter differential pressure sensor. Refer to Procedure 019-443 in Section 19. (/qs3/pubsys2/xml/en/procedures/425/425-019-443.html)
- Install the heat shield, if equipped. Refer to Procedure 011-032 in Section 11. (/qs3/pubsys2/xml/en/procedures/425/425-011-032.html)
- Connect the batteries. See equipment manufacturer service information.
- Operate the vehicle on a dynamometer or perform a road test with the engine at rated load for a minimum of 5 minutes to make sure the aftertreatment system is performing properly.
- Check for fault codes and exhaust leaks.

Last Modified: 01-Nov-2016

ANADOLU ISUZU AFTER SALES

Select Service Tools

Recommended Cummins® Service Tools

- Aftertreatment diesel particulate filter cleaning machine cone, Part Number 4918850
- Adapter ring, Part Number 4918848
- Diesel Catalyst Module Cleaning Kit, Part Number 4918877
- Threaded plastic plug, Part Number 4919495

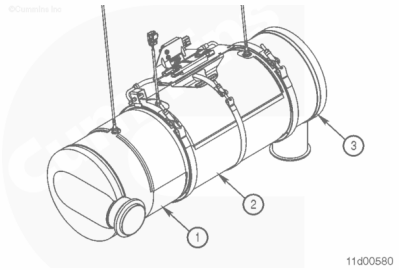
Additional Service Items

- Putty knife
- Rubber pipe reducer
- Flashlight
- Inspect mirror
- Anti-seize compound

General Information

⚠ WARNING ⚠

The material captured in a partial flow diesel particulate filter and/or a diesel particulate filter may contain elevated concentrations of metals. Primarily zinc, molybdenum, and possibly polynuclear aromatic hydrocarbons, that may be regulated. These materials must be characterized, handled, and disposed of according to applicable local regulations. In addition, due to the presence of the above-listed chemicals and other potentially toxic components such as oxides of calcium, zinc, phosphorous, silicon, sulfur, and iron, exhaust filter maintenance must be completed only by appropriately trained personnel.



⚠ CAUTION ⚠

The aftertreatment diesel oxidation catalyst elements contained in the aftertreatment system are made of brittle material. Do not drop or strike the side of the aftertreatment system as damage to the aftertreatment diesel oxidation catalyst element can result.

⚠ CAUTION ⚠

Do not steam clean the inlet of the diesel oxidation catalyst as damage to the aftertreatment diesel oxidation catalyst can result.

Due to number of exhaust aftertreatment applications, this procedure is generic. **Not** all illustrations within this procedure will represent all applications.

The exhaust aftertreatment is composed of three sections. These sections are:

1. Aftertreatment diesel oxidation catalyst
2. Aftertreatment diesel particulate filter
3. Outlet.

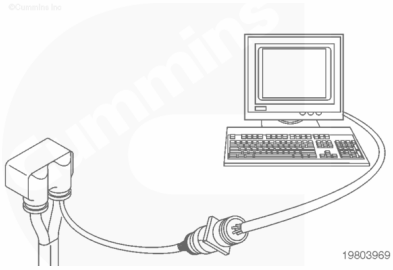
Note : The aftertreatment diesel oxidation catalyst is integrated into the inlet of the exhaust aftertreatment system.

Note : If the aftertreatment diesel particulate filter or aftertreatment diesel oxidation catalyst is being replaced due to progressive damage from engine oil or fuel, clean the tailpipe from the turbocharger outlet to the aftertreatment diesel oxidation catalyst.

Test

⚠ CAUTION ⚠

If an engine progressive damage malfunction has sent fuel or oil to the diesel particulate filter or the diesel oxidation, do not perform an Aftertreatment Diesel Particulate Filter Regeneration Test until the aftertreatment diesel oxidation catalyst and diesel particulate filter are inspected.



To test the diesel oxidation catalyst, use INSITE™ electronic service tool to perform the Aftertreatment Diesel Particulate Filter Regeneration Test. The efficiency of the diesel oxidation catalyst will be tested.

If a malfunction in the catalyst system is detected, fault codes will become active during the test. Follow the appropriate fault code troubleshooting tree.

ANADOLU EGZOZ FILTER SALES

Preparatory Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

⚠ WARNING ⚠

During regeneration, exhaust gas temperature can reach 800 °C [1500°F], and exhaust system surface temperature can exceed 700 °C [1300°F], which is hot enough to ignite or melt common materials, and to burn people. The exhaust and exhaust components can remain hot after the vehicle has stopped moving. To avoid the risk of fire, property damage, burns, or other serious personal injury, allow the exhaust system to cool before beginning this procedure or repair and make sure that no combustible materials are located where they are likely to come in contact with hot exhaust or exhaust components.

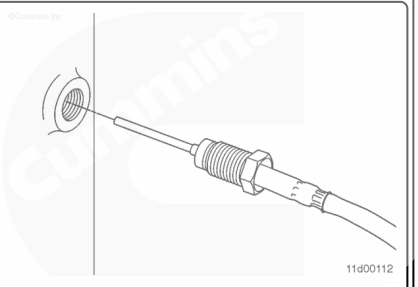
⚠ CAUTION ⚠

Aftertreatment diesel oxidation catalyst can remain hot for a long time after the engine has stopped.

- Disconnect the batteries. See equipment manufacturer service information.
- Disonnect the original equipment manufacturer (OEM) wiring harness from the aftertreatment interface harness. Refer to Procedure 019-477 in Section 19. (/qs3/pubsys2/xml/en/procedures/425/425-019-477.html)

Disassemble

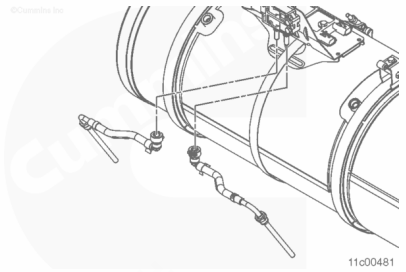
Remove the aftertreatment diesel oxidation catalyst intake temperature sensor probe and aftertreatment diesel particulate filter intake temperature sensor probes. Refer to Procedure 019-449 in Section 19. (/qs3/pubsys2/xml/en/procedures/425/425-019-449.html)



Note : The aftertreatment diesel oxidation catalyst intake temperature sensor probe and aftertreatment

diesel particulate filter intake temperature sensor probe **must** be removed prior to aftertreatment diesel oxidation catalyst removal or damage to the sensor wiring and sensor probe will occur.

Remove the diesel particulate filter inlet differential pressure sensor tube from the diesel oxidation catalyst. Refer to Procedure 011-047 in Section 11. (/qs3/pubsys2/xml/en/procedures/425/425-011-047.html)

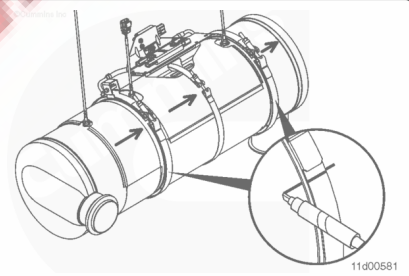


Note : The diesel particulate filter inlet differential pressure sensor tube **must** be removed prior to aftertreatment diesel oxidation catalyst removal or damage to the sensor tube will occur.

Remove

⚠ WARNING ⚠

This component or assembly weighs greater than 23 kg [50 lb]. To prevent serious personal injury, be sure to have assistance or use appropriate lifting equipment to lift this component or assembly.



⚠ CAUTION ⚠

The aftertreatment diesel oxidation catalyst elements contained in the aftertreatment system are made of brittle material. Do not drop or strike the side of the aftertreatment system as damage to the aftertreatment diesel oxidation catalyst element can result.

⚠ CAUTION ⚠

Do not use an air tool to remove the V-band clamp nut. An air tool will damage the threads. Apply thread lubricant to the V-band clamp threads prior to nut removal.

Draw an orientation reference line across each of the V-band clamps, aftertreatment canister sections, and connection points to the tailpipe. This will aid in linking up sections and V-band clamps to their original orientation during installation.

Note : If necessary, remove additional mounting hardware to remove the aftertreatment diesel oxidation catalyst from the vehicle or equipment.

Remove the V-Band clamps from the inlet and outlet of the aftertreatment diesel oxidation catalyst.

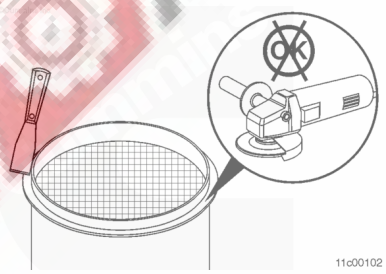
Separate the component sections by approximately 45 mm [1.75 in] to allow removal over the gasket retainer rings.

Remove and discard the gaskets.

Clean and Inspect for Reuse

⚠ WARNING ⚠

When using a steam cleaner, wear safety glasses or a face shield, as well as protective clothing. Hot steam can cause serious personal injury.



⚠ CAUTION ⚠

Do not use a grinder or abrasive air tool to remove residual gasket material, as this can damage the flange and cause the connection to leak.

⚠ CAUTION ⚠

Do not use an open flame to burn off soot accumulation from the face of the aftertreatment diesel particulate filter.

⚠ CAUTION ⚠

Do not scrape off soot accumulation from the face of the aftertreatment diesel particulate filter.

⚠ CAUTION ⚠

Do not steam clean the inlet of the diesel oxidation catalyst as damage to the aftertreatment diesel oxidation catalyst can result.

ANADOLU ISUZU PARTS

Remove any residual gasket material from the flanges on the aftertreatment diesel particulate filter, diesel oxidation catalyst, and catalyst inlet. Use a putty knife.

Note : Avoid dropping fragments of gasket material into the aftertreatment diesel particulate filter and catalyst.

Inspect the exhaust gas temperature sensor boss threads for damage.

If thread damage is found on the exhaust gas temperature sensor boss threads, a helicoil **must** be used for repair.

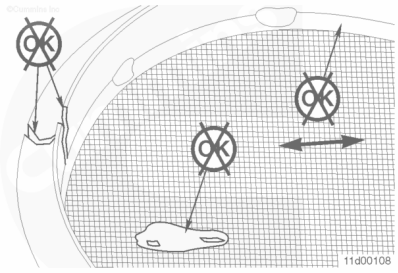
Note : If the aftertreatment diesel particulate filter is being inspected due to progressive damage that introduced engine oil or excessive fuel into the exhaust, inspect the tailpipe from the turbocharger outlet to the aftertreatment diesel oxidation catalyst.

If a trail of coolant can be seen exiting the turbocharger outlet, the diesel oxidation catalyst can be recovered without removing it for inspection. Refer to Procedure 014-015 in Section 14. (/qs3/pubsys2/xml/en/procedures/425/425-014-015.html)

If a trail of coolant can be seen exiting the turbocharger outlet, the tailpipe between the turbocharger outlet and aftertreatment diesel oxidation catalyst **must** be cleaned. See equipment manufacturer service information.

If a trail of engine oil or fuel can be seen exiting the turbocharger outlet, the tailpipe between the turbocharger outlet and aftertreatment diesel oxidation catalyst **must** be cleaned. See equipment manufacturer service information.

If the aftertreatment diesel oxidation catalyst section has shifted, moved, or is loose inside the canister, replace the aftertreatment diesel oxidation catalyst section.

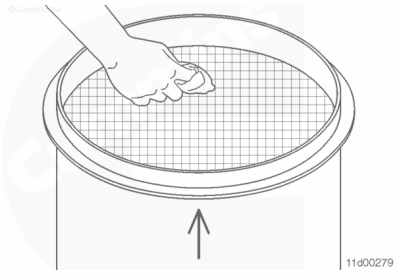


Refer to Service Bulletin, Aftertreatment Diesel Oxidation Catalyst and Aftertreatment Diesel Particulate Filter Reuse Guidelines, Bulletin 4021600 (/qs3/pubsys2/xml/en/bulletin/4021600.html), to inspect the inlet and outlet faces of the aftertreatment diesel oxidation catalyst for signs of damage.

Replace the aftertreatment diesel oxidation catalyst, if it is damaged.

⚠ WARNING ⚠

The material captured in a partial flow diesel particulate filter and/or a diesel particulate filter may contain elevated concentrations of metals. Primarily zinc, molybdenum, and possibly polynuclear aromatic hydrocarbons, that may be regulated. These materials must be characterized, handled, and disposed of according to applicable local regulations. In addition, due to the presence of the above-listed chemicals and other potentially toxic components such as oxides of calcium, zinc, phosphorous, silicon, sulfur, and iron, exhaust filter maintenance must be completed only by appropriately trained personnel.



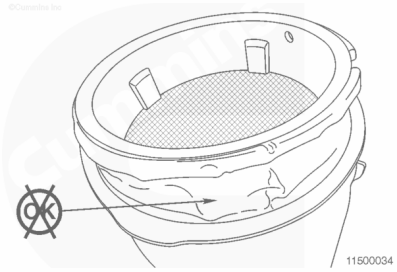
⚠ WARNING ⚠

Wear appropriate eye and face protection when using compressed air. Flying debris and dirt can cause personal injury.

Inspect the outlet of the aftertreatment diesel oxidation catalyst for loose debris and soot. Use a rag to wipe off any soot. Use a HEPA vacuum to remove any remaining loose debris.

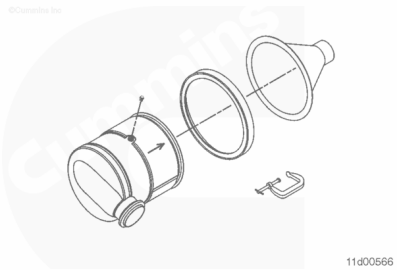
Note : Use a vacuum bag, such as a drywall dust bag, to capture the soot removed.

Inspect the aftertreatment diesel oxidation catalyst insulation for damage.



Attach aftertreatment diesel particulate filter cleaning machine cone, Part Number 4918850, to the outlet side of the aftertreatment diesel oxidation catalyst with adapter ring, Part Number 4918848. Evenly space four to five spring clamps or C-clamps around the circumference of the aftertreatment diesel oxidation catalyst to seal the cone and adapter ring to the aftertreatment diesel oxidation catalyst.

Diesel Catalyst Module Cleaning Kit, Part Number 4918877, contains the cones and rings needed for this procedure.



ANADOLU ISUZU AFTERSALES

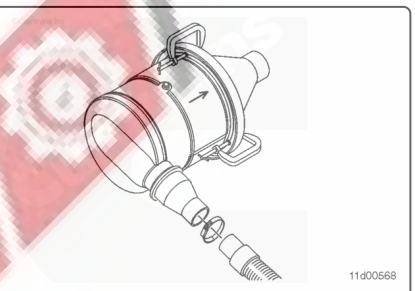
Install threaded plastic plug, Part Number 4919495, into the exhaust gas temperature sensor port on the diesel oxidation catalyst. This will prevent air from escaping the diesel oxidation catalyst.

Obtain a 51 to 102 mm [2 to 4 in] rubber pipe reducer.



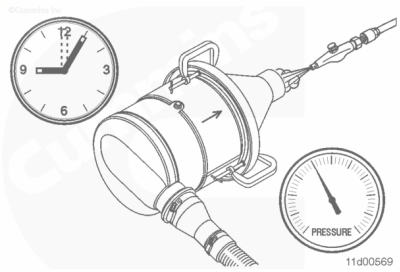
Attach the vacuum hose to the 51 mm [2”] end of the pipe reducer. Install the larger end of the reducer to the inlet of the diesel oxidation catalyst.

Use tape to seal any open ports.



⚠ CAUTION ⚠

Use only a rubber-tipped air gun near the catalyst material. Damage will result if a metal air gun strikes the catalyst material.



Adjust the air supply for a rubber-tipped air gun to 621 kPa [90 psi].

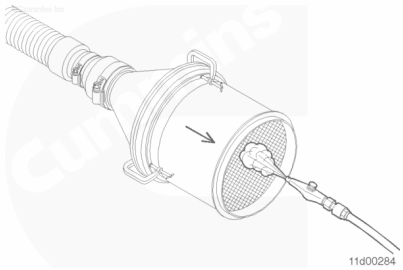
Switch on the vacuum. The vacuum and service tool kit is properly installed if the air flow through the aftertreatment diesel oxidation catalyst is opposite the exhaust flow. Exhaust flow is indicated by the arrow drawn on the canister of the diesel oxidation catalyst prior to removal.

Blow compressed air across the outlet face of the aftertreatment diesel oxidation catalyst for approximately 5 minutes.

After 5 minutes, remove the aftertreatment diesel particulate filter cleaning machine cone. Continue blowing compressed air into the outlet of the diesel oxidation catalyst for an additional 10 to 15 minutes. Maintain a 13 to 25 mm [1/2 to 1 in] distance between the air gun and diesel oxidation catalyst

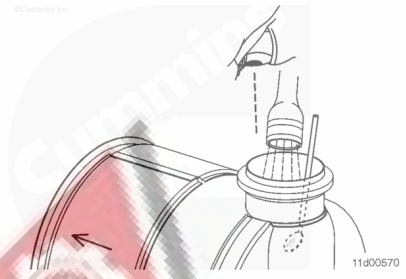
face. Use a sweeping motion across the entire face of the diesel oxidation catalyst. Attempt to blow air through every cell.

Allow the vacuum to operate for 1 minute after blowing out the aftertreatment diesel oxidation catalyst. After the vacuum is switched off, disconnect the cleaning machine cone. Inspect the cells of the diesel oxidation catalyst.



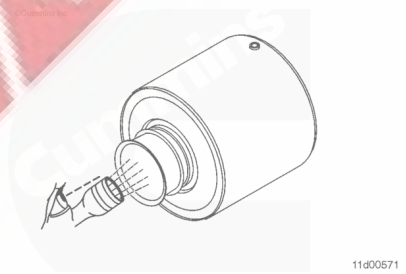
For side-in configurations:

Place an inspection mirror into the inlet of the diesel oxidation catalyst. Shine a flashlight on the mirror to inspect the cells of the inlet face.



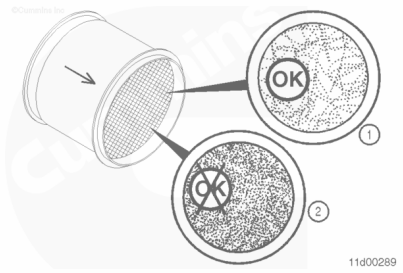
For end-in configurations:

Use a flashlight to inspect the inlet face of the diesel oxidation catalyst.



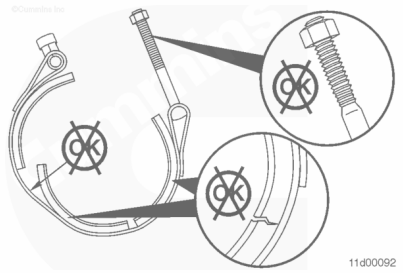
Upon inspection, if less than 50 percent of the cells are blocked (1) the aftertreatment diesel oxidation catalyst can be reused. If more than 50 percent of the cells remain blocked (2), repeat the cleaning procedure.

If fifty percent of the cells remain blocked after the second cleaning, replace the diesel oxidation catalyst.



Inspect the V-band clamps and aftertreatment diesel oxidation catalyst mounting straps for signs of overextension. The V-band **must not** be bent or otherwise damaged.

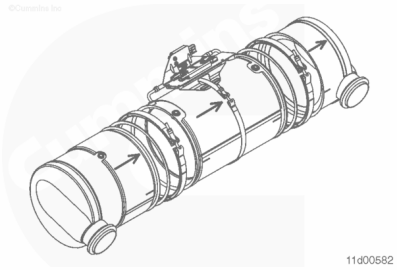
Replace the V-band clamps or aftertreatment diesel oxidation catalyst mounting straps if damage is found.



Install

⚠ WARNING ⚠

This component or assembly weighs greater than 23 kg [50 lb]. To prevent serious personal injury, be sure to have assistance or use appropriate lifting equipment to lift this component or assembly.



⚠ CAUTION ⚠

Do not use an air tool to tighten the V-band clamp. An air tool will damage the threads.

Install new gaskets on the inlet and outlet of the exhaust gas aftertreatment diesel oxidation catalyst.

Apply a coat of anti-seize compound on the threads of the V-band clamps and Torca™ clamps.

Install the aftertreatment diesel oxidation catalyst.

Tighten the V-band clamp used to secure the aftertreatment diesel oxidation catalyst to the aftertreatment diesel particulate filter.

Torque Value: 20 n•m [177 in-lb]

Tighten the V-band clamp used to secure the inlet of the aftertreatment diesel oxidation catalyst to the exhaust pipe.

Torque Value: 13.5 n•m [120 in-lb]

If necessary, install any additional mounting hardware used to secure the aftertreatment diesel oxidation catalyst to the vehicle.

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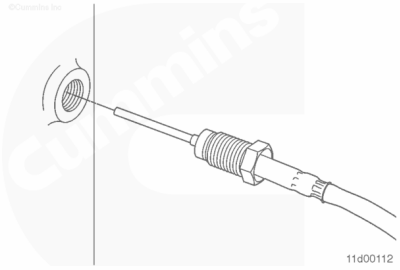
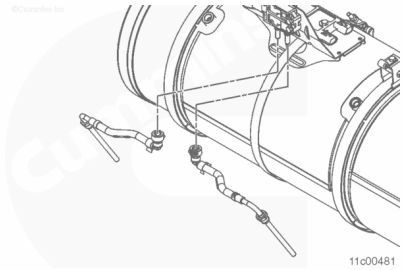
Assemble

Install the exhaust gas temperature sensor probes. Refer to Procedure 019-449 in Section 19. (/qs3/pubsys2/xml/en/procedures/425/425-019-449.html)



Install the diesel particulate filter differential pressure sensor. Refer to Procedure 011-047 in Section 11. (/qs3/pubsys2/xml/en/procedures/425/425-011-047.html)



Finishing Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

- Connect the OEM wiring harness to the aftertreatment interface harness. Refer to Procedure 019-477 in Section 19. (/qs3/pubsys2/xml/en/procedures/425/425-019-477.html)
- Connect the batteries. See equipment manufacturer service information.
- Operate the engine. Check for fault codes and exhaust leaks.

ANADOLU ISUZU AFTER SALES

Last Modified: 01-Nov-2016

Select Service Tools

Recommended Cummins® Service Tools

- No Cummins® Service Tools required.

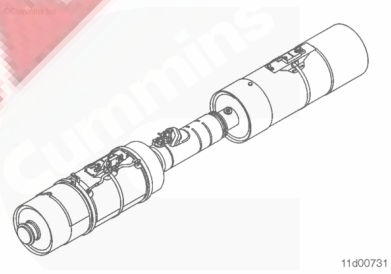
Additional Service Items

- No additional service items required.

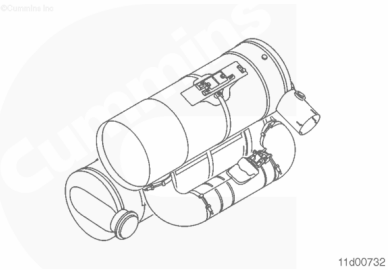
General Information

The aftertreatment system configuration will vary depending on the vehicle type and/or manufacturer. Some of the more common aftertreatment configurations are:

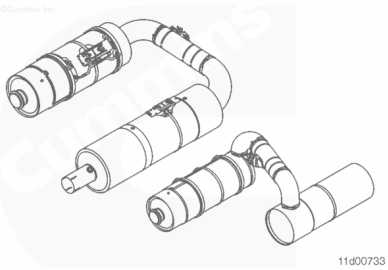
- Inline Horizontal - the selective catalytic reduction (SCR) assembly is aligned with and directly behind the diesel particulate filter assembly.



- Switchback - the diesel particulate filter and SCR assembly are side-by-side so the aftertreatment system can fit in a small area such as underneath the side steps of the vehicle.



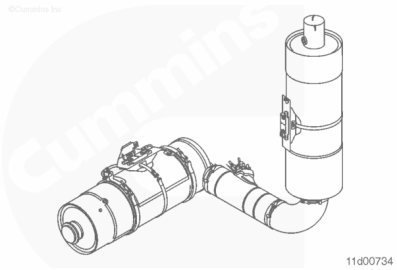
- Horizontal - the diesel particulate filter and SCR assemblies are on opposite sides of the chassis.
- Crossover - the diesel particulate filter and SCR assemblies are on opposite sides of the chassis.



- Horizontal to Vertical - the diesel particulate filter assembly is horizontal and then transitions to a vertical SCR assembly.

ANADOLU ISUZU AFTERSALES

Note : The illustration is depicting some common arrangements.



For some aftertreatment systems, if required, the entire aftertreatment system can be removed as a complete assembly. See equipment manufacturer service information.

In many cases the aftertreatment system **must** be removed component by component. See the appropriate procedures in the section for removal and installation information.

Use the following procedure for more detailed information about the aftertreatment system. Refer to Procedure 011-999 in Section F. (/qs3/pubsys2/xml/en/procedures/425/425-011-999.html)

ANADOLU ISUZU AFTER SALES

Last Modified: 05-Aug-2016

Select Service Tools

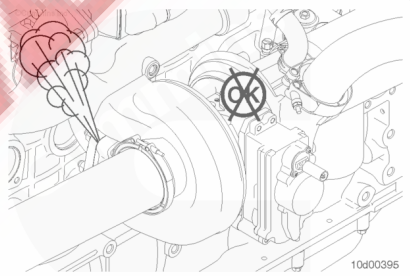
Recommended Cummins® Service Tools

- DEF refractometer, Part Number 4919554

Additional Service Items

- Container suitable for diesel exhaust fluid (DEF)

General Information



The following procedure contains troubleshooting steps and information regarding the aftertreatment system.

Leaks in the exhaust system can cause exhaust odor or white smoke.

Inspect the exhaust piping for leaks, cracks, and loose connections. Refer to Procedure 010-024 in Section 10. (/qs3/pubsys2/xml/en/procedures/425/425-010-024.html)

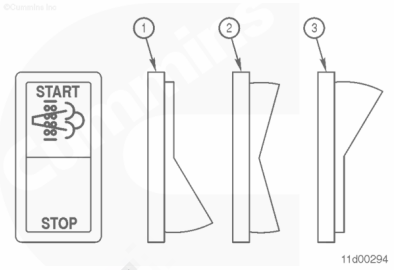
Tighten the exhaust clamps, if necessary. See equipment manufacturer service information for the correct torque value.

It can be necessary to perform a stationary (parked or non-mission) regeneration to locate exhaust leaks. Refer to Procedure 014-016 in Section 14. (/qs3/pubsys2/xml/en/procedures/425/425-014-016.html)

The ambient temperature affects the length of time it will take to perform a stationary (parked or non-mission) regeneration because the engine **must** work harder to increase the exhaust temperatures to the appropriate levels in cold ambient temperatures.

In cold ambient temperatures (approximately -18°C [0°F] or colder), stationary (parked or non-mission) regeneration can take longer to complete. In extremely cold ambient temperatures, stationary (parked or non-mission) regeneration may **not** complete.

In these cases, it can be necessary to warm the engine to operating temperature before starting the stationary (parked or non-mission) regeneration, or to move the vehicle to a location with higher ambient temperatures.



The vehicle manufacturer has the option of installing two switches that control the aftertreatment function: the start switch and the permit switch.

The start switch (called the diesel exhaust fluid (DEF) Regeneration Start Switch in INSITE™ electronic service tool) is used to start a stationary regeneration. The vehicle manufacturer can also reference this switch as a "stationary (parked or non-mission) regeneration switch," "start switch," "non-mission regeneration switch", or "parked regeneration switch".

The permit switch (called the diesel particulate filter (DPF) Permit Switch in INSITE™ electronic service tool) is used to allow the operator to disable active regeneration, if necessary. The vehicle manufacturer can also reference this switch as an "inhibit switch," "stop switch," or "disable switch".

The start switch can be hardwired to the engine control module (ECM), or it can be multiplexed over J1939 multiplexing.

If the start switch is hardwired, it shares an ECM pin with the diagnostic switch. When the switch is turned ON and the engine is OFF, the ECM interprets this signal as the diagnostic switch. When the switch is turned ON and the engine is operating, the ECM interprets this signal as the start switch.

If the start switch is J1939-multiplexed, the signal for this switch is broadcast over the J1939 data link.

A J1939-multiplexed start switch signal has priority over a hardwired start switch signal. Therefore, if the start switch is enabled over J1939, the hardwired signal is ignored by the engine ECM.

The default setting for the start switch is OFF. If the start switch is enabled to INSITE™ electronic service tool, but no switch is installed (either hardwired or J1939-multiplexed), the switch status will remain OFF.

The position of the start switch can be monitored with INSITE™ electronic service tool in the Data Monitor/Logger screen.

The position of the permit switch can be monitored with INSITE™ electronic service tool in the Data Monitor/Logger screen.

The default setting for the permit switch is ON. If the permit switch is enabled in INSITE™ electronic service tool, but no switch is installed (either hardwired or J1939-multiplexed), the switch status will remain ON.

If the vehicle is operated for an extended period of time with the permit switch OFF, fault codes for the above normal levels of aftertreatment DEF soot load can result (Fault Codes 1921, 1922, and 2639).

If the aftertreatment DPF soot load reaches an above normal level (Fault Codes 1921, 1922, and 2639), and the permit switch is OFF, the ECM will log Fault Code 2777. The ECM will also log Fault Code 2777 if the ECM is requesting active regeneration of the aftertreatment and the permit switch is OFF.

If the permit switch is multiplexed, and therefore enabled, in the J1939 section of Features and Parameters in INSITE™ electronic service tool, it **must** also be enabled in the aftertreatment section of Features and Parameters in INSITE™ electronic service tool. If it is **not**, regeneration will be inhibited.

A J1939 multiplexed permit switch signal has priority over a hardwired permit switch signal, so if the permit switch is enabled over J1939, the hardwired signal is ignored by the engine ECM.

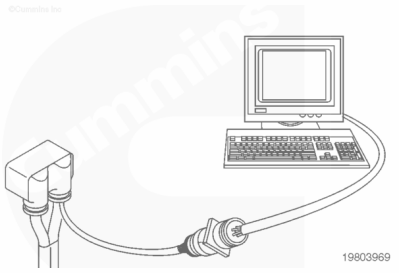
The position of the permit switch can be monitored with INSITE™ electronic service tool in the Data Monitor/Logger screen:

- When the permit switch is ON, active regeneration is allowed.
- When the permit switch is OFF, active regeneration is **not** allowed.

Note : If there is no permit switch installed and the permit switch is disabled in the J1939 section and the aftertreatment section of Features and Parameters in INSITE™ electronic service tool, the permit switch status in the Data Monitor/Logger screen will show the permit switch is OFF, but active regeneration will be allowed.

Note : This step describes possible incorrect aftertreatment exhaust gas temperature sensor wiring

conditions.

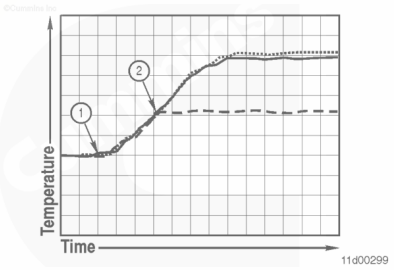


The aftertreatment sensors link to the ECM over J1939. See the appropriate Fault Code Troubleshooting Manual to diagnose and troubleshoot fault codes.

To verify the original equipment manufacturer (OEM) wiring harness and temperature sensors, use INSITE™ electronic service tool to monitor the following parameters with the engine operating. Verify they increase from room temperature.

- Aftertreatment diesel oxidation catalyst (DOC) intake temperature
- Aftertreatment DPF intake temperature
- Aftertreatment DPF outlet temperature
- Aftertreatment selective catalytic reduction (SCR) intake temperature
- Aftertreatment SCR outlet temperature.

If any of the parameters do **not** show a temperature as expected, check the aftertreatment wiring and connections to the sensor(s).



When performing a stationary (parked or non-mission) regeneration, monitor the exhaust temperatures in the aftertreatment to determine why a stationary (parked or non-mission) regeneration will **not** complete.

Possible causes for stationary (parked or non-mission) regenerations that will **not** complete include:

- Misassembled aftertreatment wiring harness
- A plugged aftertreatment DOC
- A malfunctioning turbocharger.

A normal stationary (parked or non-mission) regeneration will follow the pattern shown.

- The dashed line is for the aftertreatment DOC inlet temperature sensor.
- The dotted line is for the aftertreatment DPF inlet temperature sensor.
- The solid line is for the aftertreatment DPF outlet temperature sensor.

When the stationary (parked or non-mission) regeneration begins (1), all three temperatures should be approximately the same, and should increase at the same rate.

The wiring to the aftertreatment temperature sensors appears to be correct in this example because they all read approximately the same temperature at the beginning of the stationary (parked or non-mission) regeneration and increase at the same rate.

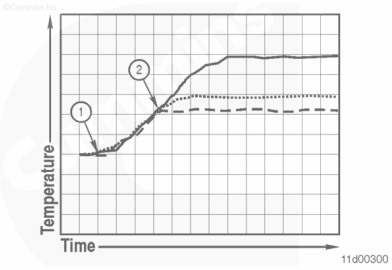
Aftertreatment injection begins when all three temperatures reach approximately 289°C [552°F] (2).

Once aftertreatment injection begins, the aftertreatment DOC inlet temperature can vary slightly, but will typically remain between 260 and 399°C [500 and 750°F].

The aftertreatment DPF inlet and outlet temperatures will increase to approximately 482 to 649°C [900 to 1200°F]. The temperatures can vary during the stationary (parked or non-mission) regeneration, as the amount of fuel injected during aftertreatment injection is changed to maintain a constant temperature.

The aftertreatment DPF inlet and outlet temperatures will remain at this temperature for the duration of the stationary (parked or non-mission) regeneration.

This graph illustrates a stationary (parked or non-mission) regeneration where the inlet of the aftertreatment DOC is blocked.



- The dashed line is for the aftertreatment DOC inlet temperature sensor.
- The dotted line is for the aftertreatment DPF inlet temperature sensor.
- The solid line is for the aftertreatment DPF outlet temperature sensor.

In this condition, the engine speed will increase to the stationary (parked or non-mission) regeneration speed of 1000 to 1100 rpm.

Raising the aftertreatment temperature to the aftertreatment injection temperature can take longer to complete than normal, if the inlet to the aftertreatment DOC is plugged, restricting some of the exhaust flow.

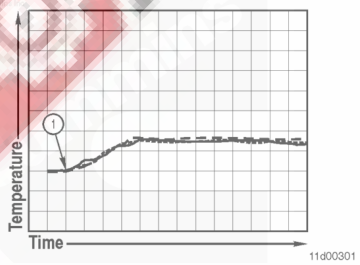
Once aftertreatment injection begins (2), the aftertreatment DPF inlet and outlet temperatures will differ greatly, due to the plugged aftertreatment DOC being unable to oxidize the injected fuel. The aftertreatment DPF has some capability to oxidize the injected fuel, but can **not** maintain this condition

without damaging the filter material over time. It is possible white smoke would be present from the vehicle tailpipe during this condition.

The wiring to the aftertreatment temperature sensors appears to be correct in this example because they all read approximately the same temperature at the beginning of the stationary (parked or non-mission) regeneration, and they increase at the same rate.

The possible cause of this condition is a plugged aftertreatment DOC. Use the following procedure to inspect the aftertreatment DOC. Refer to Procedure 011-049 in Section 11. (/qs3/pubsys2/xml/en/procedures/425/425-011-049.html)

This graph illustrates a stationary (parked or non-mission) regeneration where the engine can **not** build enough heat to start aftertreatment injection.



- The dashed line is for the aftertreatment DOC inlet temperature sensor.
- The dotted line is for the aftertreatment DPF inlet temperature sensor.
- The solid line is for the aftertreatment DPF outlet temperature sensor.

The engine speed will likely increase to the stationary (parked or non-mission) regeneration speed of 1000 to 1100 rpm, but because the aftertreatment temperatures do **not** increase enough to start aftertreatment injection, the stationary (parked or non-mission) regeneration will **not** complete.

The wiring to the aftertreatment temperature sensor appears to be correct in this example because they all read approximately the same temperature for the same conditions.

Possible causes of this issue include:

- A malfunctioning turbocharger. Use the following procedure to verify the turbocharger sector gear has full travel. Refer to Procedure 010-134 in Section 10. (/qs3/pubsys2/xml/en/procedures/425/425-010-134.html)
- Low ambient temperatures. Move the vehicle to a location with higher ambient temperatures.

This graph illustrates a stationary (parked or non-mission) regeneration where the wiring to the aftertreatment temperature sensors is incorrect.

- The dashed line is for the aftertreatment DOC inlet temperature sensor.
- The dotted line is for the aftertreatment DPF inlet temperature sensor.
- The solid line is for the aftertreatment DPF outlet temperature sensor.

In this condition, the engine speed will increase to the stationary (parked or non-mission) regeneration speed of 1000 to 1100 rpm.

Aftertreatment injection will **not** occur in this condition because the aftertreatment DOC inlet temperature does **not** reach the required temperature. Because aftertreatment injection is **not** occurring, the aftertreatment temperatures should **not** read differently.

The possible cause of this condition is an incorrectly assembled aftertreatment wiring harness. See the aftertreatment exhaust gas temperature sensor wiring section of this procedure.

This graph illustrates a stationary (parked or non-mission) regeneration where the OEM wiring to the aftertreatment DOC inlet temperature sensor and the aftertreatment DPF outlet temperature sensor are reversed.

- The dashed line is for the aftertreatment DOC inlet temperature sensor.
- The dotted line is for the aftertreatment DPF inlet temperature sensor.
- The solid line is for the aftertreatment DPF outlet temperature sensor.

In this condition, the engine speed will increase to the stationary regeneration speed of 1000 to 1100 rpm.

Aftertreatment injection can occur in this condition (2). However, the aftertreatment DOC inlet temperature increases after aftertreatment injection begins, while the aftertreatment DPF outlet temperature remains constant.

The possible cause of this condition is the connectors to the aftertreatment DOC inlet temperature sensor and aftertreatment DPF outlet temperature sensor are reversed. See the aftertreatment exhaust gas temperature sensor wiring section of this procedure.

Test

⚠ WARNING ⚠

Diesel exhaust fluid (DEF) contains urea. Do not get the substance in your eyes. In case of contact, immediately flush eyes with large amounts of water for a minimum of 15 minutes. Do not swallow. In the event the DEF is ingested, contact a physician immediately. Reference the materials safety data sheet (MSDS) for additional information.

⚠ CAUTION ⚠

It is unlawful to tamper with or remove any component of the aftertreatment system. It is also unlawful to use a DEF that does not meet the specifications provided, or to operate the vehicle/equipment with no DEF.

⚠ CAUTION ⚠

Never add water or any other fluid besides what is specified to the DEF tank. The aftertreatment system may be damaged.

Note : This section of the procedure provides information for testing the DEF concentration.

The correct concentration of DEF is critical to the engine and aftertreatment system for correct performance.

Cummins Inc. is **not** responsible for malfunctions or damage resulting from what Cummins Inc. determines to be abuse or neglect. This includes, but is **not** limited to: operation without correctly specified DEF, lack of maintenance of the aftertreatment system, improper storage or shutdown practices, or unauthorized modifications of the engine and aftertreatment system. Cummins Inc. is also **not** responsible for malfunctions caused by incorrect DEF, water, dirt, or other contaminants in the DEF. Use DEF refractometer, Part Number 4919554, to test the concentration of the DEF. Follow the instructions provided with the service tool.

The concentration of the DEF **must** be 32.5 ±0.7 percent.

If the DEF concentration does **not** meet this specification, drain the DEF tank, flush the tank with distilled water, and fill the tank with known good DEF. Check the DEF concentration.

Concentration of the DEF should be checked when:

- The vehicle has been stored for an extended period of time.
- It is suspected water has been added to the DEF tank.

Contamination/Incorrect Fluid

DEF can become contaminated by the following situations:

- If equipped, the aftertreatment DEF tank coolant heating systems malfunctions, allowing coolant to mix with the DEF.
- The aftertreatment DEF tank cap is missing/damaged or the tank vent malfunctions.
- The aftertreatment DEF tank is filled with the incorrect fluid.

In the event the DEF becomes contaminated, inspect the DEF to determine the most likely source.

Obtain a sample from the DEF tank and pour into an appropriate container. Make sure to get a sample from the highest fluid level.

Petroleum base liquids, such as, but **not** limited to:

- Diesel fuel
- Hydraulic fluid
- Brake fluid.

DEF is largely composed of water. Petroleum based liquids will separate from the DEF and rise to the top. Check for separation of the fluids as well as characteristic smells.

If the DEF is contaminated, see the steps in this section.

Non-petroleum base liquids, such as, but **not** limited to:

- Water
- Coolant
- Windshield washer fluid.

If water has been added, the DEF will remain clear. As a result, the DEF will become diluted, reducing the concentration level.

Note : If **only** water has been added to the DEF tank, drain the DEF tank, flush with distilled water, and refill with new and/or known good DEF. Check the DEF concentration after completing the refill. See the Test section in this procedure.

For other non-petroleum based liquids added to the DEF, typically those fluids have coloring and will mix with DEF. If the DEF has a color tint to it, look for other fluids used on the vehicle that can match, such as coolant or windshield washer fluid.

If the DEF is contaminated, see the steps in this section.

Note : Use INSITE™ electronic service tool to view and troubleshoot any fault codes that occur during the following steps. See the appropriate Fault Code Troubleshooting Manual. Refer to Procedure 205-001 in Section L. (/qs3/pubsys2/xml/en/procedures/425/425-205-001.html)

Use the following procedure if the DEF has been contaminated. Remove the aftertreatment DEF dosing unit filter. Refer to Procedure 011-060 in Section 11. (/qs3/pubsys2/xml/en/procedures/425/425-011-060-tr.html)

If the contaminated fluid **did not** go through the dosing system, drain the DEF tank, flush with distilled water, and replace the DEF in-tank filter. See equipment manufacturer service information for specific information on servicing the DEF tank.

After the DEF tank has been cleaned, refill with known good DEF. Check the DEF concentration after completing the refill. See the Test section in this procedure.

Note : Any discarded contaminated fluids and/or parts should be disposed of according to local area ordinances.

If the contaminated fluid did go through the dosing system:

1. Drain the DEF tank, flush with several fills of water until it is clean and clear of contamination. Replace the DEF in the tank filter. See equipment manufacturer service

information for specific information on servicing the DEF tank.

2. Replace the aftertreatment DEF dosing unit filter. Refer to Procedure 011-060 in Section 11. (/qs3/pubsys2/xml/en/procedures/425/425-011-060-tr.html)
3. Remove all of the aftertreatment DEF lines. Flush with distilled water. See equipment manufacturer service information on the handling of contaminants in the aftertreatment DEF lines. Install the aftertreatment DEF lines.
4. Fill the aftertreatment DEF tank with distilled water.
5. Perform the INSITE™ electronic service tool DEF Doser Pump Override Test. Repeat the test until the distilled water runs clear.
6. Drain the distilled water from the DEF tank and refill with known good DEF. Check the DEF concentration. Follow the instructions in the Test section of this procedure.
7. Replace the aftertreatment DEF dosing unit filter again. Refer to Procedure 011-060 in Section 11. (/qs3/pubsys2/xml/en/procedures/425/425-011-060-tr.html)
8. Perform the INSITE™ electronic service tool DEF Doser Pump Override Test. Test the performance and spray pattern of the aftertreatment DEF dosing valve.
9. Perform a stationary (parked or non-mission) regeneration. Refer to Procedure 014-016 in Section 14. (/qs3/pubsys2/xml/en/procedures/425/425-014-016.html)
10. Road test the vehicle for 30 minutes to verify system operation.

ANADOLU ISUZU

Last Modified: 01-Nov-2016

Select Service Tools

Recommended Cummins® Service Tools

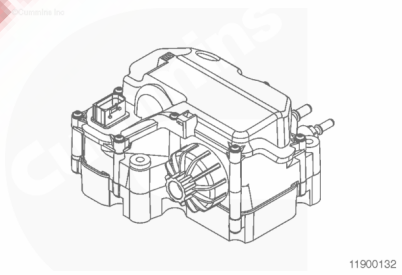
- Fluid Doser Cleaner Kit, Part Number 5298533

Additional Service Items

- Container suitable for diesel exhaust fluid (DEF)
- Soft bristle brush
- Rubber tipped air gun

General Information

The aftertreatment DEF dosing unit draws DEF from the aftertreatment DEF tank, pressurizes the DEF, and delivers the DEF to the aftertreatment DEF dosing valve. Any unused DEF is routed back to the aftertreatment DEF tank. Use the following procedure for further information on the aftertreatment DEF dosing system. Refer to Procedure 011-999 in Section F. (/qs3/pubsys2/xml/en/procedures/425/425-011-999.html)


11900132

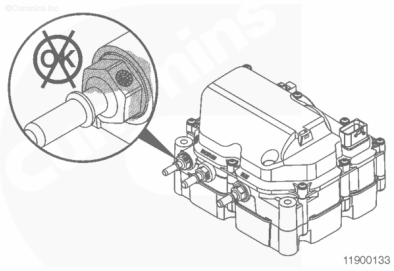
Use the following procedure for information on handling incorrect or contaminated diesel exhaust fluid. Refer to Procedure 011-056 in Section 11. (/qs3/pubsys2/xml/en/procedures/425/425-011-056.html)

Note : There are 12 volt and 24 volt versions of the DEF dosing unit. The voltage rating is stamped into the housing of the aftertreatment DEF dosing unit, next to the electrical connection. The aftertreatment DEF dosing unit can also be distinguished by the connector. If the face of the electrical connector on the electrical harness is gray, it is a 24 volt unit. If it is black, it is 12 volt unit. The electrical connectors are keyed differently and are **not** interchangeable.

Note : The aftertreatment DEF dosing unit has a serviceable filter. Refer to Procedure 011-060 in Section 11. (/qs3/pubsys2/xml/en/procedures/425/425-011-060-tr.html)

Initial Check

Note : Do **not** disconnect the vehicle batteries until the DEF dosing system has completed the purge cycle. Before beginning to remove and/or disconnect any components, wait at least five minutes after the keyswitch is turned OFF for the aftertreatment DEF dosing system to purge the DEF from the system. The purge cycle is an automatic process and does **not** require an intervention to occur. The aftertreatment DEF dosing unit will issue an audible pumping noise during the purging process.



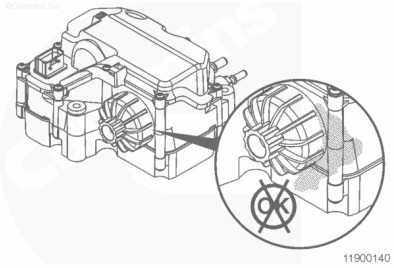
11900133

Check the DEF lines to and from the dosing unit for signs of leakage. DEF forms a white deposit around leaky fittings.

If white deposits are found, inspect the DEF line connection fittings for damage. See equipment manufacturer service information.

Check around the aftertreatment DEF dosing unit filter cap for white deposits.

See the Clean and Inspect for Reuse section of this procedure if leaks are visible from the aftertreatment DEF dosing unit line connectors or the filter cap.



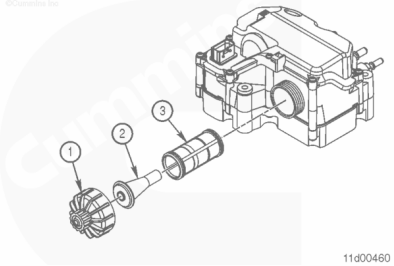
11900140

Test

In-Chassis Non Air Flush

Remove the aftertreatment DEF dosing unit filter. Refer to Procedure 011-060 in Section 11. (/qs3/pubsys2/xml/en/procedures/425/425-011-060-tr.html)

Do **not** install the new filter or DEF filter cap at this time.



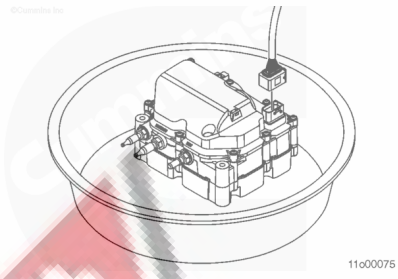
11d00460

ANADOLU ISUZU AFTER SALES

If **not** completed, clean the DEF tank thoroughly. Fill with certified DEF. See equipment manufacturer service information.



Position a collection container under the aftertreatment DEF dosing unit.



Note : Use distilled water if available. Make sure the filled fluid doser cleaner bottle is free of debris.

Fill the fluid doser cleaner bottle from Fluid Doser Cleaner Kit, Part Number 5298533, with clean water. Connect it to the aftertreatment DEF dosing unit inlet line connector.

Use INSITE™ electronic service tool DEF Doser Pump Override Test found, under Engine Control Module (ECM) Diagnostic Tests, to flush clean water through the aftertreatment DEF dosing unit. Refer to Procedure 011-063 in Section 11. (/qs3/pubsys2/xml/en/procedures/425/425-011-063.html)

Follow the on-screen instructions to perform the test.

Note : Only the fluid doser cleaner bottle and 12 pin electrical connector are to be connected to the aftertreatment DEF dosing unit during this time.

Start the DEF Doser Pump Override Test.

Squeeze the fluid doser cleaner bottle gently to push water into the aftertreatment DEF dosing unit. The water will flow out from the DEF filter cap cavity.

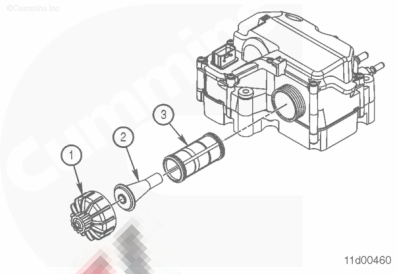
Repeat the procedure until the DEF dosing unit begins drawing fluid from the fluid doser cleaner bottle on its own.

The fluid doser cleaner bottle will start to collapse as the dosing unit starts drawing the fluid on its own. Once the aftertreatment DEF dosing unit is drawing fluid from the fluid

doser cleaner bottle on its own, press the stop button on INSITE™ electronic service tool to stop the test.

Note : If the DEF dosing unit does **not** begin drawing fluid after three full bottles, replace the DEF dosing unit.

Note : If the DEF dosing unit has been replaced, skip this step.



11d00460

Install an aftertreatment DEF dosing unit filter element. Refer to Procedure 011-060 in Section 11. (/qs3/pubsys2/xml/en/procedures/425/425-011-060-tr.html)

Note : Lubrication of the DEF filter o-rings is **not** required.

1. Slide the DEF filter equalizing element into the DEF filter cartridge.
2. Insert the assembly into the aftertreatment DEF dosing unit.
3. Install and tighten the cap.

Torque Value: 20 n•m [177 in-lb]

Connect the DEF lines to the aftertreatment DEF dosing unit in the following order to reduce the possibility of contamination of the electrical connector.

1. Backflow - DEF return to the DEF tank
2. Inlet - DEF supply to the aftertreatment DEF dosing unit
3. Outlet - DEF supply to the aftertreatment DEF dosing valve.

The DEF lines will snap when locked into place.

Lightly tug on the connectors to make sure they are secured.

Note : If the DEF dosing unit has been replaced, skip this step.


ck800wa

Perform the Aftertreatment DEF Dosing Unit Override Test to verify operation. Refer to Procedure 011-063 in Section 11. (/qs3/pubsys2/xml/en/procedures/425/425-011-063.html)

If the measured volume of the aftertreatment DEF dosing unit is within specification, install the DEF dosing unit.

Out-of-Chassis Non Air Flush

Note : Make sure to prevent DEF from contaminating the electrical connector.

Remove the aftertreatment DEF dosing unit.

Thoroughly clean the aftertreatment DEF dosing unit.

Note : Remove the connector carefully to prevent debris from entering the inlet connector cavity.

Note : Make sure the o-ring is attached to the connector and is **not** stuck inside the DEF dosing unit.

Remove the DEF inlet connector.

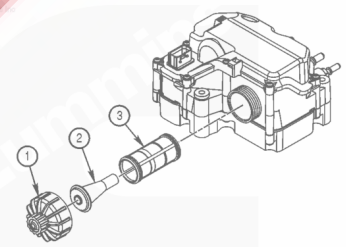
Discard the DEF inlet connector.

Install a new inlet connector. Lubricant is **not** required.

Torque Value: 4.5 n•m [40 in-lb]

Remove the aftertreatment DEF dosing unit filter element. Refer to Procedure 011-060 in Section 11. (/qs3/pubsys2/xml/en/procedures/425/425-011-060-tr.html)

Do **NOT** install the new filter or install the DEF filter cap at this time.



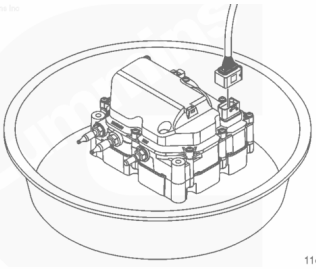
11d00460

If **not** completed, clean the DEF tank thoroughly. Fill with certified DEF. See equipment manufacturer service information.


ck800wa

⚠ CAUTION ⚠

Make sure to support the aftertreatment DEF dosing unit so the unit is not suspended by the electrical connector.


11c00075

Note : Make sure the electrical connections are clean and dry before installing.

Connect the 12 pin electrical connector on the aftertreatment DEF dosing unit.

ANADOLU ISUZU AFTER SALES

Position a collection container under the aftertreatment DEF dosing unit.

Note : Use distilled water if available. Make sure the filled fluid doser cleaner bottle is free of debris.

Fill the fluid doser cleaner bottle from the Fluid Doser Cleaner Kit, Part Number 5298533, with clean water. Connect it to the aftertreatment DEF dosing unit inlet line connector.

Use INSITE™ electronic service tool DEF Doser Pump Override Test, found under ECM Diagnostic Tests, to flush clean water through the aftertreatment DEF dosing unit. Refer to Procedure 011-063 in Section 11. (/qs3/pubsys2/xml/en/procedures/425/425-011-063.html)

Follow the on-screen instructions to perform the test.

Note : Only the fluid doser cleaner bottle and 12 pin electrical connector are to be connected to the aftertreatment DEF dosing unit during this time.

Start the DEF Doser Pump Override Test.

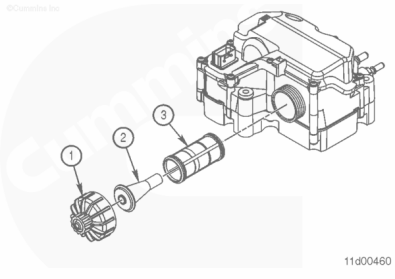
Squeeze the fluid doser cleaner bottle gently to push water into the aftertreatment DEF dosing unit. The water will flow out from the DEF filter cap cavity.

Repeat the procedure until the DEF dosing unit begins drawing fluid from the fluid doser cleaner bottle on its own.

The fluid doser cleaner bottle will start to collapse as the dosing unit starts drawing the fluid on its own. Once the aftertreatment DEF dosing unit is drawing fluid from the fluid doser cleaner bottle on its own, press the stop button on INSITE™ electronic service tool to stop the test.

Note : If the DEF dosing unit does **not** begin drawing fluid after three full bottles, replace the DEF dosing unit.

Note : If the DEF dosing unit has been replaced, skip this step.



Install a new aftertreatment DEF dosing unit filter element. Refer to Procedure 011-060 in Section 11. (/qs3/pubsys2/xml/en/procedures/425/425-011-060-tr.html)

Note : Lubrication of the DEF filter o-rings is **not** required.

1. Slide the DEF filter equalizing element into the DEF filter cartridge.
2. Insert the assembly into the aftertreatement DEF dosing unit.
3. Install and tighten the cap.

Torque Value: 20 n•m [177 in-lb]

Connect the DEF lines to the aftertreatment DEF dosing unit in the following order to reduce the possibility of contamination of the electrical connector.

1. Backflow - DEF return to the DEF tank.
2. Inlet - DEF supply to the aftertreatment DEF dosing unit.
3. Outlet - DEF supply to the aftertreatment DEF dosing valve.

The DEF lines will snap when locked into place.

Lightly tug on the connectors to make sure they are secured.

Note : Do **not** mount the aftertreatment DEF dosing unit to the original equipment manufacturer (OEM) mounting bracket at this time.

Note : If the DEF dosing unit has been replaced, skip this step.



Perform the Aftertreatment DEF Dosing Unit Override Test to verify operation. Refer to Procedure 011-063 in Section 11. (/qs3/pubsys2/xml/en/procedures/425/425-011-063.html)

If the measured volume of the aftertreatment DEF dosing unit is within specification, install the DEF dosing unit.

Preparatory Steps

⚠ WARNING ⚠

DEF contains urea. Do not get the substance in your eyes. In case of contact, immediately flush eyes with large amounts of water for a minimum of 15 minutes. Do not swallow. In the event the DEF is ingested, contact a physician immediately. Reference the materials safety data sheet (MSDS) for additional information.

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

⚠ WARNING ⚠

Wear appropriate eye and face protection when using compressed air. Flying debris and dirt can cause personal injury.

⚠ WARNING ⚠

The DEF line connecting the aftertreatment DEF dosing unit tank to the aftertreatment DEF dosing unit is under low pressure and should not be disconnected while the engine is running or before the system has completed the purge process after engine shutdown. Disconnecting the DEF line while under low pressure could cause DEF to spray.

Note : Do **not** disconnect the vehicle batteries until the DEF dosing system has completed the purge cycle. Before beginning to remove and/or disconnect any components, wait at least 5 minutes after the keyswitch is turned OFF for the aftertreatment DEF dosing system to purge the DEF from the system. The purge cycle is an automatic process and does **not** require an intervention to occur. The aftertreatment DEF dosing unit will issue an audible pumping noise during the purging process.

Note : Do **not** pressure wash or steam clean this unit. Use compressed air to remove **any** loose debris.

- Disconnect the batteries. See equipment manufacturer service information.

Note : The DEF lines are connected to the dosing unit by quick release fittings that could vary among vehicle manufacturers. See equipment manufacturer service information for the detailed removal process.

- Label and mark each DEF line and its mating connector for the aftertreatment dosing unit. If the lines are

connected incorrectly, the system will **not** function properly and will light a fault lamp.

- Disconnect the DEF lines and electrical connector in the following order to reduce the possibility of accidental DEF contamination of the electrical connector:

1. Backflow: DEF return to the DEF tank
2. Inlet: DEF supply to the aftertreatment DEF dosing unit
3. Outlet: DEF supply to the aftertreatment DEF dosing valve
4. 12 pin electrical connector.

The 12 pin electrical connector can be removed by sliding the yellow portion of the connector outward. The connector will then begin to rise and disconnect from the DEF supply module.

- Cap the DEF and electrical connectors of the aftertreatment DEF dosing unit to prevent contamination and DEF leakage.

Remove

Remove the three mounting capscrews.

Remove the aftertreatment DEF dosing unit.

Disassemble

Note : The aftertreatment DEF dosing unit should **only** be disassembled if a symptom has been identified that indicates further investigation is required.

Remove the DEF connector(s). Make sure the o-ring(s) are attached to the connector(s) and are **not** stuck inside the DEF dosing unit.

Clean and Inspect for Reuse

ANADOLU ISUZU AFTER SALES

Install the protective caps from Fluid Doser Cleaner Kit, Part Number 5298533, on the fluid connector(s) and the electrical connector on the aftertreatment DEF dosing unit.

⚠ WARNING ⚠

Wear appropriate eye and face protection when using compressed air. Flying debris and dirt can cause personal injury.

Note : This unit is not serviceable. Do not open the case. Return the unit to a Cummins® Authorized Repair Location.

Do **not** immerse the unit in any kind of solution.

Do **not** wash with any detergents.

Clean the aftertreatment DEF dosing unit. Use **only** warm water and a soft bristled brush.

Thoroughly clean the areas surrounding the backflow connector, inlet connector, outlet connector, and main filter cap.

Note : Make sure the protective caps remain on the DEF dosing unit electrical connection, backflow, inlet, and outlet connectors to prevent contamination.

Note : If damage or corrosion is found, also inspect the DEF line connection. See equipment manufacturer service information.

Inspect the outside of the unit. If there are any cracks or other damage to the exterior of the case or electrical connectors, replace the dosing unit.

If there are any cracks or other damage to the DEF quick disconnect connectors, replace the DEF quick disconnect connectors.

Use the following procedure if the aftertreatment DEF dosing unit filter cap is damaged. Refer to Procedure 011-060 in Section 11. (/qs3/pubsys2/xml/en/procedures/425/425-011-060-tr.html)

Inspect the DEF line connection ports for cracks or pitting.

If the aftertreatment DEF dosing unit connectors were removed, inspect for cracks and broken o-rings.

Replace the aftertreatment DEF dosing unit connectors or o-rings, if damaged.

The inlet connector and backflow connector on the aftertreatment DEF dosing unit have an incorporated non-serviceable filter screen.

Use a rubber tipped air gun and blow though the connector as shown, onto a piece of white paper.

Inspect for debris on the paper. Debris indicates a clogged connector.

If debris is found in the inlet connector of the aftertreatment dosing valve, inspect the aftertreatment DEF tank filter. See equipment manufacturer service information.

Inspect the electrical connection of the aftertreatment DEF dosing unit for signs of corrosion and debris buildup.

If the pins are heavily corroded or damaged, replace the aftertreatment dosing unit.

If the electrical connector on the aftertreatment DEF dosing unit is damaged, also inspect the 12 pin electrical connector wiring harness. See equipment manufacturer service information.

If replacing the aftertreatment DEF dosing unit, make sure to transfer the protective caps from the replacement aftertreatment DEF dosing unit to the old aftertreatment DEF dosing unit prior to placing it in the core return box.

Fill out any requested information: engine serial number (ESN), mileage, vehicle identification number (VIN), etc.

ANADOLU ISUZU PARTS SALES

Assemble

Note : The backflow, inlet, and outlet connectors are **not** interchangeable and can **only** be installed one way due to thread and length restraints.

Install the connector. Lubricant is **not** required.

Torque Value: 4 n•m [35 in-lb]

Install

Note : Make sure the aftertreatment DEF dosing unit remains free from **any** contamination during installation to the vehicle. To reduce the possibility of false DEF leak reports, use a clean, damp cloth to wipe away **any** DEF spilled during the repair process.

Note : Do **not** interchange 12 volt and 24 volt aftertreatment DEF dosing units.

Attach the aftertreatment DEF dosing unit to the OEM mounting bracket. Secure it with the three capscrews.

Torque Value: 20 n•m [177 in-lb]

- Remove the caps from the electrical and DEF connectors.
- Install the electrical connector first. DEF will cause the electrical connector pins to corrode.
- The 12 pin electrical connector (4) can be installed by sliding the yellow portion of the connector inward. The connector will lower and lock onto the aftertreatment DEF dosing unit.
- Connect the DEF lines to the aftertreatment DEF dosing unit in the following order to reduce the possibility of contamination of the electrical connector. The DEF lines will snap when locked into place.

1. Backflow: DEF return to the DEF tank
2. Inlet: DEF supply to the aftertreatment DEF dosing unit
3. Outlet: DEF supply to the aftertreatment DEF dosing valve.

Lightly tug in the connectors to make sure they are secured.

ANADOLU ISUZU AFTER SALES

Finishing Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

⚠ CAUTION ⚠

Do not use the flow test portion of INSITE™ electronic service tool DEF Doser Pump Override Test to check the system for leaks. This will spray DEF into the exhaust system which is at too low a temperature to evaporate, resulting in deposit formations in the exhaust system.

Note : The aftertreatment DEF dosing system will **not** prime itself until the correct SCR temperatures are reached. To verify the system is correctly installed and has no leaks, induce a stationary regeneration to raise the SCR system temperature. The dosing system status can be viewed in INSITE™ electronic service tool to confirm the aftertreatment DEF dosing unit has reached a prime state.

- Connect the batteries. See equipment manufacturer service information.
- Operate the engine. Check for leaks.

Last Modified: 05-Aug-2016

ANADOLU ISUZU AFTER SALES

Select Service Tools

Recommended Cummins® Service Tools

- Repair connector, Part Number 4919115, or equivalent
- Coolant line plugs, Part Number 4919576
- Abrasive pad, Part Number 3823258, or equivalent
- Assembly lubricant, Part Number 3163086, or equivalent

Additional Service Items

- Multimeter
- Coolant hose pinch off pliers
- Container suitable for diesel exhaust fluid (DEF)
- Pick
- Shop vacuum

General Information

⚠ CAUTION ⚠

Use care when handling and/or disconnecting the DEF line from the aftertreatment DEF dosing valve. The DEF supply connector of the aftertreatment DEF dosing valve can be easily damaged.

GRAPHIC NOT FOUND

The aftertreatment DEF dosing valve (1) is used to spray DEF into the exhaust flow prior to the intake of the selective catalytic reduction (SCR) catalyst (2). The aftertreatment DEF dosing valve is located on the decomposition tube (3), mounted on a flange with three capscrews.

Note : The same aftertreatment DEF dosing valve is used for 12 volt and 24 volt systems.

There are four primary connections at the aftertreatment DEF dosing valve:

(4) A 2 pin electrical connection, which connects the aftertreatment DEF dosing valve to the engine control module (ECM).

(5) A DEF supply line, which connects the aftertreatment DEF dosing valve to the aftertreatment DEF dosing unit.

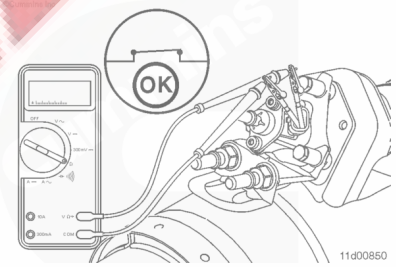
(6) The coolant supply and return connections are interchangeable. They connect the aftertreatment DEF dosing valve to the engine cooling system.

For further information on the operation of the aftertreatment DEF dosing valve, see the following procedure. Refer to Procedure 011-999 in Section F. (/qs3/pubsys2/xml/en/procedures/425/425-011-999.html)

For information on handling incorrect or contaminated DEF, see the following procedure. Refer to Procedure 011-056 in Section 11. (/qs3/pubsys2/xml/en/procedures/425/425-011-056.html)

Measure

Resistance Check



Use a multimeter to check the resistance of the aftertreatment DEF dosing valve.

Note : Repair connector, Part Number 4919115, or equivalent, can be used as a test lead.

Resistance Specification: 11 to 18 ohms.

Note : The resistance **must** be measured at room temperature (approximately 25°C [77°F]).

If the measured value is **not** within specifications, replace the aftertreatment DEF dosing valve.

If the measured resistance is out of specification, the aftertreatment DEF dosing valve may have been overheated.

Inspect the outside of the aftertreatment DEF dosing valve for signs of discoloration from excessive heat.

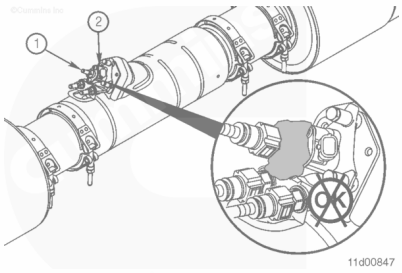
Inspect for inadequate or lack of coolant flow to the aftertreatment DEF dosing valve. Verify there are no leaks, blockages, or restrictions in the coolant supply and return lines between the engine and the aftertreatment DEF dosing valve.

To check the coolant passages internal to the aftertreatment DEF dosing valve, see the Clean and Inspect for Reuse section of this procedure.

Initial Check

⚠ WARNING ⚠

During regeneration, exhaust gas temperature can reach 800°C [1500°F], and exhaust system surface temperature can exceed 700°C [1300°F], which is hot enough to ignite or melt common materials, and to cause serious personal injury. The exhaust and exhaust components can remain hot after the vehicle has stopped moving. To avoid the risk of fire, property damage, burns or other serious personal injury, allow the exhaust system to cool before beginning this procedure or repair and make sure that no combustible materials are located where they are likely to come in contact with hot exhaust or exhaust components.



⚠ CAUTION ⚠

Do not use the flow test portion of INSITE™ electronic service tool Diesel Exhaust Fluid Doser Pump Override Test to check the system for leaks. This will spray DEF into the exhaust system at temperatures to low to evaporate, resulting in deposit formations in the exhaust system.

Note : DEF deposits could possibly be left over from a previous DEF spill or repair. Verify active leaks before replacing any components.

Inspect the area around the DEF line connection location at the aftertreatment DEF dosing valve.

Inspect for signs of leaks and/or white deposits.

A DEF leak in this area can come from:

1. The connection between the DEF line and the aftertreatment DEF dosing valve.

Note : Do **not** remove the DEF dosing valve (1) from the assembly (2). It is **not** a serviceable part.

2. The DEF dosing valve joints between the valve and valve assembly body.

Due to deposit buildups possibly masking the source of the leak, it can be necessary to remove the deposits and clean the area with warm water.

Note : The aftertreatment DEF dosing system will **not** prime until the correct selective catalytic reduction (SCR) temperatures are reached.

Test drive the vehicle for a minimum of 15 minutes to get the SCR system up to temperature. Check the area again for the source of the leak.

Once the source of the DEF leaks and/or deposits are identified, see the Clean and Inspect for Reuse section of this procedure.

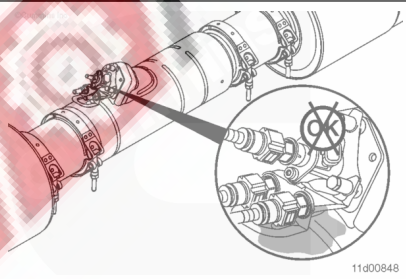
Inspect the dosing valve body and coolant fittings at the aftertreatment DEF dosing valve.

Inspect for signs of leaks and/or deposits.

If the aftertreatment DEF dosing valve is suspected to be leaking coolant and the source of the coolant leak can **not** be identified, pressurize the cooling system. Refer to Procedure 008-020 in Section 8. (/qs3/pubsys2/xml/en/procedures/425/425-008-020.html)

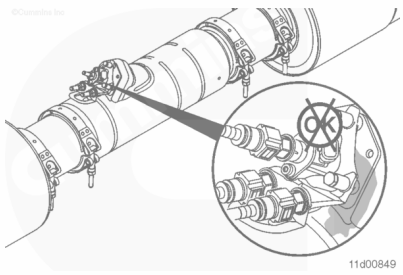
If leaks and/or deposits are identified, see the Clean and Inspect for Reuse section of this procedure after the connections are removed.

Service Tip: If removal of the coolant fittings and/or heat shield is necessary, remove/loosen the coolant fitting prior to removing the aftertreatment DEF dosing valve. See the Preparatory Steps and Disassemble sections of this procedure.



Inspect the body and around the base of the aftertreatment DEF dosing valve. Check for signs of exhaust leaks and white deposits.

If leaks and/or deposits are identified, see the Clean and Inspect for Reuse section of this procedure.



Preparatory Steps

⚠ WARNING ⚠

Diesel exhaust fluid (DEF) contains urea. Do not get the substance in your eyes. In case of contact, immediately flush eyes with large amounts of water for a minimum of 15 minutes. Do not swallow. In the event the DEF is ingested, contact a physician immediately. Reference the Materials Safety Data Sheet (MSDS) for additional information.

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

⚠ WARNING ⚠

Coolant is toxic. Keep away from children and pets. If not reused, dispose of in accordance with local environmental regulations.

⚠ WARNING ⚠

During regeneration, exhaust gas temperature can reach 800°C [1500°F], and exhaust system surface temperature can exceed 700°C [1300°F], which is hot enough to ignite or melt common materials, and to cause serious personal injury. The exhaust and exhaust components can remain hot after the vehicle has stopped moving. To avoid the risk of fire, property damage, burns or other serious personal injury, allow the exhaust system to cool before beginning this procedure or repair and make sure that no combustible materials are located where they are likely to come in contact with hot exhaust or exhaust components.

⚠ WARNING ⚠

The DEF line connecting the aftertreatment DEF dosing unit to the aftertreatment DEF dosing valve is under low pressure and should not be disconnected while the engine is running or before the system has completed

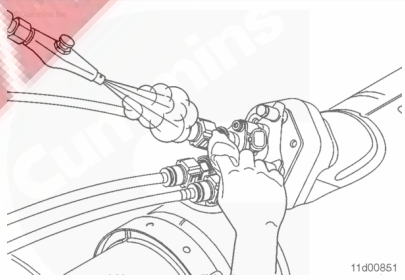
the purge process after engine shutdown. Disconnecting the DEF line while under low pressure could cause DEF to spray.

Note : Do **not** disconnect the vehicle batteries until the DEF dosing system has completed the purge cycle. Before beginning to remove and/or disconnect any components, wait at least 5 minutes after the keyswitch is turned OFF for the aftertreatment DEF dosing system to purge the DEF from the system. The purge cycle is an automatic process and does **not** require intervention to occur. The aftertreatment DEF dosing unit will create an audible pumping noise during the purging process.

- Disconnect the batteries. See equipment manufacturer service information.

⚠ WARNING ⚠

Wear appropriate eye and face protection when using compressed air. Flying debris and dirt can cause personal injury.



Use compressed air to remove any debris from around the aftertreatment DEF dosing valve and connections.

Remove any debris trapped in the gaps between the aftertreatment DEF dosing valve and aftertreatment decomposition tube, so debris does **not** fall into the aftertreatment decomposition tube upon removal of the aftertreatment DEF dosing valve.

If there are any white deposits on the DEF line connection, remove them by wiping with a clean shop towel soaked in warm water.

Do **not** drain the cooling system. Use one of the following two methods to prevent draining the cooling system when the aftertreatment DEF dosing valve coolant lines are disconnected.

Use the following instructions for method number 1.

Note : Prior to pursuing this method, inspect the aftertreatment DEF dosing valve coolant lines to make sure they are flexible hose material that will **not** be damaged when using the coolant hose pinch-off pliers.

Use a pair of coolant hose pinch-off pliers. Clamp both of the aftertreatment DEF dosing valve coolant lines.

Place a container under the aftertreatment DEF dosing valve. A small quantity of coolant can drain from the coolant lines when disconnected.

Note : The coolant supply/return and DEF lines are supplied by the original equipment manufacturer (OEM). The removal of these lines can vary by OEM. The fittings on the aftertreatment DEF dosing valve are set up for quick-disconnect style fittings.

Disconnect the coolant lines. See equipment manufacturer service information.

Insert coolant line plugs, Part Number 4919576, into the disconnected coolant lines. The coolant hose pinch-off pliers can be removed.

Use the following instructions for method number 2.

Determine the appropriate radiator/coolant expansion tank cap adapter for the vehicle being serviced. The list of available caps and applications can be found in Section 14 of the Service Products Catalog.

Install the adapter on the radiator/coolant expansion tank. Connect an automotive hand held vacuum pump and apply 76 mm-hg [3 in-hg] of vacuum.

Note : Depending on the cooling system configuration, more vacuum can be required to keep the cooling system in balance, especially on systems where there is a significant height difference between the aftertreatment DEF dosing valve and radiator/coolant expansion tank fill location.

Note : The coolant supply and DEF lines are supplied by the OEM. The removal of these lines can vary by OEM. The fittings on the aftertreatment DEF dosing valve are set up for quick-disconnect style fittings.

Place a container under the aftertreatment DEF dosing valve. A small quantity of coolant can drain from the coolant lines when disconnected.

Disconnect the coolant lines. See equipment manufacturer service information.

Insert coolant line plugs, Part Number 4919576, or equivalent, into each of the disconnected coolant lines.

The vacuum pump can be removed.

⚠ CAUTION ⚠

Care should be taken when handling and/or disconnecting the DEF line from the aftertreatment DEF dosing valve. The DEF supply line connector of the aftertreatment DEF dosing valve can be easily damaged.

Disconnect the connections at the aftertreatment DEF dosing valve in the following order:

Place a small plastic container under the aftertreatment DEF dosing valve to catch any residual DEF prior to disconnecting the DEF supply line.

(1) Disconnect the DEF line. See equipment manufacturer service information.

Note : Protect the coolant and DEF ports with plastic caps to prevent entrance of dirt and debris.

Press the tab on the electrical connector. Pull to disconnect the 2 pin electrical connector.

After the electrical connection is disconnected, cover the connection on the aftertreatment DEF dosing valve with electrical tape to prevent DEF from getting into the electrical connection.

Remove

In some applications an aftertreatment DEF dosing valve guard can be installed around the dosing valve.

Remove the capscrews.

Remove the guard.

⚠ CAUTION ⚠

Do not set the aftertreatment DEF dosing valve down on the spray area of the aftertreatment DEF dosing valve. Damage can occur.

Remove the capscrews (1) and spacers (2) that mount the aftertreatment DEF dosing valve to the decomposition tube.

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Remove the aftertreatment DEF dosing valve.

Remove the insulated gasket (3).

Remove the thermal isolator (4). The isolator can become brittle and adhere to either the aftertreatment decomposition tube or aftertreatment DEF dosing valve. Do **not** drop isolator material into the aftertreatment decomposition tube when removing. Apply water to the isolator to soften its composition. Use a pick and a shop vacuum to properly remove the isolator, if necessary.

Discard the gaskets and isolator.

Note : A small amount of DEF deposits is normal if observed on the aftertreatment DEF dosing valve face and around the isolator of the aftertreatment DEF dosing valve.

Note : Plug the aftertreatment DEF lines to reduce the possibility of debris entering the system.

Disassemble

Note : The aftertreatment DEF dosing valve should **only** be disassembled if a symptom has been identified that indicates further investigation is required.

Remove the two coolant fittings from the aftertreatment DEF dosing valve.

Remove the o-rings from the coolant fittings and discard.

Remove the heat shield.

Clean and Inspect for Reuse

Note : Do **not** remove the DEF dosing valve (1) from the assembly (2). It is **not** a serviceable part.

If leaks/deposits are found at the DEF dosing valve joints between the valve and valve assembly body during the Initial Check section of this procedure, replace the aftertreatment DEF dosing valve.

If leaks/deposits are found at the DEF line connection during the Initial Check section of this procedure, inspect the DEF line connection port for cracks or pitting.

Note : If damage/corrosion is found, also inspect the DEF line connection. See equipment manufacturer service information.

Inspect the electrical connection and pins for damage/corrosion. Refer to Procedure 019-361 in Section 19. (/qs3/pubsys2/xml/en/procedures/99/99-019-361.html)

Note : If damage/corrosion is found, inspect the electrical connector and pins on the vehicle harness. See equipment manufacturer service information.

Replace the aftertreatment DEF dosing valve if damage is found.

Note : The heat shield and coolant fittings are serviceable items of the aftertreatment DEF dosing valve.

If leaks/deposits are found at the coolant line connections during the Initial Check section of this procedure, inspect the coolant fittings for cracks and signs of corrosion and/or pitting.

If corrosion is found, the coolant can be contaminated and/or the concentration incorrect. Check the coolant. For specifications, refer to Service Bulletin, Cummins® Coolant Requirements and Maintenance, Bulletin 3666132 (/qs3/pubsys2/xml/en/bulletin/3666132.html).

Note : If damage/corrosion is found, inspect the coolant line connector(s). See equipment manufacturer service information.

Inspect the base of the coolant fittings.

Inspect the heat shield for cracks or heavy corrosion.

Replace as required. See the Disassemble section of this procedure.

If the coolant fittings were removed from the aftertreatment DEF dosing valve assembly, inspect the threads and o-ring sealing surfaces of the following for pitting and corrosion:

- Coolant fittings
- Coolant ports in the aftertreatment DEF dosing valve assembly.

Clean with abrasive pad, Part Number 3823258, or equivalent, and a clean cloth.

If the pitting and/or corrosion can **not** be removed with the abrasive pad, replace the component.

⚠ WARNING ⚠

When using solvents, acids, or alkaline materials for cleaning, follow the manufacture's recommendations for use. Wear goggles and protective clothing to reduce the possibility of personal injury.

⚠ WARNING ⚠

Wear appropriate eye and face protection when using compressed air. Flying debris and dirt can cause personal injury.

⚠ CAUTION ⚠

Do not submerge the aftertreatment DEF dosing valve in solvent or water. Damage to the aftertreatment DEF dosing valve will result.

Note : If **not** already removed, remove the coolant fittings from the aftertreatment DEF dosing valve. See the Disassemble section of this procedure.

Clean the aftertreatment DEF dosing valve coolant passages with a safety solvent. Use a pipe cleaner to clean the passageways.

Do **not** spill solvent on the dosing valve.

With the aftertreatment DEF dosing valve positioned so the coolant ports are pointing upward, pour safety solvent in one coolant port until the safety solvent begins to flow out of the opposite port.

Tip the aftertreatment DEF dosing valve so the safety solvent flows out of the port **not** filled. Verify the safety solvent flows out of this port as one continuous stream.

If safety solvent does **not** flow as one continuous stream, the coolant passage can still be restricted or blocked. Repeat the cleaning process again and inspect. If there is no change, replace the aftertreatment DEF dosing valve.

Dry with compressed air.

⚠ CAUTION ⚠

Use only warm water to clean the tip of the aftertreatment DEF dosing valve. The use of a wire wheel or brass brush or any other abrasive medium will cause permanent damage to the aftertreatment DEF dosing valve.

Use a clean shop cloth soaked in warm water to dissolve and wipe DEF deposits away on the dosing valve tip.

Inspect the dosing valve tip for cracks or other damage. Replace if damage is found.

If leaks/deposits are found at the base of the aftertreatment DEF dosing valve during the Initial Check section of this procedure, inspect the following:

- The bottom of the aftertreatment DEF dosing valve around the gasket sealing surface for signs of heavy corrosion, pitting and/or surface damage. Replace the aftertreatment DEF dosing valve if damage is found.
- The aftertreatment DEF dosing valve mounting surface on the decomposition tube. Refer to Procedure 011-062 in Section 11. (/qs3/pubsys2/xml/en/procedures/425/425-011-062.html)

If replacing the aftertreatment DEF dosing valve, make sure to transfer the protective caps from the replacement aftertreatment DEF dosing valve to the old aftertreatment DEF dosing valve prior to putting it in the core return box.

Make sure to fill out any requested information (engine serial number (ESN), mileage, and vehicle identification number (VIN)).

Inspect the capscrews for damaged threads, corroded surfaces, or a reduced shank diameter (due to capscrew stretching).

Replace if damage is found.

Assemble

Install new o-rings onto the two coolant fittings. Lubricate the o-rings. Use assembly lubricant, Part Number 3163086, or equivalent.

Install the heat shield.

Install the coolant fittings onto the aftertreatment DEF dosing valve.

Tighten the coolant fittings.

Torque Value: 6 n•m [53 in-lb]

Service Tip: If removal of the coolant fittings and/or heat shield was necessary, install the coolant fittings after installing the aftertreatment DEF dosing valve. See the Install section of this procedure.

Install

Remove any protective caps.

Make sure the aftertreatment DEF dosing valve spray port is free of gasket material and other debris.

Apply a coat of high temperature anti-seize compound to the threads of the aftertreatment DEF dosing valve mounting capscrews.

Install the insulated gasket (3) with the metallic side facing the aftertreatment DEF dosing valve. The insulated gasket can be held to the aftertreatment DEF dosing valve by inserting the capscrews (1) and spacers (2) into the square holes on the gasket to aid in alignment and installation.

Note : If the aftertreatment decomposition tube has been loosened or removed during the repair, confirm its orientation before installing the DEF dosing valve. Refer to Procedure 011-062 in Section 11. (/qs3/pubsys2/xml/en/procedures/425/425-011-062.html)

Install the aftertreatment DEF dosing valve onto the decomposition tube.

Tighten the capscrews by hand at first until the gasket is seated properly in the aftertreatment decomposition tube flange. Use the sequence shown in the left illustration.

Tighten the capscrews in the sequence shown in the right illustration.

Torque Value: 9 n•m [80 in-lb]

Install the aftertreatment DEF dosing valve guard, if removed. Tighten the capscrews.

Torque Value: 9 n•m [80 in-lb]

Finishing Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

⚠ CAUTION ⚠

Do not use the flow test portion of INSITE™ electronic service tool Diesel Exhaust Fluid Doser Pump Override Test to check the system for leaks. This will spray DEF into the exhaust system at temperatures too low to evaporate, resulting in deposit formations in the exhaust system.

Note : Remove any protective caps and/or covers from the electrical, coolant, and DEF ports just prior to making the connection.

Make the connections at the aftertreatment DEF dosing valve in the following order:

(1) The 2 pin electrical connector.

Note : The coolant supply and DEF lines are supplied by the OEM. The installation of the lines can vary by OEM. The fittings on the aftertreatment DEF dosing valve are set up for quick disconnect style fittings.

(2) Use the same method as used in the Preparatory Steps section to prevent draining the cooling system when the aftertreatment DEF dosing valve coolant lines are disconnected.

Remove coolant line plugs, Part Number 4919576, from each of the disconnected coolant lines.

Connect the coolant supply and return lines. See equipment manufacturer service information.

Remove all tools used.

(3) Connect the DEF line. See equipment manufacturer service information.

Once all connections are made, give each a slight pull to make sure they are securely installed.

- If any coolant was spilled, check the coolant level. Fill as required. Refer to Procedure 008-018 in Section 8. (/qs3/pubsys2/xml/en/procedures/425/425-008-018-tr.html)
- Connect the batteries. See equipment manufacturer service information.

Note : The aftertreatment DEF dosing system will not prime until the correct SCR temperatures are reached. To verify the system is correctly installed and has no leaks, induce a stationary regeneration to get the SCR system up to temperature.

- Operate the engine. Check for leaks.

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Last Modified: 05-Aug-2016

Select Service Tools

Recommended Cummins® Service Tools

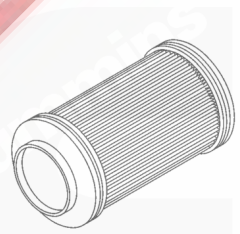
- No Cummins® service tools required.

Additional Service Items

- 27 mm wrench

General Information

The diesel exhaust fluid (DEF) dosing unit filter is designed to prevent foreign objects that can be suspended in the DEF from entering the dosing system.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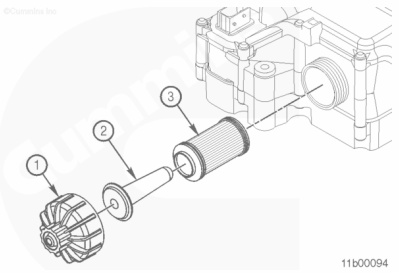
Debris can cause permanent damage and premature failure to either the aftertreatment DEF dosing unit or the aftertreatment DEF dosing valve. The aftertreatment DEF dosing unit filter is a maintenance item.

Use the following procedure for handling incorrect or contaminated DEF. Refer to Procedure 011-056 in Section 11. (/qs3/pubsys2/xml/en/procedures/425/425-011-056.html)

The aftertreatment DEF dosing unit filter consists of the following components:

1. Aftertreatment DEF dosing unit filter cap
2. Aftertreatment DEF dosing unit filter equalizing element
3. Aftertreatment DEF dosing unit filter element.



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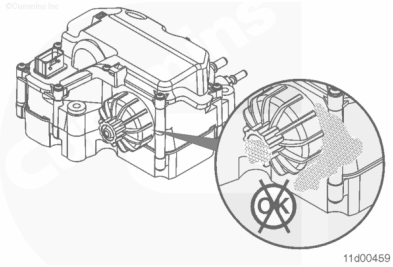
Initial Check

Locate the aftertreatment DEF dosing unit on the vehicle.
Notice the dome-shaped filter cap.

Note : The location of the aftertreatment DEF dosing unit varies on vehicles. Locate the DEF tank. Follow the DEF lines to the aftertreatment DEF unit.



Inspect the area around the seal and vent of the aftertreatment DEF dosing unit filter cap for signs of leakage.

DEF leaks leave a white deposit. If deposits are found, see the Clean and Inspect for Reuse section in this procedure.

Preparatory Steps

⚠ WARNING ⚠

Diesel exhaust fluid (DEF) contains urea. Do not get the substance in your eyes. In case of contact, immediately flush eyes with large amounts of water for a minimum of 15 minutes. Do not swallow. In the event the DEF is ingested, contact a physician immediately. Reference the Materials Safety Data Sheet (MSDS) for additional information.

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

⚠ WARNING ⚠

The diesel exhaust fluid (DEF) line connecting the aftertreatment DEF dosing unit to the aftertreatment DEF dosing valve is under low pressure and should not be disconnected while the engine is running or before the system has completed the purge process after engine shutdown. Disconnecting the DEF line while under low pressure could cause DEF to spray.

⚠ WARNING ⚠

Wear appropriate eye and face protection when using compressed air. Flying debris and dirt can cause personal injury.

Note : Do **not** disconnect the vehicle batteries until the DEF dosing system has completed the purge cycle. Before beginning to remove and/or disconnect any components, wait at least 5 minutes after the keyswitch is turned OFF for the aftertreatment DEF dosing system to purge the DEF from the system. The purge cycle is an automatic process and does **not** require intervention to occur. The

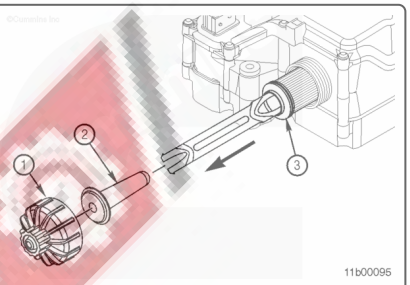
aftertreatment DEF dosing unit will create an audible pumping noise during the purging process

Note : Do **not** power wash or steam clean this unit. Use compressed air to remove any loose debris.

- Disconnect the batteries. See equipment manufacturer service information.

Remove

Note : There can be residual DEF in the filter housing. A collection container placed below the DEF filter cap is recommended.



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Unscrew the DEF filter cap (1). A 27 mm wrench can be used on the cap to aid in removal.

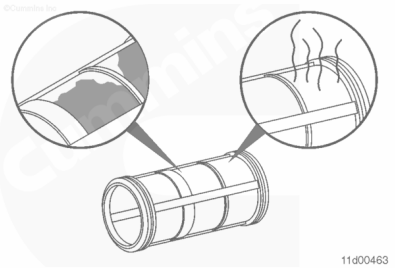
Remove the aftertreatment DEF filter equalizing element (2).

Remove the old aftertreatment DEF dosing unit filter element (3). A disposable service tool is included with the filter to aid in filter removal. Use the appropriate end of the tool, depending on the color of the plastic on the filter. When inserting the tool, a "click" sound can be heard which indicates proper engagement with the filter.

Note : If the filter element and equalizing element are removed from the aftertreatment DEF dosing unit, they **must** be discarded and replaced, regardless of condition.

Clean and Inspect for Reuse

If there is the possibility contaminated DEF has gone through the DEF dosing system, check the DEF filter prior to discarding the filter.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Check the diesel exhaust filter for evidence of contaminated DEF. Use visual and aroma characteristics of the filter to determine if contaminated fluid has passed through the dosing system.

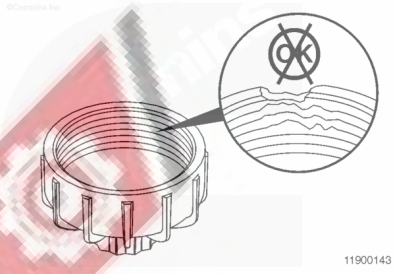
Use the following procedure for further information on contaminated DEF. Refer to Procedure 011-056 in Section 11. (/qs3/pubsys2/xml/en/procedures/425/425-011-056.html)

Inspect the diesel exhaust filter for debris. If debris is evident, also check:

- DEF tank pick up screen. See equipment manufacturer service information.
- The aftertreatment DEF dosing unit inlet connector. Refer to Procedure 011-058 in Section 11. (/qs3/pubsys2/xml/en/procedures/425/425-011-058.html)

Discard the filter element and equalizing element.

Inspect the aftertreatment DEF dosing unit filter cap for cracks or holes that could create a DEF leak path.



Check the condition of the threads on the aftertreatment DEF dosing unit cap.

If the threads are damaged, replace the aftertreatment DEF dosing unit filter cap.

Inspect the aftertreatment DEF dosing unit threads. This is especially important if the aftertreatment DEF dosing unit cap was damaged.

If the Aftertreatment DEF dosing unit threads are damaged, replace the entire aftertreatment DEF dosing unit.

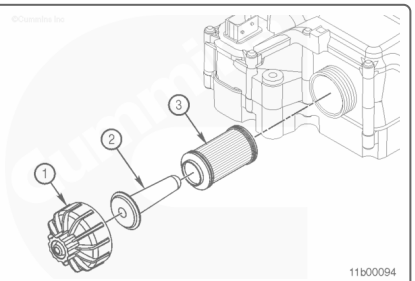
⚠ CAUTION ⚠

Never operate the vehicle with the DEF cap removed.

Clean the aftertreatment DEF dosing unit cap and threads on the dosing unit. Use warm water and a clean cloth.

Install

Note : Lubrication of the DEF filter o-rings is **not** required.



Slide the DEF filter equalizing element (2) into the DEF filter cartridge (3).

Insert the assembly into the aftertreatment DEF dosing unit.

Install and tighten the cap (1). A 27 mm wrench can be used to install and tighten the filter cap.

Torque Value: 20 n•m [177 in-lb]

Finishing Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

⚠ CAUTION ⚠

Do not use the flow test portion of the INSITE™ electronic service tool Diesel Exhaust Fluid Doser Pump Override Test to check the system for leaks. This will spray DEF into the exhaust system at temperatures too low to evaporate, resulting in deposit formations in the exhaust system.

- Connect the batteries. See equipment manufacturer service information.
- Use INSITE™ electron service tool to perform the Aftertreatment Diesel Exhaust Fluid Leak Test, under Engine Control Module Diagnostics Tests.
- Operate the system. Check for leaks.

ANADOLU FUEL AFTERSALES

Last Modified: 06-Dec-2016

Select Service Tools

Recommended Cummins® Service Tools

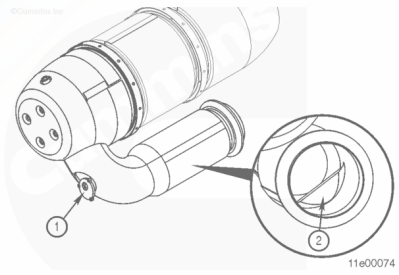
- No Cummins® Service Tools required.

Additional Service Items

- Thread lubricant
- Pressure washer
- Abrasive pad
- Anti-seize compuond

General Information

The decomposition tube is the section of exhaust pipe between the aftertreatment diesel particulate filter (DPF) and aftertreatment selective catalytic reduction (SCR) catalyst. The aftertreatment decomposition tube is designed to help atomize and mix the diesel exhaust fluid (DEF) being sprayed into the exhaust stream for complete NOx conversion.



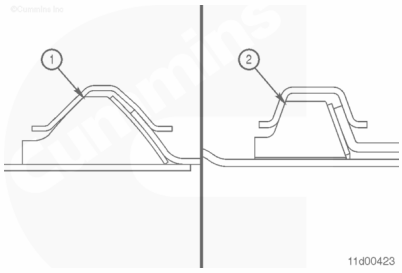
The aftertreatment decomposition tube is composed of two important areas.

1. The aftertreatment DEF dosing valve mount: The position at which the aftertreatment DEF dosing valve is mounted and allowed to spray DEF into the exhaust stream.
2. The aftertreatment decomposition tube mixer: The mixer creates a swirl pattern exhaust stream to help mix the DEF and engine exhaust.

Different vehicles will require different aftertreatment configurations. Some of the aftertreatment decomposition tubes can have elbows clamped to either end of the tube.

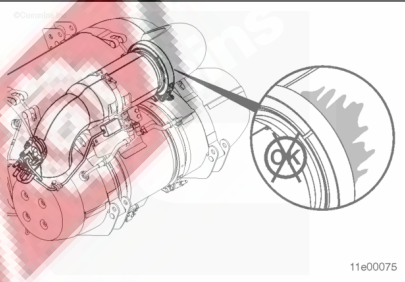
Different flanges are available to accommodate variations in vehicle aftertreatment configurations. The clamps and gaskets on either end of the aftertreatment decomposition tube can be different from one another. There are two types

of flanged joints, spherical Marman® and full Marman®. The spherical Marman® (1) joints allow a small amount of misalignment and have a rounded cross section. The full Marman® (2) joints are completely rigid and have a more edgy profile.



Initial Check

Inspect all the joints for any signs of leaks. Leaking DEF will leave white deposits. If a DEF leak is found, see the Clean and Inspect for Reuse section of this procedure.



Preparatory Steps

⚠ WARNING ⚠

During regeneration, exhaust gas temperature could reach 800°C [1500°F], and exhaust system surface temperature could exceed 700°C [1300°F], which is hot enough to ignite or melt common materials, and to burn people. The exhaust and exhaust components can remain hot after the vehicle has stopped moving. To avoid the risk of fire, property damage, burns or other serious personal injury, allow the exhaust system to cool before beginning this procedure or repair and make sure that no combustible materials are located where they are likely to come in contact with hot exhaust or exhaust components.

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

⚠ WARNING ⚠

ANADOLU ISUZU AFTER SALES

Wear appropriate eye and face protection when using compressed air. Flying debris and dirt can cause personal injury.

⚠ CAUTION ⚠

The aftertreatment DEF dosing valve is a fragile item. Use great care when handling this part. Avoid putting stresses on the fluid connectors, as damage to the component can result.

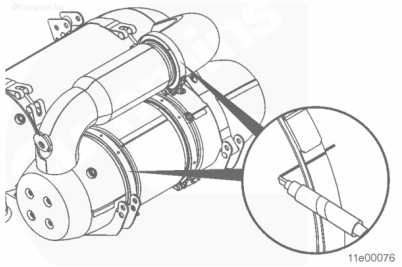
Note : It is acceptable to remove the aftertreatment dosing valve without removing the DEF and coolant lines. Support the aftertreatment DEF dosing valve. Do **not** let it suspend freely. It can damage the fluid connectors and lines.

- Disconnect the batteries. See equipment manufacturer service information.
- Clean the area. Use shop air. Remove any debris from the aftertreatment decomposition tube.
- If applicable, remove the aftertreatment DEF dosing valve guard from the aftertreatment decomposition tube. Refer to Procedure 011-059 in Section 11. (/qs3/pubsys2/xml/en/procedures/425/425-011-059.html)
- Remove the aftertreatment DEF dosing valve from the aftertreatment decomposition tube. Refer to Procedure 011-059 in Section 11. (/qs3/pubsys2/xml/en/procedures/425/425-011-059.html)

Remove

⚠ CAUTION ⚠

Do not use an air tool to remove the V-band clamp nut. An air tool will damage the threads. Apply thread lubricant to the V-band clamp threads prior to nut removal.



Note : Before removing the aftertreatment decomposition tube, note the location and orientation of the aftertreatment decomposition tube and related components. Apply identifying markings to aid in installation.

Note : There can be identifying marks from a previous repair, make sure the aftertreatment decomposition tube orientation is correct by following the Install section of this procedure.

Note : In some applications the aftertreatment decomposition tube can be welded to the aftertreatment SCR or aftertreatment elbow.

Note : Depending on the exhaust configuration, it can be necessary to loosen exhaust hangers or remove additional elbows and exhaust piping securing the rest of the aftertreatment before removing the aftertreatment decomposition tube.

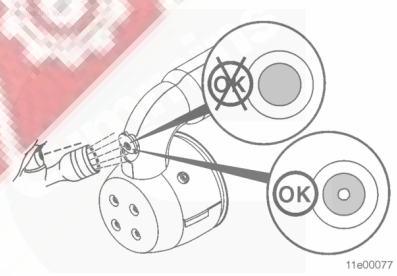
Remove the exhaust clamps from both ends of the aftertreatment decomposition tube.

Remove the aftertreatment decomposition tube.

Discard the gaskets.

Clean and Inspect for Reuse

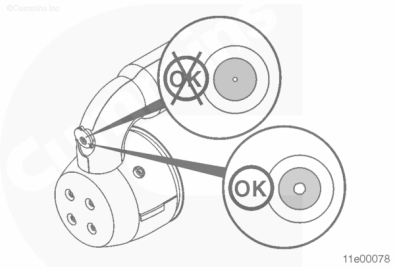
Note : If troubleshooting a fault code has a step that indicates to check the aftertreatment decomposition for DEF deposits, clean the aftertreatment decomposition tube of DEF deposits, regardless of the inspection criteria in the steps below.



Inspect the aftertreatment DEF dosing valve spray port in the aftertreatment decomposition tube for DEF deposits.

If the DEF spray port is completely blocked by DEF deposits, clean the aftertreatment decomposition tube according to the cleaning steps later in this procedure.

If the aftertreatment DEF dosing valve spray port is blocked with DEF deposits, there can be issues with the orientation of the aftertreatment dosing valve or an issue with the valve itself. Refer to Procedure 011-059 in Section 11. (/qs3/pubsys2/xml/en/procedures/425/425-011-059.html)



Inspect the aftertreament DEF dosing valve spray chamber in the aftertreatment decomposition tube. If there is a DEF deposit protruding into the main decomposition tube area that has a free flow path for a pressurized DEF stream and there are no active fault codes, no action is required.

Note : Use a light source when looking into the aftertreatment decomposition tube to inspect for a free flow path for a pressurized DEF stream.

It is **not** uncommon to see three holes in a DEF deposit. This is a formation of the three injection holes on the nozzle of the aftertreatment DEF dosing valve.

If there is a DEF deposit protruding into the main decomposition tube area restricting the free flow path for a pressurized DEF stream, clean the aftertreatment decomposition tube according to the cleaning steps later in this procedure.

If the aftertreatment DEF dosing valve spray chamber is blocked with DEF deposits, there can be issues with the orientation of the aftertreatment dosing valve or an issue with the valve itself. Refer to Procedure 011-059 in Section 11. (/qs3/pubsys2/xml/en/procedures/425/425-011-059.html)

Inspect the aftertreatment decomposition tube main area around the mixer. If the mixer area is less than 50 percent blocked by DEF deposits, no action is necessary.

If the DEF deposits in the mixer area are blocking more than 50 percent of the aftertreatment decomposition tube, regardless if any related active fault codes are present, the aftertreatment decomposition tube **must** be cleaned. See the cleaning steps below.

If the DEF deposits in the mixer area are blocking more than 50 percent of the aftertreatment decomposition tube, there can be issues with the orientation of the aftertreatment dosing valve or an issue with the valve itself. Refer to Procedure 011-059 in Section 11. (/qs3/pubsys2/xml/en/procedures/425/425-011-059.html)

Inspect the intake of the aftertreatment SCR catalyst for DEF deposits. Refer to Procedure 011-036 in Section 11. (/qs3/pubsys2/xml/en/procedures/425/425-011-036.html)

Inspect the outlet of the DPF for DEF deposits. Refer to Procedure 011-047 in Section 11. (/qs3/pubsys2/xml/en/procedures/425/425-011-047.html)

Inspect any additional elbows or exhaust pipes connected to the aftertreatment decomposition tube for DEF deposits. See the cleaning steps below.

⚠ CAUTION ⚠

Do not use a metallic object to clean the aftertreatment decomposition tube. This will scratch the surface of the aftertreatment decomposition tube which may cause future excessive diesel exhaust fluid deposits.

If DEF deposits are present, carefully scrape with a non-metallic object to remove the majority of the DEF deposits.

Use a pressure washer to dissolve the remaining DEF deposits.

Note : It is acceptable to have a small amount of DEF deposits remaining in the mixer area after the cleaning steps. The remaining DEF deposits can be removed by performing a stationary regeneration. See the Finishing Steps below.

Use **only** water to remove deposits.

Do **not** submerge the aftertreatment decomposition tube in water or solvents which can saturate the insulation.

Inspect the exhaust flanges for corrosion or other damage.

Use an abrasive pad to remove any residual gasket material from the flanges on the aftertreatment decomposition tube.

Do **not** grind on the flange surface. This can damage the flange and cause the connection to leak.

Inspect the V-band clamps and mounting straps for signs of overextension.

The band **must not** be bent or damaged.

Inspect the V-band clamp and mounting strap threads for damage.

Replace the V-band clamp or mounting strap if damage is found.

⚠ CAUTION ⚠

Do not use a metallic object to clean the aftertreatment decomposition tube dosing valve mounting area. Damage to the gasket/isolator sealing surface area can result.

Inspect the aftertreatment DEF dosing valve mounting area.

Inspect for old gasket/isolator material or corrosion.

Clean with an abrasive pad.

Check the threaded capscrew holes for damaged threads.

If the capscrew holes are damaged, the aftertreatment decomposition tube can be repaired.

ANADOLU ISUZU PARTS SALES

Inner coil threads, M6 X 1.0, can be used to repair any damaged threads.

Use **only** the wire type coil inserts because the amount of material around the threaded capscrew hole is limited.

Follow the manufacturer's recommended guidelines to install the coiled threaded insert.

Note : The aftertreatment decomposition tube should be smooth and free from scratches and other damage.

If the aftertreatment decomposition tube has **any** structural defects or material degradation, replace the aftertreatment decomposition tube.

Note : Surface corrosion such as rust on the inside of the aftertreatment decomposition tube can possibly be observed. Do **not** replace the aftertreatment decomposition tube for this condition.

Check the following areas:

1. Aftertreatment dosing valve mount
2. Mixer
3. Insulation
4. Welded joints.

Install

⚠ CAUTION ⚠

Do not use an air tool to tighten the V-Band clamp. An air tool will damage the threads.

Note : The gaskets and clamps on either end of the aftertreatment decomposition tube may **not** be the same. See the General Information section of this procedure. Where applicable, install and tighten the full Marman® clamps before the spherical Marman® clamps to account for misalignment in the aftertreatment system.

Install the aftertreatment decomposition tube. Use new gaskets.

ANADOLU ISUZU AFTER SALES

If other parts of the aftertreatment were adjusted in the removal process of the aftertreatment decomposition tube, slide them back into position.

Align the aftertreatment decomposition tube.

As viewed from the inlet/outlet of the aftertreatment decomposition tube, the aftertreatment DEF dosing valve mount **must** be placed between ±45 degrees and ±85 degrees from vertical.

Only use the identification marks made before removal if the above positioning criteria is met.

Apply a coat of anti-seize compound on the threads of the V-band clamps.

Install the clamps.

Torque Value: 14 n•m [124 in-lb]

Finishing Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

- Tighten any aftertreatment hangers that could possibly have been loosened in the removal process. See equipment manufacturer service information.
- Install the aftertreatment DEF dosing valve. Refer to Procedure 011-059 in Section 11. (/qs3/pubsys2/xml/en/procedures/425/425-011-059.html)
- If applicable, install the aftertreatment DEF dosing valve guard. Refer to Procedure 011-059 in Section 11. (/qs3/pubsys2/xml/en/procedures/425/425-011-059.html)
- Connect the batteries. See equipment manufacturer service information.
- Start the engine. Check for exhaust leaks.

Note : If DEF deposits were present, and cleaning of the aftertreatment decomposition tube was required, complete a stationary regeneration to make sure the remaining DEF deposits haves been removed from the aftertreatment system. Continue to monitor for leaks at the exhaust joints.


ANADOLU ISUZU
AFTER SALES

Select Service Tools

Recommended Cummins® Service Tools

- Aftertreatment Diesel Exhaust Fluid (DEF) Doser Shutoff Valve Test Kit, Part Number 4919573, or equivalent
- Graduated beaker, Part Number 4919139, or equivalent

Additional Service Items

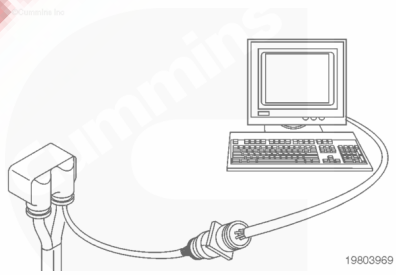
- Container suitable for DEF

General Information

Perform a dosing cycle to check the:

- Aftertreatment DEF dosing valve spray characteristics
- Amount of DEF to be delivered in a specified time (6 minutes).

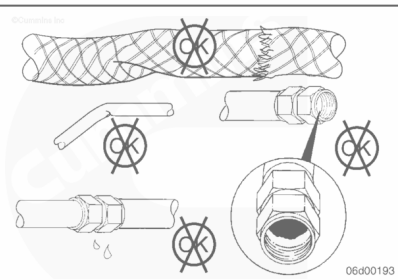
The test can be accessed through INSITE™ electronic service tool under engine control module (ECM) Diagnostic Tests. Follow the on-screen instructions to perform the test.



Initial Check

Check for any leaks, blockages, or restrictions in the DEF line between the aftertreatment DEF dosing unit and aftertreatment DEF dosing valve.

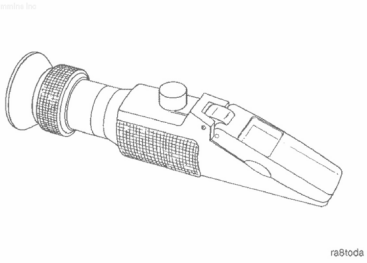
Repair, as necessary. See equipment manufacturer service information.



Check for an adequate amount of DEF in the DEF tank prior to starting this test.

ANADOLU ISUZU

Check the concentration and quality of the DEF. Refer to Procedure 011-056 in Section 11. (/qs3/pubsys2/xml/en/procedures/425/425-011-056.html)



Preparatory Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

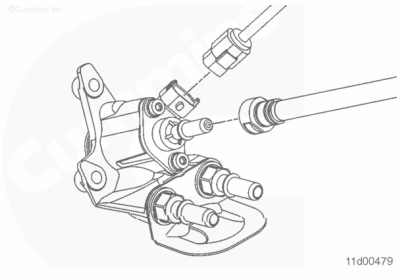
Note : Low battery voltage can cause the dosing volume to be low. Check the batteries. See equipment manufacturer service information.

- Disconnect the batteries. See equipment manufacturer service information.
- Remove the aftertreatment DEF dosing valve. Refer to Procedure 011-059 in Section 11. (/qs3/pubsys2/xml/en/procedures/425/425-011-059.html)

Setup

⚠ CAUTION ⚠

Care should be taken when handling and/or disconnecting the DEF line from the aftertreatment DEF dosing valve. The intake connection of the aftertreatment DEF dosing valve is plastic and can be easily damaged.



⚠ CAUTION ⚠

Do not connect a 12 VDC or 24 VDC supply to the aftertreatment DEF dosing valve as this will cause permanent damage.

Connect the electrical and DEF lines. Refer to Procedure 011-059 in Section 11. (/qs3/pubsys2/xml/en/procedures/425/425-011-059.html)

Note : The coolant plumbing does **not** need to be connected for this test.

Note : There may **not** be enough length for the existing electrical and/or DEF line to allow the aftertreatment DEF dosing valve to be placed in the container. Use Aftertreatment DEF Doser Shutoff Valve Test Kit , Part Number 4919573, or equivalent, which contains:

- Wiring harness extension, Part Number 4919575
- DEF extension line, Part Number 4919574
- Coolant line plug, Part Number 4919576.

Note : It can be easier to capture the DEF in a clean container and transfer the DEF to the measuring device for the final measurement.



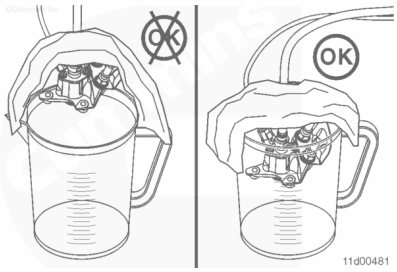
Obtain a clear plastic container (large enough to hold the aftertreatment DEF dosing valve) and graduated beaker, Part Number 4919139, or equivalent. A measuring cup marked in milliliters (ml) or ounces (oz) can also be used.

The measuring device **must** be capable of measuring between 0 ml [0.0 oz] and 500 ml [17.0 oz] in 5 ml [0.34 oz] increments

Place the aftertreatment DEF dosing valve into the container.

⚠ WARNING ⚠

Diesel exhaust fluid (DEF) contains urea. Do not get the substance in your eyes. In case of contact, immediately flush eyes with large amounts of water for a minimum of 15 minutes. Do not swallow. In the event the DEF is ingested, contact a physician immediately. Reference the materials safety data sheet (MSDS) for additional information.



Note : When the test is started, the dosing system will first prime. During this process the aftertreatment DEF dosing valve will open intermittently to purge air from the system. In doing so, some DEF will be sprayed from the tip. This is a normal operating characteristic.

When the test is being performed, the aftertreatment DEF dosing valve will spray a very fine mist of DEF. To prevent fine mist from escaping into the air and to make sure of an accurate measurement, place a clean shop towel or cover over the valve and container.

When the test begins, briefly monitor the spray pattern of the DEF exiting the aftertreatment DEF dosing valve. Check for:

- Signs of larger drops and/or dripping DEF from the tip
- Spray pattern that is **not** symmetrical (sprays more to one side).

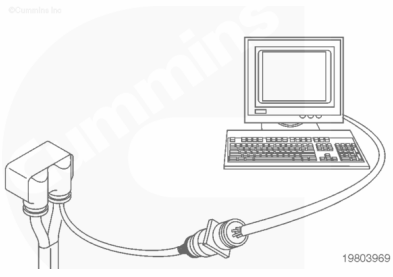
If either of these symptoms is noted, stop the test and inspect the aftertreatment DEF dosing valve tip. Refer to Procedure 011-059 in Section 11. (/qs3/pubsys2/xml/en/procedures/425/425-011-059.html)

After cleaning, perform the test again and monitor the spray pattern. If the problem persists, replace the aftertreatment DEF dosing valve. Refer to Procedure 011-059 in Section 11. (/qs3/pubsys2/xml/en/procedures/425/425-011-059.html)

Note : If a leak at the DEF dosing valve tip is suspected, the Aftertreatment Diesel Exhaust Fluid System Leak Test can be used to confirm the symptom. Refer to Procedure 011-080 in Section 11. (/qs3/pubsys2/xml/en/procedures/425/425-011-080.html)

Flow Test

Note : Prior to performing this test, if **not** already directed by a fault code troubleshooting tree, view and troubleshoot any fault codes with INSITE™ electronic service tool. See the L9 CM2350 L119B Fault Code Troubleshooting Manual, Bulletin 5411270.



- Turn the keyswitch ON.
- Connect INSITE™ electronic service tool.
- Locate the Diesel Exhaust Fluid Doser Pump Override Test under ECM Diagnostic Tests.
- Follow the on-screen instructions to perform the test.

INSITE™ electronic service tool will start the test and inject the DEF for 6 minutes. INSITE™ electronic service tool will automatically disable the injector at the end of the test. If the

test needs to be stopped before finishing, click the STOP button.

After the test is complete (test runs for 6 minutes), measure the amount of DEF sprayed into the container. Pour the DEF into graduated beaker, Part Number 4919139, or equivalent.

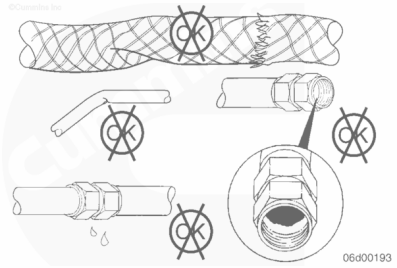
Perform the test three times. The amount of DEF measured for each test **must** be within specification.

Aftertreatment DEF Dosing Valve Volume Specifications		
ml		fl-oz
85	MIN	2.9
115	MAX	3.9

Note : Do **not** pour the DEF back into the DEF tank. Dispose of the DEF in accordance with local environmental regulations.

Note : Inspect the collected sample of DEF for signs of debris or contamination.

Note : Low battery voltage can cause the dosing volume to be low. Check the batteries. See equipment manufacturer service information. View and troubleshoot any fault codes with INSITE™ electronic service tool. See the L9 CM2350 L119B Fault Code Troubleshooting Manual, Bulletin 5411270.



If the amount of DEF is **not** within specification, check for leaks, blockages, or restrictions in the DEF line between the aftertreatment DEF dosing unit and aftertreatment DEF dosing valve. Use the following as a guide if the amount of DEF is still **not** within specification for one or more of the three tests:

- Clean the DEF dosing valve if one or more of the test results is below 85 ml [2.9 oz].
- Replace the DEF dosing valve if one or more of the test results is above 115 ml [3.9 oz].
- Replace the DEF dosing valve if the test results vary with both below-specification and above-specification conditions. This could be an erratic valve with intermittent malfunction and **must** be replaced. Refer to Procedure 011-059 in Section 11. (/qs3/pubsys2/xml/en/procedures/425/425-011-059.html)

Note : The aftertreatment DEF dosing valve may have been plugged by debris. Inspect the aftertreatment DEF dosing unit filter for signs of contamination and debris prior to installing the new aftertreatment DEF dosing valve. Refer to Procedure 011-060 in Section 11. (/qs3/pubsys2/xml/en/procedures/425/425-011-060-tr.html)

⚠ CAUTION ⚠

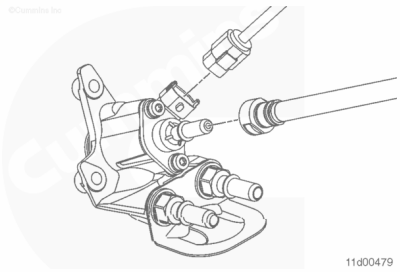
Do not submerge the aftertreatment DEF dosing valve in solvent or water. Damage to the aftertreatment DEF dosing valve will result.

After the test is complete, a light coating of DEF will cover the aftertreatment DEF dosing valve, DEF line, and electrical line.

Prior to disconnecting anything, use a clean shop towel soaked in warm water to wipe the coating of DEF from the components.

Note : Clean any service tools used for this test with warm distilled water before storage.

Disconnect the electrical and DEF lines. Refer to Procedure 011-059 in Section 11. (/qs3/pubsys2/xml/en/procedures/425/425-011-059.html) If used, remove the service tool extensions.



Finishing Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

- Install the aftertreatment DEF dosing valve. Refer to Procedure 011-059 in Section 11. (/qs3/pubsys2/xml/en/procedures/425/425-011-059.html)
- Connect the batteries. See equipment manufacturer service information.

Last Modified: 05-Aug-2016



Select Service Tools

Recommended Cummins® Service Tools

- No Cummins® service tools required.

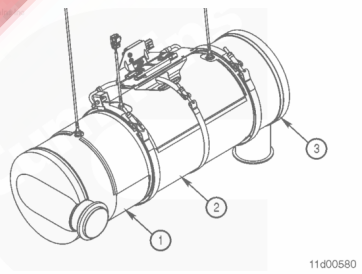
Additional Service Items

- Putty knife
- Anti-seize compound

General Information

⚠ WARNING ⚠

The material captured in a partial flow diesel particulate filter and/or a diesel particulate filter may contain elevated concentrations of metals. Primarily zinc, molybdenum, and possibly polynuclear aromatic hydrocarbons, that may be regulated. These materials must be characterized, handled, and disposed of according to applicable local regulations. In addition, due to the presence of the above-listed chemicals and other potentially toxic components such as oxides of calcium, zinc, phosphorous, silicon, sulfur, and iron, exhaust filter maintenance must be completed only by appropriately trained personnel.



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⚠ CAUTION ⚠

The aftertreatment diesel oxidation catalyst elements contained in the aftertreatment system are made of brittle material. Do not drop or strike the side of the aftertreatment system as damage to the aftertreatment diesel oxidation catalyst element can result.

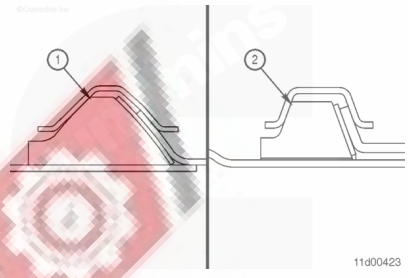
Due to the number of exhaust aftertreatment applications, this procedure has been written to be generic. Illustrations within this procedure will **not** represent all applications.

The aftertreatment system is composed of three sections:

1. Aftertreatment diesel oxidation catalyst
2. Aftertreatment diesel particulate filter
3. Outlet.

Note : The aftertreatment diesel oxidation catalyst is integrated into the inlet of the exhaust aftertreatment system. Use the following procedure for aftertreatment inlet service guidelines. Refer to Procedure 011-049 in Section 11. (/qs3/pubsys2/xml/en/procedures/425/425-011-049.html)

A variation in vehicle aftertreatment configuration will drive the aftertreatment to have different flanges. The clamps and gaskets on either end of the aftertreatment SCR catalyst can be different from one another. There are two types of flanged joints, spherical Marman® and full Marman®. The spherical Marman® (1) joints allow a small amount of misalignment an have a rounded cross section. The full Marman® (2) joints are completely rigid and have a more edgy profile.



Preparatory Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

⚠ WARNING ⚠

During regeneration, exhaust gas temperature can reach 800 °C [1500°F], and exhaust system surface temperature can exceed 700 °C [1300°F], which is hot enough to ignite or melt common materials, and to burn people. The exhaust and exhaust components can remain hot after the vehicle has stopped moving. To avoid the risk of fire, property damage, burns, or other serious personal injury, allow the exhaust system to cool before beginning this procedure or repair and make sure that no combustible materials are located where they are likely to come in contact with hot exhaust or exhaust components.

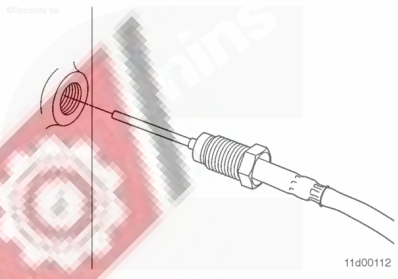
- Disconnect the batteries. See equipment manufacturer service information.
- Mark the direction of exhaust flow to aid in assembly.

- Draw an orientation reference line across each V-band clamp, aftertreatment canister sections, and connection points to the tailpipe. This will aid in lining up the sections and the V-band clamps to their original orientation during installation.
- Remove the mounting straps or bolts from the outlet, if necessary. See equipment manufacturer service information.

Disassemble

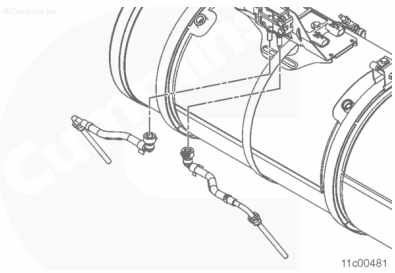
Remove the aftertreatment diesel particulate filter outlet temperature sensor probe. Refer to Procedure 019-449 in Section 19. (/qs3/pubsys2/xml/en/procedures/425/425-019-449.html)

Note : The aftertreatment diesel particulate filter outlet temperature sensor probe **must** be removed prior to aftertreatment outlet removal or damage to the sensor wiring and sensor probe will occur.



Remove the diesel particulate filter outlet differential pressure sensor tube from the diesel oxidation catalyst. Refer to Procedure 011-047 in Section 11. (/qs3/pubsys2/xml/en/procedures/425/425-011-047.html)

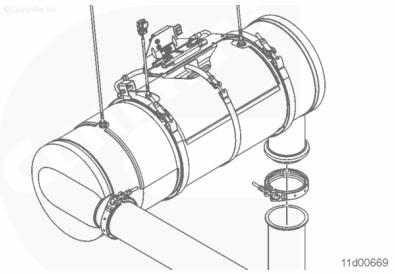
Note : The diesel particulate filter outlet differential pressure sensor tube **must** be removed prior to aftertreatment outlet removal or damage to the sensor tube will occur.



Remove

⚠ WARNING ⚠

This component or assembly weighs greater than 23 kg [50 lb]. To prevent serious personal injury, be sure to have assistance or use appropriate lifting equipment to lift this component or assembly.



⚠ CAUTION ⚠

The aftertreatment diesel oxidation catalyst elements contained in the aftertreatment system are made of brittle material. Do not drop or strike the side of the

aftertreatment system as damage to the aftertreatment diesel oxidation catalyst element can result.

⚠ CAUTION ⚠

Do not use an air tool to remove the V-band clamp nut. An air tool will damage the threads. Apply thread lubricant to the V-band clamp threads prior to nut removal.

Support the aftertreatment decomposition tube and aftertreatment diesel particulate filter to avoid applying a cantilevered load on the V-band joints.

Remove the V-band clamp used to connect the aftertreatment outlet to the aftertreatment decomposition tube.

Remove the V-band clamp connecting the outlet to the aftertreatment diesel particulate filter.

Remove and discard the gaskets.

Clean and Inspect for Reuse

Inspect the aftertreatment outlet canister for cracks or other damage.

⚠ CAUTION ⚠

Do not use a metallic object to clean the aftertreatment diesel particulate filter (DPF) outlet. This will scratch the surface of the aftertreatment DPF outlet which may cause future excessive diesel exhaust fluid (DEF) crystallization buildup.

Inspect the aftertreatment DPF outlet for DEF deposits.

If buildups are present, carefully scrape them with a non-metallic object to clean the majority of the buildup. Use a pressure washer to remove any remaining buildup.

Note : If crystallization buildup was present, complete a stationary regeneration after installation to make

sure the remaining DEF crystallization has been removed from the aftertreatment system.

Flange Preparation - Use a putty knife to remove any residual gasket material from the flanges on the aftertreatment diesel particulate filter.

Avoid dropping fragments of gasket material into the aftertreatment diesel particulate filter.

Do **not** use compressed air to remove fragments of gasket material that have fallen into the filter during gasket removal.

Do **not** grind on the flange surface, as this can damage the flange and cause the connection to leak.

Inspect the V-band clamps and mounting straps for signs of overextension.

The band **must not** be bent or damaged.

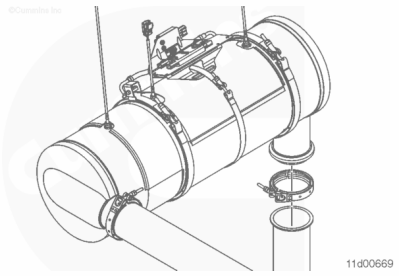
Inspect the V-band clamp and mounting strap threads for damage.

Replace the V-band clamp or mounting strap if damage is found.

Install

⚠ CAUTION ⚠

Do not use an air tool to tighten the V-band clamp. An air tool will damage the threads.



Apply a coat of anti-seize compound on the threads of the V-band clamps.

Note : The gasket and clamp on the outlet end of the aftertreatment outlet canister can be different. See the General Information section of this procedure. Where applicable, install and tighten the full Marman® clamps before the spherical Marman® to account for misalignment in the aftertreatment.

Note : Install a new gasket between the exhaust pipe and aftertreatment outlet.

ANADOLU ISUZU AFTER SALES

Tighten the V-band clamp used to secure the outlet of the aftertreatment to the exhaust pipe, if necessary.

Torque Value: 13.5 n•m [120 in-lb]

Install a new gasket between the outlet and the aftertreatment diesel particulate filter.

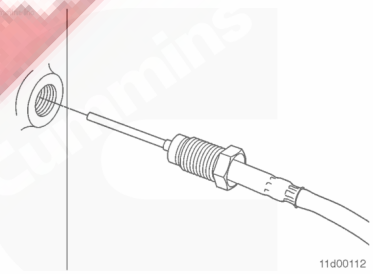
Install the V-band clamp used to connect the outlet to the aftertreatment diesel particulate filter.

Tighten the V-band clamp.

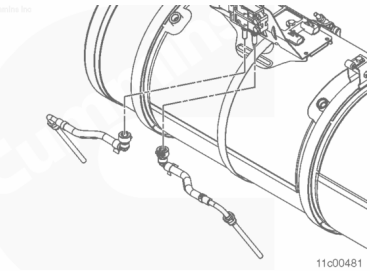
Torque Value: 20 n•m [177 in-lb]

Assemble

Install the aftertreatment diesel particulate filter outlet temperature sensor probe. Refer to Procedure 019-449 in Section 19. (/qs3/pubsys2/xml/en/procedures/425/425-019-449.html)



Install the diesel particulate filter outlet differential pressure sensor tube from the diesel oxidation catalyst. Refer to Procedure 011-047 in Section 11. (/qs3/pubsys2/xml/en/procedures/425/425-011-047.html)



Finishing Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

- Install the mounting straps or bolts used to support the outlet, if necessary. See equipment manufacturer service information.
- Connect the batteries. See equipment manufacturer service information.
- Operate the engine. Check for leaks.

Check for active fault codes. If buildups were present, complete a stationary regeneration to make sure any remaining DEF crystallization has been removed from the aftertreatment system. Continue to monitor for leaks at the exhaust joints.

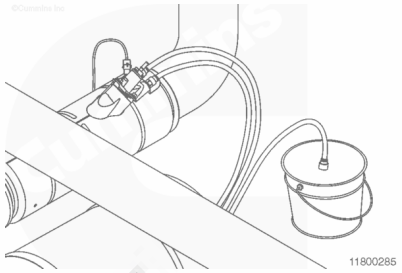
Last Modified: 01-Nov-2016

ANADOLU ISUZU AFTER SALES

Setup

⚠ CAUTION ⚠

Care should be taken when handling and/or disconnecting the diesel exhaust fluid line from the aftertreatment diesel exhaust fluid dosing valve. The intake of the aftertreatment diesel exhaust fluid dosing valve is plastic and can be easily damaged.



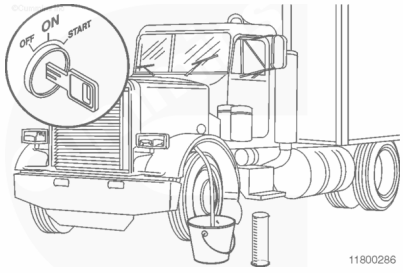
Remove the aftertreatment diesel exhaust fluid dosing valve supply line from the aftertreatment diesel exhaust fluid dosing valve.

Install the diesel exhaust fluid extension line, Part Number 4919574, from the Aftertreatment Diesel Exhaust Fluid (DEF) Doser Shutoff Valve Test Kit, Part Number 4919573.

Obtain a container suitable for collection of the diesel exhaust fluid that exits the aftertreatment diesel exhaust fluid dosing valve supply line. A 3.8 liter [1 gal] bucket is recommended.

Measure

Route the outlet of the diesel exhaust fluid extension line into the collection container.



Turn the keyswitch to the ON position and connect the recommended Cummins® electronic service tool or equivalent.

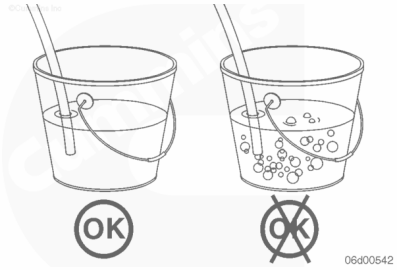
Select the Diesel Exhaust Fluid Doser Pump Override test under the ECM Diagnostic Tests menu.

This test will attempt to prime the dosing system. During this test, diesel exhaust fluid will be drawn from the tank and pumped through the diesel exhaust fluid extension line.

Note : Once the test is initiated it will continue to pump diesel exhaust fluid, even when attempting to stop the test with the electronic service tool. To stop the test, it is necessary to turn the keyswitch to the OFF position.

ANADOLU ISUZU AFTER SALES

Observe the diesel exhaust fluid flow exiting the diesel exhaust fluid extension line while the Override Test is running.



Bubbles are an indication of a leak that allows air to enter the dosing system. If bubbles are present, check the following components for damage or leaks:

- Aftertreatment diesel exhaust fluid dosing unit fittings
- Aftertreatment diesel exhaust fluid dosing unit supply line
- Aftertreatment diesel exhaust fluid tank assembly
- Aftertreatment diesel exhaust fluid tank fittings.

Repair or replace any damaged components.

Turn the keyswitch to the OFF position to end the test.

Note : If this test is run for an extended period of time, Fault Code 1682 will become active. Limit the test time to 5 minutes or less.



Finishing Steps

- Remove the aftertreatment diesel exhaust fluid extension line.
- Connect that aftertreatment diesel exhaust fluid dosing valve supply line.
- Discard the collected diesel exhaust fluid. Dispose of the collected diesel exhaust fluid in accordance with local environmental regulations.
- Operate the engine and check for leaks.

ANADOLU ISUZU POWER SALES

Last Modified: 07-Oct-2020

Select Service Tools

Recommended Cummins® Service Tools

- Anti-seize compound, Part Number 3824879, or equivalent

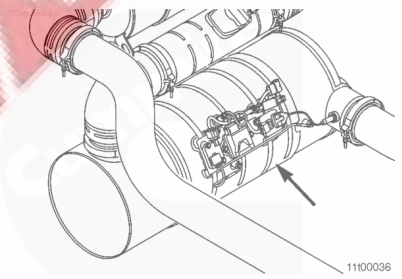
Additional Service Items

- No additional service items required.

General Information

⚠ WARNING ⚠

The exhaust and exhaust components can remain hot after the engine has been shut down or secured. To avoid the risk of fire, property damage, burns or other serious personal injury, allow the exhaust system to cool before beginning this procedure or repair and make sure that no combustible materials are located where they might come in contact with hot exhaust or exhaust components.



⚠ CAUTION ⚠

The catalyst elements contained in the aftertreatment system are made of brittle material. Do not drop or strike the side of the aftertreatment system, as damage to the catalyst element can result.

Note : Due to the number of various exhaust aftertreatment applications, this procedure has been written to be generic. **Not** all illustrations within this procedure will represent the application being serviced.

Preparatory Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

⚠ CAUTION ⚠

The aftertreatment diesel particulate filter and catalyst can remain hot for long periods of time after the engine has stopped.

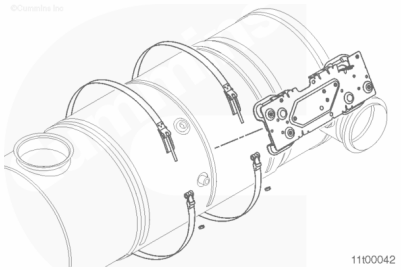
- Disconnect the batteries. See equipment manufacturer service information.
- Mark the orientation and location of the bracket before it is removed, to aid installation.
- Disconnect the aftertreatment interface harness from the original equipment manufacturer (OEM) wiring harness connection.
- Remove the NOx sensor probe from the aftertreatment selective catalytic reduction (SCR) catalyst body. Refer to Procedure 019-451 in Section 19. (/qs3/pubsys2/xml/en/procedures/425/425-019-451.html)
- Remove the aftertreatment temperature sensor probes from the aftertreatment SCR catalyst body. Refer to Procedure 019-449 in Section 19. (/qs3/pubsys2/xml/en/procedures/425/425-019-449.html)

Note : The aftertreatment SCR catalyst temperature sensor interface module **must** be oriented in the same location when it is installed. Make sure to check the orientation.

Remove

Remove the nuts on the aftertreatment SCR catalyst temperature sensor interface module mounting bracket straps.

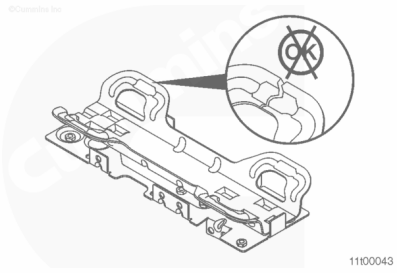
Remove the aftertreatment SCR catalyst temperature sensor interface module mounting bracket.



Clean and Inspect for Reuse

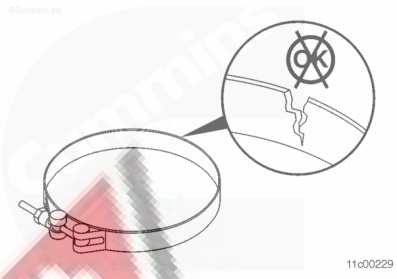
Inspect the aftertreatment SCR catalyst temperature sensor interface module mounting bracket for cracks, damaged threads, or broken studs.

Replace the aftertreatment SCR catalyst temperature sensor interface module mounting bracket.



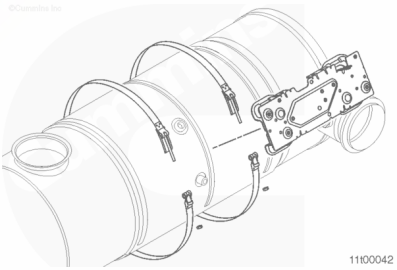
Inspect the aftertreatment SCR catalyst temperature sensor interface module mounting bracket straps for cracks, damaged threads, or bends.

Replace the aftertreatment SCR catalyst temperature sensor interface module mounting bracket straps if they are damaged.



Install

Note : Make sure the aftertreatment SCR catalyst is oriented so the aftertreatment SCR catalyst temperature sensor interface module mounting bracket is installed in the same orientation noted during removal.



Install the aftertreatment SCR catalyst temperature sensor interface module mounting bracket and straps. Make sure to align the mounting bracket by using the reference mark made during removal.

Apply a coating of anti-seize compound, Part Number 3824879, or equivalent, to the threads of the aftertreatment SCR catalyst temperature sensor interface module mounting bracket straps.

Install the aftertreatment SCR catalyst temperature sensor interface module mounting bracket and strap. Make sure to align the mounting bracket with the reference mark made during removal.

Apply a coating of anti-seize compound to the threads of the aftertreatment diesel particulate filter differential pressure sensor mounting bracket strap.

Tighten the nuts on the aftertreatment SCR catalyst temperature sensor interface module mounting bracket.

Torque Value: 7 n•m [62 in-lb]

Finishing Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

- Install the aftertreatment temperature sensor probes into the SCR catalyst body. Refer to Procedure 019-449 in Section 19. (/qs3/pubsys2/xml/en/procedures/425/425-019-449.html)
- Install the aftertreatment outlet NOx sensor probe. Refer to Procedure 019-451 in Section 19. (/qs3/pubsys2/xml/en/procedures/425/425-019-451.html)
- Connect the aftertreatment interface harness to the OEM wiring harness connection.
- Connect the batteries. See equipment manufacturer service information.
- Operate the engine. Check for proper operation.

ANADOLU ISUZU AFTERSALES

Last Modified: 01-Nov-2016

Select Service Tools

Recommended Cummins® Service Tools

- No Cummins® service tools required.

Additional Service Items

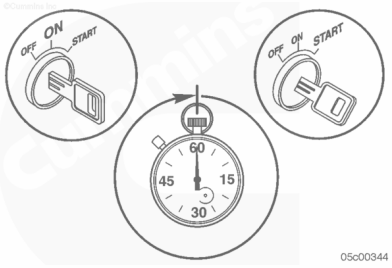
- No additional service items required.

General Information

If the aftertreatment diesel exhaust fluid (DEF) dosing system has been serviced or repaired, it will be necessary to prime the DEF dosing system, in order to check for proper operation.

Setup

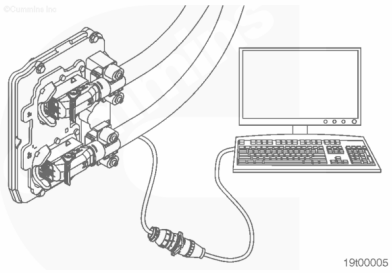
Note : It can be necessary to allow the aftertreatment system time to cool, to allow for accessibility to check for leaking components.



- Make sure the DEF tank is full of DEF. See equipment manufacturer service information.
- Make sure the DEF is **not** frozen. If the DEF is frozen, it will be necessary to run the engine to allow the system to thaw.
- Make sure all DEF dosing system lines are properly connected to the DEF tank, DEF dosing unit, and DEF dosing valve. See equipment manufacturer service information.
- Connect INSITE™ electronic service tool.

Prime

With the keyswitch ON and the engine **not** running, select the Aftertreatment Diesel Exhaust Fluid System Leak Test found under the ECM diagnostics test menu in INSITE™ electronic service tool.



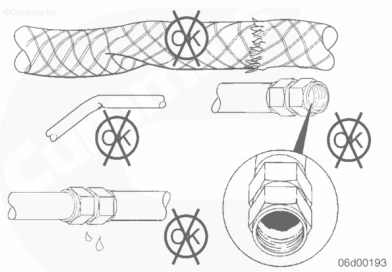
This test will cause the DEF dosing unit to draw DEF from the tank and pressurize it in the DEF dosing valve supply line. During this test, the dosing unit will continuously run and all unused DEF will return to the tank. An audible pumping noise will be noticeable during the test.

During the initialization of this test, a note will pop up on the screen, indicating the system has reached a prime state.

When the test is started, the dosing system will prime. During this process the aftertreatment DEF dosing valve will be held in the closed position. As a result, DEF droplets can potentially be observed exiting the tip of the dosing valve. This is a normal operating characteristic. Do **not** remove the injector.

Inspect

Note : If the system is unable to prime due to leaks, it will be necessary to turn the keyswitch OFF in order to stop the dosing unit. The dosing unit can **not** be stopped using INSITE™ electronic service tool.

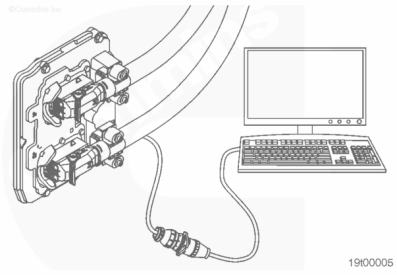


While the test is running, inspect all DEF lines, fittings, and connections for external leaks. Refer to Procedure 011-058 in Section 11. (/qs3/pubsys2/xml/en/procedures/425/425-011-058.html) Refer to Procedure 011-059 in Section 11 (/qs3/pubsys2/xml/en/procedures/425/425-011-059.html). See equipment manufacturer service information.

Repair and replace any leaking component(s). Refer to Procedure 011-058 in Section 11. (/qs3/pubsys2/xml/en/procedures/425/425-011-058.html) Refer to Procedure 011-059 in Section 11 (/qs3/pubsys2/xml/en/procedures/425/425-011-059.html). See equipment manufacturer service information.

Note : If the system fails to prime, a key cycle will be required before attempting to run the aftertreatment DEF system leak test again.

Note : The aftertreatment DEF system leak test can **only** be attempted twice consecutively. A key cycle will be required before attempting to run the aftertreatment DEF system leak test again after two attempts.



If the system is able to successfully prime, a pop-up message will appear in INSITE™ electronic service tool to notify the technician.

Upon completion of inspecting the lines, fittings, and connections for leaks, press the STOP button in INSITE™ electronic service tool. The dosing unit will then purge the system of DEF. An audible purging noise will be noticeable.

If the test is **not** STOPPED using INSITE™ electronic service tool, it will continue to pump for 20 minutes and then automatically purge the system of DEF.

If the system can **not** build pressure, it will attempt to prime multiple times before flagging a fault code.

If any fault codes occur while running this test, see the appropriate fault code troubleshooting tree.

Finishing Steps

- During the test, a small quantity of DEF is sprayed into the aftertreatment decomposition tube. After completion of the test, it is necessary to run the engine at high idle for 5 minutes in order to prevent DEF deposits from forming in the aftertreatment decomposition tube.
- Check for fault codes.

ANADOLU ISUZU
PARTS SALES

Last Modified: 13-Jun-2019

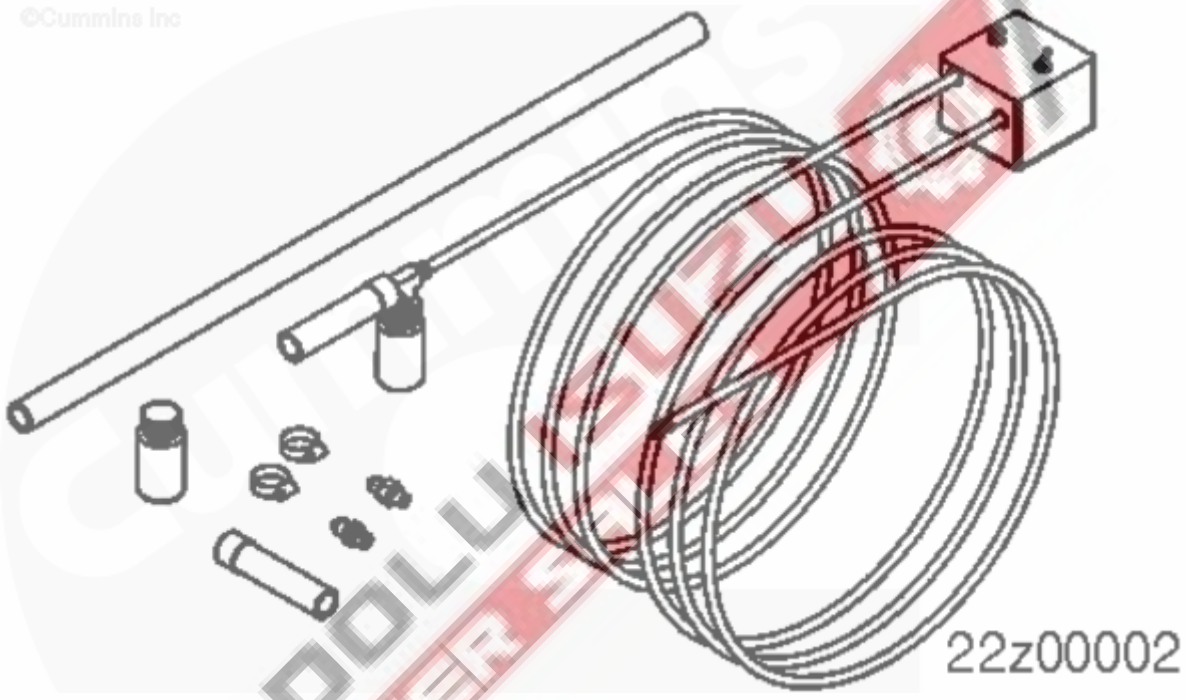
Compressed Air System

Tool Number

2892280

Air Compressor Cleaning Kit

Used to clean and remove internal carbon deposits and other foreign material from WABCO™ air compressor cylinder heads.



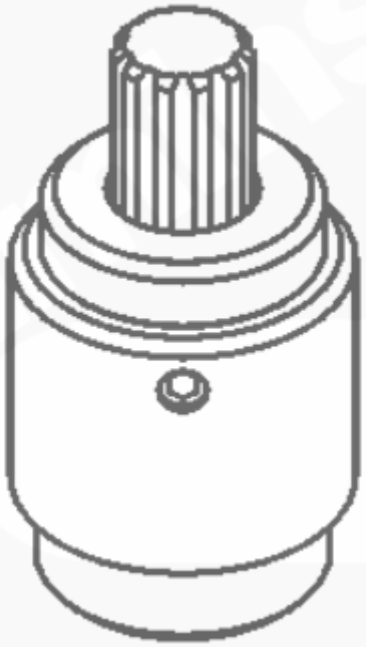
Tool Number

3165101

Air Compressor Adapter Replacer (11 tooth Spline)

Used to address wear problems on the air compressor spline adapter.

©Cummins Inc



Tool Number

3165102

Air Compressor Adapter Replacer (13 tooth Spline)

Used to address wear problems on the air compressor spline adapter.

GRAPHIC NOT FOUND

Tool Number

3824040

Threadlocker Loctite® 242

This threadlocker is a general purpose medium strength thread locking compound. It is ideal for all nut and bolt applications. It works especially well for ¼ inch and larger fasteners.

ANADOLU ISUZU PARTS SALES

©Cummins Inc



SP000795

Tool Number

4918883

Air Compressor Discharge Tool

Used to measure acceptable oil carryover on Knorr-Bremse™ air compressors.

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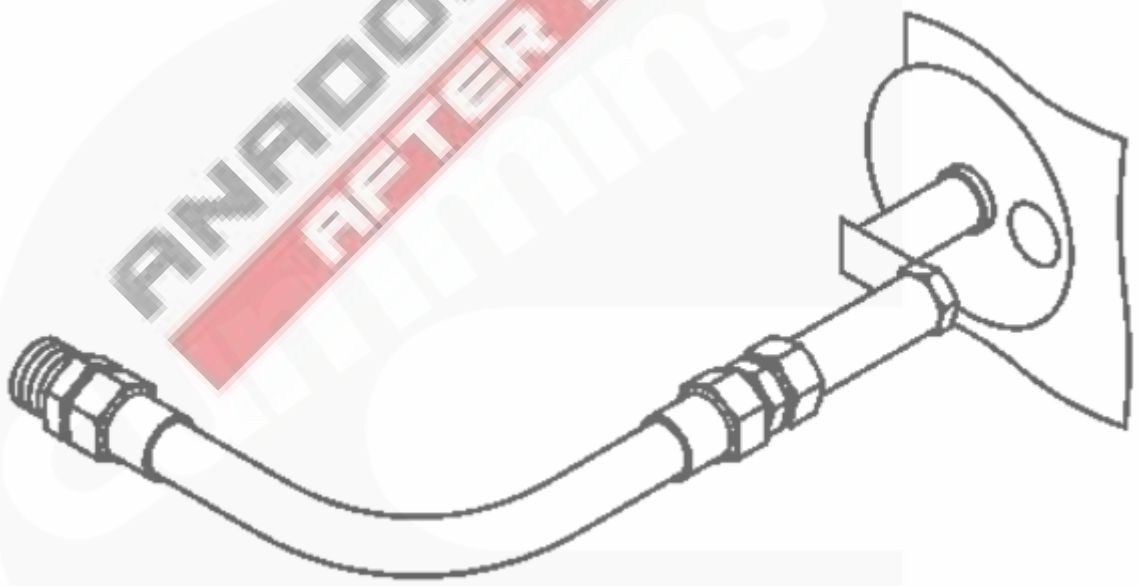


22800637

Tool Number

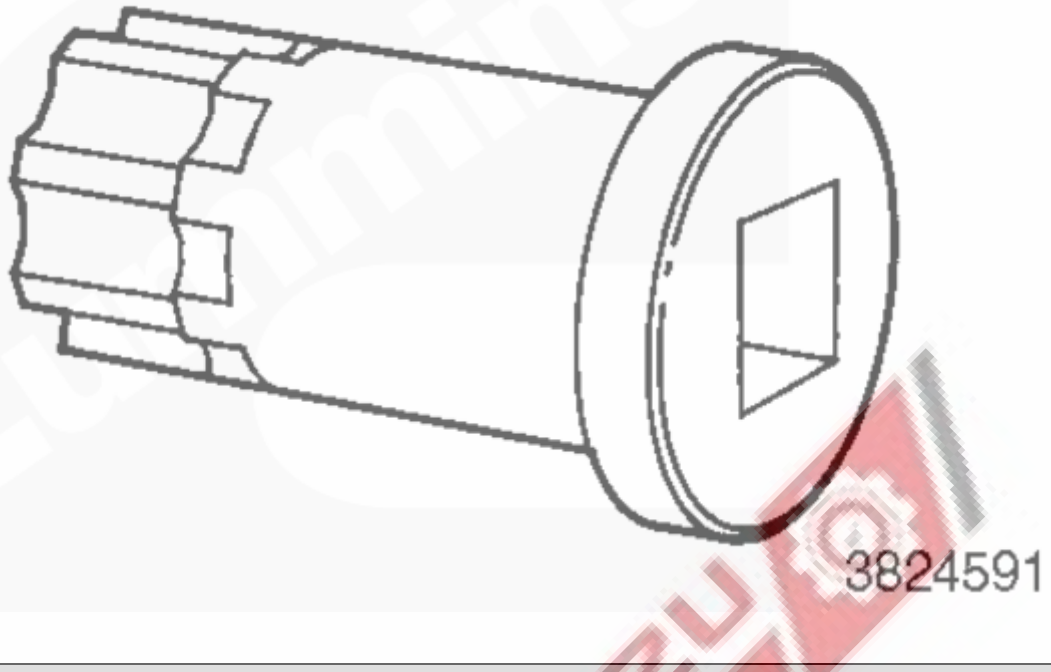
5299073

Barring Tool

ANADOLU ISUZU AFTER SALES

Used to engage the flywheel ring gear to rotate the crankshaft.

©Cummins Inc



Last Modified: 10-Aug-2016

ANADOLU ISUZU AFTER SALES

Select Service Tools

Recommended Cummins® Service Tools

- Air Compressor Cleaning Kit, Part Number 2892280

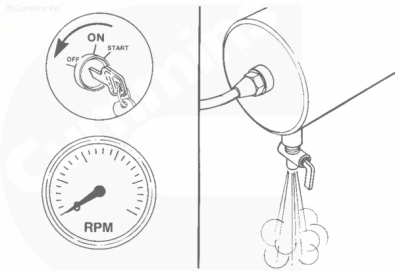
Additional Service Items

- Stiff wooden handle
- Engraving pen
- Bucket
- Oil absorption pads

Initial Check

⚠ WARNING ⚠

Wear appropriate eye and face protection when using compressed air. Flying debris and dirt can cause personal injury.

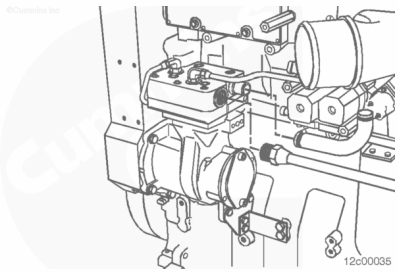


Shut the engine OFF.

Open the drain cock on the wet tank to release the compressed air from the system.

⚠ WARNING ⚠

Air discharge lines can be very hot. Make sure the lines are cool before touching to reduce the possibility of personal injury.



Remove the air inlet and outlet connections from the air compressor.

Measure the total carbon buildup thickness inside the air discharge line as shown.

Note : The carbon buildup thickness **must not** exceed 1.6 mm [0.06 in].

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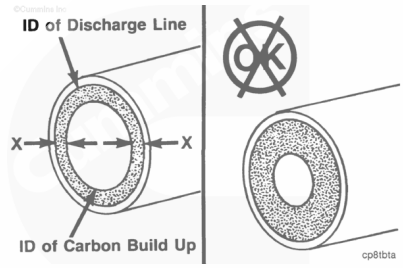


⚠ WARNING ⚠

The air discharge line must be capable of withstanding extreme heat and pressure to prevent personal injury and property damage. Refer to the manufacturer's specifications.

GRAPHIC NOT FOUND

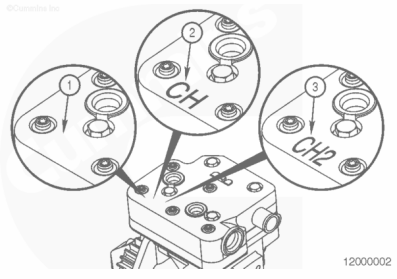
Note : If the total carbon deposit thickness exceeds specification, remove and clean, or replace, the air discharge line. See equipment manufacturer service information for manufacturer specifications.

Continue to check for carbon buildup in the air discharge line connections up to the first connection or wet tank.

Clean or replace any lines and fittings with carbon buildup thicker than 1.6 mm [0.06 in]. See equipment manufacturer service information for cleaning or replacement instructions.

Preparatory Steps

Check the marking on the air compressor head before cleaning or replacing the cylinder head.



Repair Direction:

1. No marking: Perform On-Engine Repair.
2. CH marking: Perform Off-Engine Repair.
3. CH2 marking: Replace the air compressor cylinder head. Refer to Procedure 012-007 in Section 12. (/qs3/pubsys2/xml/en/procedures/425/425-012-007.html)

ANADOLU ISUZU PARTS SALES

Clean

On-Engine Repair

Use Air Compressor Cleaning Kit, Part Number 2892280, to clean and remove internal carbon deposits and other foreign material from the air compressor cylinder head.

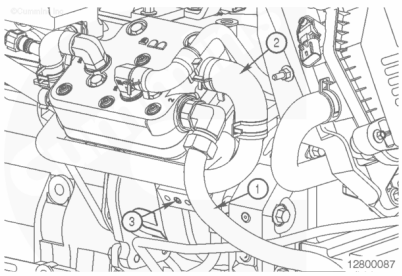
The items below are **not** included in Air Compressor Cleaning Kit, Part Number 2892280, but are required to perform the repair.

- Regulated shop air 621 kPa [90 psi]
- Automatic transmission fluid
- Shop rags, and a 19 liter [5 gal] bucket
- INSITE™ electronic service tool.

Park vehicle on a level surface and in an area where it is safe to idle for an extended period of time. Chock the vehicle wheels. Completely drain the vehicle air system.



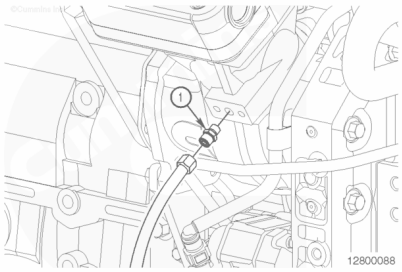
Remove the air compressor discharge line (1), air compressor intake line (2), and air governor signal line (3) at the air compressor.



Install and tighten the M10 connector (1) into the unloader port of the air compressor housing.

Install and tighten the unloader control valve hose to the M10 connector installed into the air compressor housing.

Note : Some air compressors have two unloader ports in the air compressor housing. Make sure one port is plugged with an appropriate pipe plug.



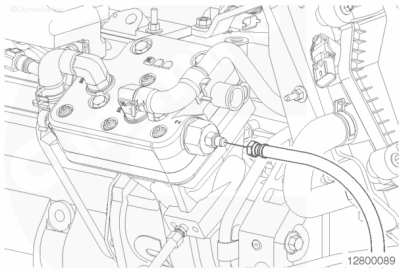
⚠ CAUTION ⚠

While cleaning the air compressor cylinder head, do NOT install the original intake or discharge plumbing. Only use the intake and discharge lines and fitting

ANADOLU ISUZU AFTER SALES

supplied with the air compressor cleaning kit during this procedure.

Install the discharge line and clamp from Air Compressor Cleaning Kit, Part Number 2892280, onto the discharge port fitting on the air compressor cylinder head.



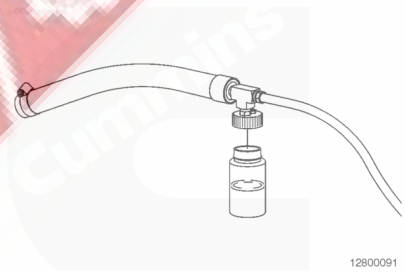
Place the discharge line into a 19 liter [5 gal] bucket. Cover with several oil absorption pads.



Pour 89 ml [3 fluid ounces] of automatic transmission fluid into the dispensing bottle.

Install the dispensing bottle onto the dispensing hose assembly.

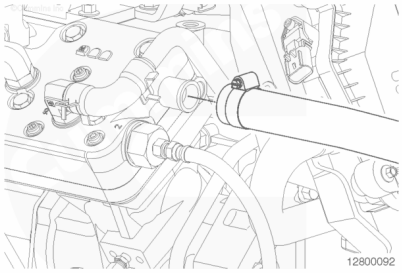
Note : For best results, use Dexron® III automatic transmission fluid or equivalent.



Install and tighten the dispensing hose assembly. Clamp to the intake port of the air compressor cylinder head.

Connect regulated shop air at 621 kPa [90 psi] to the air compressor cleaner.

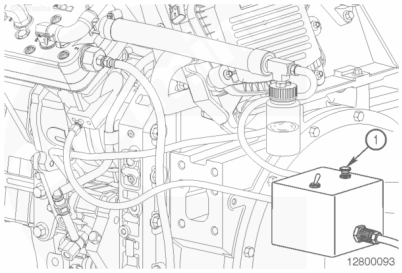
Note : The next three steps will happen quickly. For best results, read the remaining instructions prior to continuing with the cleaning procedure. Do **not** cycle the unloader until all 89 ml [3 fl oz] of automatic transmission fluid have been applied.



Start the engine. Let it idle for 1 minute.

The air compressor can draw in the automatic transmission fluid naturally (no forced air applied). If the fluid is **not** pulled from the dispensing bottle, press and hold the ‘Clean’ button (1) on the air compressor cleaner until all 89 ml [3 fluid ounces] of automatic transmission fluid have been dispensed.

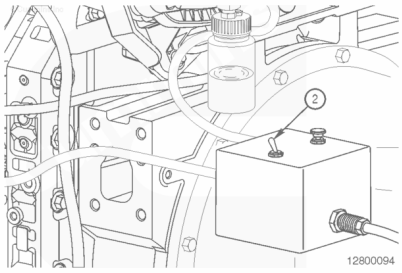
Shut the engine OFF.



Pour 89 ml [3 fl oz] of automatic transmission fluid into the dispensing bottle. Install back onto the dispensing hose assembly.

Toggle the ‘Unloader’ switch (2) ON to apply air pressure to the unloader signal port.

Do **not** relieve pressure at the unloader valve at this time.



Start the engine.

Immediately depress and hold the ‘Clean’ button on the air compressor cleaner until all 89 ml [3 fl oz] of automatic transmission fluid have been dispensed. Continue to hold the ‘Clean’ button down for an additional 10 to 20 seconds.

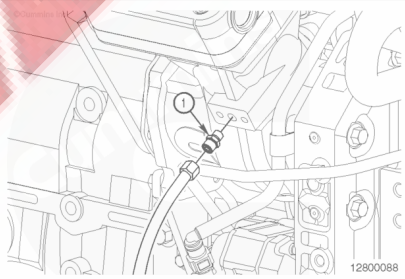
Note : A heavy mist of automatic transmission fluid will be coming from the discharge hose.



Shut the engine OFF.

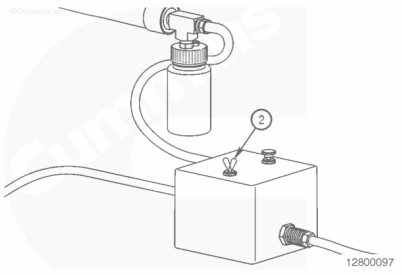
Remove the discharge hose assembly from the air compressor cylinder head intake port.

Start the engine.

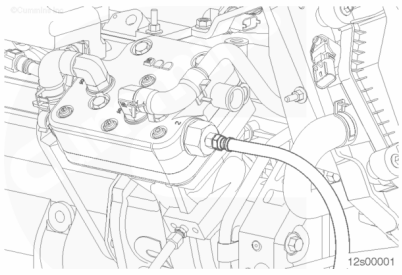


Continuously cycle the ‘Unloader’ switch on the air compressor cleaner for up to 25 cycles.

Note : When the air compressor cylinder head has been adequately cleaned, there should be an audible difference between loaded and unloaded states of the air compressor. Installation of a 1.5 meter [5 ft] length of rubber hose over the intake port can help to audibly identify when the unloader is functioning properly.



Verify constant suction at the air compressor cylinder head intake port when the air compressor is loaded (unloader switch OFF), and fluctuating air flow when unloaded (unloader switch ON). If constant suction is **not** present in a loaded state, repeat the cleaning process one additional time.



⚠ CAUTION ⚠

ANADOLU ISUZU
PAPER SALES

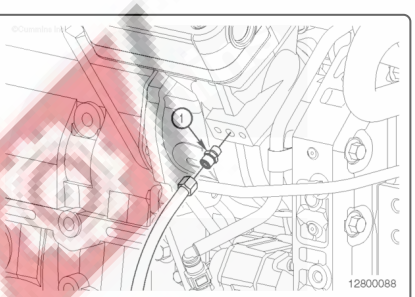
Operating the air compressor with no filter in place at the intake port can allow dust or debris to enter the air compressor. A rubber hose should be placed over the intake port and routed to an area free of airborne dust and debris.



With the discharge hose still installed, relieve the pressure at the unloader port (switch OFF), and operate the engine at high idle for 3 to 5 minutes to remove any excess automatic transmission fluid.

Allow engine to return to low idle. Shut the engine OFF.

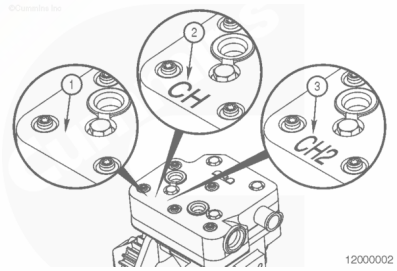
Remove the unloader control valve hose and M10 connector (1).



Use an engraving pen and mark the letters CH below the head bolt as shown.

Refer to Procedure 012-014 in Section 12. (/qs3/pubsys2/xml/en/procedures/425/425-012-014.html)

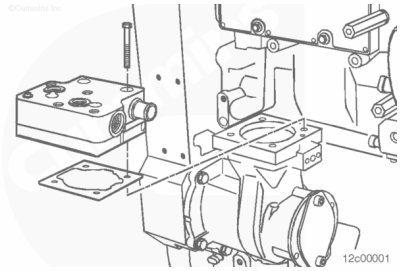
If the air compressor does **not** function properly, perform the Off-Engine Repair.



Off-Engine Repair

⚠ WARNING ⚠

Use skin and eye protection when handling caustic solutions to reduce the possibility of personal injury.



⚠ WARNING ⚠

Wear appropriate eye and face protection when using compressed air. Flying debris and dirt can cause personal injury.

⚠ CAUTION ⚠

Do not use a sharp object to remove carbon. The sealing surfaces can be damaged.

ANADOLU ISUZU MASTER SALES

⚠ CAUTION ⚠

Avoid getting debris and solvents into the clearance between the piston and bore.

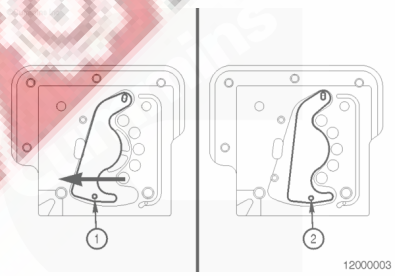
⚠ CAUTION ⚠

Avoid the use of abrasive products similar to “Scotch Brite™” because any abrasive grit left after cleaning will shorten the life of the air compressor.

Remove the compressor head and valve assembly. Refer to Procedure 012-007 in Section 12. (/qs3/pubsys2/xml/en/procedures/425/425-012-007.html)

⚠ WARNING ⚠

When using solvents, acids, or alkaline materials for cleaning, follow the manufacturer’s recommendations for use. Wear goggles and protective clothing to reduce the possibility of personal injury.



Remove carbon from the compressor head and valve assembly components. Use a non-abrasive solvent and a non-metallic brush.

Note : Using an abrasive solvent like carburetor cleaner can lead to further lubrication loss in the air compressor head.

Blow out passages with compressed air.

Verify the unloader slider plate is fully closed when at rest.

Remove the unloader slider plate and verify proper unloader piston travel. Use a stiff wood handle or equivalent non-abrasive device to move the unloader piston by pushing back on the unloader slider plate guide pin in the direction of the arrow as indicated. Be careful **not** to damage the aluminum surface of the head or drop debris into the open slot in which the guide pin travels.

Note : When released, the unloader piston should return to the loaded position (closed) with a quick, smooth motion and audible snap.

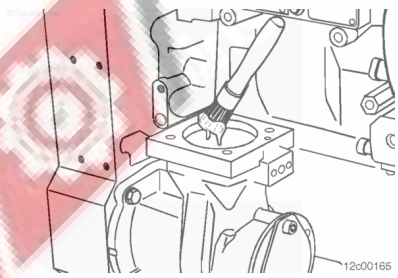
If the unloader piston does **not** return completely to the loaded position with an audible snap; fill the open slot between the unloader slider plate guide pin and the closed

position of the unloader position with automatic transmission fluid.

Actuate the unloader back and forth for three periods of 10 seconds. If the unloader is not free after 10 seconds, fill the open slot again with automatic transmission fluid each time until the piston is free and returns to the loaded position (closed) with a quick, smooth motion and audible snap.

If the unloader piston does **not** return to the loaded position with a quick smooth motion and an audible snap when released after performing the steps above, replace the cylinder head.

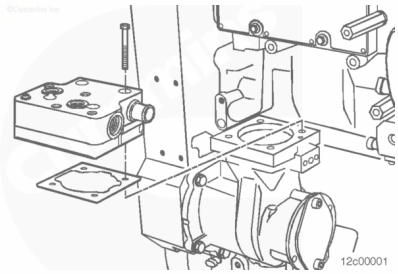
Clean the compressor cylinder.



Rotate the crankshaft until the piston is at the top of the cylinder bore.

Remove any accumulated carbon and varnish by careful scraping and light application of solvents.

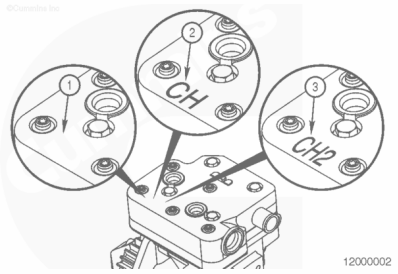
Using an engraving pen, mark the number 2 next to the CH marking already engraved on the cylinder head.



Install the compressor head and valve assembly.

Install the compressor head and valve assembly. Refer to Procedure 012-007 in Section 12. (/qs3/pubsys2/xml/en/procedures/425/425-012-007.html)

Perform the Air Compressor Diagnostic Test to verify the air compressor is functioning properly. Refer to Procedure 012-014 in Section 12. (/qs3/pubsys2/xml/en/procedures/425/425-012-014.html)



If the air compressor does **not** function properly, replace the air compressor cylinder head. Refer to Procedure 012-007 in Section 12. (/qs3/pubsys2/xml/en/procedures/425/425-012-007.html)

ANADOLU ISUZU PARTS

Last Modified: 01-Nov-2016


ANADOLU ISUZU
AFTER SALES

Select Service Tools

Recommended Cummins® Service Tools

- Removal tool, Part Number 4918878

Additional Service Items

- No additional service items required.

Preparatory Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

⚠ WARNING ⚠

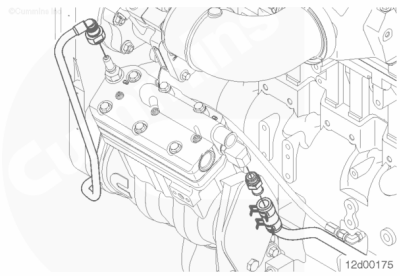
Do not remove the pressure cap from a hot engine. Wait until the coolant temperature is below 50°C [120°F] before removing the pressure cap. Heated coolant spray or steam can cause personal injury.

⚠ WARNING ⚠

Coolant is toxic. Keep away from children and pets. If not reused, dispose of in accordance with local environmental regulations.

- Disconnect the batteries. See equipment manufacturer service information.
- Drain the cooling system. Refer to Procedure 008-018 in Section 8. (/qs3/pubsys2/xml/en/procedures/425/425-008-018-tr.html)
- Remove the starting motor, if necessary. Refer to Procedure 013-020 in Section 13. (/qs3/pubsys2/xml/en/procedures/425/425-013-020-tr.html)
- Remove the fuel filter, if necessary. Refer to Procedure 006-015 in Section 6. (/qs3/pubsys2/xml/en/procedures/425/425-006-015-tr.html)

Remove



Note : The air compressor cooling lines illustrated can differ depending on the compressor installed. Some options will have the air compressor coolant return line routed behind the engine and plumbed to the water inlet connection. In this case, the coolant return line is composed of three different segments, all connected by quick-disconnect fittings.

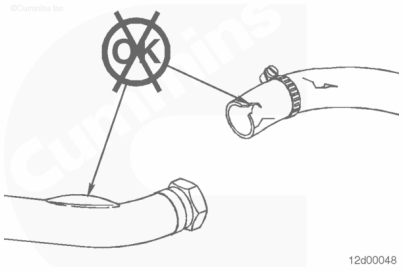
Remove the coolant supply and return lines from the air compressor cylinder head.

Remove the coolant supply line from the engine cylinder head and coolant return line from the water inlet connection.

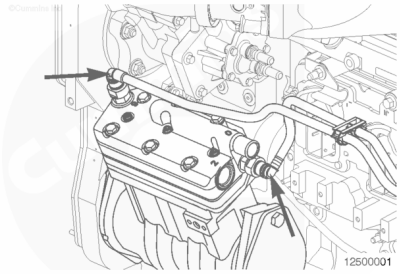
Note : If equipped with quick-disconnect lines, remove the quick-disconnect lines by pressing in the locking tangs on both sides of the quick-disconnect fitting. To aid in removal, slide removal tool, Part Number 4918878, over the locking tangs. Make sure the tool is removed from the fitting as soon as possible after the line is disconnected. Inadvertently leaving the tool in place can result in leaks.

Inspect for Reuse

Inspect the coolant hoses and coolant lines for restriction of coolant flow.



Install



Note : The air compressor cooling lines illustrated can differ depending on the compressor installed. Some options will have the air compressor coolant return line routed behind the engine and plumbed to the water inlet connection. In this case, the coolant return line is composed of three different segments, all

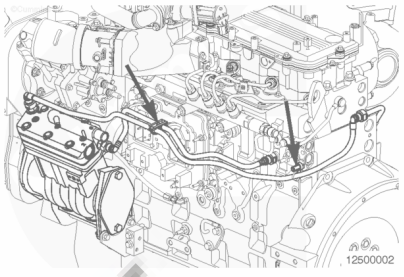
ANADOLU ISUZU AFTER SALES

connected by quick-disconnect fittings. The torque specification for all options remains the same.

Install the coolant supply and return lines onto the air compressor cylinder head.

Install the coolant supply line onto the engine cylinder head and coolant return line onto the water inlet connection.

Torque Value: 24 n•m [212 in-lb]



If equipped with quick-disconnect lines, install the quick-disconnect lines by pushing the quick-disconnect fitting onto the male union until it clicks.

GRAPHIC NOT FOUND

Finishing Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

- Install the fuel filter, if removed. Refer to Procedure 006-015 in Section 6. (/qs3/pubsys2/xml/en/procedures/425/425-006-015-tr.html)
- Install the starting motor, if removed. Refer to Procedure 013-020 in Section 13. (/qs3/pubsys2/xml/en/procedures/425/425-013-020-tr.html)
- Fill the cooling system. Refer to Procedure 008-018 in Section 8. (/qs3/pubsys2/xml/en/procedures/425/425-008-018-tr.html)
- Connect the batteries. See equipment manufacturer service information.
- Operate the engine. Check for leaks.

ANADOLU ISUZU Series


ANADOLU ISUZU
AFTER SALES

Select Service Tools

Recommended Cummins® Service Tools

- No Cummins® Service Tools required.

Additional Service Items

- No additional service items required.

Preparatory Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

⚠ WARNING ⚠

Do not remove the pressure cap from a hot engine. Wait until the coolant temperature is below 50°C [120°F] before removing the pressure cap. Heated coolant spray or steam can cause personal injury.

⚠ WARNING ⚠

Coolant is toxic. Keep away from children and pets. If not reused, dispose of in accordance with local environmental regulations.

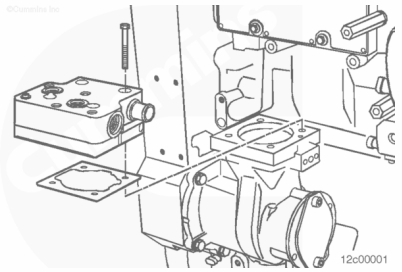
- Disconnect the batteries. See equipment manufacturer service information.
- Drain the cooling system. Refer to Procedure 008-018 in Section 8. (/qs3/pubsys2/xml/en/procedures/425/425-008-018-tr.html)
- Remove the air compressor coolant lines.
- Remove the air governor or air governor signal line, if equipped.
- Remove the air inlet and outlet connections from the air compressor.

ANADOLU ISUZU

Remove

Remove the four 8 mm capscrews.

Remove the head and gasket.



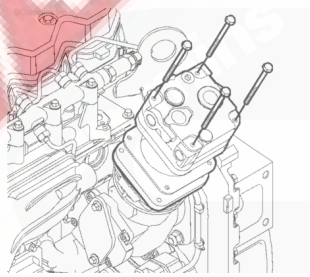
Install

Knorr-Bremse™ Air Compressors

Install the cylinder head and new gasket in the same orientation as removed.

Install four new mounting capscrews.

Tighten the capscrews to the proper value. See the air compressor manufacturer for specific torque values.



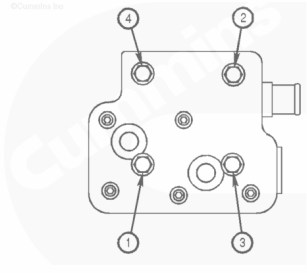
Wabco™ Air Compressors

Assemble the air compressor. Use a new gasket.

Install the head and gasket.

Install the four 8 mm capscrews.

Tighten the capscrews in the sequence shown. Use the torque plus angle method.



Torque Value:

Cylinder Head Capscrews

1. 25 n•m [221 in-lb]
2. Rotate 90 degrees.

Note : If a new head assembly is being installed, the five small head cover bolts **must** be tightened.

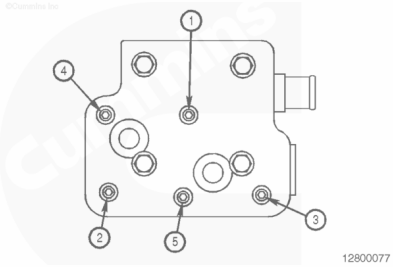
If a new head assembly is being installed, tighten the five small head cover bolts in the sequence shown.

Torque Value:

1. 6 n•m [53 in-lb]

ANADOLU ISUZU AFTER SALES

2. Rotate 90 degrees.



Finishing Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

⚠ WARNING ⚠

Coolant is toxic. Keep away from children and pets. If not reused, dispose of in accordance with local environmental regulations.

- Install the air inlet and outlet connections from the air compressor.
- Install the air governor or air governor signal line, if equipped.
- Install the air compressor coolant lines.
- Fill the cooling system. Refer to Procedure 008-018 in Section 8. (/qs3/pubsys2/xml/en/procedures/425/425-008-018-tr.html)
- Connect the batteries. See equipment manufacturer service information.
- Operate the engine. Check for leaks.

ANADOLU ISUZU PARTS

Last Modified: 05-Aug-2016

Select Service Tools

Recommended Cummins® Service Tools

- No Cummins® Service Tools required.

Additional Service Items

- Stiff wooden handle

Preparatory Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

⚠ WARNING ⚠

Do not remove the pressure cap from a hot engine. Wait until the coolant temperature is below 50°C [120°F] before removing the pressure cap. Heated coolant spray or steam can cause personal injury.

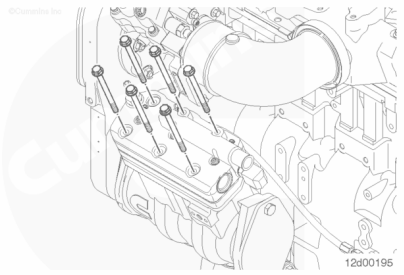
⚠ WARNING ⚠

Coolant is toxic. Keep away from children and pets. If not reused, dispose of in accordance with local environmental regulations.

- Disconnect the batteries. See equipment manufacturer service information.
- Drain the coolant. Refer to Procedure 008-018 in Section 8. (/qs3/pubsys2/xml/en/procedures/425/425-008-018-tr.html)
- Remove the air governor or air governor signal line, if necessary. See equipment manufacturer service information.
- Remove the air compressor coolant lines. Refer to Procedure 012-004 in Section 12. (/qs3/pubsys2/xml/en/procedures/425/425-012-004.html)

Remove

Note : During the removal of the air compressor cylinder head, it is **not** necessary to remove the three M6 internal hex capscrews.



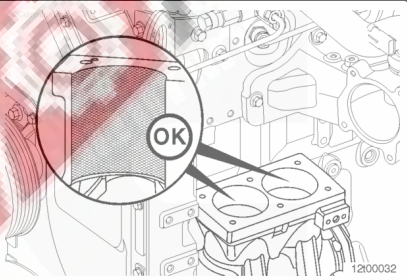
Remove the six M8 cylinder head bolts.

Remove the air compressor cylinder head and gasket.

Inspect for Reuse

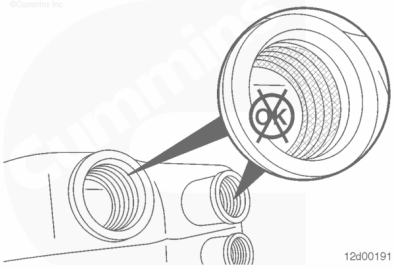
⚠ CAUTION ⚠

Do not use an abrasive cleaning tool on any surface of the air compressor cylinder head. If an abrasive cleaning tool is used, the air compressor cylinder head can become damaged.

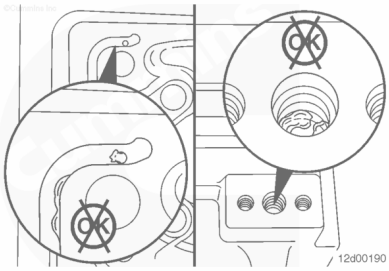


Inspect the air compressor cylinder bores for damage. Refer to Procedure 012-014 in Section 12. (/qs3/pubsys2/xml/en/procedures/425/425-012-014.html)

Inspect the intake and exhaust ports for excessive carbon buildup. Refer to Procedure 012-003 in Section 12. (/qs3/pubsys2/xml/en/procedures/425/425-012-003.html)



Inspect the air governor signal channel in the air compressor cylinder head. The channel **must** appear as a clean aluminum surface.



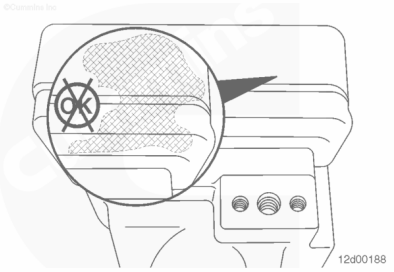
The air compressor cylinder head **must** be replaced if there is any sign of rust, dirt, or exhaust gas recirculation debris present.

Note : If rust is found in the air governor signal channel, it is the result of poor system maintenance. Check for proper operation of the air dryer and wet tanks. See equipment manufacturer service information.

Inspect the air compressor cylinder head for signs of a coolant leak.

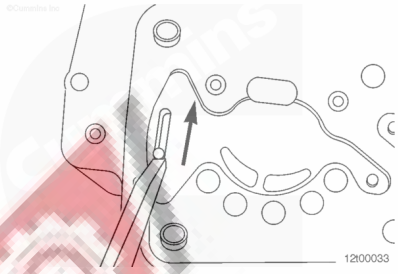
A coolant leak will be identified by an area of engine paint appearing to have been washed away. White crystalline clusters of material are **not** a sign of a coolant leak.

If a leak is found, replace the air compressor cylinder head.



Verify the unloader slider plate is fully closed when at rest.

Remove the unloader slider plate and verify proper unloader piston travel. Use a stiff wooden handle or equivalent non-abrasive device to move the unloader piston by pushing back on the unloader slider plate guide pin in the direction of arrow as indicated. Be careful **not** to damage the aluminum surface of the head or drop debris into the open slot in which the guide pin travels.



Note : When released, the unloader piston should return to the loaded position with a quick, smooth motion and an audible snap.

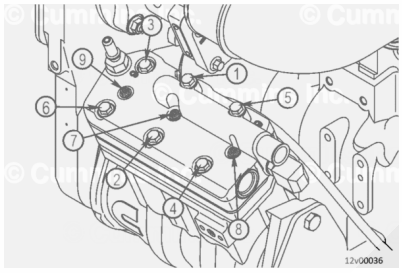
If the unloader piston does **not** return to the loaded position with a quick, smooth motion and audible snap, see the table below for repair direction.

Unloader Movement Check	
Guide Pin Action	**Repair Direction**
Guide pin can be moved to loaded (closed) position by hand.	Spring is broken or weak. Replace the cylinder head. Refer to Procedure 012-003 in Section 12. (/qs3/pubsys2/xml/en/procedures/425/425-012-003.html)
Guide pin does **not** return or slow to return to loaded position.	

Install

Note : If a new head assembly is being installed, see the instructions provided in the new head assembly kit.

Assemble the air compressor using a new gasket and capscrews.



Install the head and gasket to the air compressor body.

Install the six 8 mm capscrews. Tighten in the sequence illustrated.

Tighten the capscrews.

Step	Capscrew	Torque	Rotation Degrees
1	1	25 N•m [221 in-lb]	
2	2	25 N•m [221 in-lb]	
3	3	25 N•m [221 in-lb]	
4	4	25 N•m [221 in-lb]	
5	5	25 N•m [221 in-lb]	
6	6	25 N•m [221 in-lb]	
7	1		270 degrees
8	2		180 degrees
9	3		180 degrees
10	4		180 degrees
11	5		270 degrees
12	6		180 degrees
13	7	7 N•m [62 in-lb]	
14	8	7 N•m [62 in-lb]	
15	9	7 N•m [62 in-lb]	
16	7		180 degrees
17	8		135 degrees
18	9		180 degrees

Finishing Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

- Install the air governor or air governor signal line, if necessary. See equipment manufacturer service information.
- Install the air compressor coolant lines. Refer to Procedure 012-004 in Section 12. (/qs3/pubsys2/xml/en/procedures/425/425-012-004.html)
- Fill the cooling system. Refer to Procedure 008-018 in Section 8. (/qs3/pubsys2/xml/en/procedures/425/425-008-018-tr.html)
- Connect the batteries. See equipment manufacturer service information.
- Operate the engine. Check for leaks.

Last Modified: 14-Apr-2020

ANADOLU ISUZU AFTER SALES

Select Service Tools

Recommended Cummins® Service Tools

- No Cummins® Service Tools required.

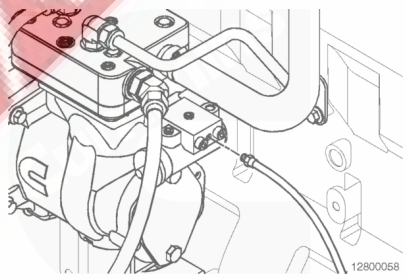
Additional Service Items

- No additional service items required.

Preparatory Steps

⚠ WARNING ⚠

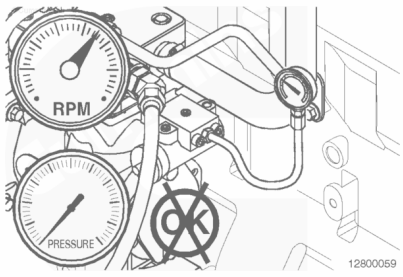
Air pressure must be released from the system before removing the air governor. The governor can be under pressure and cause personal injury.



Disconnect the air governor or air governor signal line from the air compressor.

Operate the engine to activate the air compressor.

If the air system pressure does **not** rise, the unloader valve assembly is malfunctioning. Refer to Procedure 012-003 in Section 12. (/qs3/pubsys2/xml/en/procedures/425/425-012-003.html)

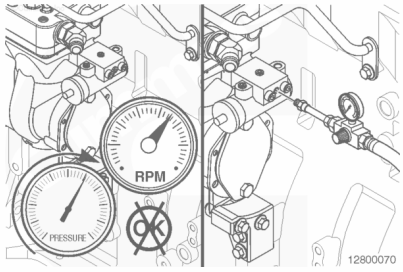


If the air compressor has multiple air governor unloader ports, install a pipe plug into one of the ports, and a shop air fitting into another unloader port.

Connect a regulated shop air hose to the fitting in the unloader port.

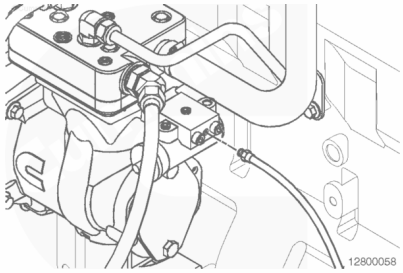
Operate the engine to activate the air compressor.

When the air system pressure has reached 586 kPa [85 psi], apply 698 kPa [100 psig] of shop air pressure to the unloader port. If the system air pressure continues rising, the



unloader valve assembly is malfunctioning. Refer to Procedure 012-003 in Section 12. (/qs3/pubsys2/xml/en/procedures/425/425-012-003.html)

Connect the original equipment manufacturer (OEM) air governor signal line to the air compressor unloader port.



Operate the engine to activate the air compressor. Verify the system still builds pressure properly.

If the air system pressure continues to build beyond the governed point, the air governor is malfunctioning.

- Refer to Procedure 012-018 in Section 12. (/qs3/pubsys2/xml/en/procedures/425/425-012-018.html)
- Refer to Procedure 012-017 in Section 12. (/qs3/pubsys2/xml/en/procedures/100/100-012-017.html)

ANADOLU ISUZU AFTER SALES

Last Modified: 06-Oct-2016

Select Service Tools

Recommended Cummins® Service Tools

- Water pump bearing separator, Part Number 3375326, or equivalent
- Barring tool, Part Number 3824591, or equivalent
- Loctite®, Part Number 3824040, or equivalent

Additional Service Items

- No additional service items required.

Pressure Test

⚠ WARNING ⚠

The external pressure tank used must meet SAE J10 and FMVSS121 standards, and have a safety pressure relief valve which opens between 1034 to 1207 kPa [150 to 175 psi]. Failure to use the proper pressure vessel and plumbing can result in property damage and serious personal injury.

Air Compressor Diagnostic Test

1. Park vehicle on a level surface and in an area where it is safe to idle for an extended period of time. Chock the vehicle wheels or use an appropriate anti-roll device to stabilize the vehicle.
2. Drain the vehicle air system.
3. Remove the air discharge hose and air governor signal hose from the air compressor.
4. Plumb an air discharge hose from the air compressor into an external pressure tank. The external pressure tank **must** be equipped with a 1034 kPa [150 psi] pressure gauge and 1034 kPa [150 psi] pressure relief valve. Make sure the fittings are installed with appropriate thread sealant and do **not** leak.

Start the engine. Operate at rated engine speed.

Note : Once the external pressure tank pressure reaches 862 kPa [125 psi], shut the engine OFF. Depending on the size of the external tank and the diameter/length of the discharge hose being used, the buildup time will vary.

For example, a single cylinder (318 cc) compressor filled 42 liters [11 gal] tank to 862 kPa [125 psi], using a (#10 x 6ft length) discharge hose in 90 seconds. This was considered in specification for this setup.

Verify the air compressor will build pressure in the external tank. If air pressure successfully builds to 862 kPa [125 psi], the air compressor functions properly. Remove the external air discharge hose from the air compressor and install the vehicle air discharge hose and air governor signal hose to the compressor. See the symptom tree being utilized to inspect the rest of the air system components for leaks. Verify proper operation.

If the air compressor fails to build to 862 kPa [125 psi], the air compressor is malfunctioning and the cylinder head needs to be repaired, based on the marking scribed on the head. Refer to Procedure 012-003 in Section 12. (/qs3/pubsys2/xml/en/procedures/425/425-012-003.html)

Preparatory Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

⚠ WARNING ⚠

Coolant is toxic. Keep away from children and pets. If not reused, dispose of in accordance with local environmental regulations.

⚠ WARNING ⚠

Wear safety glasses or a face shield, as well as protective clothing, to prevent personal injury when using a steam cleaner or high-pressure water.

⚠ WARNING ⚠

Wear appropriate eye and face protection when using compressed air. Flying debris and dirt can cause personal injury.

⚠ WARNING ⚠

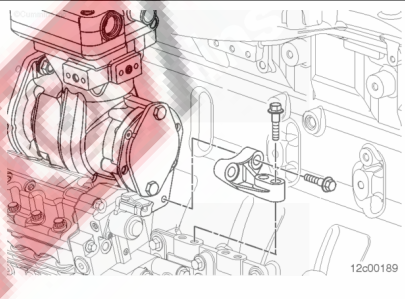
Do not remove the pressure cap from a hot engine. Wait until the coolant temperature is below 50°C [120°F] before removing the pressure cap. Heated coolant spray or steam can cause personal injury.

- Disconnect the batteries. See equipment manufacturer service information.
- Drain the engine cooling system. Refer to Procedure 008-018 in Section 8. (/qs3/pubsys2/xml/en/procedures/425/425-008-018-tr.html)

- Clean the air compressor. Use steam. Dry with compressed air.
- Remove the coolant lines. Refer to Procedure 012-004 in Section 12. (/qs3/pubsys2/xml/en/procedures/425/425-012-004.html)
- Remove the air connections from the air compressor. Refer to Procedure 012-003 in Section 12 (/qs3/pubsys2/xml/en/procedures/425/425-012-003.html).
- Remove or disconnect the air governor. See equipment manufacturer service information.
- Remove any driven equipment from the back of the air compressor, if equipped.

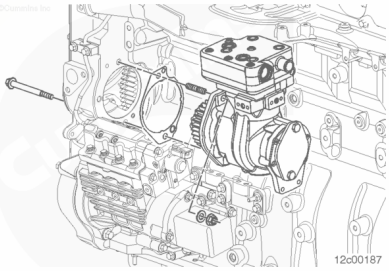
Remove

Remove the air compressor support bracket and capscrews.



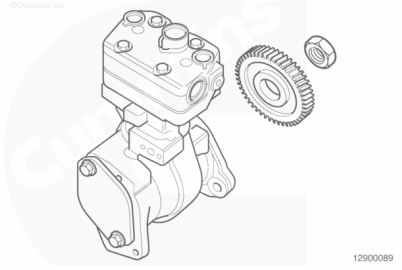
Remove the mounting nut, capscrew, and air compressor.

Discard the gasket.



Disassemble

Note : Replacement Knorr-Bremse™ air compressors are shipped without an air compressor drive gear. If replacing the air compressor or if the air compressor drive gear is damaged, remove the drive gear from the air compressor.



Remove the air compressor drive gear mounting fastener.

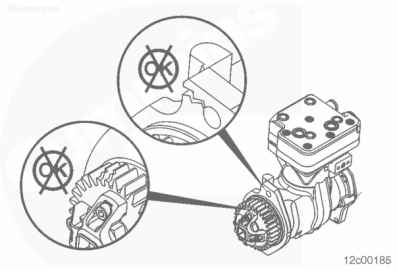
Use a suitable gear puller or bearing separator, such as Part Number 3375326, or equivalent, to remove the air compressor drive gear.

ANADOLU ISUZU AFTER SALES

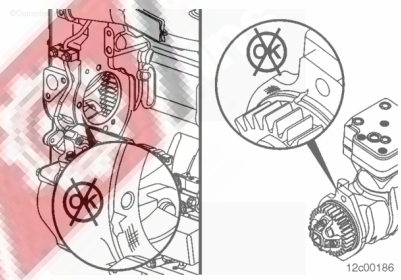
Time

Inspect the air compressor housing for cracks or other damage.

Inspect the air compressor drive gear for cracks or other damage.



Make sure the gasket surfaces of the front gear housing and air compressor are clean and **not** damaged.

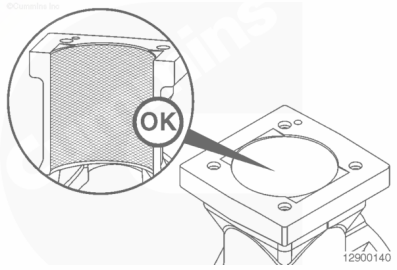


Remove the air compressor cylinder head if it is **not** already removed. Refer to Procedure 012-007 in Section 12. (/qs3/pubsys2/xml/en/procedures/425/425-012-007.html)

Inspect the inside circumference for vertical scratches deep enough to be felt with a fingernail.

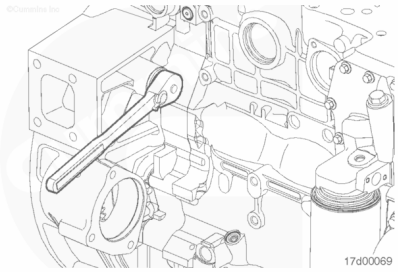
If a fingernail catches in the scratch, the air compressor **must** be replaced.

Inspect the inside circumference for scuffing, scoring, or polishing.

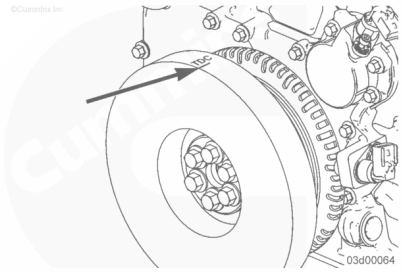


Note : To make sure the air compressor does **not** contribute to engine vibrations when installed, the air compressor **must** be properly timed to the engine.

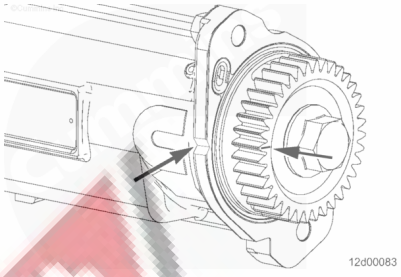
Use barring tool, Part Number 3824591, or equivalent, to rotate the crankshaft until the number 1 is at top dead center (TDC).



Align the vibration damper so the TDC indicator on the vibration damper is at the 12 o'clock position.

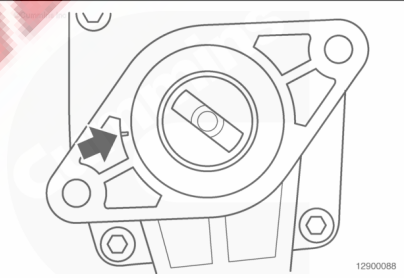


Note : If no TDC mark is present on either the vibration damper or the crankshaft speed indicator ring, align the large gap in the crankshaft speed indicator ring to the 5 o'clock position. The dowel pin can also be visible in the 9 o'clock position.



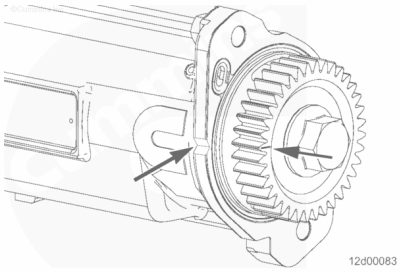
Wabco™ Air Compressors

Set the timing mark on the air compressor gear to the 9 o'clock position when looking at the gear. It **must** point at the casting depression on the side of the air compressor mounting flange.



Knorr-Bremse™ Air Compressors

Set the air compressor to TDC by aligning the two timing marks on the rear of the compressor and on the rear drive.



ANADOLU ISUZU AFTER SALES

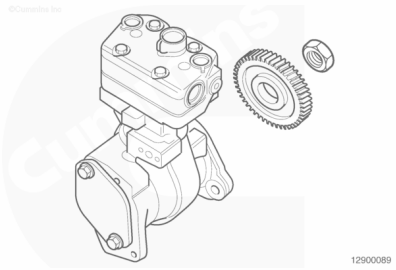
Assemble

Note : Make sure the drive gear and air compressor drive shaft nose are clean and free of any oil before installing the gear on the air compressor driveshaft.

Install the drive gear onto the air compressor drive shaft.

Install the air compressor drive gear mounting fastener. Tighten.

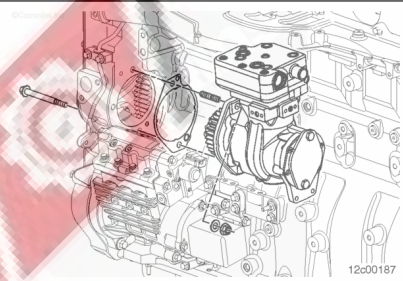
Torque Value: 165 n•m [122 ft-lb]



Install

Install the air compressor, gasket, mounting nut, and capscrew onto the front gear housing.

Note : If the stud is removed, use Loctite®, Part Number 3824040, or equivalent, and install the stud.



Tighten the capscrews.

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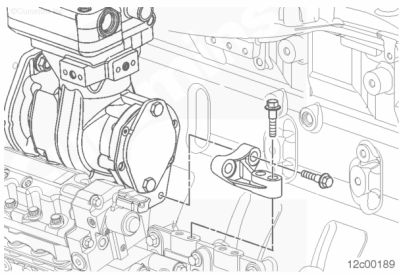
Torque Value: 81 n•m [60 ft-lb]

Tighten the capscrews again.

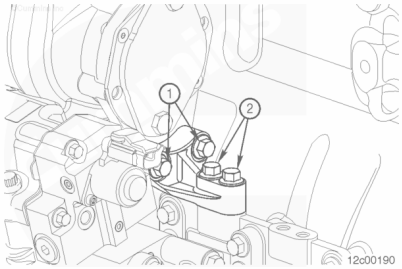
Torque Value: 81 n•m [60 ft-lb]

Install the air compressor mounting brace and four capscrews on the block beneath the air compressor. Start threading all four capscrews.



Tighten the capscrews in the sequence shown on the fuel pump support bracket and air compressor.

Torque Value: 61 n•m [45 ft-lb]



ANADOLU ISUZU AFTER SALES

Finishing Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

⚠ WARNING ⚠

Coolant is toxic. Keep away from children and pets. If not reused, dispose of in accordance with local environmental regulations.

- Install any driven equipment removed to the back of the air compressor, if equipped.
- Install or connect the air governor. See equipment manufacturer service information.
- Install the air connections to the air compressor. Refer to Procedure 012-003 in Section 12. (/qs3/pubsys2/xml/en/procedures/425/425-012-003.html)
- Install the coolant lines. Refer to Procedure 012-004 in Section 12. (/qs3/pubsys2/xml/en/procedures/425/425-012-004.html)
- Fill the engine cooling system. Refer to Procedure 008-018 in Section 8. (/qs3/pubsys2/xml/en/procedures/425/425-008-018-tr.html)
- Connect the batteries. See equipment manufacturer service information.
- Operate the engine to activate the air compressor. Check for leaks.

Last Modified: 27-Feb-2018

ANADOLU ISUZU AFTER SALES

Select Service Tools

Recommended Cummins® Service Tools

- No Cummins® service tools required.

Additional Service Items

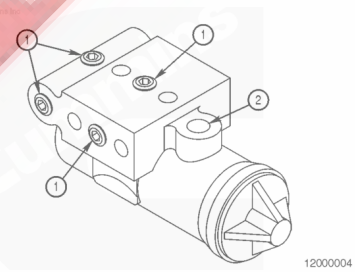
- No additional service items required.

Inspect for Reuse

Verify the air governor signal line is plumbed correctly to the unloader port on the air compressor.

Disconnect and inspect the line for kinks, cuts, nicks or plugging inside the line.

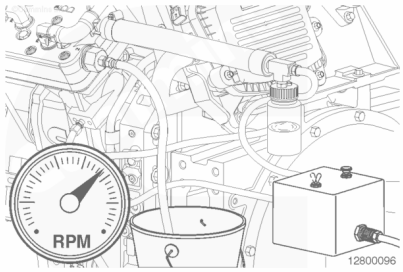
Verify all unused ports (1) on the air governor are plugged except the exhaust port. The exhaust port (2) **must** be vented to the atmosphere at all times.



Activate the air compressor and allow the air pressure to buildup.

If pressure is reading below 125 psi according to the dash gauge, relieve 25 psi of pressure by applying the vehicle brakes to see if the air compressor starts to pump again.

If the air compressor only pumps to the level it was before, the air governor needs to be inspected for proper operation. See equipment manufacturer service information.



ANADOLU ISUZU
AFTER SALES

Last Modified: 24-Oct-2016

Select Service Tools

Recommended Cummins® Service Tools

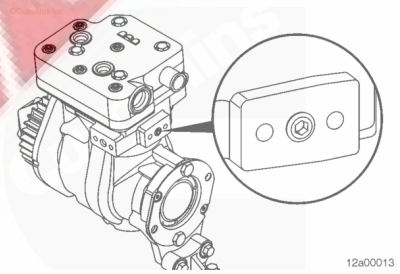
- No Cummins® Service Tools required.

Additional Service Items

- Master gauge

Initial Check

Verify the unused unloader port, if applicable, on the air compressor has a pipe plug installed.



Remove and inspect the air governor signal line from the air compressor for kinks, cuts, nicks, or plugging inside the line.

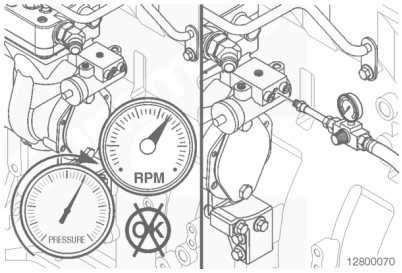
GRAPHIC NOT FOUND

Install pipe plugs in the air governor unloader ports.

Operate the engine to activate the air compressor.

If air pressure stops rising, there is a leak in an accessory or an accessory air line. See equipment manufacturer service information for troubleshooting and repair.

If the air compressor does **not** stop pumping (air pressure continues to rise) at the governed air pressure, connect a regulated shop air pressure line to the air compressor unloader valve port.



Note : Be sure the air pressure gauge is accurate and the supply lines and fittings are in good condition

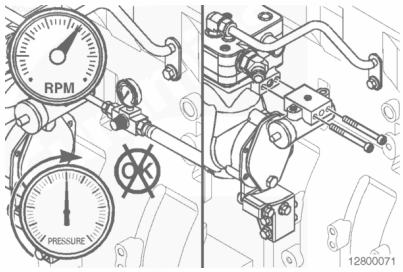
GRAPHIC NOT FOUND

before performing any air pressure checks.

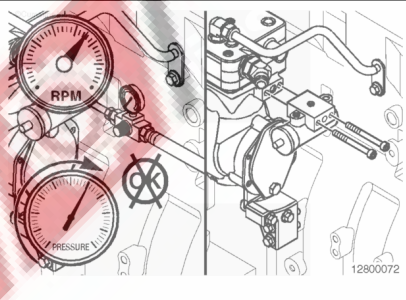
Check the air pressure gauge. Use a master gauge of known accuracy.

Apply 690 kPa [100 psi] air pressure to the unloader port.

If the air compressor stops pumping (air pressure stops rising), the air governor is malfunctioning and **must** be repaired or replaced. See equipment manufacturer instructions.



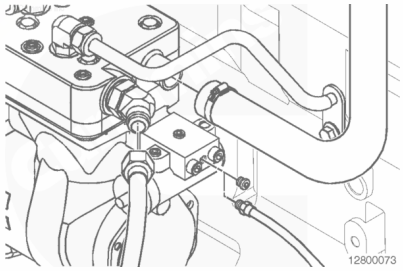
If the air compressor continues to pump (air pressure continues to rise), the unloader valve is malfunctioning and **must** be replaced. Refer to Procedure 012-013 in Section 12. (/qs3/pubsys2/xml/en/procedures/425/425-012-013.html)



Remove the pipe plugs from the unloader ports used for accessory air lines.

Install and tighten the accessory air lines.

Connect the line to the unloader valve.



Operate the engine. Check for air leaks.

GRAPHIC NOT FOUND

ANADOLU ISUZU AFTER SALES

Last Modified: 05-Aug-2016

Select Service Tools

Recommended Cummins® Service Tools

- No Cummins® Service Tools required.

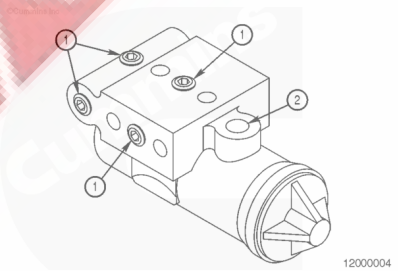
Additional Service Items

- No additional service items required.

Initial Check

Verify the unused unloader port, if applicable, on the air compressor has a pipe plug installed.

Verify all unused ports are plugged with pipe plugs except for the exhaust port on the air governor. The air governor exhaust port **must always** be ventilated to the atmosphere.

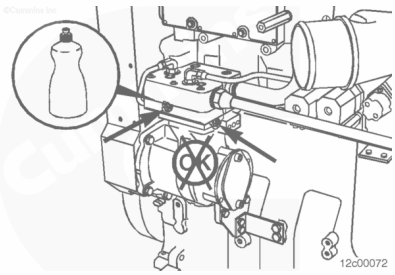


12000004

Operate the engine to activate the air compressor.

With the air compressor pumping between 550 to 690 kPa [80 to 100 psi], use a solution of soapy water to check for air leaks in the following areas:

- Air compressor head gasket
- Air compressor cover gasket
- Fittings and hoses connected to the intake, discharge, and air governor signal line on the air compressor
- Fittings and hoses connected at the air governor, wet tank, and air dryer.


12c00072

If air leaks are found at the air compressor head or cover gasket, verify the air compressor head and cover bolts are tightened properly. Refer to Procedure 012-007 in Section 12. (/qs3/pubsys2/xml/en/procedures/425/425-012-007.html)

Shut the engine OFF. Check for air leaks both at keyswitch OFF and keyswith ON.

Note : Some components at keyswitch ON can make the sound of an air leak.

Walk around the vehicle. Listen for air leaks from the rest of the air system **not** already inspected.

Last Modified: 05-Aug-2016

ANADOLU ISUZU AFTER SALES

Select Service Tools

Recommended Cummins® Service Tools

- Oil carryover test tool, Part Number 4918883 (No longer available)

Additional Service Items

- High temperature flexible hose
- Sealable plastic bag

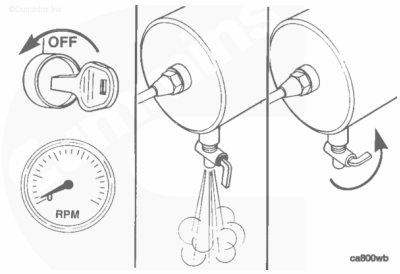
Inspect for Reuse

Perform this test in conjunction with troubleshooting the air compressor pumping oil into the air system.

Note : Small oil deposits at the air dryer purge valve are normal. The air compressor is lubricated with engine oil, and small amounts of carryover are to be expected. Oil carryover is more common on naturally aspirated air compressors. Oil carryover is usually caused by high inlet restriction to the air compressor. If oil carry over is suspected or found, check the engine air filter and air supply plumbing. See original equipment manufacturer (OEM) service information.

⚠ WARNING ⚠

The air discharge line and other equipment will become hot during the course of the test. To prevent burns, use protective gloves when touching heated surfaces.



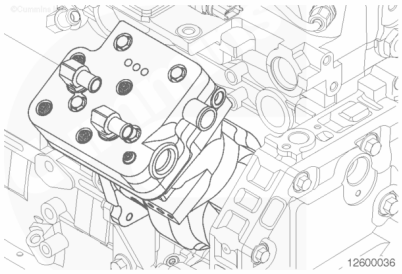
Operate the engine until the coolant temperature reaches normal operating temperature. Once the coolant has reached operating temperature, shut the engine down and completely drain the vehicle air system.

Note : Failure to warm the engine adequately can result in false test results.

⚠ WARNING ⚠

The discharge from the air compressor delivery will be hot, possibly contain oil vapors, and will be noisy. Be sure that there is adequate ventilation and that hearing

protection is used, particularly if the type of vehicle requires that the test be conducted in an enclosed environment.

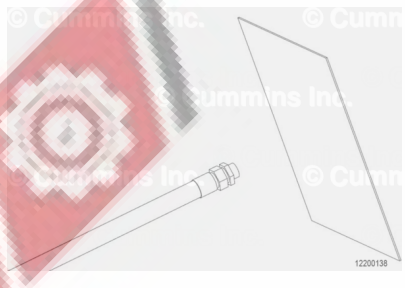


Isolate the air compressor from the rest of the system as follows:

Disconnect the discharge pipe from the air compressor cylinder head.

Disconnect the air inlet plumbing at the air compressor cylinder head.

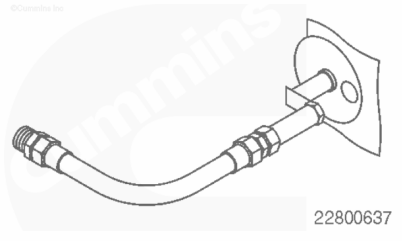
Connect the oil carryover test tool, Part Number 4918883, piping to the air compressor cylinder head discharge port. Do **not** connect the test tool at this stage. This tool has been discontinued and is no longer available for purchase. If you do not have the oil carryover test tool, Part Number 4918883, remove the air compressor discharge line from the air dryer, position the test paper at a distance of 75 mm (3.0 in, **not** to exceed 100 mm [3.9 in] from the end of the OEM compressor discharge line or flexible hose if fitted.



Make sure to have a 90 degree bend or a loop in the flexible hose during testing to create back-pressure.

Note : If the application presents restricted access to the air compressor, a high temperature flexible hose (minimum 15 mm [0.6 in] inside diameter) can be connected directly to the discharge port of the compressor in order to carry out the test outside the engine compartment. Be sure to have a 90 degree bend near the end of the flexible hose during testing.

Start the engine. Operate at high idle for 15 minutes to stabilize temperature and remove standing oil in the air compressor head. The air compressor should be pumping while the engine is running.



After 15 minutes and engine operating temperature is reached (this can be done by using a recommended Cummins® electronic service tool or equivalent to make sure the coolant temperature is above 85°C [185°F]; if the temperature is **not** reached within 15 minutes, continue to operate the engine until temperature is reached, shut down the engine.

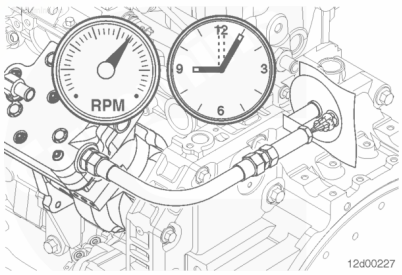
Connect the test tool. Install the test paper into the service tool, Part Number 4918883, if available. Make sure it is held at a right angle to and in line with the flow of compressed air, at a distance **not** to exceed 100 mm [3.9 in] from the end of the compressor discharge pipe or flexible hose, if fitted.

The test paper can be standard clean copier paper, typically 80 grams/sq meter. It **must** be mounted in the air compressor discharge line tool, leaving a 70 mm [2.76 in] diameter circle of the paper exposed. The outline of the circle in the mask **must** be drawn onto the test paper to later aid in comparison.

Note : It can be necessary to use a recommended Cummins® electronic service tool or equivalent to increase the maximum engine speed, without vehicle speed sensor (VSS), to 2100 rpm.


19r00163

To perform the test, start the engine and run at high idle (between 2000 and 2500 rpm). Leave the test paper in the air flow for exactly 5 minutes. Rotate the tool mask exposing a new circular test area.



12d00227

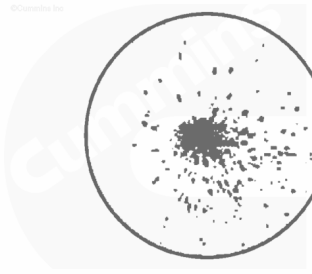
Repeat this test three times, using a new circular test area/paper each time.

Shut the engine OFF. Remove the test paper.

Note : If the maximum engine speed, without VSS, was adjusted in the previous step, change it back to the original value upon completion of the test.

Note : The three test samples should be comparable (similar in size). If **not**, run the test again.

Note : To make sure **only** oil is observed and **not** moisture, look at the back-side of the test paper. Moisture will have a yellow tint, and oil will be black. Compare the test results with the reference results shown below.


12800081

Time Air Compressor Has Been In Service (Months/Years):

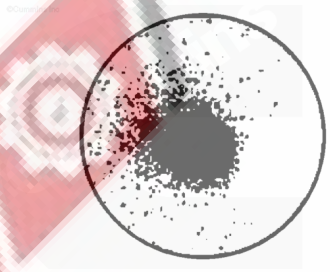
- Less than 6 months:
  - 62,500 miles,
  - 1563 kilometers,
  - or 1563 hours.

- Compressor is in good condition.

- 6 months to 2 years:
  - 62,500 to 250,000 miles,
  - 100,854 to 402,336 kilometers,
  - or 1563 to 6250 hours.
  - Compressor is in good condition.

- Greater than 2 years:
  - 250,000 miles,
  - 402,336 kilometers,
  - or 6250 hours.
  - Compressor is in good condition.

Time Air Compressor Has Been In Service (Months/Years):

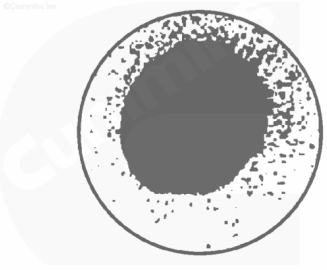


- Less than 6 months:
  - 62,500 miles,
  - 1563 kilometers,
  - or 1563 hours.
  - Compressor needs to be replaced.

- 6 months to 2 years:
  - 62,500 to 250,000 miles,
  - 100,584 to 402,336 kilometers,
  - or 1563 to 6250 hours.
  - Compressor is in acceptable condition.

- Greater than 2 years:
  - 250,000 miles,
  - 402,336 kilometers,
  - or 6250 hours.
  - Compressor is in good condition.

Time Air Compressor Has Been In Service (Months/Years):



- Less than 6 months:
  - 62,500 miles,
  - 1563 kilometers,
  - or 1563 hours.
  - Compressor needs to be replaced.

- 6 months to 2 years:
  - 62,500 to 250,000 miles,
  - 100,584 to 402,336 kilometers,
  - or 1563 to 6250 hours.
  - Compressor needs to be replaced.

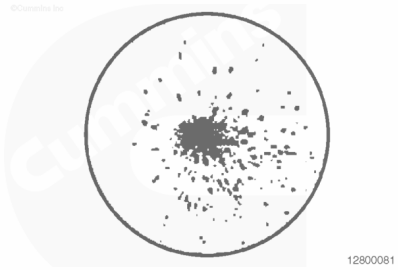
- Greater than 2 years:
  - 250,000 miles,

ANADOLU ISUZU
PARTS SALES

- 402,336 kilometers,
- or 6250 hours.
- Compressor needs to be replaced.

Note : This step **must** be completed if the compressor assembly is replaced as a result of this test and is requested to be returned via the CORE, or enhanced parts return return process.

If the compressor is deemed failed and needs to be replaced, place the test paper, with results of Oil Carryover Test, in a sealable plastic bag, seal to prevent oil contamination, and include with the failed compressor.



ANADOLU ISUZU
AFTER SALES

Last Modified: 23-Mar-2020

Select Service Tools

Recommended Cummins® Service Tools

- No Cummins® service tools required.

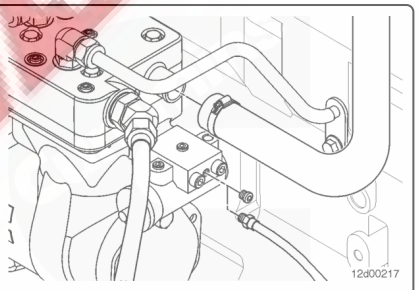
Additional Service Items

- No additional service items required.

Test

⚠ WARNING ⚠

Air pressure must be released from the system before removing the air governor. The governor can be under pressure and cause personal injury.

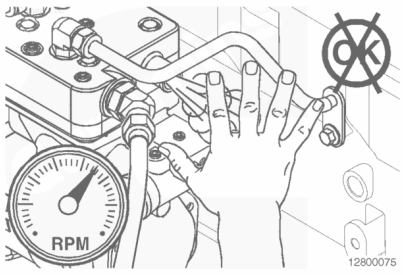


Remove the air governor or air governor line from the air compressor.

Remove the air intake line from the air compressor cylinder head.

⚠ CAUTION ⚠

Do not hold a hand too close to the intake port of the air compressor.

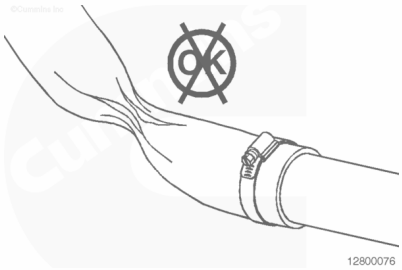


Operate the engine to activate the air compressor.

Hold a hand 5 cm [2 in] from the air compressor intake port. If air is coming out of the intake port, the pressure relief valve is malfunctioning and the air compressor cylinder head **must** be replaced. Refer to Procedure 012-007 in Section 12. (/qs3/pubsys2/xml/en/procedures/425/425-012-007.html) Refer to Procedure 012-008 in Section 12. (/qs3/pubsys2/xml/en/procedures/425/425-012-008.html)

ANADOLU ISUZU
OTHER SALES

If no air is felt from the intake port, check downstream air system components for damage or restrictions. Verify the intake and exhaust valves are functioning properly. Refer to Procedure 012-014 in Section 12. (/qs3/pubsys2/xml/en/procedures/425/425-012-014.html)



Last Modified: 01-Nov-2016

ANADOLU ISUZU AFTER SALES

Select Service Tools

Recommended Cummins® Service Tools

- No Cummins® Service Tools required.

Additional Service Items

- No additional service items required.

Preparatory Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

- Disconnect the batteries. See equipment manufacturer service information.

Remove

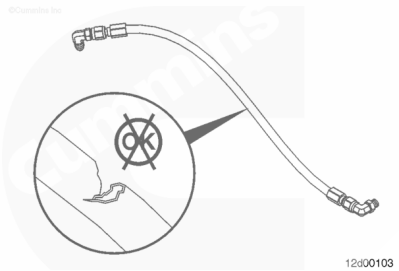
Remove the air compressor oil supply line from the air compressor and cylinder block.

GRAPHIC NOT FOUND

Clean and Inspect for Reuse

Inspect the air compressor oil supply line for cracks, wear, or damage. Replace if any damage is found.

Inspect the air compressor oil supply line and fittings for any obstruction that might prevent proper oil flow. Remove the obstruction or replace the air compressor oil supply line or fittings as necessary.



Install

Install the air compressor oil supply line to the air compressor and cylinder block.

GRAPHIC NOT FOUND

Torque Value: 12 n•m [106 in-lb]

Finishing Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

- Disconnect the batteries. See equipment manufacturer service information.
- Operate the engine. Check for leaks.

ANADOLU ISUZU AFTER SALES

Last Modified: 05-Aug-2016

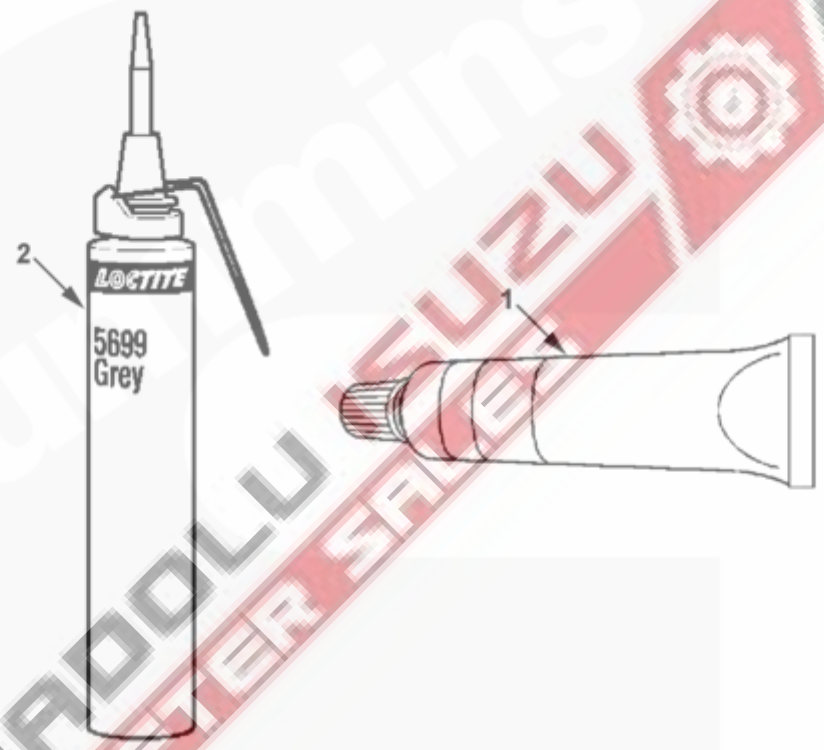
Electrical Equipment

Tool Number

3164067

Sealant Loctite® 5699

Loctite® 5699 Grey RTV silicone sealant (1)(2) is very durable and was released to be used for multiple applications. It can provide a seal in the T-gasket joint on oil pan gaskets.



3164067

Tool Number

3164488 or 3164489

Digital Multimeter

Used to measure electrical circuits: voltage (volts), resistance (ohms), and current (amperes). Standard meter, Part Number 3164488, Automotive meter, Part Number 3164489, with built-in temperature adapter and tachometer.

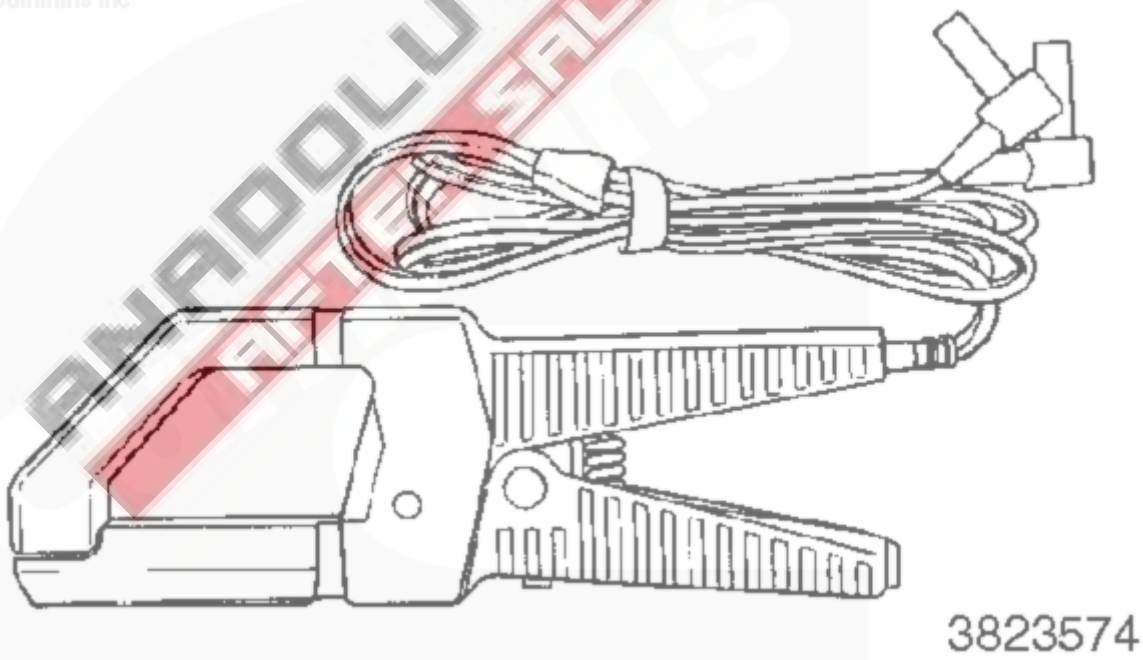


Tool Number

3164490

Clamp-on Current Probe

Used to measure DC current from 0 to 1000 amperes or AC current from 0 to 1000 amperes.

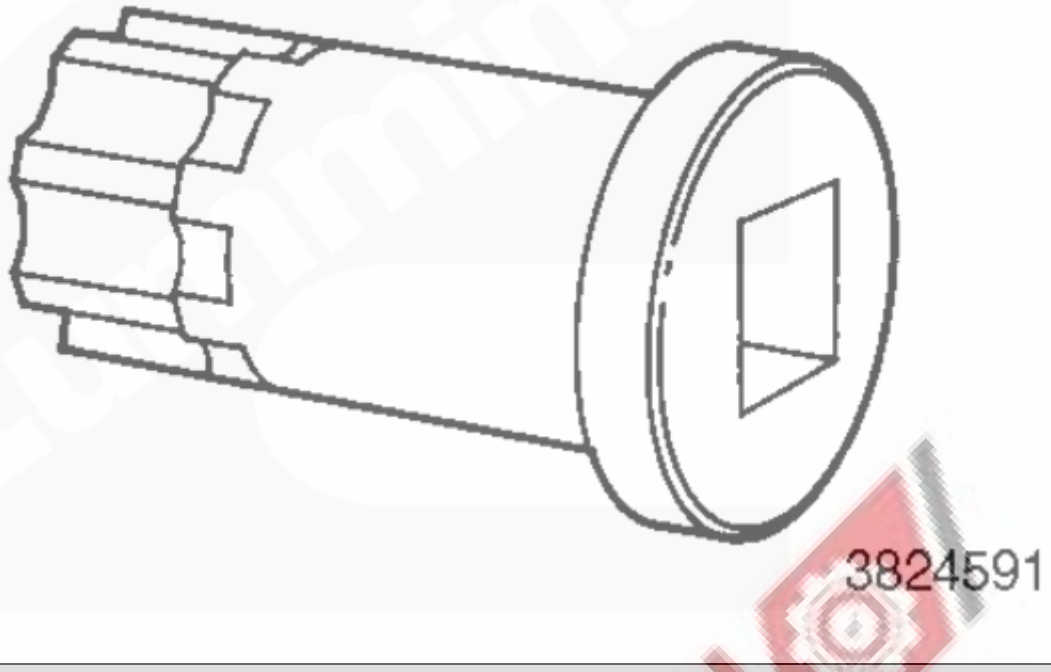


Tool Number

5299073

Barring Tool

Used to engage the flywheel ring gear to rotate the crankshaft.

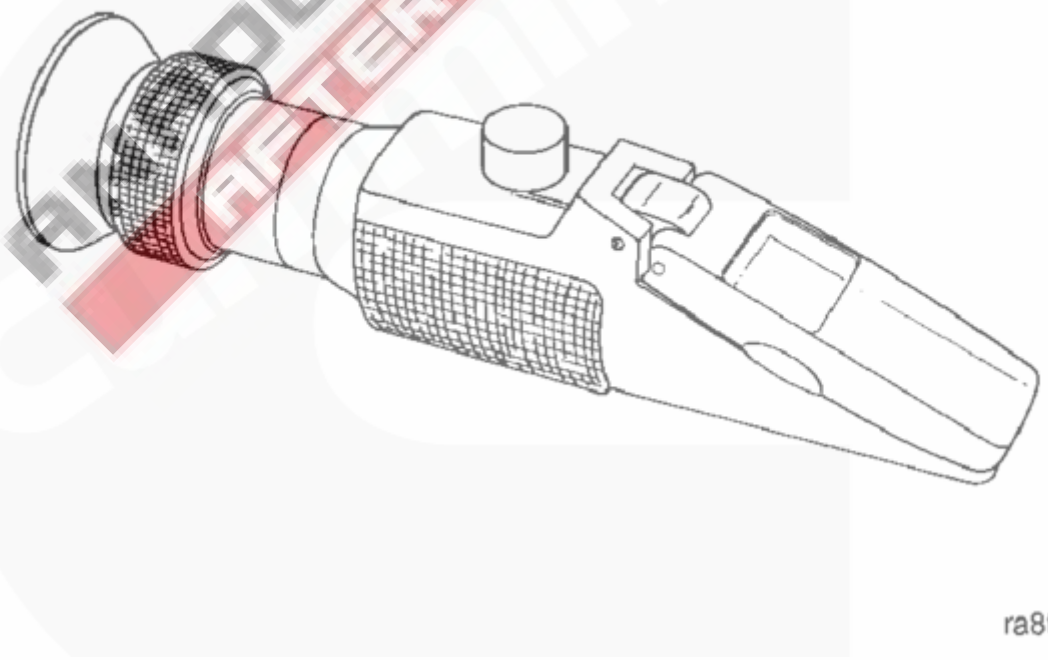


Tool Number

CC 2806

Refractometer

The Fleetguard® refractometer is used to check the charge condition of a conventional battery.




ANADOLU ISUZU
AFTER SALES

Select Service Tools

Recommended Cummins® Service Tools

- Multimeter, Part Number 3164488 or 3164489, or equivalent
- Digital multimeter, Part Number 3164488 or 3164489, or equivalent
- Clamp-on current probe, Part Number 3164490, or equivalent.

Additional Service Items

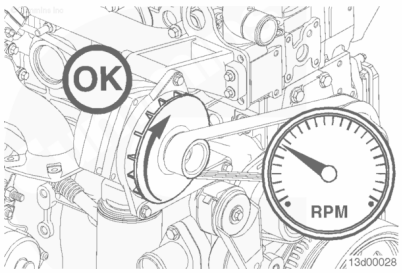
- No additional service items required.

General Information

Due to the number of different alternator brands and configurations, the following procedure has been generalized to cover the most common configurations. Consult the alternator manufacturer for any information **not** covered in this procedure.

Initial Check

Check the drive belt and alternator pulley to make sure the alternator is rotating properly.



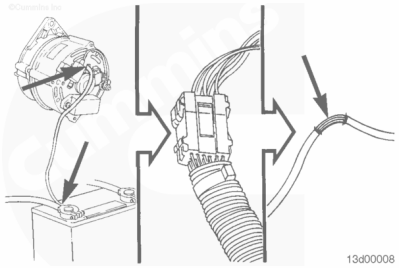
If any problems exist, check the following:

- If the drive belt is slipping on the alternator pulley, inspect the drive belt. Refer to Procedure 008-002 in Section 8. (/qs3/pubsys2/xml/en/procedures/425/425-008-002-tr.html)
- Inspect the belt tensioner. Refer to Procedure 008-080 in Section 8. (/qs3/pubsys2/xml/en/procedures/425/425-008-080-tr.html)
- Check if the alternator pulley is loose on the shaft. If loose, remove the pulley and inspect for damage. See alternator manufacturer and/or the equipment manufacturer service information.
- If the alternator will **not** rotate or does **not** rotate freely, the alternator **must** be replaced. See the Remove and Install sections of this procedure.

ANADOLU ISUZU DEALER SALES

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

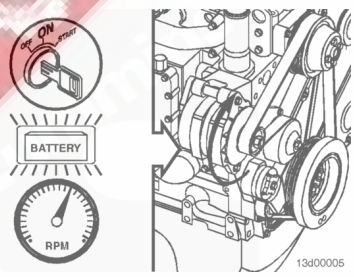


Check the battery and all wiring connections.

Inspect the wiring for defects.

Check all connections for tightness and cleanliness, including the slip connectors at the alternator and engine compartment bulkhead, and connections at the battery.

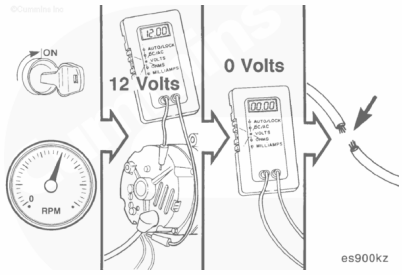
Check the drive belt and alternator pulley to be sure the alternator is rotating.



Test

Note : This test applies to Delco™ alternators.

Note : Any multimeter reading of zero voltage indicates an open circuit.



Check for open circuits.

Turn the keyswitch to the ON position.

Connect multimeter, Part Number 3164488 or 3164489, or equivalent, to the following locations:

Delco™ Alternators

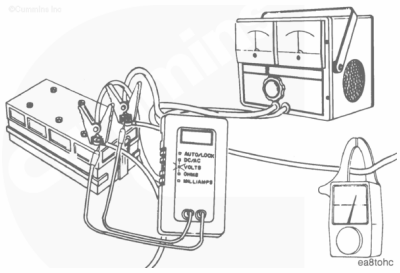
- Alternator "BAT" terminal to ground
- Alternator blade terminal "Number 1" to ground
- Alternator blade terminal "Number 2" to ground.

Locate and repair the open circuit.

ANADOLU ISUZU PARTS SALES

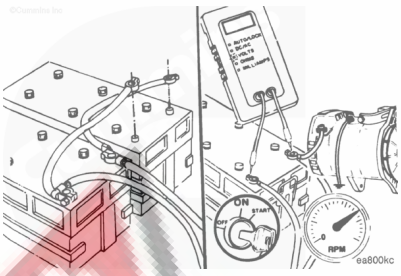
Connect a carbon-pile load (battery/alternator tester) across the battery posts of the battery boxes.

Clamp an induction pickup-type ampere-hour meter around the battery cable; or use digital multimeter, Part Number 3164488 or 3164489, or equivalent, with clamp-on current probe, Part Number 3164490, or equivalent.



⚠ WARNING ⚠

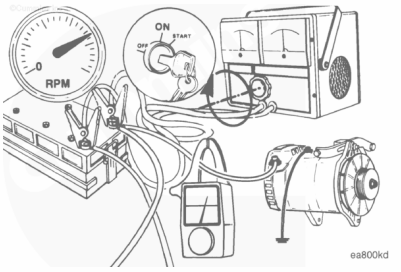
Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.



Disconnect any cables that lead to any other battery boxes in the circuit, negative (-) cables first.

Operate the engine at high idle. Measure the alternator voltage output to the batteries with digital multimeter, Part Number 3164488 or 3164489, or equivalent. See equipment manufacturer service information.

Operate the engine at high idle. Adjust the carbon-pile load-testing equipment to apply the maximum rated amperage load to the alternator. See equipment manufacturer service information.



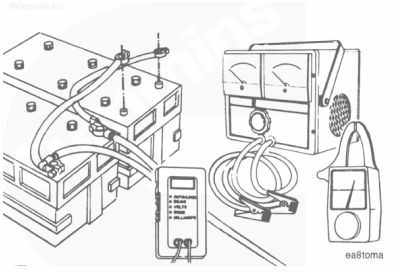
Note : The alternator maximum rated amperage output is normally stamped or labeled on the alternator.

Measure the alternator amperage output. See equipment manufacturer service information.

If the alternator output (amps) is **not** within 10 percent of rated output, repair or replace the alternator. See equipment manufacturer service information for repair procedures.

Shut off the engine. Remove the test equipment.

Connect all battery cables, negative (-) cable last.



Preparatory Steps

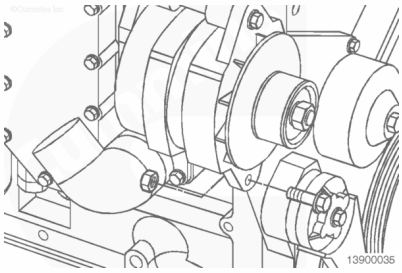
⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

- Disconnect the batteries. See equipment manufacturer service information.
- Disconnect the battery ground cable.
- Install the drive belt. Refer to Procedure 008-002 in Section 8. (/qs3/pubsys2/xml/en/procedures/425/425-008-002-tr.html)
- Tag and label wires attached to the alternator.
- Remove the wires attached to the alternator.

Remove

Remove the alternator link capscrew.



Remove the alternator mounting capscrew.

GRAPHIC NOT FOUND

Remove the alternator.

Install

Install the alternator and alternator capscrews in the reverse order of removal.

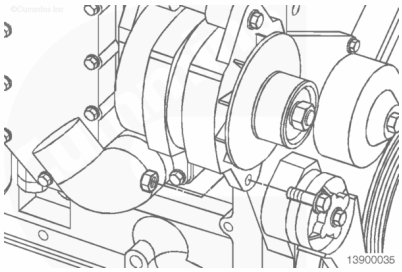
GRAPHIC NOT FOUND

Torque Value: 43 n•m [32 ft-lb]

ANADOLU ISUZU AFTER SALES

Install the alternator link capscrew.

Torque Value: 24 n•m [18 ft-lb]



Finishing Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

- Install the drive belt. Refer to Procedure 008-002 in Section 8. (/qs3/pubsys2/xml/en/procedures/425/425-008-002-tr.html)
- Connect the battery ground cable.
- Connect the battery. See equipment manufacturer service information.
- Operate the engine. Verify proper alternator operation.

ANADOLU ISUZU
CENTER

Last Modified: 05-Aug-2016

Preparatory Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

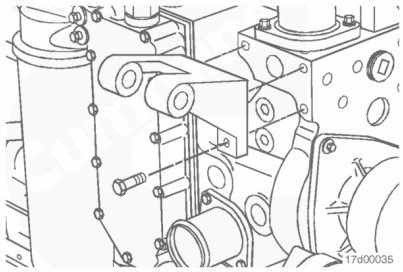


- Disconnect the batteries. See equipment manufacturer service information.
- Remove the drive belt. Refer to Procedure 008-002 in Section 8. (/qs3/pubsys2/xml/en/procedures/425/425-008-002-tr.html)
- Remove the alternator. Refer to Procedure 013-001 in Section 13. (/qs3/pubsys2/xml/en/procedures/425/425-013-001-tr.html)

Remove

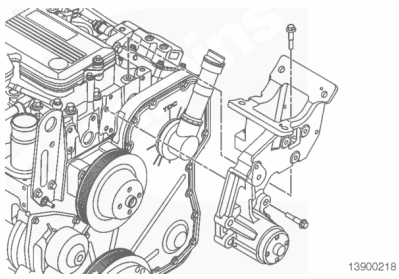
Side Mounted Bracket

Remove the bracket mounting capscrews and the side-mounted bracket.



Front Mounted Bracket

Remove the bracket mounting capscrews and the front-mounted bracket.



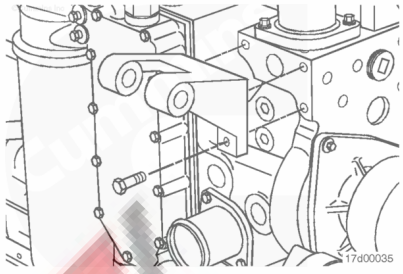
ANADOLU ISUZU AFTER SALES

Install

Side Mounted Bracket

Install the side-mounted bracket and bracket mounting capscrews.

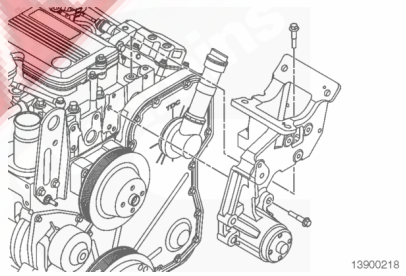
Torque Value: 24 n•m [212 in-lb]



Front Mounted Bracket

In a diagonal pattern, install the front-mounted bracket and the bracket mounting capscrews.

Torque Value: 65 n•m [48 ft-lb]



Finishing Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.



- Install the alternator. Refer to Procedure 013-001 in Section 13. (/qs3/pubsys2/xml/en/procedures/425/425-013-001-tr.html)
- Install the drive belt. Refer to Procedure 008-002 in Section 8. (/qs3/pubsys2/xml/en/procedures/425/425-008-002-tr.html)
- Connect the batteries. See equipment manufacturer service information.

ANADOLU ISUZU AFTER SALES

- Start the engine. Check for proper operation.

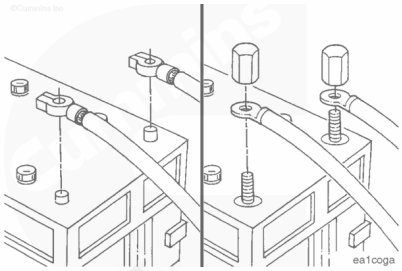
Last Modified: 12-Jun-2018



General Information

⚠ WARNING ⚠

Batteries can emit explosive gas. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the battery (-) negative cable first and attach the battery negative cable last.



There are many types of batteries with varying technology. Common battery types include:

- Standard lead acid (also called flooded or wet cell)
  - Starting
  - Deep cycle
  - Serviceable or maintenance free
- Maintenance free absorbent glass mat (AGM)
- Maintenance free gel cell

Check Original Equipment Manufacturer (OEM) or battery supplier service literature for battery removal and installation, maintenance, inspection, and testing requirements.



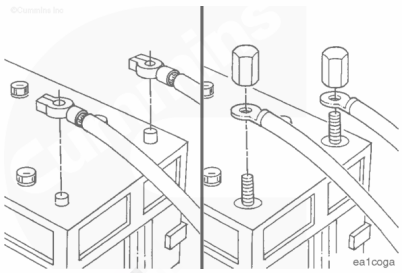
ANADOLU ISUZU
AFTER SALES

Last Modified: 25-Aug-2015

Initial Check

There are two possible heavy-duty battery connections:

- Battery terminal and clamp (1)
- Threaded battery terminal and nut (2).



⚠ WARNING ⚠

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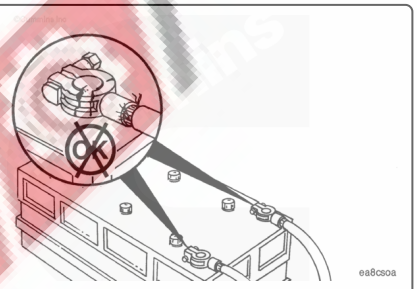
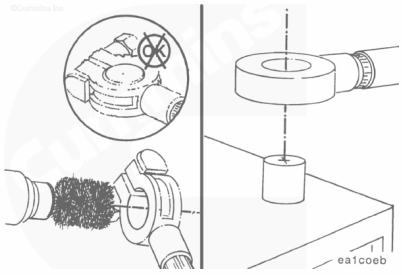


Remove and inspect the battery cables and connections for cracks or corrosion.

Replace broken terminals, connectors, or cables.

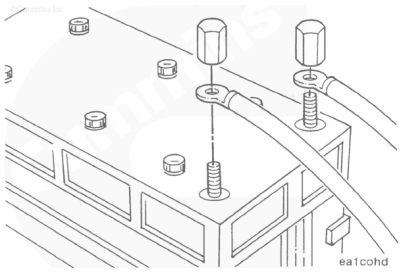
If the connections are corroded, use a battery brush or wire brush to clean the connections until shiny.

Make sure all debris is removed from the connecting surfaces.



⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.



Install the cables and tighten the battery connections.

Coat the terminals with grease to prevent corrosion.

ANADOLU ISUZU AFTER SALES

Last Modified: 26-Aug-2003



Select Service Tools

Recommended Cummins® Service Tools

- Digital multimeter, Part Number 3164488

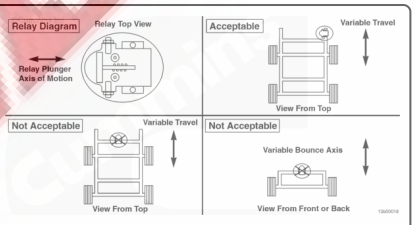
Additional Service Items

- No additional service items required.

Initial Check

⚠ CAUTION ⚠

Improper installation of the starter magnetic switch can result in starter over-run damage.



To make sure the magnetic switch is **not** activated by vehicle movement, the axis of the plunger **must** be horizontal to the ground and perpendicular to vehicle travel.

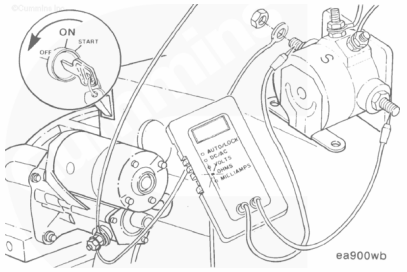
Do **not** mount an external magnetic switch on the engine or on any metal that can possibly resonate as the result of road or engine vibration.

- See equipment manufacturer service information manual for proper magnetic switch installation.

Resistance Check

Remove the cable connecting the magnetic switch to the starting motor solenoid from the magnetic switch terminal.

Set digital multimeter, Part Number 3164488, to measure resistance (ohms).

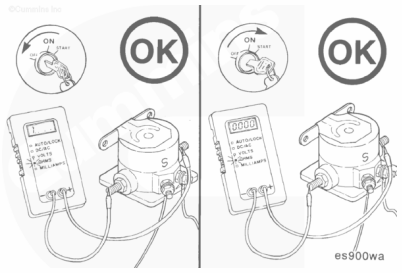


Connect the leads to the two large switch terminals.

With the starting motor switch in the OFF position, the multimeter **must** indicate resistance greater than 100k ohms.

Turn the starting motor switch to the START position.

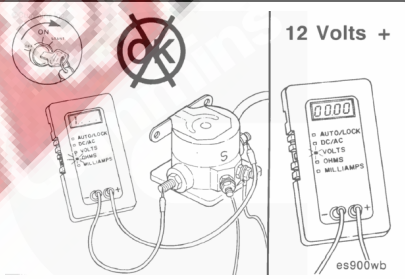
The multimeter **must** indicate less than 10 ohms. If **not** within specifications, replace the starter magnetic switch according to manufacturer instructions.



Voltage Check

If the multimeter indicates resistance at greater than 100k ohms with the starting motor switch in the "START" position, turn the starting motor switch to the "OFF" position.

Set the multimeter scale to read DC voltage.



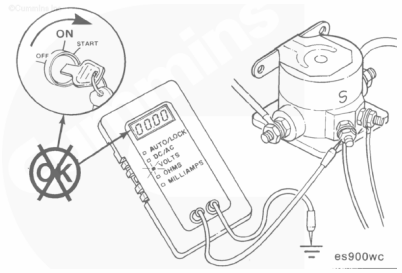
Connect one multimeter lead to the magnetic switch terminal marked "S" and the other lead to ground.

Turn the starting motor switch to the "START" position.

If the multimeter indicates no voltage, the magnetic switch is **not** the cause of the complaint. Refer to Procedure 013-018 in Section 13. (/qs3/pubsys2/xml/en/procedures/425/425-013-018.html)

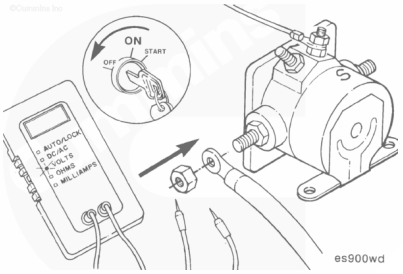
If the starter magnetic switch is **not** within specification, replace the switch according to manufacturer instructions.

Note : For Cummins® branded Delco-Remy™ starters, a service kit is avaialble to replace **only** the magnetic switch as opposed to the whole starter assembly.



Turn the starting motor switch to the "OFF" position.

Remove the multimeter leads. Connect the magnetic switch to the starting motor solenoid wire.



ANADOLU ISUZU PARTS SALES

Last Modified: 05-Aug-2016

Select Service Tools

Recommended Cummins® Service Tools

- Digital multimeter, Part Number 3164488, or equivalent

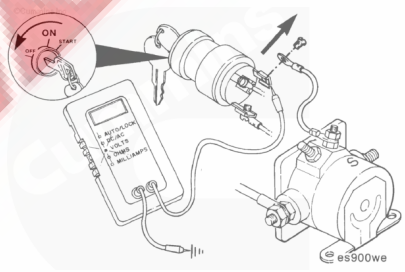
Additional Service Items

- No additional service items required.

Voltage Check

⚠ WARNING ⚠

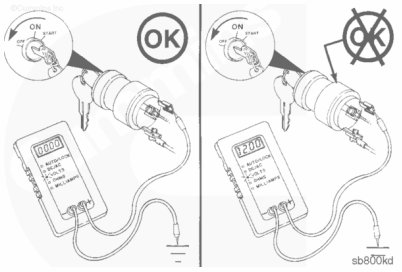
Be sure the starter motor switch is in the “OFF” position to prevent electrical shock and personal injury.



Remove the wire connecting the starting motor switch to the magnetic switch (marked “S” or “START”) from the starter switch terminal.

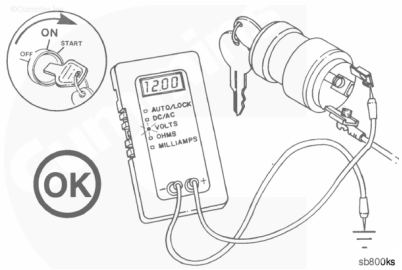
Connect the positive (+) lead of digital multimeter, Part Number 3164488, or equivalent, to the starter switch terminal and the negative (-) lead to a chassis or engine ground location.

Note : Set the multimeter to indicate DC volts with the starting motor switch in the "OFF" position. There must **not** be voltage at the starter switch terminal. If the meter indicates voltage, the starter switch is malfunctioning and **must** be replaced.



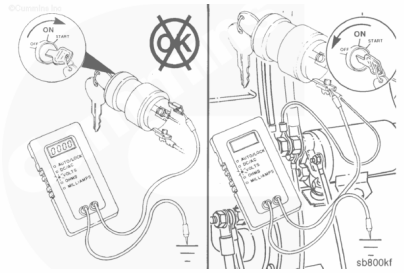
Turn the starting motor switch to the “START” position.

The multimeter **must** indicate system voltage.



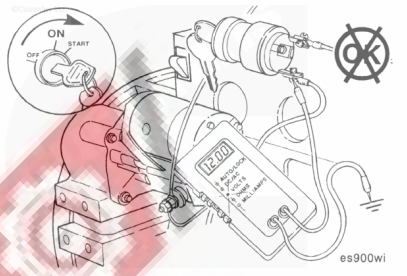
If there is no voltage, turn the starting motor switch to the “OFF” position.

Connect the multimeter positive (+) lead to the starter switch terminal having a wire connecting the starter switch to the starting motor solenoid B terminal.



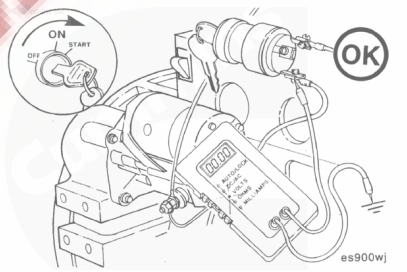
Turn the starting motor switch to the “START” position.

If the meter indicates system voltage at the starter switch input terminal, the starter switch is malfunctioning and **must** be replaced. See equipment manufacturer service information for the replacement procedure.



If the meter indicates no voltage, the switch is **not** the cause of the complaint.

Check the wiring from the starter switch to the starting motor solenoid B terminal and from the starting motor solenoid to the battery for broken or damaged wires.



ANADOLU ISUZU
AFTER SALES

Last Modified: 01-Nov-2016

Select Service Tools

Recommended Cummins® Service Tools

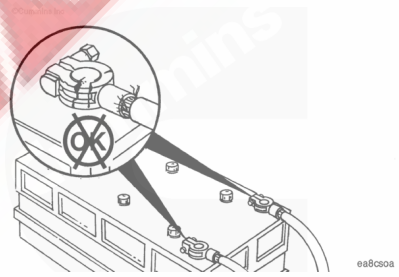
- Digital multimeter, Part Number 3164488, or equivalent

Additional Service Items

- No additional service items required.

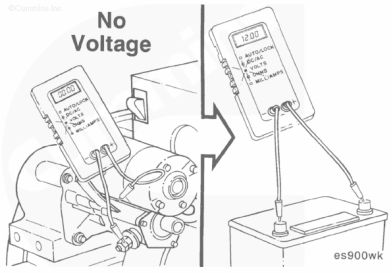
Initial Check

Before troubleshooting the starting motor, make sure the battery terminals are **not** loose or corroded. Refer to Procedure 013-009 in Section 13. (/qs3/pubsys2/xml/en/procedures/99/99-013-009.html)



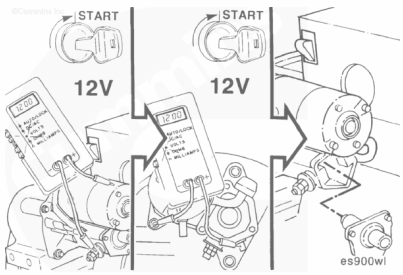
Use digital multimeter, Part Number 3164488, or equivalent, to set the voltage scale.

Check for system voltage at the starting motor solenoid battery terminal.



If the multimeter indicates system voltage at the starting motor battery terminal, check the voltage at the starting motor solenoid S terminal, when the starting switch is energized.

If the multimeter indicates system voltage at the S terminal, but the starter does **not** engage, the starting motor solenoid is malfunctioning and the starter **must** be replaced. Refer to Procedure 013-020 in Section 13. (/qs3/pubsys2/xml/en/procedures/425/425-013-020-tr.html)



ANADOLU ISUZU
AFTER SALES

If the multimeter does **not** indicate system voltage at the S terminal, check:

GRAPHIC NOT FOUND

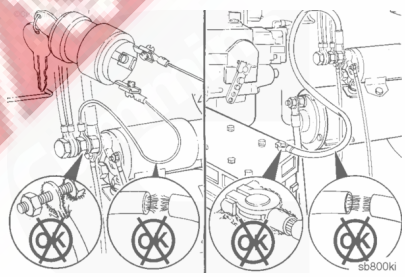
- Fuses
- Voltage to the ignition switch and magnetic switch. Refer to Procedure 013-018 in Section 13. (/qs3/pubsys2/xml/en/procedures/425/425-013-018.html) Refer to Procedure 013-017 in Section 13. (/qs3/pubsys2/xml/en/procedures/425/425-013-017.html)
- Application safety shutoff systems.

Voltage Check

Set digital multimeter, Part Number 3164488, to measure DC voltage.

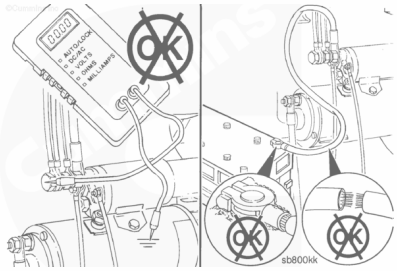
Connect the multimeter positive (+) lead to the starter solenoid positive cable terminal and the negative (-) lead to a chassis or engine ground location.

The multimeter **must** show a voltage with the starter switch “OFF” to be normal.



If the multimeter does **not** indicate a voltage, check the cable connecting the starter solenoid and battery for breaks.

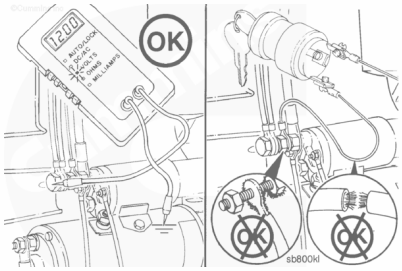
Also check for loose or corroded connections.



If the multimeter indicates a voltage, but the starter will **not** operate, check the wire connecting the starter solenoid to the starter switch for breaks.

Also check for loose or corroded connections.

Make sure to check for:

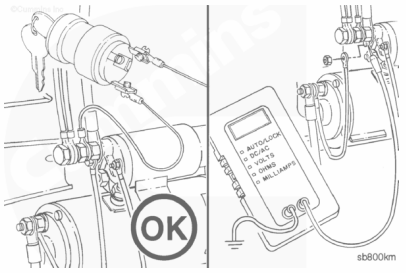


- Fuses
- Application engine shutoff systems.

ANADOLU ISUZU PARTS SALES

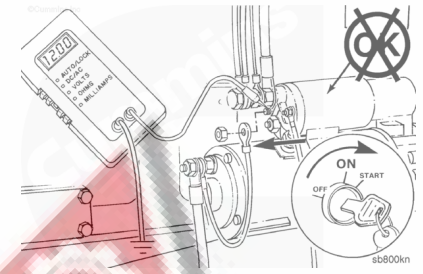
If the wire connecting the starter solenoid and starter switch is **not** loose or damaged, and the starter will **not** operate, remove the cable connecting the starter and starter solenoid from the solenoid terminal.

Connect the multimeter positive (+) lead to the solenoid positive (+) terminal and the negative (-) lead to the chassis or an engine ground location.

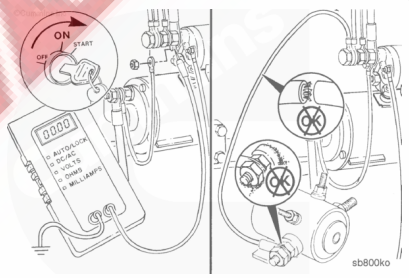


Turn the starter switch to the ”START” position.

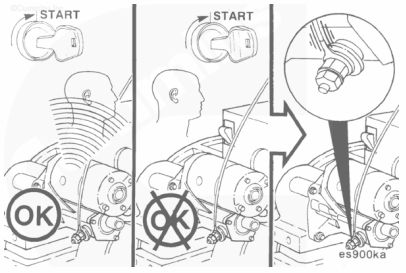
If the multimeter indicates a voltage, the starter solenoid is malfunctioning and **must** be replaced. Refer to Procedure 013-020 in Section 13. (/qs3/pubsys2/xml/en/procedures/425/425-013-020-tr.html)



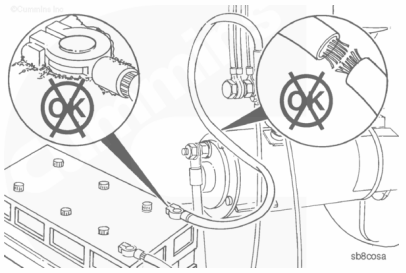
If the multimeter does **not** indicate a voltage, check the wire connecting the starter solenoid to the magnetic switch for breaks, and for loose or corroded connections.



If the wire connecting the starter solenoid to the magnetic switch is **not** loose or damaged and the starter will **not** operate, check the cable connecting the starter solenoid to the starting motor for breaks, and for loose or corroded connections.



Check the cable connecting the starting motor to the battery for breaks, and for loose or corroded connections.



If the cables are **not** loose or damaged, the starting motor is malfunctioning and **must** be replaced. Refer to Procedure 013-020 in Section 13. (/qs3/pubsys2/xml/en/procedures/425/425-013-020-tr.html)

GRAPHIC NOT FOUND

ANADOLU ISUZU PARTS

Last Modified: 05-Aug-2016

Select Service Tools

Recommended Cummins® Service Tools

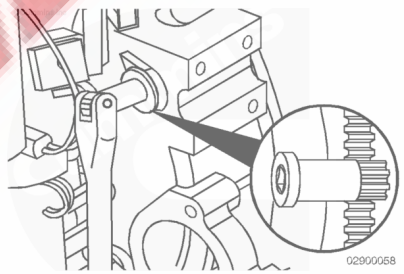
- Barring tool, Part Number 5299073
- Sealant, Part Number 3164067, or equivalent

Additional Service Items

- Depth micrometer or vernier caliper

Rotation Check

If the starting motor solenoid is making a sound but the engine is **not** rotating, turn the keyswitch to the OFF position, and attempt to bar the crankshaft in both directions.

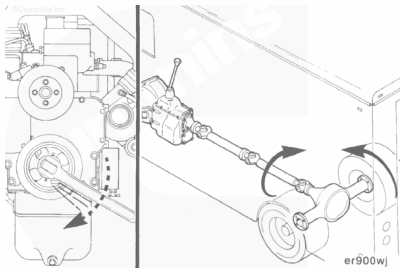


Bar the engine with the barring tool, Part Number 5299073.

If the crankshaft will bar over, attempt to start the engine. If the starting motor cranks the engine, check the starting motor pinion gear and flywheel ring gear for damage.

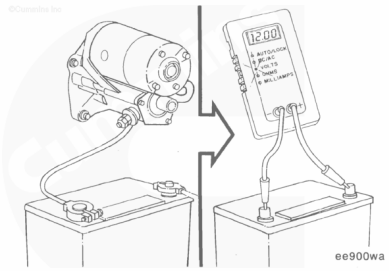
If damage to the starting motor pinion gear and/or flywheel ring gear is found when replacing the components, make sure to measure the distance from the starting motor mounting flange to the forward face of the front side of the flywheel ring gear. Follow the Measure step of this procedure.

If the crankshaft does **not** rotate or requires more than the normal effort to bar, check for an internal malfunction or a problem with the drive unit and/or accessories.



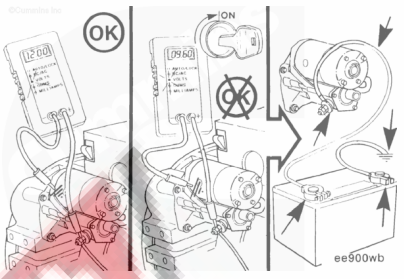
If the engine cranking speed is too slow or will **not** crank at all, and the engine rotates freely:

- Make sure the wiring connections are clean, tight, and **not** damaged.
- Check the battery voltage. See equipment manufacturer service information.



Check the voltage at the starting motor during cranking. If the voltage drops more than 2.4 VDC on a 12 volt system, or 4.8 VDC on a 24 volt system, check that all connections are clean and tight.

If the cables are correct and the voltage drop exceeds the limit, replace the starting motor.



Preparatory Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

⚠ WARNING ⚠

When using a steam cleaner, wear safety glasses or a face shield, as well as protective clothing. Hot steam can cause serious personal injury.

⚠ WARNING ⚠

Wear appropriate eye and face protection when using compressed air. Flying debris and dirt can cause personal injury.

- Disconnect the batteries. See equipment manufacturer service information.
- Identify each wire with a tag indicating its location on the starting motor.
- Remove the electrical connections from the starting motor.
- Prior to removing the starter, use steam to clean the area around the starting motor, to prevent debris from entering the flywheel housing.
- Dry with compressed air.

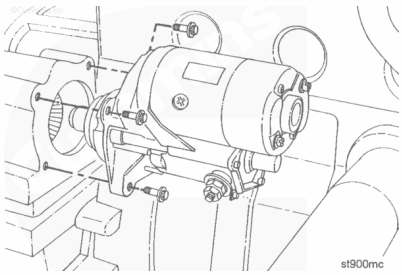
Remove

Identify each wire with a tag indicating itslocation on the starting motor.

Remove the electrical connections from the starting motor.

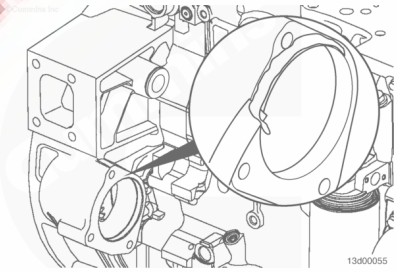
Remove the three capscrews and starting motor.

If equipped with a starting motor spacer, remove the spacer. Clean all surfaces between the starting motor, starting motor spacer, and flywheel housing. Use a wire brush.



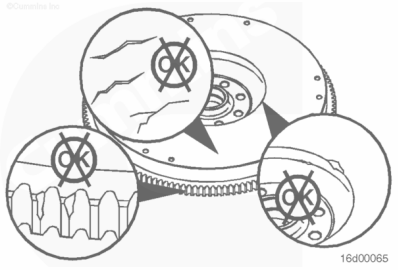
Clean and Inspect for Reuse

For engines that use wet flywheel housing, clean any left over sealant from the starting motor mounting flange on both the flywheel housing and starting motor. Make sure these surfaces are clean of oil and debris.



Inspect the starting motor pinion gear and/or flywheel/flexplate ring gear for chipping or uneven wear.

If the start motor pinion gear and/or flywheel ring gear teeth are damaged, they **must** be replaced, if equipped, with a flexplate. Refer to Procedure 016-008 in Section 16. (/qs3/pubsys2/xml/en/procedures/425/425-016-008.html)



Measure

Use a depth micrometer or vernier caliper to measure the distance from the starting motor mounting flange to the forward face of the front side of the flywheel ring gear.

Note : Include any spacers previously removed when completing the measurement.

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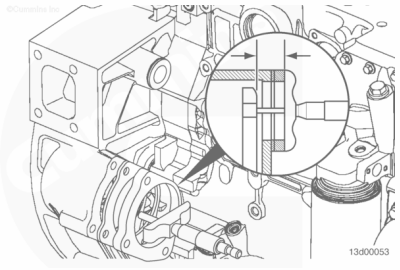
USED PARTS SALES

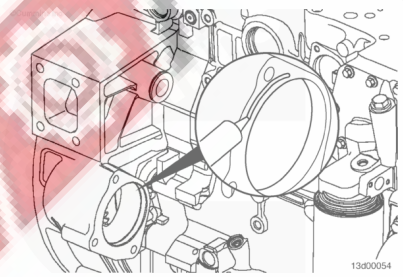
Starting Motor Spacing		
mm		in
49.28	MIN	1.94
52.32	MAX	2.06



Add or remove spacers as necessary to achieve the correct starting motor spacing.

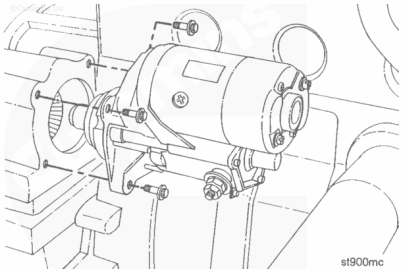
Install

Note : If a starting motor spacer is required, make sure to apply sealant to the side of the spacer that contacts the starting motor.



For engines with wet flywheel housings, apply a 1.5 to 2.0 mm [0.06 to 0.09 in] wide bead of sealant, Part Number 3164067, or equivalent, to the flywheel housing starting motor mounting flange.

Install the three capscrews, starting motor, and starting motor spacer, if required.

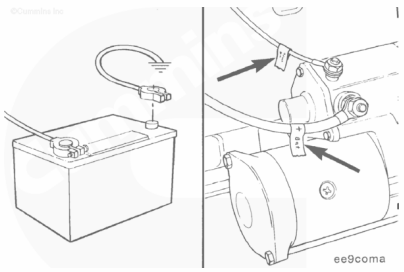


Torque Value: 43 n•m [32 ft-lb]

Cummins® Branded Starters

⚠ CAUTION ⚠

Do not overtighten the electrical connections. Starting motor damage can result.



Note : Use the location tags to help identify where each wire connection goes.

Connect the electrical connections to the starting motor.

Torque Value:
M5 4 n•m [35 in-lb]

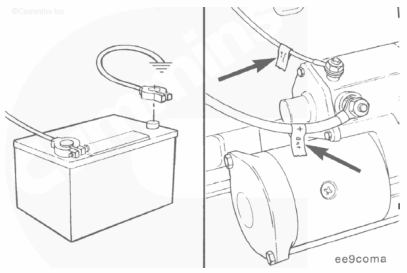
Torque Value:
M10 21 n•m [186 in-lb]

ANADOLU ISUZU AFTER SALES

Non-Cummins® Branded Starters

⚠ CAUTION ⚠

Do not overtighten the electrical connections. Starting motor damage can result.



Note : Use the location tags to help identify where each wire connection goes.

Connect the electrical connections to the starting motor.

For Non-Cummins® branded starters, see equipment manufacturer service information for torque specifications.

Finishing Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

- Connect the batteries. See equipment manufacturer service information.
- Operate the starter. Check for proper operation.

ANADOLU ISUZU AFTER SALES

Last Modified: 01-Nov-2016

Select Service Tools

Recommended Cummins® Service Tools

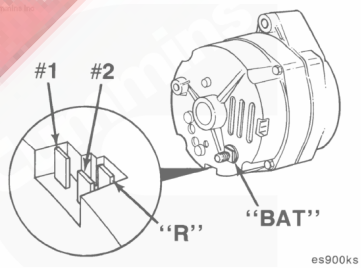
- No Cummins® Service Tools required.

Additional Service Items

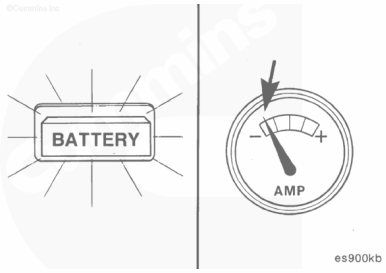
- No additional service items required.

Initial Check

Make sure the correct terminals are being used on the alternator. The R terminal (Delco™) or W terminal (Bosch™ K1) provide half of the system voltage and is used to operate accessories such as the tachometer on generator sets.

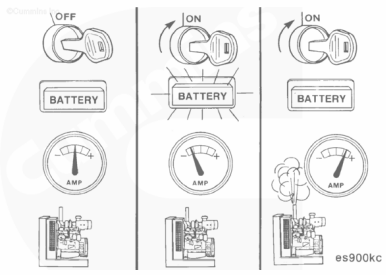


Trouble with the starting system can be indicated by the indicator lamp or ampmeter.



Check the indicator lamp for normal operation as shown below:

Engine	Switch	Lamp	Ampmeter
Stopped	OFF	OFF	0
Stopped	ON	ON	-
Running	ON	OFF	+



If the lamp is on when the switch is OFF and the engine is **not** running, disconnect the lamp lead at the ignition switch.

- If the lamp stays on, there is a short to a positive wire.

ANADOLU ISUZU AFTER SALES

- If the lamp goes out, there is a short in the switch.

If the lamp goes off when the switch is ON and the engine is **not** running, there can be an open in the circuit.

Check for a blown fuse, a burned out bulb, defective bulb socket, or an open in the Number 1 or D (+) lead circuit between alternator and ignition switch.

If the lamp is on when the switch is ON and the engine is running, disconnect the lead to the alternator.

- If the lamp stays on, there is a short to the ground in the lamp circuit.
- If the lamp goes out, inspect the alternator.

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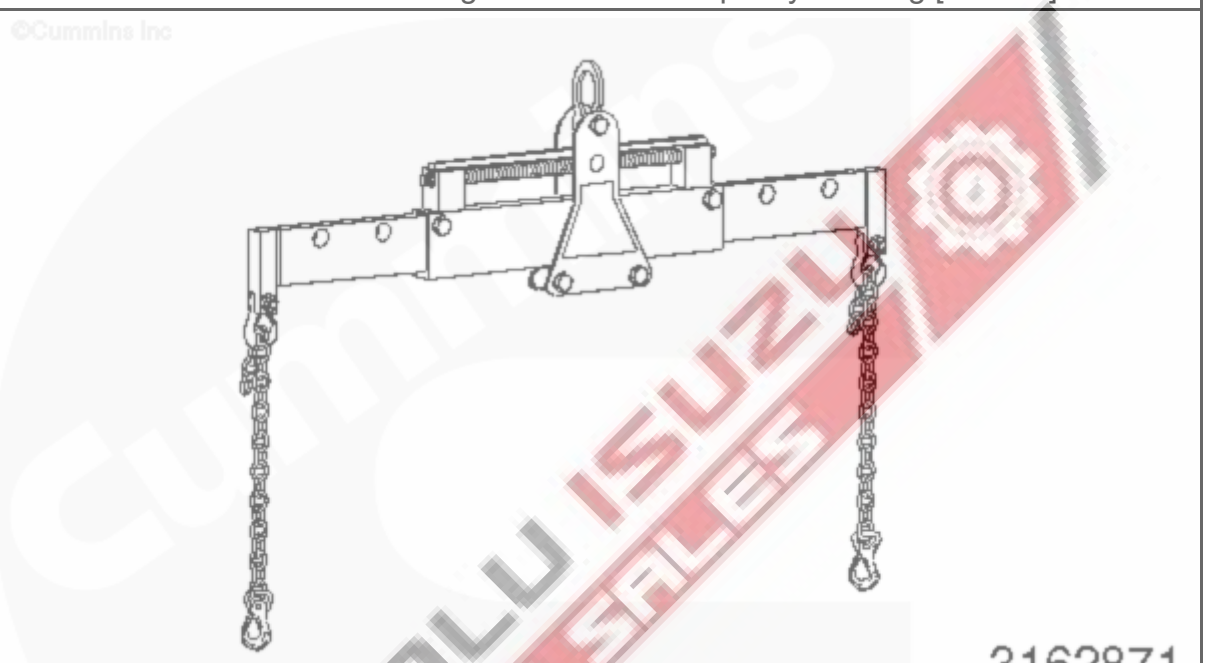
Last Modified: 05-Aug-2016

Engine Testing

Tool Number
3162871
Engine Lifting Fixture Used to remove and install the engine. Maximum capacity 2722 kg [6000 lb].


Tool Number
3164488 or 3164489
Multimeter Used to measure electrical circuits: voltage (volts), resistance (ohms), and current (amperage). 3164488 - Standard meter. 3164489 - Automotive meter with built in temperature adapter and tachometer.

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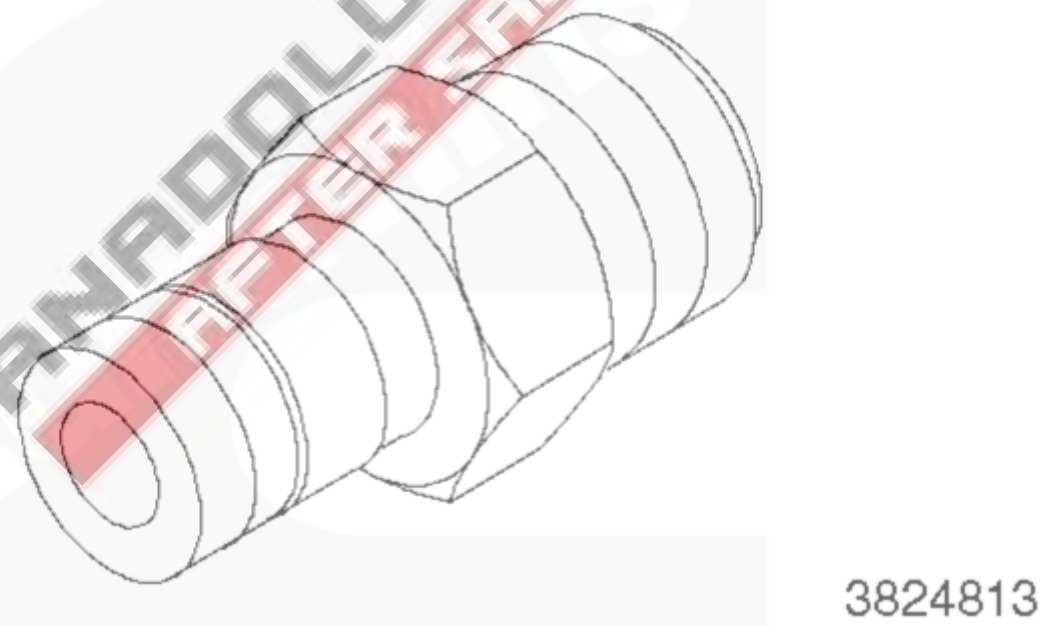
Tool Number

3377244

Compuchek™ Fitting

Used to connect to the diagnostics machine. With 1/8 NPT connection.

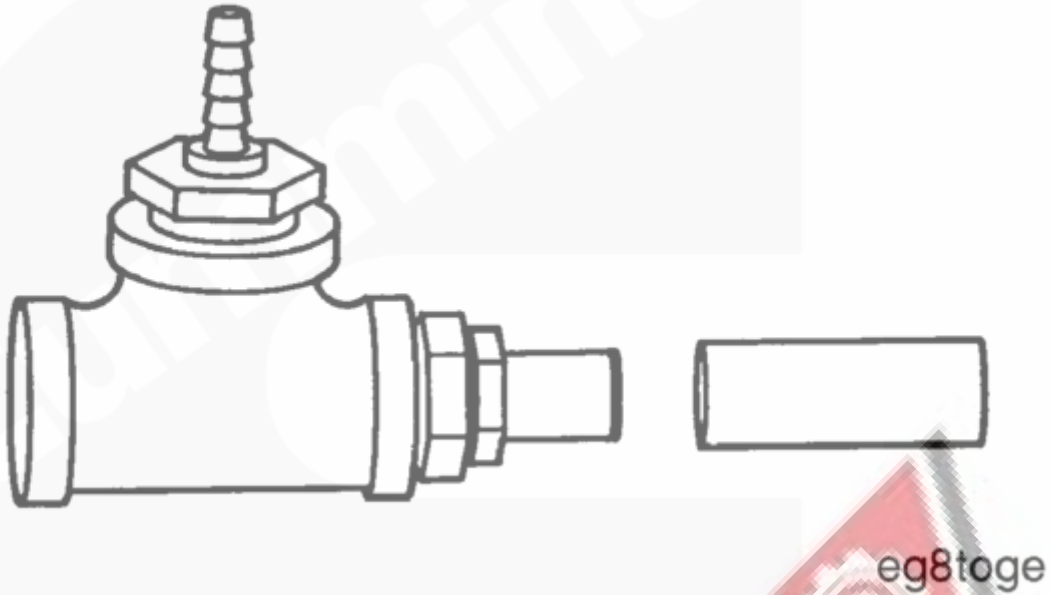


Tool Number

3822566

Blowby Tool

Used to check engine crankcase blowby.



Tool Number

4919041

Digital Optical Tachometer

Used to measure engine speed (rpm).



Tool Number

ST 434

Vacuum Gauge

This tool is used to check fuel filter restriction.

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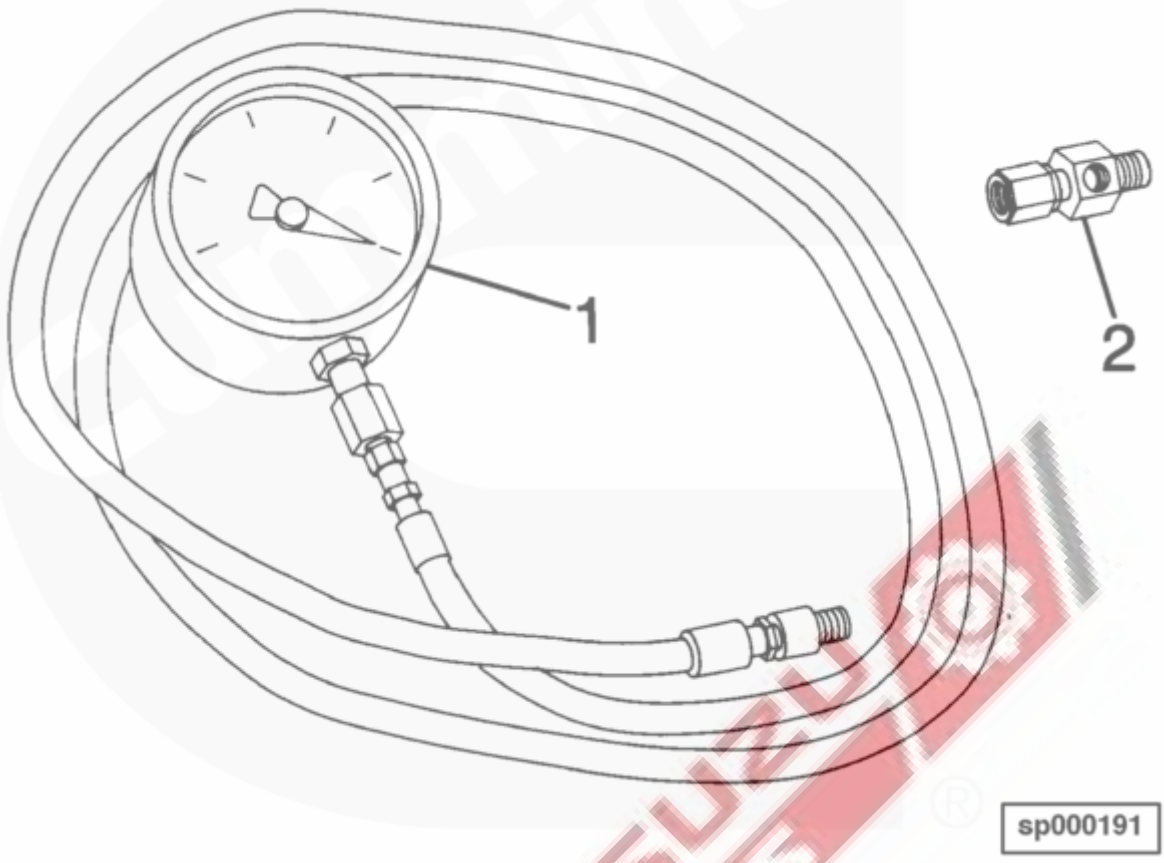

Tool Number

ST 1111-3

Water Manometer

Use to measure engine crankcase blowby with blowby orifice, Part Number 3822476.

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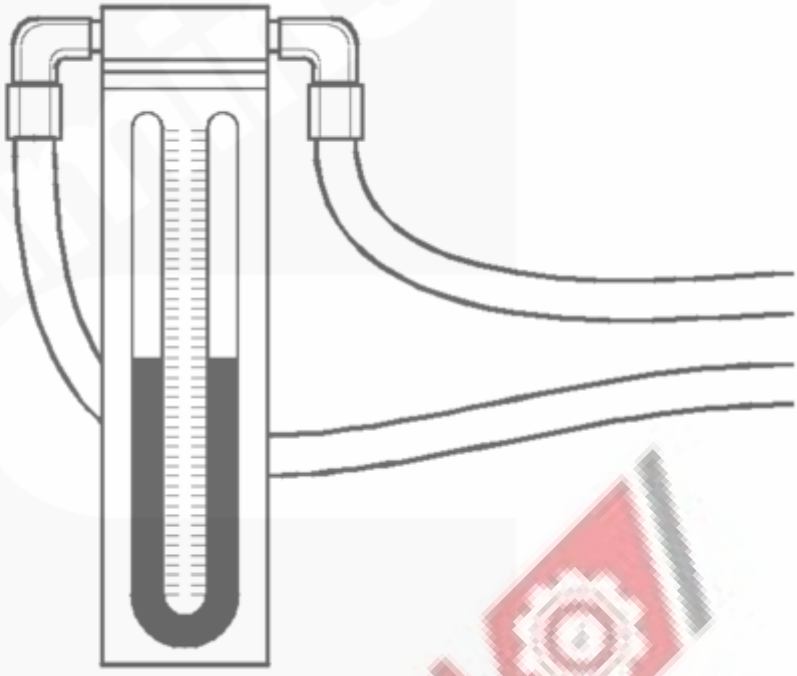

Tool Number

ST 1273

Pressure Gauge

This pressure gauge is used to measure intake manifold pressure turbocharger boost as well as fuel return line restriction.

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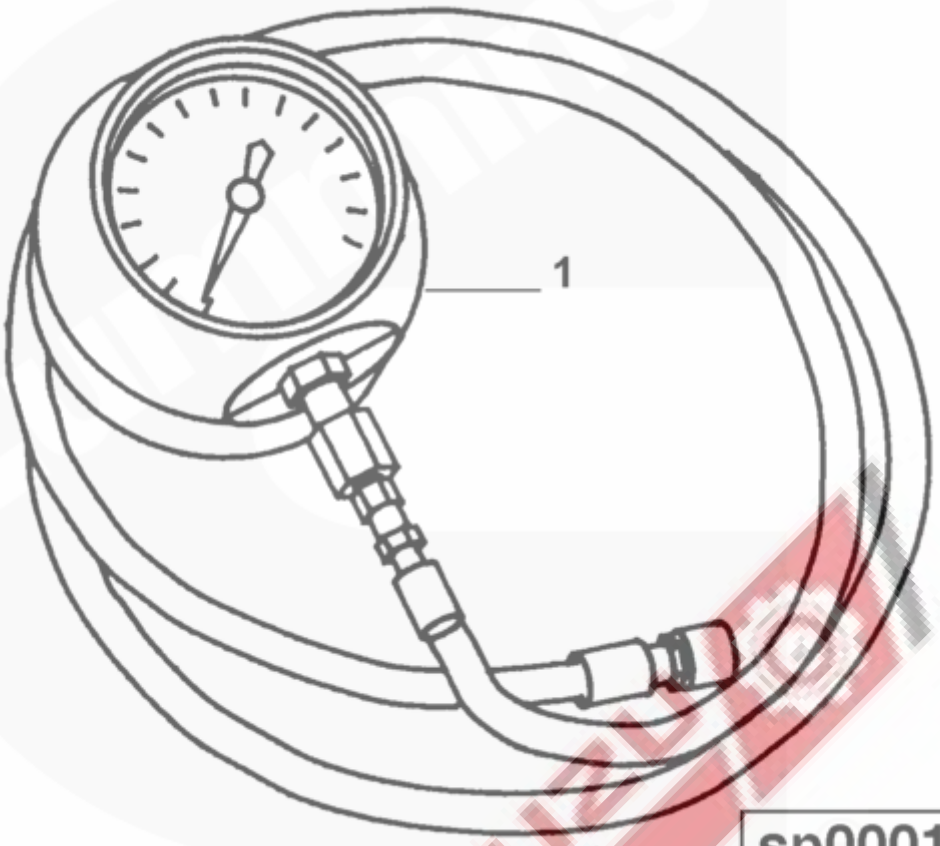


Last Modified: 10-Aug-2016

ANADOLU ISUZU AFTER SALES

Select Service Tools

Recommended Cummins® Service Tools

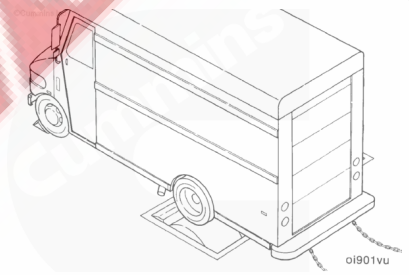
- No Cummins® Service Tools required.

Additional Service Items

- No additional service items required.

Setup

The performance of an engine installed in on-highway vehicles can be tested on a chassis dynamometer.



Note : Because of live driveline efficiency and engine-driven accessories, the engine horsepower when measured at the rear wheels will be reduced by approximately:

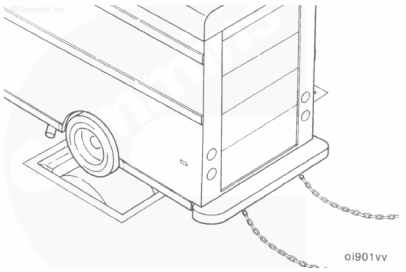
- 20 percent for single-axle vehicles
- 25 percent for tandem-axle vehicles
- 30 percent for tri-axles vehicles
- 35 percent for recreational vehicles.

These specifications apply to drive axles **only**, **not** tag axles.

Note : These percentages are used for engine run-in **only** and are **not** to be used as absolute figures.

⚠ WARNING ⚠

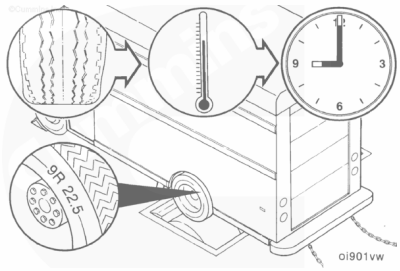
Follow all the OEM's safety precautions before installing or operating a vehicle on a chassis dynamometer. Failure to do so can cause damage to the vehicle and/or cause personal injury.



⚠ CAUTION ⚠

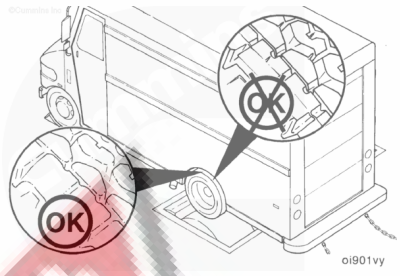
Low-profile tires are more sensitive to heat than bias ply tires. Excessive operating time at full load can damage the tires due to overheating. Check tire

manufacturer recommendations for the maximum allowable chassis dynamometer operating time.

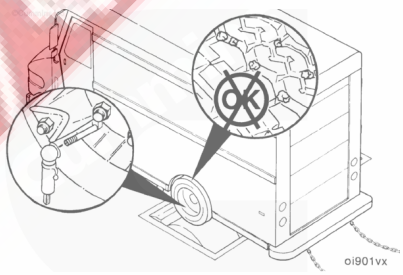


While operating the chassis dynamometer, follow the general safety precautions listed below:

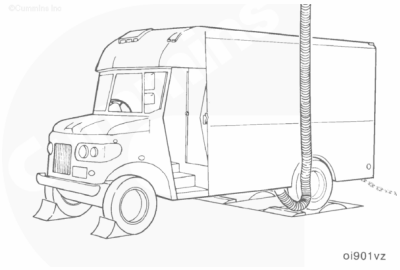
- Use tires that have more than 160 km [100 mi] of use. Do **not** use new tires.
- Do **not** use recapped tires or tires of different sizes or designs.



- Make sure the tires are inflated to manufacturer specifications.
- Remove all rocks or other materials from the treads of the tires rotating on the dynamometer rollers.

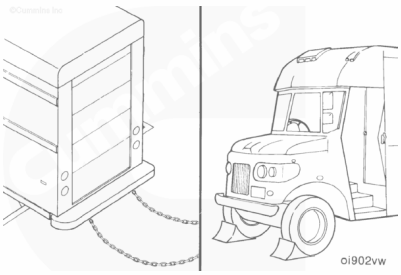


- Make sure there is correct overhead clearance for exhaust stacks, air deflectors, or other attachments above the cab.



⚠ CAUTION ⚠

To prevent damage to the chassis dynamometer, make sure there is enough slack in the tie-down chains.



Carefully position the vehicle on the rollers.

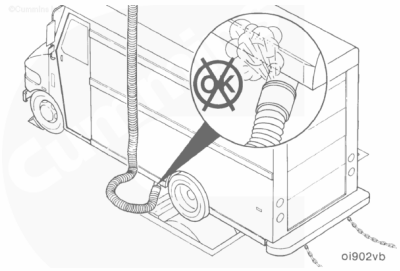
Attach the tie-down chains to the rear of the vehicle.

Place wheel chocks in front of the front tires.

⚠ WARNING ⚠

ANADOLU ISUZU AFTER SALES

Some exhaust gas constituents may be toxic and/or carcinogenic. Make sure the ventilation hose does not leak.



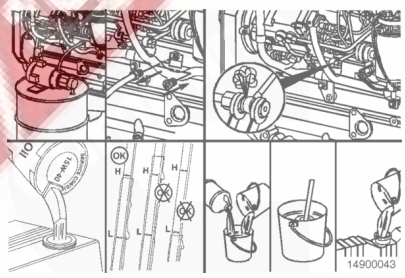
Adjust the vehicle and dynamometer room exhaust system to make sure all the exhaust gases are removed from the room.

Read chassis dynamometer and vehicle manufacturer recommendations and specifications for testing procedures.

Test

⚠ WARNING ⚠

Do not remove the pressure cap from a hot engine. Wait until the coolant temperature is below 50°C [120°F] before removing the pressure cap. Heated coolant spray or steam can cause personal injury.



The following procedure assumes the lubricating oil and fuel systems were correctly primed, the dipstick calibrated, and the engine filled to the correct levels with lubricating oil and coolant during installation of the engine into the chassis. If these systems were **not** serviced during installation of the engine.

Use the following procedures for instructions on priming the lubricating oil and fuel system and calibrating the dipstick.Refer to Procedure 014-006 in Section 14. (/qs3/pubsys2/xml/en/procedures/425/425-014-006.html)

See the Operation and Maintenance Manual for instructions on filling the lubricating oil and the cooling systems.



The number of instruments and gauges required to perform a chassis dynamometer test will vary according to type and capability of the test equipment used.

See the service tools listed at the beginning of this section.

To correctly monitor engine performance, record the following parameters:

- Lubricating oil pressure (vehicle instrument panel)
- Engine speed (rpm) (vehicle instrument panel)
- Wheel horsepower (whp) (dynamometer controls)
- Blowby: Refer to Procedure 014-010 in Section 14. (/qs3/pubsys2/xml/en/procedures/425/425-014-010.html)
- Exhaust back pressure: Refer to Procedure 011-009 in Section 14. (/qs3/pubsys2/xml/en/procedures/425/425-011-009.html)
- Coolant temperature (vehicle instrument panel): Refer to Procedure 008-018 in Section 8. (/qs3/pubsys2/xml/en/procedures/425/425-008-018-tr.html)
- Coolant pressure:. Refer to Procedure 008-018 in Section 8. (/qs3/pubsys2/xml/en/procedures/425/425-008-018-tr.html)
- Intake manifold pressure: Refer to Procedure 019-159 in Section 19. (/qs3/pubsys2/xml/en/procedures/425/425-019-159.html)
- Inlet air restriction: Refer to Procedure 010-031 in Section 10. (/qs3/pubsys2/xml/en/procedures/425/425-010-031.html)
- Fuel supply pressure: Refer to Procedure 006-051 in Section 6. (/qs3/pubsys2/xml/en/procedures/425/425-006-051.html) Refer to Procedure 006-024 in Section 6. (/qs3/pubsys2/xml/en/procedures/425/425-006-024.html)

ANADOLU ISUZU PARTS

Last Modified: 02-Aug-2020

Select Service Tools

Recommended Cummins® Service Tools

- No Cummins® Service Tools required.

Additional Service Items

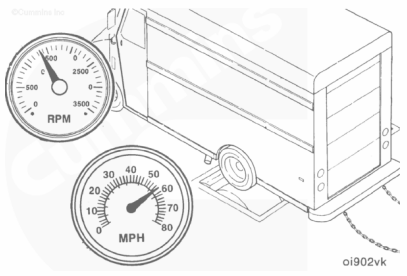
- No additional service items required.

General Information

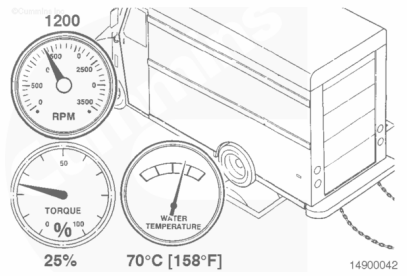
For general chassis dynamometer, operating/testing procedures and safety precautions. Refer to Procedure 014-002 in Section 14. (/qs3/pubsys2/xml/en/procedures/425/425-014-002.html)

Test

Operate the vehicle in a gear that produces a road speed of 90 to 95 km/h [56 to 59 mph].

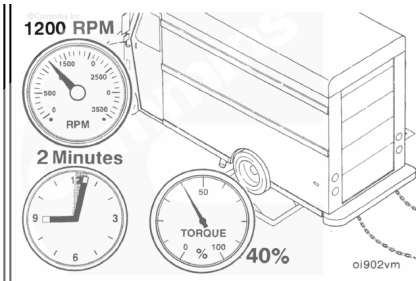


Operate the engine at 1200 rpm and 25 percent of torque peak load until the water temperature reaches 70°C [158°F].

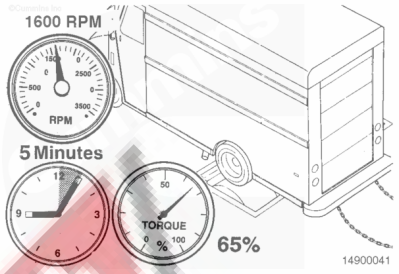


Operate the engine at 1200 rpm and 40 percent of torque peak load for 2 minutes. Check the gauges. Record the readings.

ANADOLU ISUZU AFTER SALES

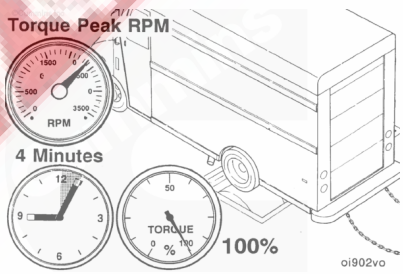


Operate the engine at 1600 rpm and 65 percent of torque peak load for 5 minutes. Check the gauges. Record the readings.



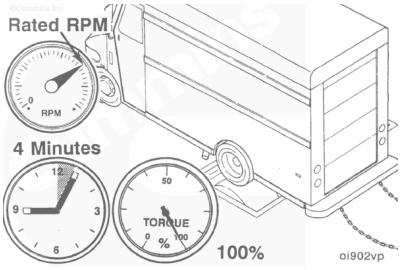
Operate the engine at torque peak rpm and full load for 4 minutes. Check the gauges. Record the readings.

Note : See the engine data sheet for the torque peak rpm of the engine model being tested.



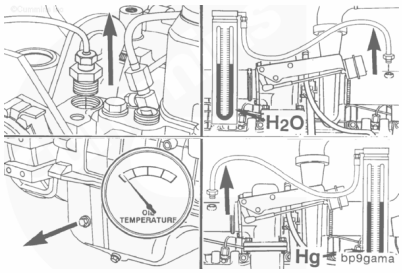
⚠ CAUTION ⚠

Do not shut off the engine immediately after the run-in is completed. Allow the engine to cool by operating it at low idle for a minimum of 3 minutes to avoid engine component damage.



Operate the engine at rated speed (rpm) and full load for 4 minutes. Check the gauges. Record the readings. Compare the readings to those published on the appropriate engine data sheet.

Make sure all instrumentation is removed before removing the vehicle from the dynamometer.



ANADOLU ISUZU GENUINE SALES

Last Modified: 05-Aug-2016



Select Service Tools

Recommended Cummins® Service Tools

- No Cummins® Service Tools required.

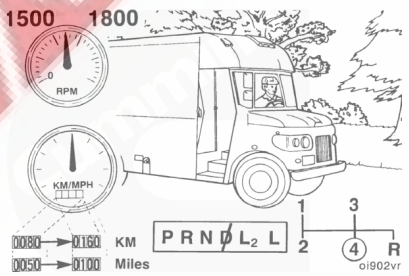
Additional Service Items

- No additional service items required.

Test

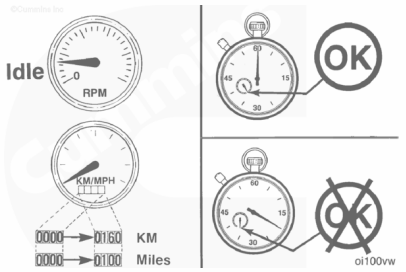
⚠ CAUTION ⚠

Before operating the engine and to avoid internal component damage. Refer to Procedure 014-005 in Section 14. (/qs3/pubsys2/xml/en/procedures/425/425-014-005.html)



Operate the engine at 1500 to 1800 rpm in high gear for the first 80 to 160 km [50 to 100 mi] after rebuild.

Note : Do **not** idle the engine for more than 5 minutes at any one time during the first 160 km [100 mi] of operation.



ANADOLU ISUZU
OFFER

Last Modified: 05-Aug-2016

Select Service Tools

Recommended Cummins® Service Tools

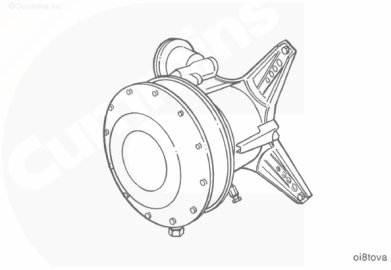
- Engine lifting fixture, Part Number 3162871
- Vacuum gauge, Part Number ST 434
- Water manometer, Part Number ST 1111 3
- Pressure gauge, Part Number ST 1273

Additional Service Items

- No additional service items required.

Setup

Note : Make sure the dynamometer capacity is sufficient to permit testing at 100 percent of engine rated horsepower. If the capacity is **not** enough, the testing procedure **must** be modified to the restrictions of the dynamometer.

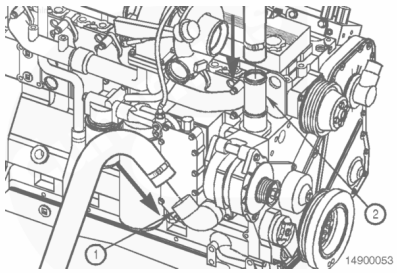


Use engine lifting fixture, Part Number 3162871, to install the engine to the test stand. Align and connect the dynamometer. See manufacturer instructions for aligning and testing the engine.

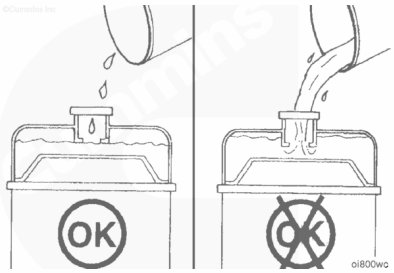
Connect the coolant supply to the water inlet connection (1).

Connect the coolant return to the water outlet connection (2).

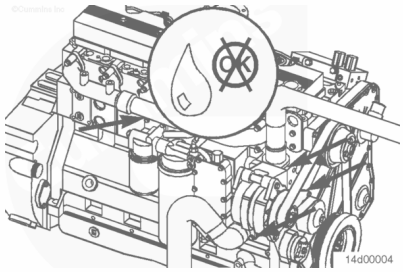
Install the drain plugs, close all the water drain cocks, and make sure all of the clamps and fittings are tight.



Fill the cooling system with coolant to the bottom of the fill neck in the radiator fill (or expansion) tank.



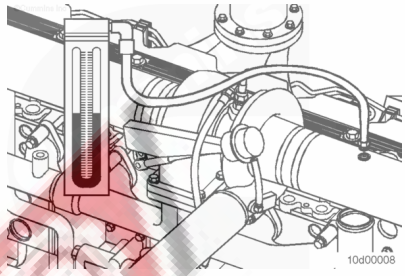
Inspect the engine for coolant leaks at connections, fittings, plates, and plugs. Repair if necessary.



Air Inlet Restriction

Note : The manometer connection **must** be installed at a 90 degree angle to the airflow in a straight section of pipe, one pipe diameter before the turbocharger.

Note : A vacuum gauge, Part Number ST 434, can be used in place of the water manometer.



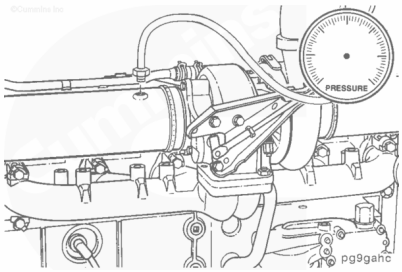
Connect water manometer, Part Number ST 1111 3, to the turbocharger air inlet pipe to test air restriction.

Measurements		
	mm-h2o	in-h2o
Minimum Gauge Capacity	760	30

Exhaust Restriction

Note : For automotive applications, a tapped hole is provided on the inlet side of the catalyst for checking exhaust restrictions.

Note : A pressure gauge, Part Number ST 1273, can be used in place of the mercury manometer.



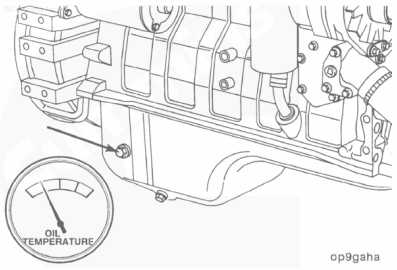
Connect a mercury manometer to a straight section of the exhaust piping near the turbocharger outlet to check exhaust restriction.

Measurements		
	mm-hg	in-hg
Minimum Gauge Capacity	254	10

Attach the lubricating oil temperature sensor in the location illustrated.

ANADOLU ISUZU PARTS

Measurements		
	celsius	fahrenheit
Minimum Gauge Capacity	150	300



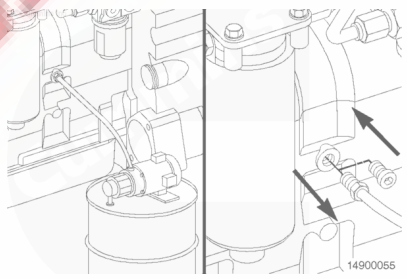
⚠ CAUTION ⚠

The lubricating oil system must be primed before operating the engine after if has been rebuilt to avoid internal damage.

GRAPHIC NOT FOUND

To prime the lubricating oil system using external pressure, connect the supply to a tapped hole in the main lubricating oil rifle.

Use a pump capable of supplying 210 kPa [30 psi] of continuous pressure. Connect the pump to the port on the main lubricating oil rifle as shown.

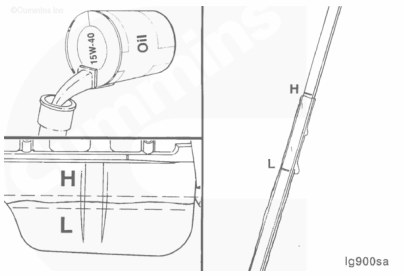


Use clean lubricating oil to prime the system until the oil pressure registers on the gauge.

Remove the lubricating oil supply tube. Install the plug.

Make sure the lubricating oil has had time to drain to the lubricating oil pan and fill the engine to the high mark, as measured on the dipstick.

Use the correct lubricating oil as specified in the equipment manufacturer service information.



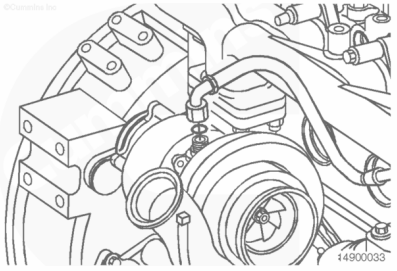
If an external pressure pump is **not** available, prime the lubricating system according to the following procedure.

Fill the engine with lubricating oil to the high-level mark on the dipstick.

Disconnect the turbocharger lubricating oil supply tube.

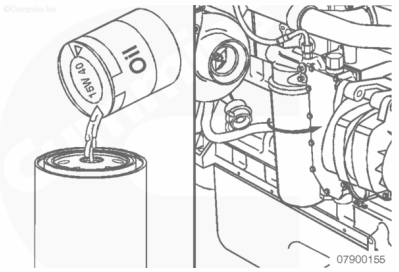
Pour 50 to 60 cc [2.0 to 3.0 fl oz] of clean engine lubricating oil into the turbocharger lubricating oil supply hole.

Connect the lubricating oil supply tube to the turbocharger.



⚠ CAUTION ⚠

Mechanical overtightening can distort the threads or damage the filter element seal.



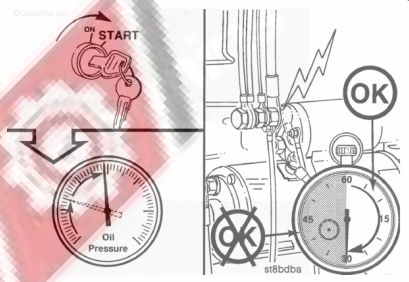
Fill the lubricating oil filter with clean engine lubricating oil.

Screw the filter onto the filter head fitting until the gasket contacts the filter head surface.

Tighten the filter as specified by the manufacturer.

⚠ CAUTION ⚠

Do not crank the starting motor for periods longer than 30 seconds. Excessive heat will damage the starting motor.



Crank the engine until the lubricating oil pressure gauge indicates system pressure.

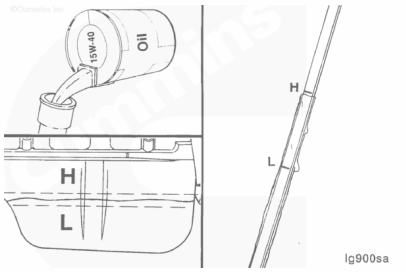
Note : Allow 2 minutes between the 30 second cranking periods so the starter motor can cool.

Note : If pressure is **not** indicated, find and correct the problem before continuing.

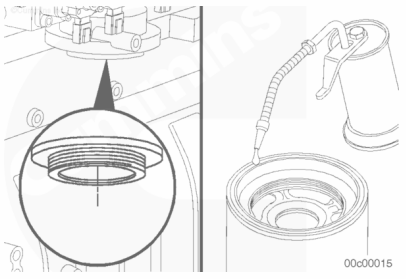
CM2350 Control Module - Connect the original equipment manufacturer (OEM) connector to the engine control module (ECM).

Allow the lubricating oil to drain into the lubricating oil pan. Measure the lubricating oil level with the dipstick.

Add lubricating oil as necessary to bring the level to the high mark.



Lubricate the gasket on the oil filter. Use clean engine lubricating oil.



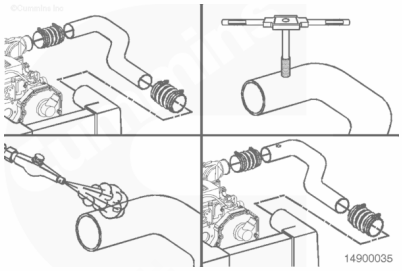
Screw the oil filter onto the filter head until the gasket contacts the filter head surface.

GRAPHIC NOT FOUND

Tighten the filter as specified by the manufacturer.

⚠ CAUTION ⚠

Do not attempt to install pipe thread fittings in plastic or rubber intake piping.

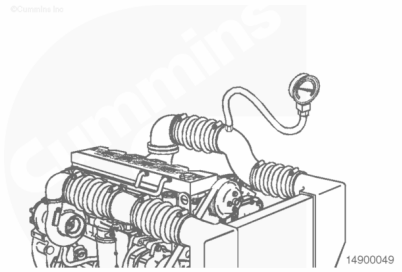


If INSITE™ electronic service tool is available, use it to monitor intake manifold pressure during the test. This eliminates the need to install a gauge as shown below.

If the air crossover tube does **not** have a pipe plug and tapped hole, perform the following procedure:

- Remove the charge air cooler air crossover tube from the engine.
- Drill and tap a 1/8 inch pipe thread hole in the tube, 101.6 to 152.4 mm [4 to 6 in] from the intake opening.
- Clean all metal shavings from the air crossover tube.
- Install the crossover tube.

To determine the amount of turbocharger boost, remove the pipe plug in the air crossover tube and install the intake manifold pressure sensor or pressure gauge, Part Number ST 1273.



Measurements		
	mm-hg	in-hg
Minimum Gauge Capacity	1905	75

Use the following procedure for an accurate engine crankcase blowby measurement. Insert a blowby checking tool in the crankcase breather vent.

For blowby specifications. Refer to Procedure 014-010 in Section 14. (/qs3/pubsys2/xml/en/procedures/100/100-014-010.html)

Connect a water manometer to the blowby tool. A pressure gauge can be used in place of the manometer.

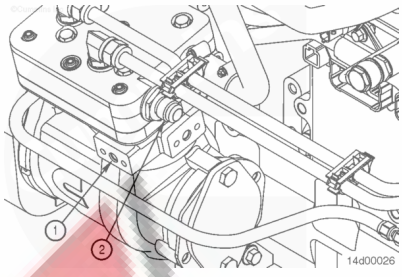
Measurements

ANADOLU ISUZU GUTER PARTS

Measurements	mm-h2o	in-h2o

	mm-h2o	in-h2o
Minimum Gauge Capacity	1270	50

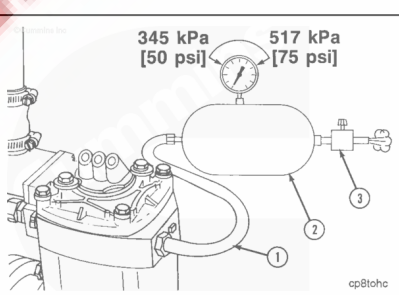
Note : All air compressors manufactured by Cummins Inc. **must** be loaded during engine run-in. All air compressors **must** be unloaded during the engine performance check.



Note : The compressed air load in the accompanying illustration **must** be attached to the air compressor outlet (2).

To be able to unload the compressor, connect a source of compressed air to the unloader (1). This air line **must** contain a valve between the source and the unloader.

Note : The engine is equipped with a variable geometry turbocharger (VGT). The turbocharger control valve will require a continuous air supply of at least 621 kPa [90 psi].

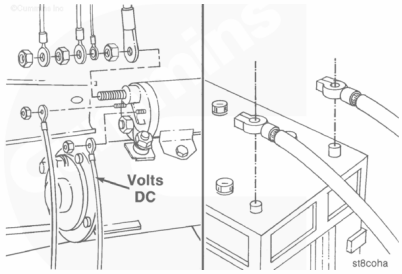


To provide a load on the air compressor, connect an air tank (2) to the compressor outlet, with steel tubing or a high-temperature hose (1).

Install an air regulator (3) that can maintain tank air pressure of 345 to 517 kPa [50 to 75 psi] at both the minimum and maximum engine rpm.

Measurements		
	celsius	fahrenheit
Hose Temperature (Minimum)	260	500

Note : If another method of starting the engine is used, use the equipment manufacturer service information to make the necessary connections.



Inspect the voltage rating on the starter motor before installing the electrical wiring.

Attach electrical wires to the starter motor and the batteries, if used.

Last Modified: 14-Sep-2016



Select Service Tools

Recommended Cummins® Service Tools

- No Cummins® Service Tools required.

Additional Service Items

- No additional service items required.

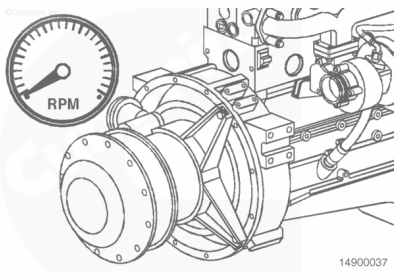
General Information

Use the following procedure for general engine dynamometer, operating/testing procedures and safety precautions. Refer to Procedure 014-005 in Section 14. (/qs3/pubsys2/xml/en/procedures/425/425-014-005.html)

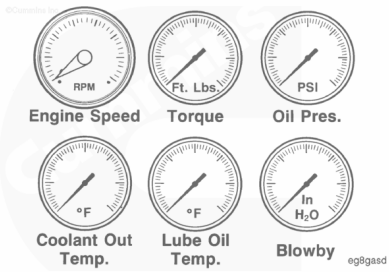
Run-In Instructions

Note : The amount of time specified for the following engine run-in phases are minimums. Additional time can be used, if desired, at each phase except engine idle periods.

The engine run-in period allows the tester to detect assembly errors and make final adjustments needed for performance that meets specifications.



Measurements from these indicators and gauges **must** be observed closely during all phases of the engine run-in period. Refer to Procedure 014-005 in Section 14. (/qs3/pubsys2/xml/en/procedures/425/425-014-005.html)

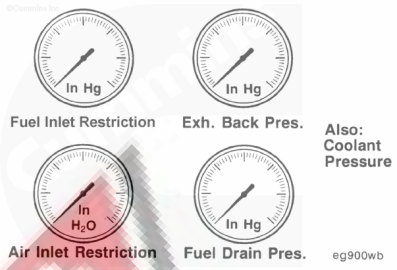


AYAZOĞLU ISUZU PARTS SALES

To evaluate engine performance correctly, this additional measurement **must** be observed during engine run-in phases.



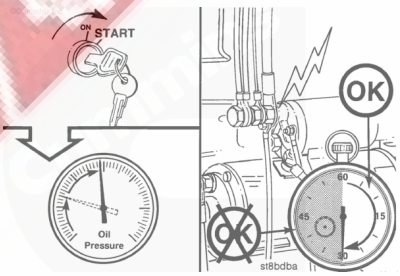
It is good practice to observe these measurements even if engine performance meets specifications. If engine performance does **not** meet specifications, these measurements can indicate possible reasons for under performance.



⚠ CAUTION ⚠

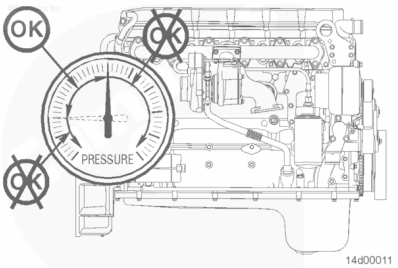
Do not crank the engine for more than 30 seconds. Excessive heat will damage the starter motor.

Crank the engine and observe the lubricating oil pressure when the engine starts. If the engine fails to start within 30 seconds, allow the starter motor to cool for 2 minutes before cranking the engine again.



⚠ CAUTION ⚠

If the lubricating oil pressure is not within specifications, shut off the engine immediately. Low lubricating oil pressure will cause engine damage.

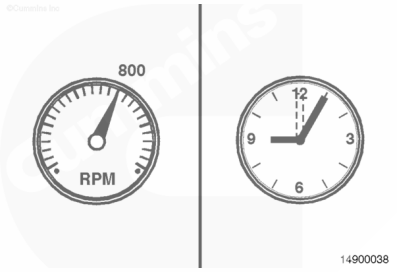


Engine lubricating oil pressure **must** be at least the minimum allowable at idle. Refer to Procedure 018-017 in Section V. (/qs3/pubsys2/xml/en/procedures/425/425-018-017.html)

Correct the problem if the lubricating oil pressure is **not** within specifications.

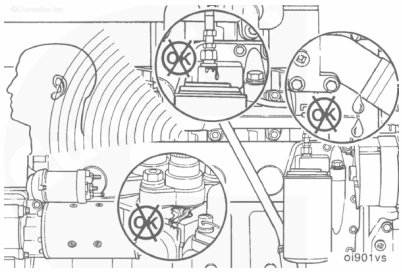
⚠ CAUTION ⚠

Do not operate the engine at idle speed longer than specified during engine run-in. Excessive carbon formation will cause damage to the engine.



Operate the engine at approximately 800 rpm for 3 to 5 minutes.

Note : Repair all leaks or component problems before continuing the engine run-in.

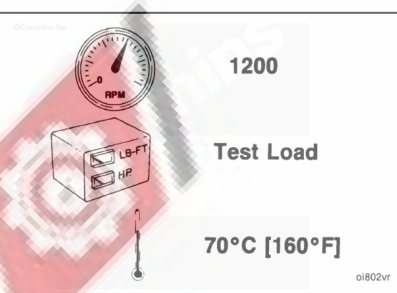


Listen for unusual noises.

Watch for coolant, fuel, and lubricating oil leaks.

Check for correct engine operation in general.

Move the throttle to obtain 1200 rpm engine speed. Set the test load to 25 percent of the rated load.

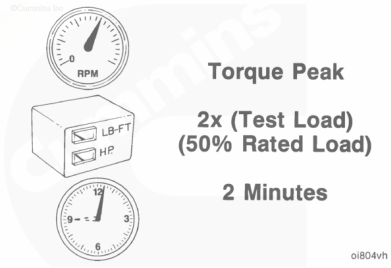


Operate the engine at this speed and load level until the coolant temperature is 70°C [158°F].

Check all gauges. Record the data.

Note : Do **not** proceed to the next step until a steady blowby reading is obtained.

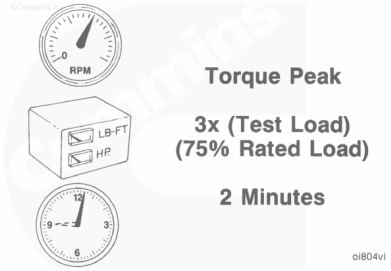
Adjust the throttle to obtain peak torque rpm. Adjust the dynamometer load to 50 percent of torque peak load. Operate the engine at this speed and load level for 2 minutes.



Check all gauges. Record the data.

Note : Do **not** proceed to the next step until blowby is stable within specifications.

With the engine speed remaining at torque peak rpm, increase the dynamometer load to 75 percent of torque peak load. Operate the engine at this speed and load level for 2 minutes.



Check all gauges. Record the data.

Note : Do **not** proceed to the next step until blowby is stable within specifications.

Move the throttle lever to its fully opened position. Increase the dynamometer load until the engine speed is at torque peak rpm. Operate the engine at this speed and load level for 10 minutes or until the blowby becomes stable within specifications.

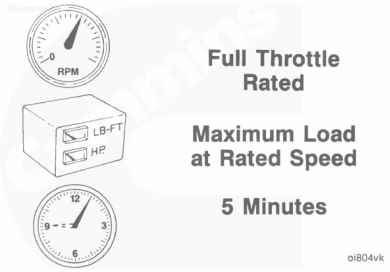


Check all gauges. Record the data.

Reduce the dynamometer load until the engine speed increases to the engine's rated rpm.

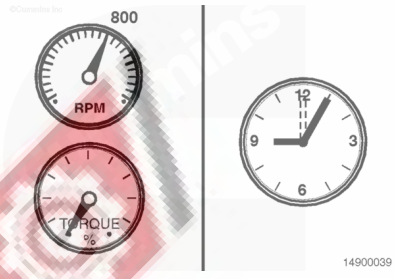
Operate the engine at rated rpm for 5 minutes.

Check all gauges. Record the data.



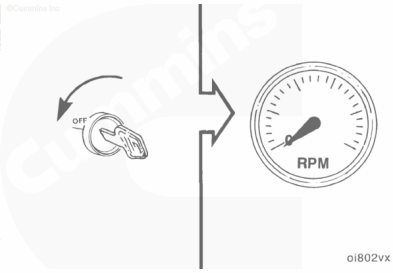
⚠ CAUTION ⚠

Shutting off the engine immediately after operating at full load will damage the turbocharger and internal components. Always allow the engine to cool before shutting it off.



Remove the dynamometer load completely. Operate the engine at 800 rpm for 3 to 5 minutes. This period will allow the turbocharger and other components to cool.

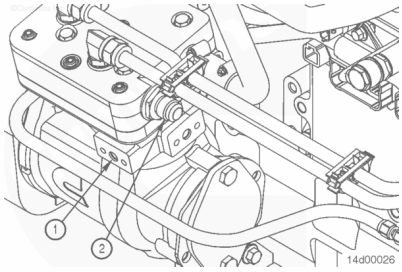
Shut the engine OFF.



Engine Dynamometer Test - Performance Check

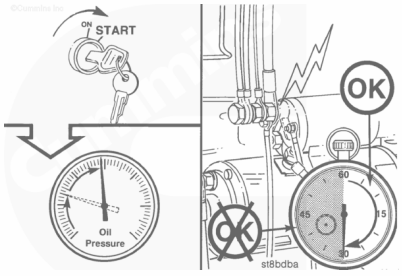
Make sure the air compressor will be unloaded during the performance check.

Apply regulated air pressure of 655 kPa [95 psi] to the air compressor unloader (1).



⚠ CAUTION ⚠

Do not crank the engine for more than 30 seconds. Excessive heat will damage the starter motor.



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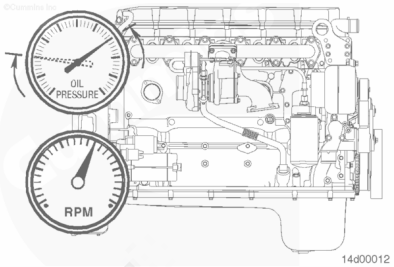
Crank the engine. Observe the oil pressure when the engine starts. If the engine fails to start within 30 seconds, allow the starter motor to cool for 2 minutes before cranking the engine again.

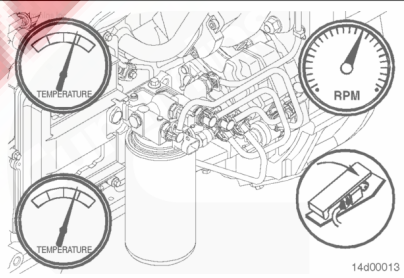
⚠ CAUTION ⚠

If the lubricating oil pressure is not within specifications, shut off the engine immediately. Low lubricating oil pressure will cause engine damage. Correct the problem if lubricating oil pressure is not within specifications.



Engine lubricating oil pressure **must** be at least the minimum allowable at idle. Refer to Procedure 018-017 in Section V. (/qs3/pubsys2/xml/en/procedures/425/425-018-017.html)

Note : The horsepower reading will **not** be accurate if the lubricating oil temperature and fuel temperature are **not** within specifications.



Make sure the engine is at operating temperature (71.1°C [160°F] minimum coolant temperature).

Move the throttle pedal to 100 percent throttle. Adjust the dynamometer load until the engine maintains the rated rpm.

Allow the readings to stabilize. Read the horsepower.

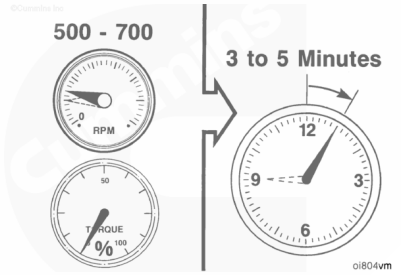
Lubricating Oil Temperature		
celsius		fahrenheit
90	MIN	194

Fuel Temperature		
celsius		fahrenheit
32	MAX	90

Check all gauges. Record the data.

⚠ CAUTION ⚠

Do not shut off the engine immediately after it has been loaded. It must be allowed to cool sufficiently.



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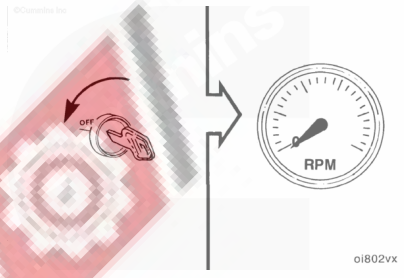
Note : Idle periods longer than 5 minutes are to be avoided.

Move the throttle lever to its fully opened position. Increase the dynamometer load until the engine speed is at torque peak rpm. Allow the readings to stabilize. Read the torque. Check all of the gauges. Record the readings.

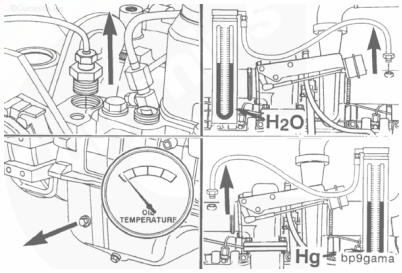
Remove the dynamometer load completely.

Operate the engine at idle speed for 3 to 5 minutes. This will allow the turbocharger and other components to cool.

Shut the engine OFF after the cool down period.



Note : If the engine is to be stored temporarily and does **not** have permanent-type antifreeze, it is necessary to drain all coolant.



Remove all test instrumentation.

Remove the engine from the dynamometer.

Prepare the engine for engine painting. Refer to Procedure 000-007 in Section 0. (/qs3/pubsys2/xml/en/procedures/425/425-000-007.html)

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Last Modified: 05-Aug-2016

Select Service Tools

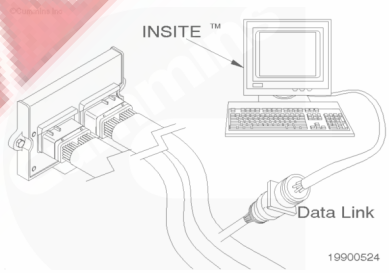
Recommended Cummins® Service Tools

- No Cummins® Service Tools required.

Additional Service Items

- Stopwatch

Setup



The setup for dynamometer function is used to prepare the attached engine control module (ECM) for advanced diagnostic tests run on the dynamometer. For purposes of this test, the maximum engine speed without vehicle speed sensor (VSS), maximum vehicle speed in top gear, and maximum vehicle speed in lower gear are set to their maximum values. The idle shutdown feature is disabled. All of these values are automatically reset to their previous values when the engine keyswitch is in the OFF position.

Settings:

Maximum Engine Speed without VSS: For testing purposes, this speed is temporarily set to the maximum value allowed (3000 rpm).

Maximum Vehicle Speed in Top Gear; For testing purposes, this speed is temporarily set to the maximum value allowed (120 mph).

Maximum Vehicle Speed in Lower Gear: For testing purposes, this speed is temporarily set to the maximum value allowed (120 mph).

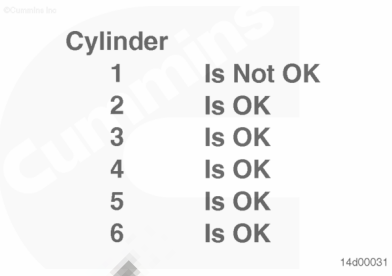
Idle Shutdown: This feature is temporarily disabled for testing purposes (Disable).

Some J1939 electronic subsystems **must** be disabled. The user has the ability to enable or disable the J1939 data link with the service tool.

See INSITE™ electronic service tool user's manual for detailed setup for dynamometer instructions.

Automated Cylinder Performance Test

The automated cylinder performance test is the most thorough test of cylinder performance (versus the single-cylinder cutout test, which tests the performance if individual cylinders **only**). The service tool **must** be attached to an ECM to perform the test. Follow the steps outlined in Preparing to Run the Automated Cylinder Performance test, to make sure the best possible outcome is achieved.



This test is automated in the sense that, once the test is started, the service tool controls what cylinders are disabled or enabled, what ECM values are recorded, and what information displays as a result of the test. Once the test is finished, follow the steps outlined in the After Running the Automated Cylinder Performance Test to make sure the engine returns to its original state.

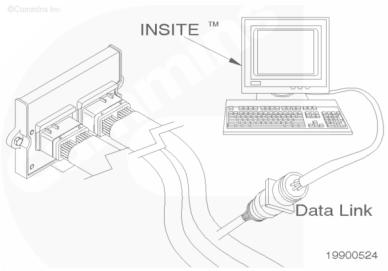
This test will produce a Pass or Fail message for each cylinder. Its percent contribution value is also displayed.

Preparing to Run the Automated Cylinder Performance Test:

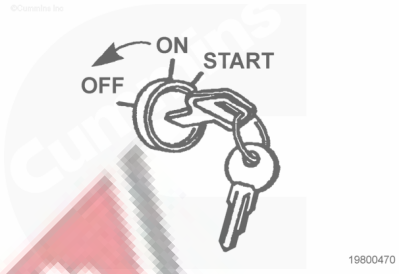
Before performing the test, make sure the following are completed:

1. Clear the areas around the engine and fan. Make sure the exhaust is vented correctly.
2. Operate the engine until the coolant temperature is a minimum of 76.7°C [170°F].
3. Shut off the engine.
4. Lock the fan clutch in the ON position for continuous operation.
5. Shut off the air conditioning.
6. Disengage any devices that can cause the load on the engine to vary.
7. With the vehicle stationary, start the engine and let it idle.
8. Start the test using INSITE™ electronic service tool.

See INSITE™ electronic service tool user's manual for detailed automated cylinder performance test instructions.



After Running the Automated Cylinder Performance Test:

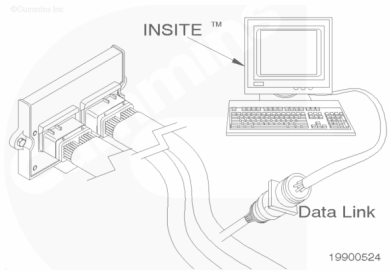


It is normal for the engine rpm to vary during the test, but if the engine rpm goes to high idle for more than 5 seconds at a time, shut off the engine.

Once the test is complete, make sure to complete the following:

1. Shut off the engine.
2. Return the fan to normal operation, if necessary.
3. Perform the suggested repairs that resulted from the test.
4. Return any disengaged devices to their normal mode of operation.

Cylinder Cutout Test



Use the Single-Cylinder Cutout Test to remove individual cylinders from the engine firing cycle and monitor a running engine while the selected cylinder is disabled. The system displays the percent load and rpm values while the cylinder is disabled.

The service tool **must** be attached to a running engine in a non-moving vehicle to perform this test.

See the INSITE™ electronic service tool user's manual for detailed cylinder cutout test instructions.

Cylinder to be Cut Out:

None: Select this option to run all cylinders.

1 to 6: Select one of these options to shut off cylinder number 1 through number 6, respectively. **Only** one cylinder can be shut off at a time.

Monitor:

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Percent Load: The percent of load that the engine is carrying.

rpm: Engine revolutions per minute.

Turbocharger Actuator Test:

Use the turbocharger actuator test to verify the correct functioning of the variable geometry turbocharger actuator.

INSITE™ electronic service tool **must** be attached to an ECM to perform this test.

See INSITE™ electronic service tool user's manual for detailed turbocharger actuator test instructions.

Stall Speed Check

Converter Transmission Stall Speed:

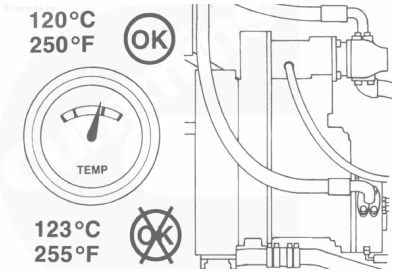
The stall speed is the engine speed (rpm) obtained at full throttle when the converter output shaft is locked.

Note : It is possible the vehicle brakes will **not** hold an electronically controlled transmission.



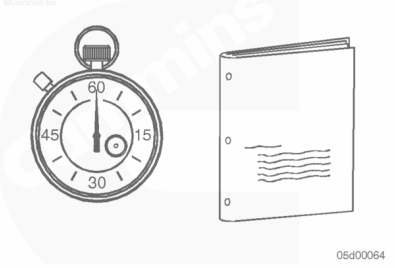
⚠ CAUTION ⚠

Do not exceed 120°C [248°F] converter oil temperature. Overheating can result and converter damage can occur. If the oil temperature exceeds 120°C [248°F], put the transmission in neutral, and operate the engine until the oil temperature is below 120°C [248°F]. Check the converter oil level.

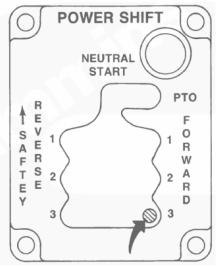


The following equipment is needed for this check:

- Stopwatch
- Equipment manufacturer stall speed and time-to-stall specifications.



Place the gear selector in the highest gear or full forward.

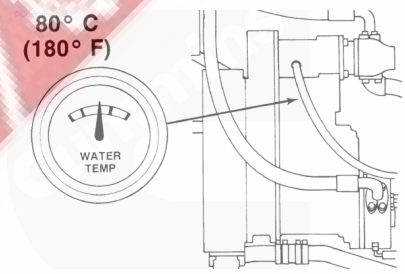


Note : The brakes **must** prevent the vehicle from moving when the engine is at full throttle. Engage the vehicle brakes to keep the vehicle from moving.

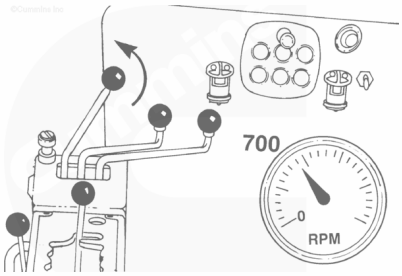
Make sure the vehicle has good brakes and air pressure in the brake system.



Operate the engine until the converter temperature is 80°C [176°F] or above.

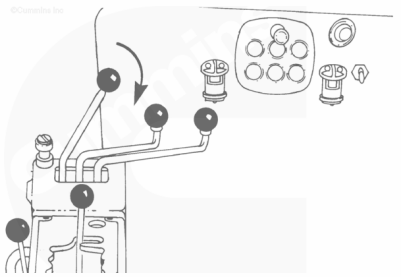


Bring the engine speed back to low idle.



⚠ CAUTION ⚠

Do not exceed 120°C [248°F] converter oil temperature. Overheating and damage to the converter can occur.



Quickly move the throttle to the full-open position with the vehicle brakes applied.

Check the engine speed (rpm) at the point of stall:

- **Always** hold the speed until it is stable.
- Take several readings.
- Make sure the readings are accurate.

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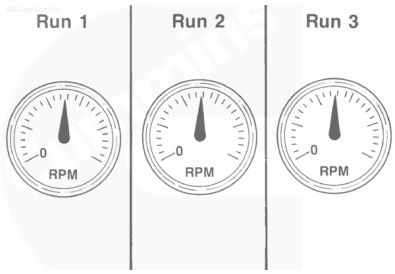
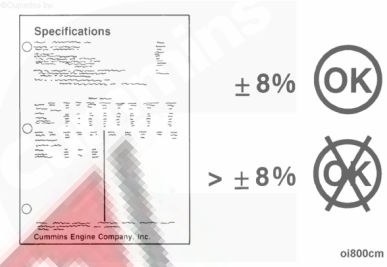


Note : The stall speed for the engine and converter/transmission can vary ±8 percent from manufacturer specifications.

Check the speed (rpm) against the specifications for the equipment, converter, or automatic transmission.



If the stall speed is **not** within the specifications, see the Stall Speed Checklist in this section.

Check equipment manufacturer troubleshooting procedures for other reasons for stall speed problems.


STALL SPEED CHECK LIST

IF THE STALL SPEED IS TOO LOW, CHECK THE FOLLOWING:

	Yes	No	
1.	. . .	. . .	The tachometer is in error.
2.	. . .	. . .	The engine is up to or above 70°C [160°F].
3.	. . .	. . .	The converter oil is up to temperature 80°C [180°F] minimum.
4.	. . .	. . .	The stall has been held long enough for the engine to accelerate to full power.
5.	. . .	. . .	The match curve stall speed was recorded correctly.
6.	. . .	. . .	The converter oil is to the converter manufacturer's recommendation. (SAE 30 instead of SAE 10 for instance.)
7.	. . .	. . .	The engine driven accessory power requirements exceed 10 percent of the gross engine power. Check for abnormal accessory horsepower losses such as hydraulic pumps, large fans, oversize compressors, etc. Either remove the accessory or accurately determine the power requirement and adjust accordingly.
8.	. . .	. . .	The AFC (Air Fuel Control) is propery adjusted.
9.	. . .	. . .	The unit is operating at an altitude high enough to affect the engine power.
10.	. . .	. . .	The converter charging pressure is correct.
11.	. . .	. . .	The tailshaft governor is interfering with and preventing a full throttle opening. (Disconnect the tailshaft governor.)
12.	. . .	. . .	The converter blading is interfering or in a stage of failure. Check the sump or filter for metal particles.
13.	. . .	. . .	The converter stators are free-wheeling instead of locking up.
14.	. . .	. . .	The engine is set for power other than that specified on the power curve.

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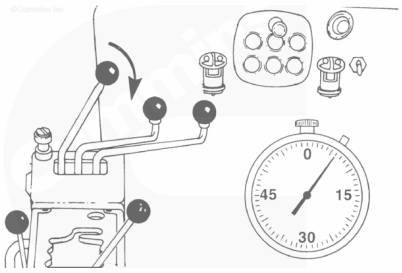
Time Speed Check

Perform the previous Stall Speed Check procedure through the ”Bring the engine speed back to low idle” step then complete the following:

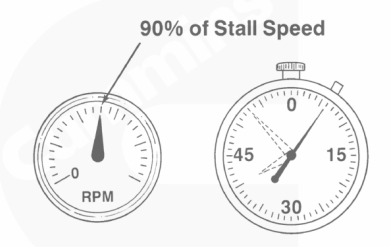
- Quickly move the throttle to the full-open position. Start the stopwatch at the same time.



Note : The type of unit and stall speed rpm can make the stall speed time a maximum of 10 seconds.

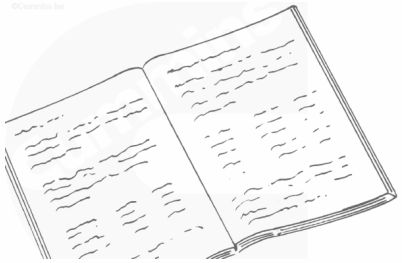
- When the engine speed is 90 percent of the stall speed rpm, stop the stopwatch.

Example: Stall speed 2089 [2089 x 0.90 = 1880 rpm].



Check equipment manufacturer specifications for the time to stall or the acceleration time.

If the time is excessive, see the Stall Speed Checklist in this procedure.



Stall Speed Checklist

Stall Speed Too Low

	Yes	No	
1.			The tachometer is in error.
2.			Engine temperature is up to or above 70°C [160°F].
3.			The converter oil is up to temperature 80°C [180°F].
4.			The stall has been held long enough for the engine to accelerate to full-power.
5.			The match curve stall speed was recorded correctly.
6.			The converter oil is to converter manufacturer recommendation (Society o Automotive Engineers (SAE) 30 instead of SAE 10, for instance).

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	Yes	No	
7.			The engine-driven accessory power requirements exceed 10 percent of the gross engine power. Check for abnormal accessory horsepower losses such as hydraulic pumps, large fans, oversized compressors, and so on. Either remove the accessory or accurately determine the power requirement. Adjust accordingly.
8.			The unit is operating at an altitude high enough to affect engine power.
9.			The converter charging pressure is correct.
10.			The tailshaft governor is interfering with and preventing a full-throttle opening. Disconnect the tailshaft governor. Do **not** exceed the manufacturer's maximum output speed.
11.			The converter blading is interfering or in a stage of failure. Check the sump or filter for particles.

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	Yes	No	
12.			The converter stators are free-wheeling instead of locking up.
13.			The engine is set for power other than that specified on the power curve.
14.			The converter is wrong due to improper build or rebuild of unit.
15.			The converter is performing to the published absorption curve.
16.			The engine and converter match is correct. Check the engine and converter models for the proper match.
17.			The engine is matched to too large of a converter. If this condition is believed to exist, please report the engine-converter-accessory information to the factory.
18.			The engine power is down. The engine torque rise could be less than shown on the standard engine curve. See the fuel setting adjustments and the turbocharger air manifold pressure check.

Stall Speed Too High

	Yes	No	

ANADOLU ISUZU AFTER SALES

	Yes	No	
1.			The engine is high in power.
2.			The tachometer is in error.
3.			The accessory power requirements are less than 10 percent of the gross engine power.
4.			The converter oil is aerating or foaming. Check for low oil level, air leaks in suction line, lack of foam inhibitor in the oil, or suction screen or filter. It will be accompanied by a noticeable loss of machine performance.
5.			The converter is being held at full-stall. Check for slipping front disconnect clutch or a rotating output shaft. On the converter-transmission package, this can be impossible to check.
6.			The converter turbine element is beginning to fail and lose blades, or the converter was originally built with the wrong size element.

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	Yes	No	
7.			The engine and converter match is correct due to a revision in the engine rating or the converter performance.
8.			If the oil level is too high on the transmission-converter units with the oil sump in the transmission, it can cause severe aeration due to parts dipping into the oil.
9.			The converter is performing to the published absorption curve.
10.			The converter charging pressure is correct.

The reasons for abnormal stall speeds listed above are some encountered by Cummins Inc. representatives and probably do **not** include all possible causes. The correction of the problem is either covered in the vehicle service manual, the converter service manual, or is self-explanatory.

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Last Modified: 05-Aug-2016

Select Service Tools

Recommended Cummins® Service Tools

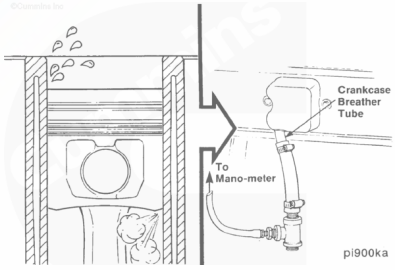
- Water manometer, Part Number ST 1111 3, or equivalent
- Blowby tool, Part Number 3822476 or 3822566
- Straight thread plug, Part Number 3089567
- Oil fill adapter, Part Number 3990099

Additional Service Items

- No additional service items required.

General Information

Excessive crankcase blowby can indicate an engine or engine-related component malfunction that allows combustion gases or air to enter the crankcase. This results in the buildup of higher than normal crankcase pressure, which results in increased levels of blowby.



This procedure describes how to measure crankcase blowby and how to determine what component is malfunctioning.

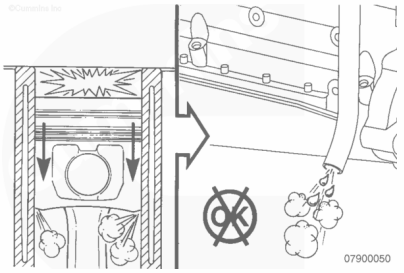
Blowby is typically measured for the following situations:

- Verifying engine break-in after an engine rebuild
- Troubleshooting for excessive lubricating oil out of the crankcase breather tube, commonly referred to as oil carryover (for open crankcase ventilation systems)
- Troubleshooting oil in the air intake system (for closed crankcase ventilation systems)
- Troubleshooting high crankcase pressure (for engines equipped with a crankcase pressure sensor)
- Troubleshooting possible internal engine damage (worn piston rings, valve stem seals, or guides, turbocharger, air compressor, etc.).

Note : For specific crankcase gases (blowby) symptom information and direction, see the Crankcase Gases (Blowby) Excessive troubleshooting symptom tree in Section TS.

The following measure step will give general guidelines for measuring blowby relative to the above situations.

Note : Some illustrations in this procedure do **not** show actual engine configurations. However, the procedure is the same.



It is important to note the terms blowby and carryover (oil out of the breather tube) are commonly used interchangeably.

When measuring blowby, and there is an excessive amount of oil coming out of the breather tube, the quantity of oil can affect the blowby measurement.

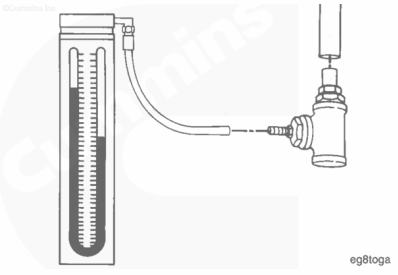
The blowby measurement is affected by the oil collecting on the orifice of the blowby measurement service tool. This reduces the size of the orifice, which results in higher than actual blowby measurements.

If this occurs, it will be necessary to:

- Find a different location on the engine to measure blowby (oil fill, oil fill cap, unused turbocharger drain location, etc.).
- Clean any oil residue from the breather. Dry thoroughly before measuring blowby.

Determine if there is an issue causing the breather to be flooded with oil, for example:

- Incorrect oil level
- Vehicle operation (excessive angularity, excessive engine side-to-side movement)
- Internal engine components deflecting oil toward the breather cavity (piston cooling nozzles, accessory oil drains, etc.)
- Determine if another breather option is available for the engine being serviced.



The tools used to measure blowby are similar in design. The difference between the tools is in the size of the orifice. Different size orifices are available to more accurately measure blowby by accommodating the wide variety of engine configurations and ratings. This is due to the fact engine blowby is dependent on the volume of intake airflow.

For example:

If measuring blowby on two identically configured and sized engines, but the horsepower ratings and rated speed are different, the maximum blowby values measured will be different.

The engine with the higher horsepower rating and rated speed will have a higher volume of intake airflow, which will result in higher blowby. This means if the smaller orifice blowby tool was used on the engine with a higher horsepower rating and rated speed, the measurement can exceed the limits of the pressure measuring tool.

Blowby Tool Part Number	Orifice Size mm [in]
3822476	5.61 mm [0.221 in]
3822566	7.67 mm [0.302 in]

To measure the crankcase blowby pressure, connect water manometer, Part Number ST 1111 3, or equivalent, pressure gauge, or transducer to the blowby tool.

Note : Cummins® water manometer, Part Number ST 1111 3, can measure a maximum of 944 mm [36 in] of water.

The following charts show the relationship of measured pressure to flow rate, depending on the blowby tool used.

Blowby Conversion Table (5.61 mm [0.221 in] orifice, Blowby Tool, Part Number 3822476)	
mm [in] of H_2O	Liter [cfm] per Minute
25.4 [1]	27 [0.953]
50.8 [2]	40 [1.413]
76.2 [3]	48 [1.695]
101.6 [4]	58 [2.048]
127 [5]	64 [2.260]
152.4 [6]	71 [2.507]
177.8 [7]	76 [2.684]
203.2 [8]	81 [2.860]
228.6 [9]	86 [3.037]
254 [10]	90 [3.178]
279.4 [11]	94 [3.320]
304.8 [12]	98 [3.461]
330.2 [13]	102 [3.602]
355.6 [14]	105 [3.708]
381 [15]	109 [3.849]
406.4 [16]	112 [3.955]
431.8 [17]	115 [4.061]
457.2 [18]	118 [4.167]
482.6 [19]	121 [4.723]

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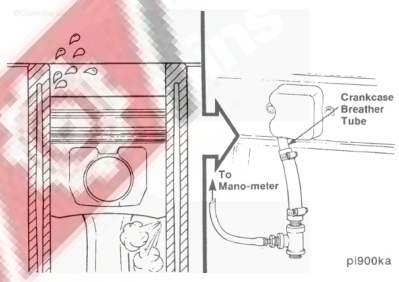
Blowby Conversion Table (5.61 mm [0.221 in] orifice, Blowby Tool, Part Number 3822476)	
mm [in] of H_2O	Liter [cfm] per Minute
508 [20]	124 [4.379]
533.4 [21]	128 [4.520]
558.2 [22]	131 [4.626]
584.2 [23]	135 [4.767]
609.6 [24]	137 [4.838]
635 [25]	140 [4.944]
660.4 [26]	144 [5.085]
685.8 [27]	147 [5.191]
711.2 [28]	150 [5.297]
736.6 [29]	154 [5.438]
762 [30]	157 [5.544]
787.4 [31]	160 [5.650]
812.8 [32]	163 [5.756]
838.2 [33]	166 [5.862]
863.6 [34]	169 [5.968]
889 [35]	172 [6.074]
Blowby Conversion Table (7.67 mm [0.302 in] orifice, Blowby Tool, Part Number 3822566)	
mm [in] of H_2O	**Liter [cfm] per Minute**
25.4 [1]	50 [1.766]
50.8 [2]	84 [2.966]
76.2 [3]	103 [3.637]
101.6 [4]	119 [4.202]
127 [5]	133 [4.697]
152.4 [6]	145 [5.121]
177.8 [7]	155 [5.474]
203.2 [8]	164 [5.792]
228.6 [9]	172 [6.074]
254 [10]	180 [6.357]
279.4 [11]	187 [6.604]
304.8 [12]	193 [6.816]
330.2 [13]	200 [7.063]
355.6 [14]	206 [7.275]
381 [15]	211 [7.451]
406.4 [16]	217 [7.663]
431.8 [17]	222 [7.840]

Blowby Conversion Table (7.67 mm [0.302 in] orifice, Blowby Tool, Part Number 3822566)	
mm [in] of H_2O	Liter [cfm] per Minute
457.2 [18]	226 [7.981]
482.6 [19]	229 [8.087]
508 [20]	235 [8.299]
533.4 [21]	239 [8.440]
558.8 [22]	242 [8.546]
584.2 [23]	246 [8.687]
609.6 [24]	248 [8.758]

The following chart contains general blowby specifications. Due to the wide variety of engine types, configurations, and ratings, these specifications are intended to **only** be used as a guide to help identify if a problem exists. These specifications are **not** intended to be used as engine condemnation limits.



Note : If internal engine damage is suspected to be the cause of the excessive blowby condition, other steps can be taken to confirm this.

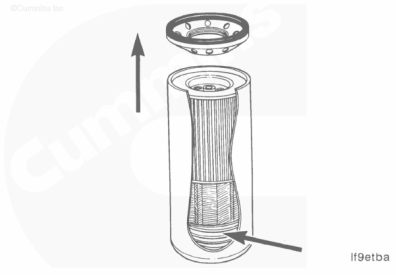
Measuring blowby **must only** be considered when confirming engine break-in after a rebuild or if another symptom is present. These symptoms can include:

- Excessive carryover (oil out of the crankcase breather tube)
- High crankcase pressure (for engines equipped with a crankcase pressure sensor)
- Low power
- Oil consumption
- Exhaust smoke.

If no other symptom is present, blowby measurements need **not** be taken.

If internal engine damage is suspected to be the cause of the excessive blowby condition, other steps can be taken to confirm this. The steps include:

- Confirm engine maintenance practices.
- Cut the oil filter open. Check for debris.
- Take an oil sample and inspect for contamination.

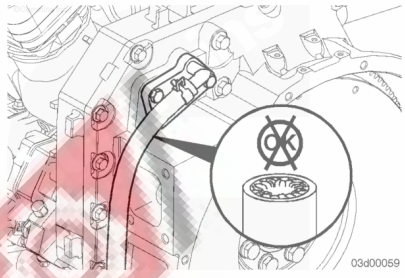


Blowby Tool Part Number

Blowby Specifications For New or Rebuild - mm [in] H_2O	Blowby Specification For Troubleshooting - mm [in] H_2O
203.2 [8]	304.8 [12]

Initial Check

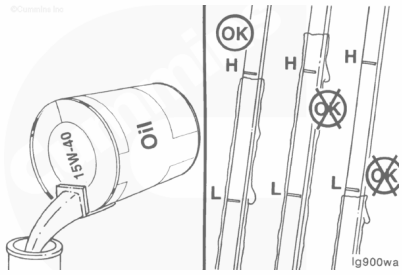
Note : The location and type of crankcase breathers vary by engine configuration (Front Gear Train or Rear Gear Train) and/or engine application (Marine, Industrial, and Automotive).



Prior to measuring blowby pressure, check the crankcase breather tube for obstructions. Refer to Procedure 003-018 in Section 3. (/qs3/pubsys2/xml/en/procedures/425/425-003-018.html)

If troubleshooting a complaint of excessive oil out of the breather tube, it can be necessary to remove the breather components to clean and remove any lubricating oil buildup before performing any blowby measurements.

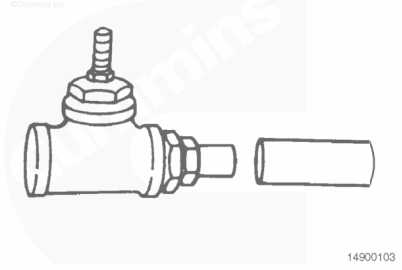
Check the engine oil level and, if necessary, proper calibration of the dipstick. If the level is too high, it can cause a higher than normal blowby pressure and/or excessive carryover. Refer to Procedure 007-037 in Section 7. (/qs3/pubsys2/xml/en/procedures/425/425-007-037.html)



Measure

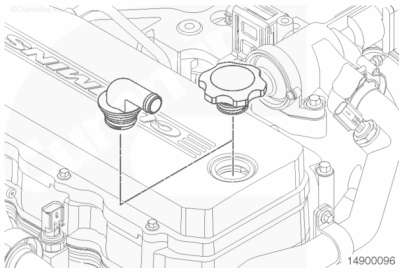
Obtain the appropriate blowby measurement service tool.

Blowby Tool Part Number	Orifice Size mm [in]
3822566	7.67 mm [0.302 in]

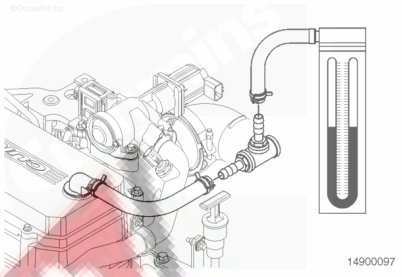


Use the following steps to connect the blowby measurement tools.

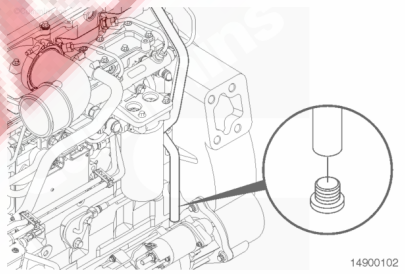
- Remove the oil fill cap from the rocker lever cover. Install oil fill adapter, Part Number 3990099.



- Connect the blowby measurement service tool to the outlet of the oil fill adapter. Connect a water manometer, Part Number ST 1111 3, pressure gauge, or transducer to the blowby measurement service tool.



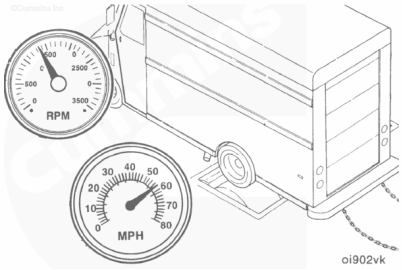
- Use a suitable fitting to plug the crankcase breather tube.



Engine Blowby Contribution:

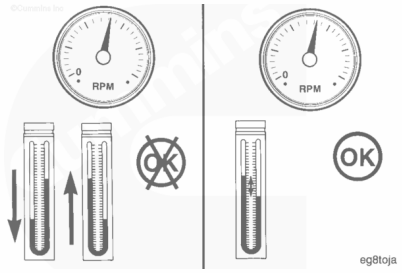
Operate the engine at rated speed and under load by:

- For engine run-in, a chassis dynamometer or engine dynamometer.
- For engine testing, a chassis dynamometer or engine dynamometer.
- A stall speed test (for engines equipped with automatic transmissions **only**).



⚠ CAUTION ⚠

When measuring blowby and there is an excessive amount of oil coming out of the breather tube, the quantity of oil can affect the blowby measurement.



Operate the engine at rated rpm and full load until a steady reading is obtained.

Note : When measuring blowby, the value can “spike” initially as the engine reaches peak power and rated

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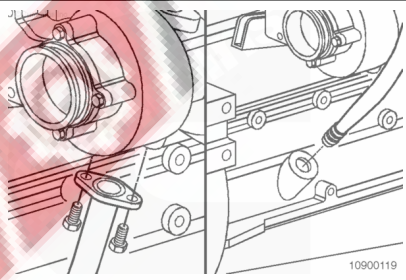
speed. Wait for the blowby measurement to stabilize before taking a reading.

Note : For engine run-in, if a sudden increase in blowby occurs, or if blowby exceeds the maximum allowable limit during any run-in step, return to the previous step and continue the run-in. If blowby does **not** reach an acceptable level, discontinue the run-in and determine the cause.

Record the steady blowby measurement.

Remove the engine blowby service tool and the water manometer, pressure gauge, or transducer, if the blowby is within specification.

Turbocharger Blowby Contribution:

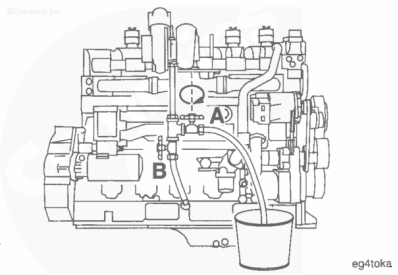


Note : For engines equipped with dual turbochargers, the Turbocharger Oil Drain Line Isolation Test may need to be conducted twice to determine which turbocharger is contributing high blowby. The first test should be conducted with both turbocharger drain lines isolated. If the blowby contribution is above specifications, conduct a second test with **only** the low pressure turbocharger oil drain line isolated. If the blowby contribution is within specification, inspect the compressor and turbine areas of the low pressure turbocharger for signs of an oil leak. Replace the low pressure turbocharger, if necessary. If the blowby contribution is out of specification, replace the high pressure turbocharger.

With the engine blowby service tool and water manometer or pressure gauge still installed:

- Isolate the turbocharger, if equipped, to determine if the high blowby pressure is due to turbocharger seal leakage.
- To measure the turbocharger blowby contribution, disconnect the turbocharger oil drain line. Refer to Procedure 010-045 in Section 10. (/qs3/pubsys2/xml/en/procedures/425/425-010-045.html)

Preferred Turbocharger Isolation Method:

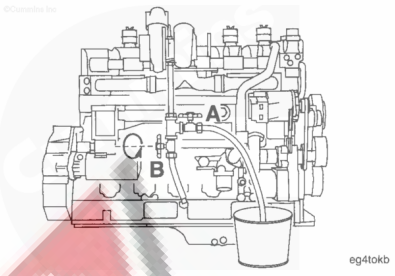


Install a hose assembly with two shutoff valves (A and B), as shown in the illustration, between the turbocharger and turbocharger drain line location in the cylinder block. The valves **must** have a minimum inside diameter of 19 mm [0.75 in]. Place the other hose in a 8 to 9 liter [2 to 3 gal] container.

Note : Some turbocharger oil drain tubes are a single one piece tube. It can be necessary to create a turbocharger isolation tool. Use a new or used turbocharger drain line and cut a middle section out of the turbocharger drain line to fit the check valves and hoses.

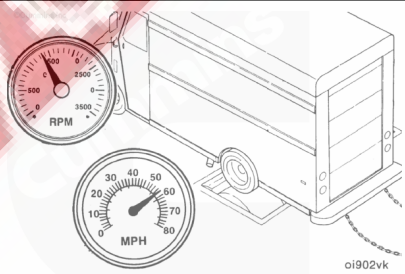
Close the valve (A) that allows oil to drain into the bucket.

Open the valve (B) that allows oil to drain into the engine.



Operate the engine at rated speed and under load by either:

- For engine testing, a chassis dynamometer or engine dynamometer
- A stall speed test (for engines equipped with automatic transmissions **only**).

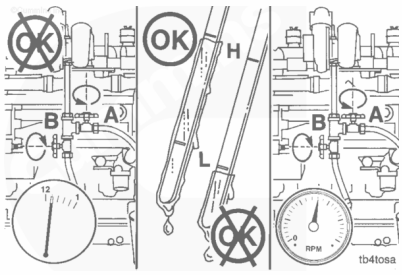


Operate the engine at rated rpm and full load until a steady reading is obtained.

Note : When measuring blowby, the value can “spike” initially as the engine reaches peak power and rated speed. Wait for the blowby measurement to stabilize before taking a reading.

⚠ WARNING ⚠

To reduce the possibility of personal injury, keep hands, long hair, jewelry, and loose fitting or torn clothing away from fans and other moving parts.



⚠ WARNING ⚠

Troubleshooting presents the risk of equipment damage, personal injury, or death. Troubleshooting must be performed by trained, experienced technicians.

⚠ CAUTION ⚠

Do not operate the engine with valve (A) open and valve (B) closed for more than 1 minute. Monitor the amount of oil accumulating in the bucket. The engine can run

out of lubricating engine oil and severe engine damage will occur.

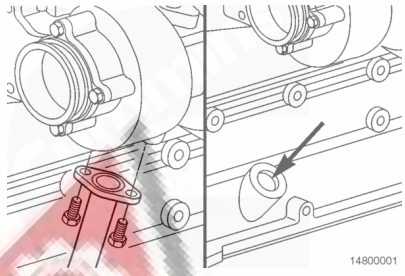
Continue operating at rated speed and load.

Open valve (A) and close valve (B).

Record the blowby pressure reading.

⚠ CAUTION ⚠

Do not operate the engine for more than 1 minute. Monitor the amount of oil accumulating in the container. The engine can be run out of lubricating engine oil and severe engine damage will result.



Alternate Turbocharger Isolation Method:

With the turbocharger oil drain line disconnected from the cylinder block, run the turbocharger drain line into a large container.

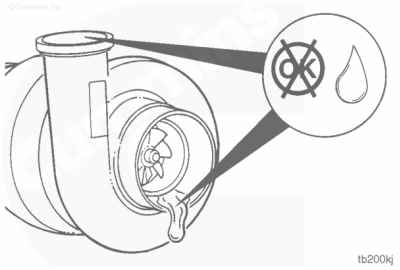
Plug the turbocharger oil drain port in the cylinder block.

Operate the engine at rated speed and under load by either:

- For engine testing, a chassis dynamometer or engine dynamometer
- A stall speed test (for engines equipped with automatic transmissions **only**).

Record the peak blowby pressure measurement.

Determine the turbocharger blowby pressure contribution by determining the difference in the blowby pressure measurement with the turbocharger drain isolated, valve (A) open, and turbocharger drain **not** isolated, valve (A) closed.

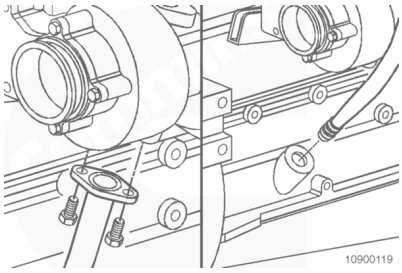


Blowby Pressure Differential	
Turbocharger Blowby Contribution	Maximum: 30 percent

If the turbocharger blowby contribution is out of specification, inspect the compressor and turbine areas of the turbocharger for signs of an oil leak. Replace the turbocharger, if necessary. Refer to Procedure 010-033 in Section 10. (/qs3/pubsys2/xml/en/procedures/425/425-010-033.html)

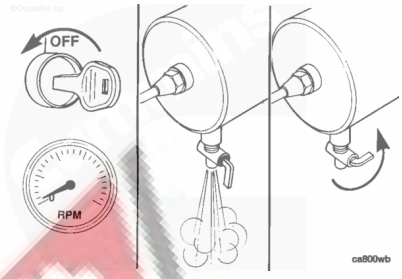
If installed, remove the turbocharger oil drain line assembly and shutoff valves. Refer to Procedure 010-045 in Section 10. (/qs3/pubsys2/xml/en/procedures/425/425-010-045.html)

Check the engine oil level and add oil, if necessary.



⚠ WARNING ⚠

Wear appropriate eye and face protection when using compressed air. Flying debris and dirt can cause personal injury.

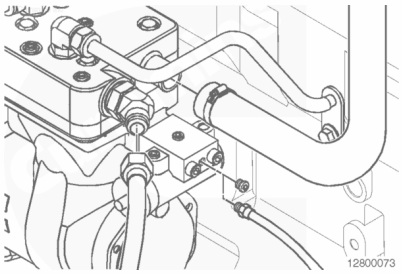


Air Compressor Blowby Contribution:

With the engine blowby service tool and water manometer, pressure gauge, or transducer still installed, isolate the air compressor, if equipped, to determine if there is internal damage to the air compressor contributing to high engine crankcase pressure. The air compressor can be isolated by unloading the air compressor.

With the engine shut off, bleed the vehicle's air system down by opening the drain cock on the wet tank to release compressed air from the system.

Note : The air compressor governor/unloader location can vary on each engine application. The air governor/unloader can be air compressor mounted or chassis mounted.



Disconnect the air signal line from the air compressor governor/unloader air signal port.

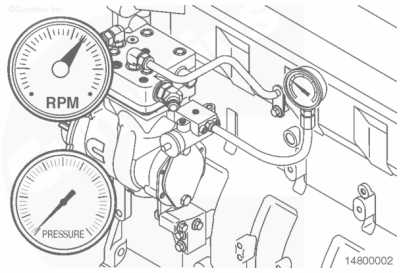
Disconnect the air compressor discharge line and air intake hose from the air compressor.

Note : On turbocharged air compressors, make sure to plug the air intake hose connected to the engine intake manifold or the engine will **not** reach full power during test.

To unload the air compressor, determine the pressure needed at the governor/unloader air signal port to start and stop the air compressor from pumping.

Note : Typical 621 kPa [90 psi] of air pressure is the set point between starting and stopping of the air

compressor pumping. See equipment manufacturer service information.



Connect a regulated shop air pressure line, with pressure gauge, to the air compressor governor/unloader air signal port.

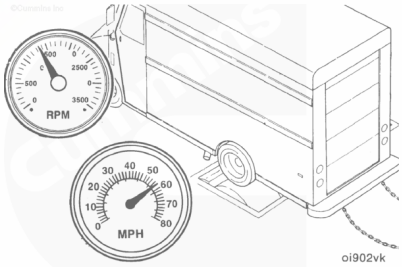
Note : When performing the test, make sure that the air system pressure does **not** exceed the manufacturer's maximum allowable pressure.

Run the engine and increase the signal pressure to the air governor/unloader to determine when the air compressor will stop pumping (system pressure stops rising at this point). Record the signal line pressure.

Reduce the signal pressure to determine when system pressure starts the air compressor pumping again (system pressure will begin to rise again at this point). Record the signal line pressure.

Note : Allow the air compressor to pump long enough to build enough pressure in the system to release and operate the air brakes.

With the regulated shop air pressure line still connected to the air compressor governor/unloader air signal port, regulate the signal pressure so that the air compressor starts pumping (system pressure will begin to rise again at this point). Use the pressure value recorded previously as a set point.



Operate the engine at rated speed and under load by either:

- For engine testing, a chassis dynamometer or engine dynamometer.
- A stall speed test (for engines equipped with automatic transmissions **only**).

Operate the engine at rated rpm and full load until a steady reading is obtained.

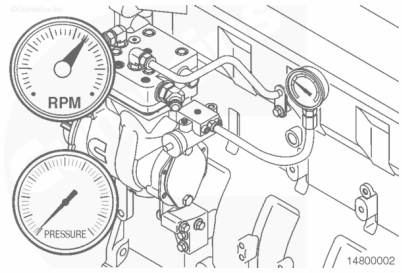
Note : When measuring blowby, the value can “spike” initially as the engine reaches peak power and rated speed. Wait for the blowby measurement to stabilize before taking a reading.

Continue operating the engine at rated speed and load.

Increase the signal pressure (system pressure stops rising at this point). Use the pressure value recorded previously as a set point.

Operate the engine at rated rpm and full load until a steady reading is obtained.

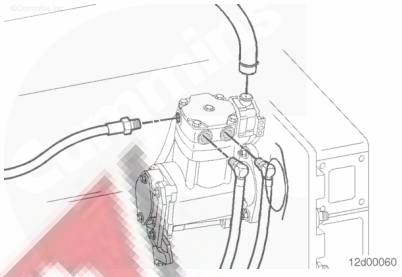
Note : When measuring blowby, the value can “spike” initially as the engine reaches peak power and rated speed. Wait for the blowby measurement to stabilize before taking a reading.



Determine the air compressor blowby pressure contribution by determining the difference in the blowby pressure measurement with the air compressor pumping and the air compressor **not** pumping.

Blowby Pressure Differential	
Air Compressor Contribution	Maximum: 30 percent

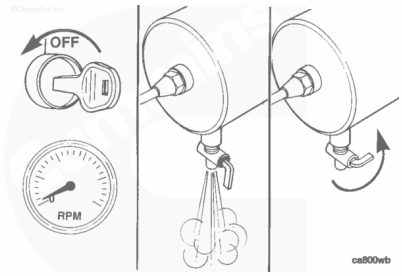
If the air compressor blowby contribution is out of specification, replace the air compressor. Refer to Procedure 012-014 in Section 12. (/qs3/pubsys2/xml/en/procedures/425/425-012-014.html)



⚠ WARNING ⚠

Wear appropriate eye and face protection when using compressed air. Flying debris and dirt can cause personal injury.

With the engine shut off, bleed the vehicle's air system down by opening the drain cock on the wet tank to release compressed air from the system.



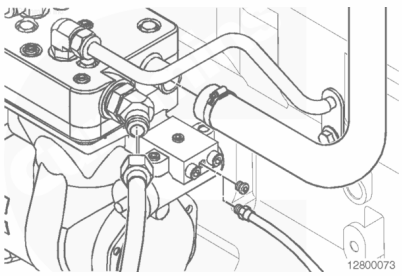
Disconnect the regulated shop air pressure line, with pressure gauge, from the air compressor governor/unloader air signal port.

Connect the air signal line. See equipment manufacturer service information.

Remove the engine blowby service tool and water manometer or pressure gauge if the blowby is within specification.

Note : On turbocharged air compressors, make sure to remove the plug previously installed in the air intake hose connected to the engine intake manifold.

Connect the air compressor discharge line and air intake hose from the air compressor.



ANADOLU ISUZU PARTS

Base Engine Component Blowby Contribution:

Base engine components can also be contributing factors of increased crankcase blowby and higher than normal crankcase pressure. Reference the Crankcase Gases (Blowby) Excessive troubleshooting symptom tree in Section TS of the appropriate engine service manual to evaluate the remaining possible causes for increased blowby and higher than normal crankcase pressure. The following are listed as possible base engine component causes:

- Valve stem clearance is excessive or the valve stem seals are damaged. Refer to Procedure 002-004 in Section 2. (/qs3/pubsys2/xml/en/procedures/425/425-002-004.html)
- Cylinder head valve guides are excessively worn. Refer to Procedure 002-004 in Section 2. (/qs3/pubsys2/xml/en/procedures/425/425-002-004.html)
- Air compressor is malfunctioning. Refer to Procedure 012-014 in Section 12. (/qs3/pubsys2/xml/en/procedures/425/425-012-014.html)
- Piston or piston rings are worn or damaged. Refer to Procedure 001-043 in Section 1. (/qs3/pubsys2/xml/en/procedures/425/425-001-043.html)

ANADOLU ISUZU AFTER SALES

Last Modified: 08-Nov-2016

Select Service Tools

Recommended Cummins® Service Tools

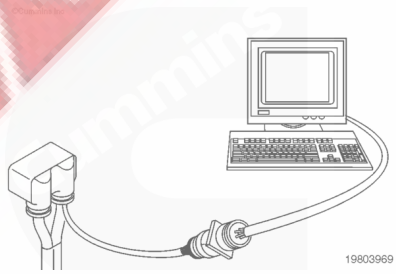
- No Cummins® service tools required.

Additional Service Items

- No additional service items required.

General Information

The INSITE™ electronic service tool Fuel Injector Performance Test is a diagnostic test used to identify malfunctioning fuel injectors. When initiated, the test will increase engine rpm to a specified value and then perform a number of engine decelerations. During these engine decelerations, fuel pressure stability is verified, fuel pressure drop is monitored, fuel injectors are fired, and fuel injector operation is evaluated. At the conclusion of the test, the engine will return to idle and injectors will be identified as either a pass or fail.



The Fuel Injector Performance Test can take up to 30 minutes to complete.

Check for active fault codes prior to performing this procedure. If any active fault codes are present, follow the appropriate fault code troubleshooting tree.

Preparatory Steps

⚠ WARNING ⚠

The test will produce significant engine noise due to the varying engine speeds that will occur during the test process. Do not perform this test in an enclosed environment. Move the equipment to a secluded location. To reduce the possibility of personal injury, hearing protection must be used while conducting this test.

⚠ CAUTION ⚠

The Fuel Injector Performance Test operates the engine at varying speeds from idle to 2000 rpm. Engine speed will change significantly during the test process.

To perform the Fuel Injector Performance Test, connect INSITE™ electronic service tool and check for active fault codes. Any fault codes related to the fuel system, such as Fault Code 3727, 559, or 553, injector circuit Fault Code 322, 323, 324, 325, 331, or 332, or high aftertreatment temperature Fault Code 3311, or 3312, go to section TF for fault code troubleshooting before proceeding. Do **not** perform the Fuel Injector Performance Test with active fault codes, unless guided to do so by the fault code troubleshooting.

Note : The Fuel Injector Performance Test is designed to run on standard Number 2 diesel fuel. Low fuel viscosity; for example, Number 1 diesel fuel, kerosene, or aviation fuel, will result in erroneous test results. Verify the fuel type being used before running the Fuel Injector Performance Test.

Before performing the Fuel Injector Performance Test, follow the steps listed below:

1. Select an appropriate location to park the vehicle.
    - The Fuel Injector Performance Test is an extremely noisy test.
    - Do **not** perform the Fuel Injector Performance Test in the shop.
    - Move the vehicle to a secluded location, such as a back parking lot.
    - Perform the test on a reasonably level surface.
2. Park the truck securely.
    - Verify parking brake operation per the vehicle manufacturers specifications.
    - Set the parking brake.
    - Turn engine brakes off.
    - Place the transmission in Park, if provided; otherwise in Neutral.
    - Set wheel chocks at the front and rear of at least one tire.
3. Set up a safe area.
    - If by-standers might enter the area, set up barriers to keep people at least 1.5 m [5 ft] from the front and rear of the vehicle during the Fuel Injector Performance Test.
    - Make certain the cab and sleeper are clear of occupants.
    - Keep a fire extinguisher nearby.
4. Prepare for engine speed changes during the Fuel Injector Performance Test.
    - Do **not** operate any power takeoff (PTO)-powered devices. Disconnect these devices before starting the Fuel Injector Performance Test.
    - Stay clear of the engine compartment.
5. Begin the Fuel Injector Performance Test.
    - Use INSITE™ electronic service tool to perform the Fuel Injector Performance Test.
    - Engine speed will increase to a specified value and then the engine control module (ECM) will perform a number of engine decelerations. During these engine decelerations, fuel pressure stability is verified, fuel pressure drop is monitored, fuel injectors are fired, and fuel injector operation is evaluated.
    - At the conclusion of the test, the engine will return to idle and suspect fuel injectors will be identified as either pass or fail.
6. Monitor the area.

- Make sure the vehicle and surrounding area are monitored during Fuel Injector Performance Test. If any unsafe condition occurs, shut the engine off immediately.

To stop the Fuel Injector Performance Test, click on the STOP button on the INSITE™ electronic service tool screen. The Fuel Injector Performance Test can also be stopped by engaging the clutch, brake, or throttle pedal; or by turning the engine OFF.

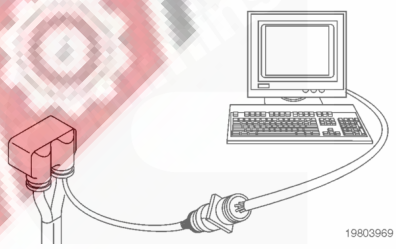
Once the Fuel Injector Performance Test is complete, the engine will return to idle. INSITE™ electronic service tool will display the test results for review.

Setup

Start the engine. Bring it to operating temperature (above 70°C [158°F]).

Allow the engine to idle.

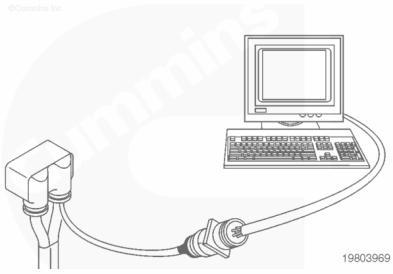
Connect INSITE™ electronic service tool.



Test

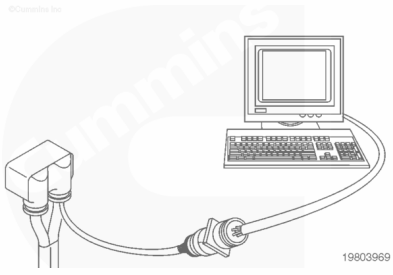
The Fuel Injector Performance Test can be found under the ECM Diagnostic Test menu in the INSITE™ electronic service tool.

Follow the on-screen prompts to perform the test.



When the test is started, engine speed will be raised automatically to the required level. Engine speed will reach between 1800 and 2000 rpm.

The engine will then, through the engine controls, operate in a manner to test the fuel injectors. The engine will enter a motoring event. Engine speed will drop to approximately 1000 rpm. During this motoring event, the fuel pressure and fuel injectors will be tested. Engine speed will then return to between 1800 and 2000 rpm and the sequence will repeat. This is normal.

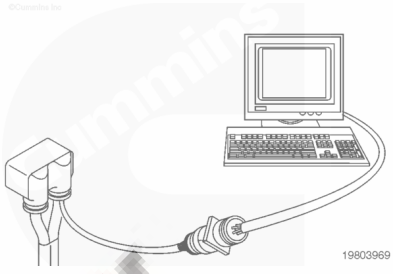


ANADOLU ISUZU USED SALES

This process can repeat as many as 24 times before the test is complete.

Once the Fuel Injector Performance Test is complete, the engine will automatically return to normal idle speed.

Note : If the Fuel Injector Performance Test will **not** initiate, a message will be displayed. The identified issue will need to be corrected before continuing.



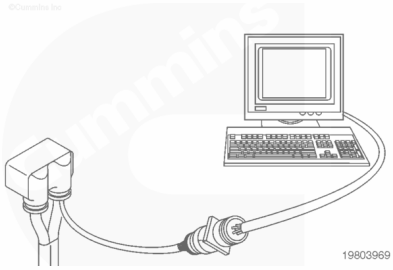
Note : If the Fuel Injector Performance Test aborts, a message will be displayed. The identified issue will need to be corrected before continuing or restarting the Fuel Injector Performance Test.

The Fuel Injector Performance Test can take up to 30 minutes to complete. At any time, the Fuel Injector Performance Test can be aborted by clicking on the STOP button in INSITE™ electronic service tool.

The Fuel Injector Performance Test will also be aborted if:

- A fault becomes active
- Accelerator is depressed
- Clutch pedal is depressed
- Brake pedal is depressed
- Transmission is put into gear
- High aftertreatment temperature faults are generated.

If INSITE™ electronic service tool Fuel Injector Performance Test will **not** activate, a message will be displayed. Correct the issue identified before proceeding. See the Fuel Injector Performance Test - Will Not Activate troubleshooting symptom tree in Section TS.

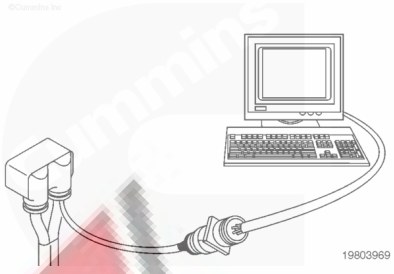


Possible causes include:

- Low coolant temperature (below 72C [162F])
- Fuel system faults are active
- Clutch switch malfunction
- Brake switch malfunction
- Parking brake **not** set
- Accelerator pedal malfunction
- Transmission in gear
- Vehicle speed greater than 0 mph
- PTO engaged
- Engine protection
- Aftertreatment regeneration active
- High aftertreatment temperature faults
- Another diagnostic test is running.

Note : If the Fuel Injector Performance Test will **not** initiate due to the parking brake **not** set, review features and parameters in INSITE™ electronic service tool. The Parking Brake Switch is defaulted to Enable. If the parking brake status is **not** transmitted to the ECM, this parameter should be set to Disabled for the Fuel Injector Performance Test to run properly.

If the Fuel Injector Performance Test is aborted for any reason, INSITE™ electronic service tool will display a message describing why the test was aborted. Correct the issue identified before proceeding. See the Fuel Injector Performance Test - Will Not Complete troubleshooting symptom tree in Section TS.

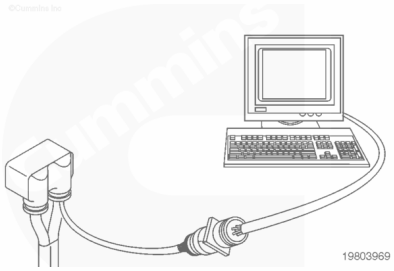


The Fuel Injector Performance Test will **not** complete if:

- Any of the causes listed for the Fuel Injector Performance Test can **not** initiate above
- A fault becomes active
- Accelerator is depressed
- Clutch pedal is depressed
- Brake pedal is depressed
- Transmission is put into gear
- High aftertreatment temperature faults
- High fuel system leakage
- Fuel pressure instability
- Self pumping
- Engine speed too low
- Engine speed too high.

Pass or Fail Criteria:

Note : The Fuel Injector Performance Test is designed to run on standard Number 2 diesel fuel. Low fuel viscosity; for example, kerosene or aviation fuel, will result in erroneous test results.



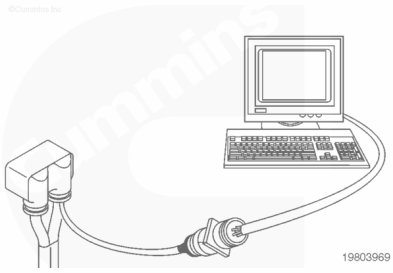
INSITE™ electronic service tool will display the pass/fail test results on screen.

If one or two individual fuel injectors fail one or more test points of the Fuel Injector Performance Test, replace those fuel injectors. Refer to Procedure 006-026 in Section 6. (/qs3/pubsys2/xml/en/procedures/425/425-006-026.html)

If all fuel injectors in a bank (1, 2, and 3 for the front bank or 4, 5, and 6 for the rear bank) show failed on test point 2 and 3 or 3 and 4 the fuel injector driver in the ECM is suspect.

ANADOLU ISUZU DEALER SALES

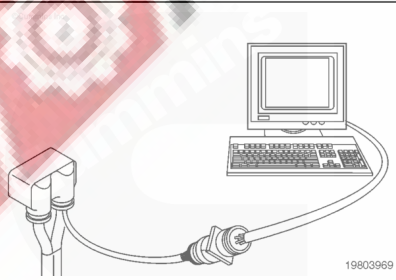
To verify, use the injector cut-out test to cut out the front bank of fuel injectors. Perform a brief snap throttle. Note how the engine accelerates. Enable the front bank of fuel injectors. Cut out the rear bank of fuel injectors. Perform a brief snap throttle. Note how the engine accelerates.



If the engine accelerates slowly on the same bank indicated by the Fuel Injector Performance Test results, replace the ECM. Refer to Procedure 019-031 in Section 19. (/qs3/pubsys2/xml/en/procedures/425/425-019-031.html)

If there is no noticeable difference in engine acceleration from bank to bank, replace the fuel injectors in that bank. Refer to Procedure 006-026 in Section 6. (/qs3/pubsys2/xml/en/procedures/425/425-006-026.html)

If all the fuel injectors show failed on test point 2 and 3 or 3 and 4, the fuel injector drivers in the ECM are suspect.



Verify the customer complaint is for low power, and/or Fault Code 125.

Replace the ECM. Refer to Procedure 019-031 in Section 19. (/qs3/pubsys2/xml/en/procedures/425/425-019-031.html)

Finishing Steps

- Do **not** turn the key OFF until the test has completed and the results are displayed.
- A copy of the Fuel Injector Performance Test results **must** be printed and returned with the malfunctioning ECM. Do **not** print the screen. Instead, print a copy of the file generated by INSITE™ electronic service tool. The file can be found by opening the start menu, then click on computer, then C:, then Intellect, then Fuel Injector Performance Test. The file can be identified by the date and time the test was performed. Open the file. Verify the engine serial number (ESN) matches the ESN of the corresponding engine.
- Check to make sure the CHECK ENGINE lamp and/or malfunction indicator lamp (MIL) lamp are **not** illuminated.
- Check for any active fault codes. If active fault codes are present, use Section TF for fault code troubleshooting.
- Use INSITE™ electronic service tool to clear all inactive fault codes.

ANADOLU ISUZU PARTS SALES


ANADOLU ISUZU
AFTER SALES

Select Service Tools

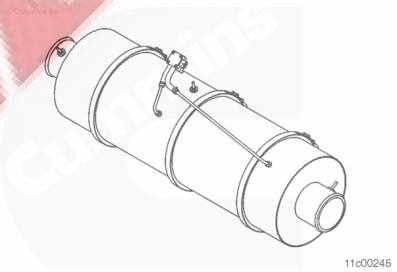
Recommended Cummins® Service Tools

- No Cummins® Service Tools required.

Additional Service Items

- No additional service items required.

General Information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Use the following procedure for additional information on the aftertreatment system. Refer to Procedure 011-999 in Section F. (/qs3/pubsys2/xml/en/procedures/425/425-011-999.html)

The following procedure contains information about how to inspect the aftertreatment DPF and perform a stationary regeneration.

There are two main steps when checking the DPF:

- The Initial Check section of this procedure is used to determine the condition of the aftertreatment DPF without removal of the filter. The Initial Check step should be used to determine if the aftertreatment DPF has malfunctioned due to progressive damage.
- The Test section of the procedure explains how to perform a stationary regeneration using an electronic service tool or an original equipment manufacturer (OEM)-provided stationary regeneration method. The Test step should **only** be performed when troubleshooting procedures and/or engine indicator lamps indicate this is necessary.

If the aftertreatment DPF requires replacement, before replacing:

- Troubleshoot and clear all fault codes.
- Verify the correct fuel type is being used.
- Troubleshoot **any** oil consumption complaint.
- Troubleshoot **any** coolant consumption complaint.

- Inspect the diesel oxidation catalyst (DOC). Refer to Procedure 011-049 in Section 11. (/qs3/pubsys2/xml/en/procedures/425/425-011-049.html)

The INSITE™ electronic service tool Aftertreatment DPF Stationary Regeneration Test can be used to:

- Regenerate an aftertreatment DPF.
- Recover the aftertreatment DOC and aftertreatment DPF after coolant contamination.
- Reset the stored soot load in the engine control module (ECM).
- Check the aftertreatment DOC efficiency.
- Check for the presence of the aftertreatment DOC.
- Check for the correct installation of the aftertreatment temperature sensors.

The INSITE™ electronic service tool Aftertreatment DPF Stationary Regeneration Test can be used to regain functionality of the aftertreatment DOC and aftertreatment DPF, after either or both have been exposed to coolant.

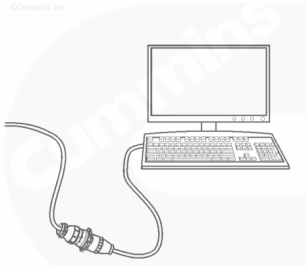
The temperatures achieved during regeneration are high enough to evaporate the coolant out of both components and return them to normal operating specifications.

Note : If these components are suspected of having coolant contamination, do **not** perform the Snap Acceleration Test before performing the regeneration.

Initial Check

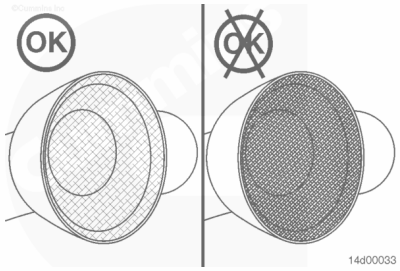
Use INSITE™ electronic service tool to check for fault codes. If **any** fault codes are present, follow the corresponding troubleshooting tree before performing **any** part of this procedure.

The fault code troubleshooting tree, in some cases, will refer back to this procedure to complete the diagnostics.



- Inspection of the exhaust system outlet can reveal the condition of the aftertreatment DPF. The exhaust system outlet should appear clean with little to no exhaust residue/soot buildup.

- The aftertreatment DPF is **not** 100 percent efficient. Some accumulation of exhaust residue/soot is normal and does **not** indicate a malfunctioning aftertreatment DPF.
- A heavy buildup of exhaust residue/soot can indicate a malfunctioning aftertreatment DPF.



To determine if the exhaust residue/soot accumulation on the exhaust system outlet is the result of a malfunctioning aftertreatment DPF, perform one of the following:

- Snap Acceleration Test. Refer to Procedure 014-017 in Section 14. (/qs3/pubsys2/xml/en/procedures/425/425-014-017.html)
- Clean the last 152 to 254 mm [6 to 10 in] of the exhaust system outlet. Operate the vehicle for one shift or trip. Inspect the exhaust system outlet for exhaust residue/soot accumulation.
- Inspect the aftertreatment DPF. Refer to Procedure 011-041 in Section 11. (/qs3/pubsys2/xml/en/procedures/425/425-011-041-tr.html)

Test

⚠WARNING⚠

During testing, exhaust gas temperature could reach 800°C [1500°F] and exhaust system surface temperature can exceed 700°C [1300°F], which is hot enough to ignite or melt common materials, and to burn people. The exhaust and exhaust components can remain hot after the vehicle stops moving. To avoid the risk of fire, property damage, burns or other serious personal injury, allow the exhaust system to cool before beginning this procedure or repair and make sure that no combustible materials are located where they are likely to come in contact with hot exhaust or exhaust components.

Note : If the stationary regeneration is being performed to recover either the DOC or DPF, or both, after coolant contamination, the DOC does **not** need to be removed or inspected unless there are active faults that require inspection as part of the fault code troubleshooting steps.

Note : Unless there are complaints of black smoke during operation and the exhaust stack is black, the DPF does **not** need to be removed or inspected during this process.

Before performing stationary regeneration, follow the steps listed below:

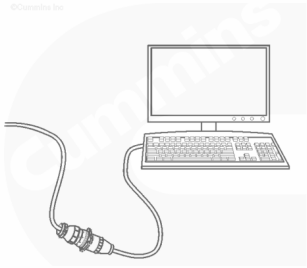
BURDLU ISUZU SALES

1. Select an appropriate location to park the vehicle.
    a. On a surface that will **not** burn or melt under high temperatures (such as clean concrete or gravel, **not** grass or asphalt)
    b. Away from anything that can burn, melt, or explode
        - Nothing within 0.6 m [2 ft] of the exhaust outlet
        - Nothing that can burn, melt, or explode within 1.5 m [5 ft] (such as gasoline, wood, paper, plastics, fabric, compressed gas containers, and hydraulic lines)
            - No gas or vapors nearby that could burn, explode, or contribute to a fire (such as liquid petroleum gas, gasoline vapors, oxygen, and nitrous oxide).
2. Park the truck securely.
    a. Set the parking brake.
    b. Place the transmission in Park, if provided. Otherwise, place the transmission in Neutral.
    c. Set the wheel chocks at the front and rear of at least one tire.
3. Set up a safe exhaust area.
    a. If bystanders can possibly enter the area, use barriers to keep people at least 1.5 m [5 ft] from the exhaust outlet during regeneration.
    b. When indoors, attach an exhaust discharge pipe rated for at least 800°C [1500°F].
    c. Keep a fire extinguisher nearby.
4. Check exhaust system surfaces.
    a. Confirm nothing is on or near the exhaust system surfaces (such as tools, rags, grease, or debris).
5. Prepare for engine speed changes during regeneration.
    a. Do **not** operate **any** power takeoff (PTO)-powered devices. Disconnect these devices before starting regeneration.
    b. Stay clear of the engine compartment.
6. Begin the stationary regeneration. This can be performed in two ways:
    a. A manual non-mission regeneration switch can be found on the equipment. The manual non-mission regeneration switch can be a stand-alone switch, or it can be combined with a diagnostic switch, at the discretion of the vehicle manufacturer.
    b. INSITE™ electronic service tool can be used to perform regeneration by starting the Aftertreatment DPF Regeneration Test.
    c. In either case, the engine will create enough heat to regenerate the aftermarket DPF. Engine speed will increase and the turbocharger can whistle loudly during the regeneration process. Once the aftermarket DPF is regenerated, the engine will automatically return to normal idle speed.
    d. Make sure the vehicle and surrounding area is monitored during regeneration. If **any** unsafe condition occurs, shut the engine off immediately.
7. Monitor the area.
    a. Make sure the vehicle and surrounding area is monitored during regeneration. If **any** unsafe condition occurs, shut the engine OFF immediately.

To stop a stationary regeneration, engage the clutch, brake, or throttle pedal; or turn off the engine.

Once regeneration is complete, exhaust gas and exhaust surface temperatures will remain elevated for 3 to 5 minutes.

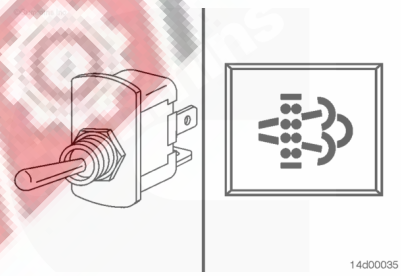
The test can be found under the ECM Diagnostics Test menu in INSITE™ electronic service tool. Follow the on-screen instructions to perform the test.


19r00163

To stop the stationary regeneration test at **any** time during the test:

1. Select the stop button on the INSITE™ electronic service tool monitor screen.
2. Depress the clutch, if equipped.
3. Depress the brake.
4. Depress the accelerator pedal.
5. Turn the engine off.

Note : If INSITE™ electronic service tool is **not** available, some vehicles can be equipped with an OEM-provided stationary regeneration method. The most common type is a stationary regeneration switch in the cab. The stationary regeneration switch can be a stand-alone switch, or can be combined with the diagnostic switch, at the discretion of the vehicle manufacturer.

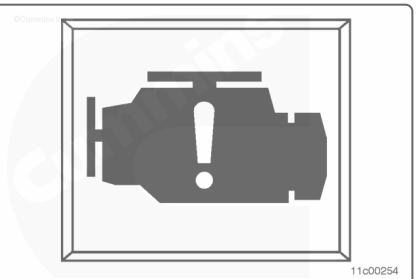

14d00035

OEM stationary regeneration initiations vary. See equipment manufacturer service information for specific instructions.

In order for the stationary regeneration switch to function, the stationary regeneration switch parameter **must** be enabled in the ECM.

Unlike the Aftertreatment Stationary Regeneration Test with INSITE™ electronic service tool, this switch will **only** start a stationary regeneration if the soot load of the filter is high enough. This is indicated by an illuminated or flashing aftertreatment lamp.

If the red STOP ENGINE indicator lamp is illuminated and an active Fault Code 1922 is present, indicating the aftertreatment DPF soot load is at the most severe level, the Aftertreatment DPF Regeneration Test should **not** be performed.

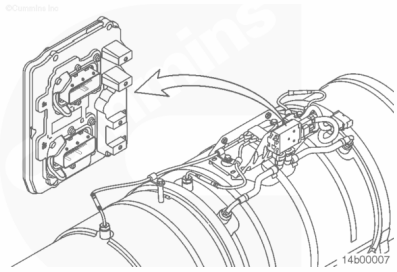

11c00254

The aftertreatment DPF **must** be inspected. Refer to Procedure 011-041 in Section 11. (/qs3/pubsys2/xml/en/procedures/425/425-011-041-tr.html)

After the aftertreatment DPF is cleaned or replaced, the troubleshooting tree associated with the red STOP ENGINE lamp **must** be followed to reset the soot load value stored in

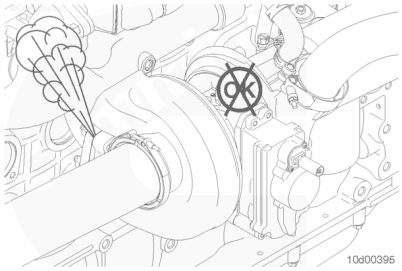
the ECM.

During the Aftertreatment DPF Regeneration Test, the following will be monitored:



- Aftertreatment Injector Status: Informs the user when fuel is being injected, in a small quantity, into the exhaust system upstream of the DOC.
- Aftertreatment DPF Soot Load: Informs the user of the current soot load of the filter:
- Normal: No regeneration is necessary.
- Above Normal: Least Severe Level - A stationary regeneration can be performed.
- Above Normal: Moderately Severe Level - A stationary regeneration can be performed.
- Above Normal: Most Severe Level - A stationary regeneration should **not** be performed unless the filter is cleaned or a new filter has been installed and the troubleshooting steps indicate it should be performed.
- Aftertreatment DPF Outlet Temperature
- Aftertreatment DPF Inlet Temperature
- Aftertreatment DOC Inlet Temperature.

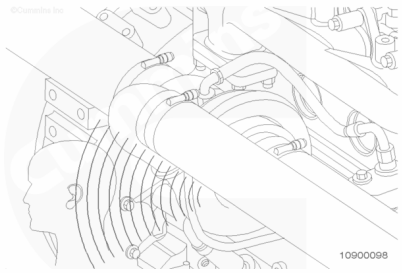
Before starting the Aftertreatment DPF Regeneration Test, inspect the exhaust piping for leaks, cracks, and loose connections. Refer to Procedure 010-024 in Section 10. (/qs3/pubsys2/xml/en/procedures/425/425-010-024.html)



Tighten the exhaust clamps, if necessary. See equipment manufacturer service information for the correct torque value.

Any leaks in the exhaust system will cause the Aftertreatment DPF Test to be less efficient in reducing the soot load of the filter. This will result in the test running longer and possibly **not** completing.

Note : If the Aftertreatment DPF Regeneration Test will **not** initiate, see the Stationary Regeneration - Will Not Activate troubleshooting symptom tree in Section TS.

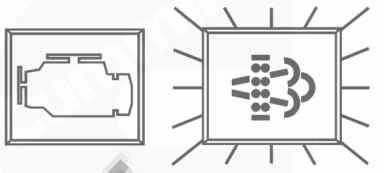


Once the Aftertreatment DPF Regeneration Test is started, follow INSITE™ electronic service tool on-screen instructions. When the test is started, engine idle speed will be raised automatically to the required level.

The engine will, through engine controls, operate in a manner to build exhaust heat. The turbocharger will emit a slight whining noise during this test. This is normal.

Once the Aftertreatment DPF Regeneration Test is complete, the engine will automatically return to normal idle speed.

Once the test is complete, check for active fault codes and/or engine indicator lamps for high aftertreatment diesel particulate soot load after performing the Aftertreatment DPF Regeneration Test. If **any** active fault codes are present, follow the appropriate fault code troubleshooting tree.



ANADOLU ISUZU AFTER SALES

Last Modified: 05-Aug-2016

Select Service Tools

Recommended Cummins® Service Tools

- No Cummins® Service Tools required.

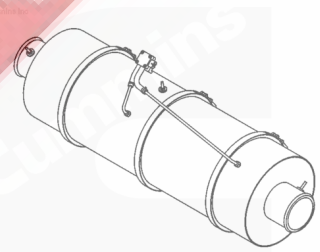
Additional Service Items

- No additional service items required.

General Information

Use the following procedure for additional information on the aftertreatment system. Refer to Procedure 011-999 in Section F. (/qs3/pubsys2/xml/en/procedures/425/425-011-999.html)

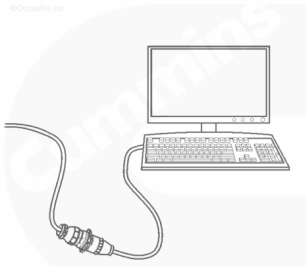
The following procedure contains information about how to perform a Snap Acceleration Test with the aftertreatment system connected and disconnected.



Initial Check

Use INSITE™ electronic service tool to check for fault codes. If **any** fault codes are present, follow the corresponding troubleshooting tree before performing **any** part of this procedure.

The fault code troubleshooting tree, in some cases, will refer back to this procedure to complete the diagnostics.



Test

Snap Acceleration - Aftertreatment Connected

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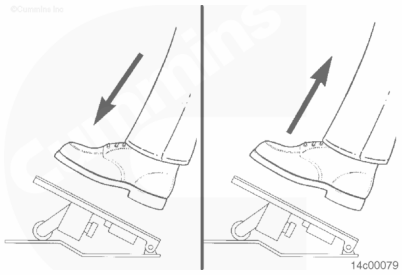
Monitoring the condition of the exhaust leaving the exhaust system outlet during a snap acceleration can reveal the condition of the aftertreatment diesel particulate filter (DPF).



The engine **must** be at minimum operating temperature or above when completing this test. The vehicle transmission **must** be in neutral and the vehicle parking brake **must** be applied.

Start and idle the engine. Rapidly depress the accelerator pedal from 0 to 100 percent. This can be performed multiple times, if necessary.

During this test, check for black smoke exiting the exhaust stack, as the engine is accelerated from low idle to high idle.

Note : In some applications, a Snap Acceleration Test may **not** provide the conditions necessary to reveal a malfunctioning aftertreatment DPF. If there is a heavy buildup of exhaust residue/soot on the exhaust system outlet and a snap acceleration does not reveal a condition outlined in the following steps, it can be necessary to perform a brief acceleration run under partial to full load and/or a stall test. Refer to Procedure 014-008 in Section 14. (/qs3/pubsys2/xml/en/procedures/425/425-014-008.html)

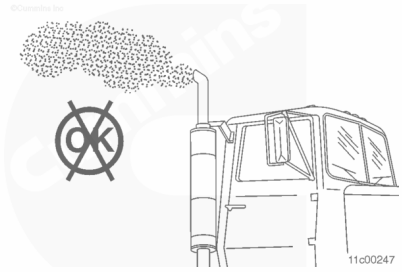
Note : If an opacity meter is used to measure the condition of the exhaust gas leaving the exhaust system outlet, the engine and aftertreatment system **must** be at operating temperature.



White smoke can indicate condensation in the exhaust and/or some unburned fuel. White smoke is **not** an indication of a malfunction of the aftertreatment system.

If excessive white smoke is present, see the Engine Performance troubleshooting symptom tree in Section TS.

Visible gray smoke or faint black smoke out of the exhaust system outlet indicates the aftertreatment DPF is damaged. Inspect the aftertreatment DPF. Refer to Procedure 011-041 in Section 11. (/qs3/pubsys2/xml/en/procedures/425/425-011-041-tr.html)



Visible black smoke out of the exhaust system outlet indicates a malfunction of the aftertreatment DPF.

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Note : If the vehicle has experienced the diesel particulate lamp illuminating frequently, high exhaust temperature lamp, if equipped, illuminating frequently, and/or requires frequent stationary regenerations, use the appropriate troubleshooting symptom tree in Section TS.

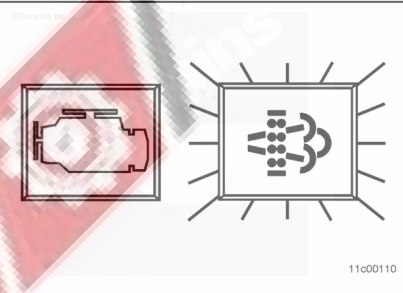


See the following service bulletin for pass or fail guidelines. Refer to Service Bulletin, Aftertreatment Diesel Oxidation Catalyst and Aftertreatment DPF Reuse Guidelines, Bulletin 4021600. (/qs3/pubsys2/xml/en/bulletin/4021600.html)

Snap Acceleration - Aftertreatment Disconnected

⚠ WARNING ⚠

The exhaust and exhaust components can remain hot after the engine has been shut down or secured. To avoid the risk of fire, property damage, burns or other serious personal injury, allow the exhaust system to cool before beginning this procedure or repair and make sure that no combustible materials are located where they might come in contact with hot exhaust or exhaust components.



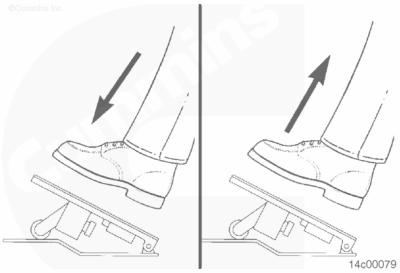
One of the functions of the aftertreatment system is to remove particulates from the exhaust gas. This function prevents the use of black smoke as a diagnostic symptom.

The Snap Acceleration Test (aftertreatment disconnected) is used to check for abnormally high amounts of black smoke in the exhaust gas.

Disconnect the exhaust pipe from the turbocharger turbine outlet.

The vehicle transmission **must** be in neutral.

The vehicle parking brake **must** be applied.

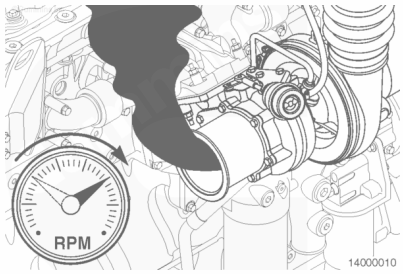


It can be necessary to temporarily adjust the maximum engine speed with no vehicle speed sensor (VSS) parameter in INSITE™ electronic service tool to the high idle speed of the engine.

Start the engine. Let it idle.

Quickly depress the accelerator pedal from 0 percent to 100 percent and hold for 5 seconds then release. This can be performed multiple times, if necessary.

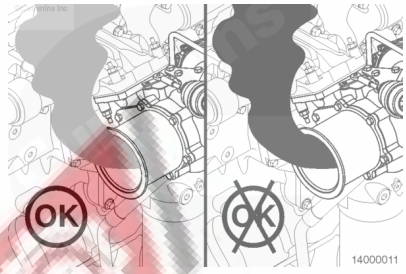
During this test, check for black smoke exiting the turbocharger turbine outlet as the engine is accelerated from low idle to high idle and at high idle.



A small puff of black smoke upon acceleration that clears at a steady high idle speed is normal.

White smoke during the Snap Acceleration Test does **not** indicate a malfunction. No repair is necessary.

Heavy black smoke indicates other upstream engine issues that need to be diagnosed. See the Black Smoke - Excessive troubleshooting symptom tree in Section TS.

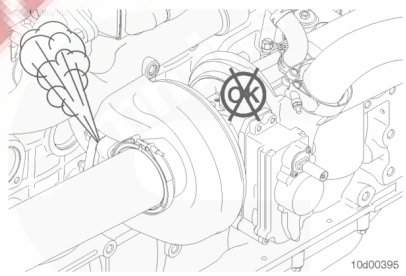


Reconnect the exhaust system.

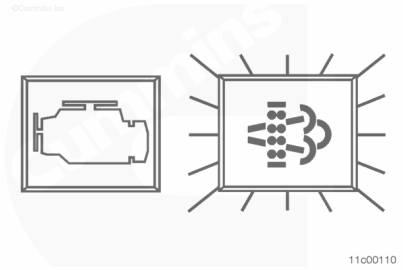
Inspect the exhaust piping for leaks, cracks, and loose connections.

Tighten the exhaust clamps if necessary.

See equipment manufacturer service information for the correct torque value.



Once the test is complete, check for active fault codes and/or engine indicator lamps for high aftertreatment diesel particulate soot load after performing the Aftertreatment DPF Regeneration Test. If **any** active fault codes are present, follow the appropriate fault code troubleshooting tree.



ANADOLU ISUZU
PARTS SALES

Last Modified: 05-Aug-2016

Select Service Tools

Recommended Cummins® Service Tools

- Leak Test Kit, Part Number 2892320
- Fluorescent dye additive for fuel and lubricating oil, Part Number 3376891
- Fluorescent dye additive for coolant, Part Number 3377438

Additional Service Items

- No additional service items required.

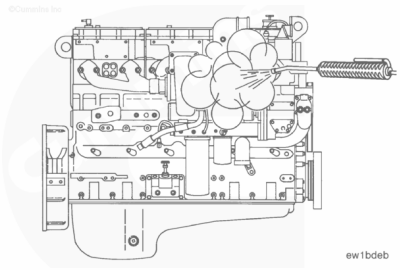
General Information

The Fluorescent Tracer Dye Test is used to aid in locating fluid leaks in the lubricating oil system, cooling system, and fuel system. The instructions and illustrations in this procedure are generic and do **not** cover component specific instructions. For component specific testing instructions, see the appropriate procedure in the corresponding Cummins® Service Manual or the equipment manufacturer service information.

Preparatory Steps

⚠ WARNING ⚠

When using a steam cleaner, wear safety glasses or a face shield, as well as protective clothing. Hot steam can cause serious personal injury.



⚠ WARNING ⚠

When using solvents, acids, or alkaline materials for cleaning, follow the manufacturer's recommendations for use. Wear goggles and protective clothing to reduce the possibility of personal injury.

⚠ WARNING ⚠

Some solvents are flammable and toxic. Read the manufacturer’s instructions before using.

⚠ CAUTION ⚠

Protect all electrical components, openings, and wiring from the full force of the cleaner spray nozzle.

Some rust prevention oils applied at the factory have fluorescent dyes, which can provide false test results. Check suspect areas with a black light to make sure there is not already fluorescent dye present before adding fluorescent dyes to the fluid under test.

Steam clean the affected areas on the engine.

If steam is not available, use an appropriate solvent to clean the engine.

Setup

Initial Setup

See the corresponding Cummins® Service Manual or the equipment manufacturer service information to determine the total volume of the fluid system being tested. Select the appropriate fluorescent dye additive for the fluid system being tested.

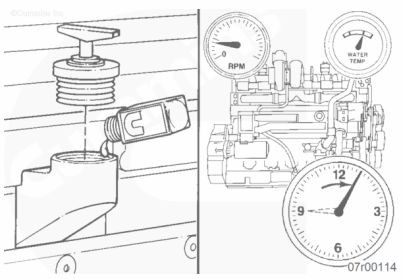
- For lubricating oil or fuel use fluorescent dye additive, Part Number 3376891.
- For coolant use fluorescent dye additive, Part Number 3377438.

Determine the amount of fluorescent dye additive required for the fluid system being tested. Use the instructions provided with the fluorescent dye additive being used.

Lubricating Oil

⚠ WARNING ⚠

To reduce the possibility of personal injury, avoid direct contact of hot oil with your skin.



⚠ WARNING ⚠

Some state and federal agencies have determined that used engine oil can be carcinogenic and cause reproductive toxicity. Avoid inhalation of vapors,

ANADOLU ISUZU USED SALES

ingestion, and prolonged contact with used engine oil. If not reused, dispose of in accordance with local environmental regulations.

Remove the lubricating oil fill cap and add the appropriate amount of fluorescent dye additive to the lubricating oil system. Install the lubricating oil fill cap.

Note : Lubricating oil with high levels of soot may need to be changed in order to make the fluorescent dye visible. Up to three times the standard amount of fluorescent dye additive may be used if necessary. The use of fluorescent dye additive does **not** interfere with engine performance and can be left in the lubricating oil after use.

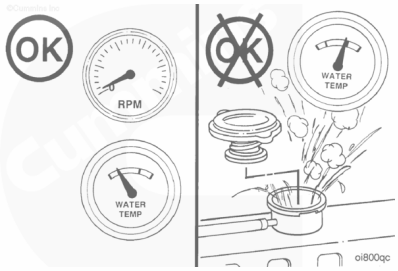
Operate the engine in a manner to distribute the fluorescent dye additive throughout the lubricating oil system evenly. This can typically be achieved by operating the engine at high idle for approximately five minutes.

For engine or equipment specific test procedures, see the corresponding Cummins® Service Manual or the equipment manufacturer's service information.

Coolant

⚠ WARNING ⚠

Do not remove the pressure cap from a hot engine. Wait until the coolant temperature is below 50°C [120°F] before removing the pressure cap. Heated coolant spray or steam can cause personal injury.



⚠ WARNING ⚠

Coolant is toxic. Keep away from children and pets. If not reused, dispose of in accordance with local environmental regulations.

⚠ WARNING ⚠

The coolant line(s) can be hot and under pressure. Do not disconnect the coolant lines while the engine is running or before the system has cooled down after engine shutdown. Heated coolant spray can cause personal injury. To reduce the possibility of personal injury, use eye and face protection, gloves and appropriate personal protective equipment.

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Verify the coolant temperature is below 50°C [120°F]. Remove the radiator cap.

Add the appropriate amount of fluorescent dye additive to the cooling system.

Install the radiator cap.

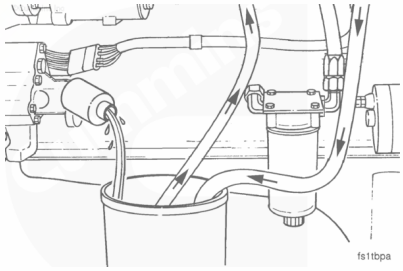
Operate the engine in a manner to evenly distribute the fluorescent dye additive throughout the cooling system. Raise coolant temperature until coolant thermostats are open. This can typically be achieved by operating the engine at high idle while monitoring engine coolant temperature. Operate engine for an additional ten minutes after coolant thermostats have opened.

For coolant thermostat opening temperatures, see corresponding Cummins® Service Manual or equipment manufacturer service information.

Fuel

⚠ WARNING ⚠

Fuel can be returned at highly elevated temperatures. Wear safety glasses and protective gloves and clothing when performing this test. Avoid any contact with returned fuel.



⚠ WARNING ⚠

Fuel is flammable. Keep all cigarettes, flames, pilot lights, arcing equipment, and switches out of the work area and areas sharing ventilation to reduce the possibility of severe personal injury or death when working on the fuel system.

Note : This section **only** applies to engines operating on diesel fuel.

Test method when operating engine from equipment fuel reservoir:

Remove fuel fill cap and add appropriate amount of fluorescent dye additive to fuel tank. Install fuel fill cap.

Operate equipment to evenly distribute fluorescent dye additive in fuel system.

Test method when operating engine from a temporary fuel reservoir:

Fill a container suitable for fuel with clean diesel fuel. Add appropriate amount of fluorescent dye additive to container. Mix fuel and fluorescent dye additive for even distribution.

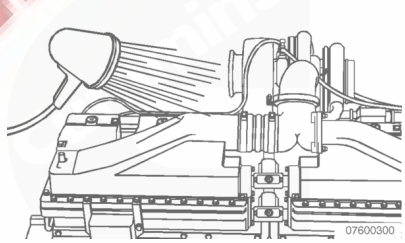
Disconnect fuel supply and return lines from engine. See appropriate procedures in corresponding Cummins® Service Manual. Fabricate temporary fuel lines to connect from temporary fuel reservoir to engine fuel inlet and return ports.

Operate equipment to evenly distribute fluorescent dye additive in fuel system.

Test

⚠ WARNING ⚠

To reduce the possibility of personal injury, avoid direct contact of hot oil with your skin.



⚠ WARNING ⚠

To reduce the possibility of personal injury, keep hands, long hair, jewelry, and loose-fitting or torn clothing away from fans and other moving parts.

Inspect area of suspected leak for presence of fluorescent dye. Use the black light from leak test kit, Part Number 2892320.

Operation of the engine may be necessary during the inspection process to determine the origin of the leak.

Always start at the bottom of the engine or component being inspected and work toward the top. Liquids will flow to the lowest point before forming droplets. Follow the fluorescent dye trail upward to determine the origin of the leak. If a leak is suspected in a given area, verify the fluorescent dye trail does **not** originate from a location above.

Components like the cooling fan may create air flow that will distribute the fluorescent dye in a horizontal direction. In these cases, follow the fluorescent dye trail in the opposite direction of flow to find the origin of the leak.

Rotating components like the flywheel or vibration damper, will distribute fluorescent dye in a circular pattern. For this situation, determine if the fluorescent dye is being dripped on the component from above and being redistributed, or if the leak originates at the seal near the center of the component.

Repair or replace the component or components that the fluorescent dye originates from.

If the origin of the fluorescent dye can **not** be found, consider cleaning the engine or component and test again.

If fluorescent dye is **not** found during the inspection, no leak is present.

Finishing Steps

Install any components that were removed for access during the test.

To verify repair:

- Operate equipment in same manner used to generate leak(s).
- Check for leaks.

ANADOLU ISUZU AFTER SALES

Last Modified: 23-Jul-2019

Select Service Tools

Recommended Cummins® Service Tools

- Recommended Cummins® electronic service tool or equivalent

Additional Service Items

- No additional service items required.

General Information

The Aftertreatment Selective Catalytic Reduction System Test is a diagnostic used to identify malfunctioning aftertreatment SCR system components. The test is located in the recommended Cummins® electronic service tool or equivalent under the diagnostic tests tab.

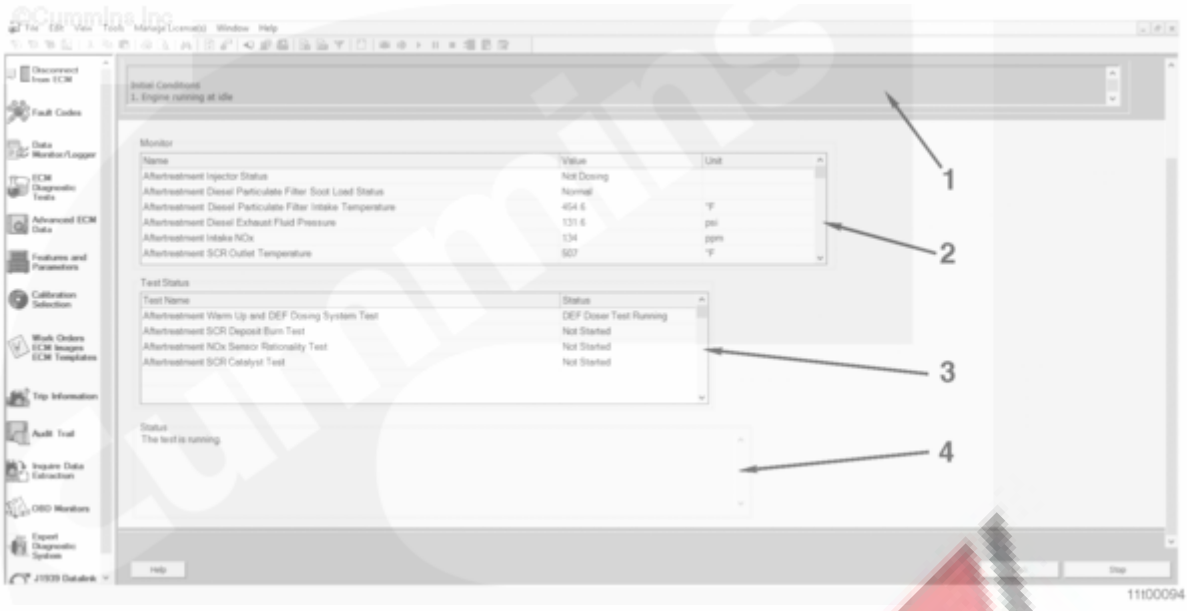
The test consists of the following subtests.

- Aftertreatment Warm-Up and Diesel Exhaust Fluid (DEF) Dosing System Test
- Aftertreatment SCR Deposit Burn Test
- Aftertreatment Nitrogen Oxides (NOx) Sensor Rationality Test
- Aftertreatment SCR Catalyst Test.

The SCR system test will display the status of each of the subtests in the subtest status window.

The SCR system test will take approximately 60 to 80 minutes to complete.

ANADOLU ISUZU AFTER SALES

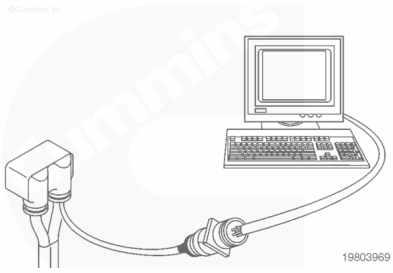


Aftertreatment SCR System Test Screen (INSITE™ electronic service tool)

1. Test Instruction Window
2. Monitor Parameter Window
3. Subtest Status Window
4. Main Status Window.

System Requirements

Check the engine control module (ECM) calibration revision history for calibration updates for this test. If the ECM does not contain that revision or higher, update the calibration. Refer to Procedure 019-032 in Section 19. (/qs3/pubsys2/xml/en/procedures/105/105-019-032.html)



The SCR system test should **only** be used when directed by a service procedure, fault code troubleshooting tree, symptom troubleshooting tree, or expert diagnostic system (EDS).

Preparatory Steps

⚠ WARNING ⚠

The test will produce significant engine noise due to the varying engine speeds that will occur during the test process. Do not perform this test in an enclosed environment. Move the equipment to a secluded location. To reduce the possibility of

personal injury, hearing protection must be used while conducting this test.

Connect the recommended Cummins® electronic service tool or equivalent and check for active fault codes. Troubleshoot any active fault codes prior to performing this test. Do **not** perform the SCR system test with active fault codes, unless guided to do so by the fault code troubleshooting.

Before performing the SCR system test, follow the steps listed below:

1. Perform initial inspection of the aftertreatment system.
   - Check for exhaust leaks.
2. Select an appropriate location to park the vehicle.
   - The SCR system test is an extremely noisy test
   - Move the vehicle to a secluded location, such as a back parking lot
   - It is **not** recommended to perform the SCR system test in the shop. If the test **must** be run indoors due to low ambient temperature, be sure the proper exhaust ventilation measures are taken and all personnel in the area are wearing hearing protection
   - Perform the test on a reasonably level surface.
3. Park the vehicle securely.
   - Set the parking brake. See equipment manufacturer instructions
   - Turn engine brakes OFF
   - Place the transmission in Park, if equipped; otherwise in Neutral
   - Set wheel chocks at the front and rear of at least one tire.
4. Set up a safe area.
   - If bystanders might enter the area, set up barriers to keep them at least 1.5 m [5 ft] from the front and rear of the vehicle during the SCR system test.
   - Make certain that the cab and sleeper are clear of occupants.
   - Keep a fire extinguisher nearby.
5. Prepare for engine speed changes during the SCR system test.
   - Do **not** operate any power takeoff (PTO) powered devices. Disconnect or disable these devices before starting the SCR system test
   - Stay clear of the engine compartment.
6. Start a datalog with the recommended Cummins® electronic service tool or equivalent.
   - Log all parameters in the data monitor/logger screen.

Test

Note : If the connection between the recommended Cummins® electronic service tool or equivalent and the ECM is lost for any reason, a pop-up message will

appear. When this occurs, the test will automatically abort. The test can be restarted after cycling the keyswitch OFF for 90 seconds and then back ON.

Note : After each run of the SCR system test, a key cycle is required, allowing the ECM to completely power down (90 seconds) before the test can be rerun.

1. Begin the SCR system test.

- Use the recommended Cummins® electronic service tool or equivalent to perform the SCR system test
- Engine speed will increase to a specified value and then the ECM will perform the analysis process
- At the conclusion of the test, the engine will return to idle and the SCR system test will display either pass or fail status for all systems tested.

2. Monitor the area.

- Make sure that the vehicle and surrounding area are monitored during the SCR system test. If any unsafe condition occurs, shut the engine OFF immediately.

To stop the SCR system test click the STOP button on the test screen. The SCR system test can also be stopped by engaging the clutch, brake, or throttle pedal; or by turning the engine OFF.

When the test is started, engine speed will vary from 950 revolutions per minute (rpm) up to 1700 rpm during the different stages of the test.

Test progress can be monitored using the subtest status window.

Test results will be displayed as each subtest completes. The test will stop if a subtest makes a decision other than PASS and repair action is required.

Once the SCR system test is complete, the engine will automatically return to normal idle speed. The SCR system test will display the test results for review until the next key cycle.

After the test has completed stop the recommended Cummins® electronic service tool or equivalent datalog.

For information on repair action based on subtest results, see the analyzing the Data section of this procedure. Record the subtest results for later reference.

The SCR system test will **not** start if:

- Another diagnostic test is running
- Aftertreatment diesel particulate filter (DPF) regeneration is active
- DEF tank level is low
- Ambient temperature is too low
- Barometric pressure is too low
- DEF system is frozen.

The SCR system test will **not** start or will be aborted if:

- Coolant temperature too low after the warmup period
- Accelerator pedal is depressed
- Clutch pedal is depressed
- Brake pedal is depressed

- Parking brake **not** set
- Transmission is put into gear
- PTO engaged
- Vehicle speed detected
- Engine brake switch is ON
- Engine protection state active
- A regeneration inhibiting fault becomes active
- High aftertreatment temperature faults become active.

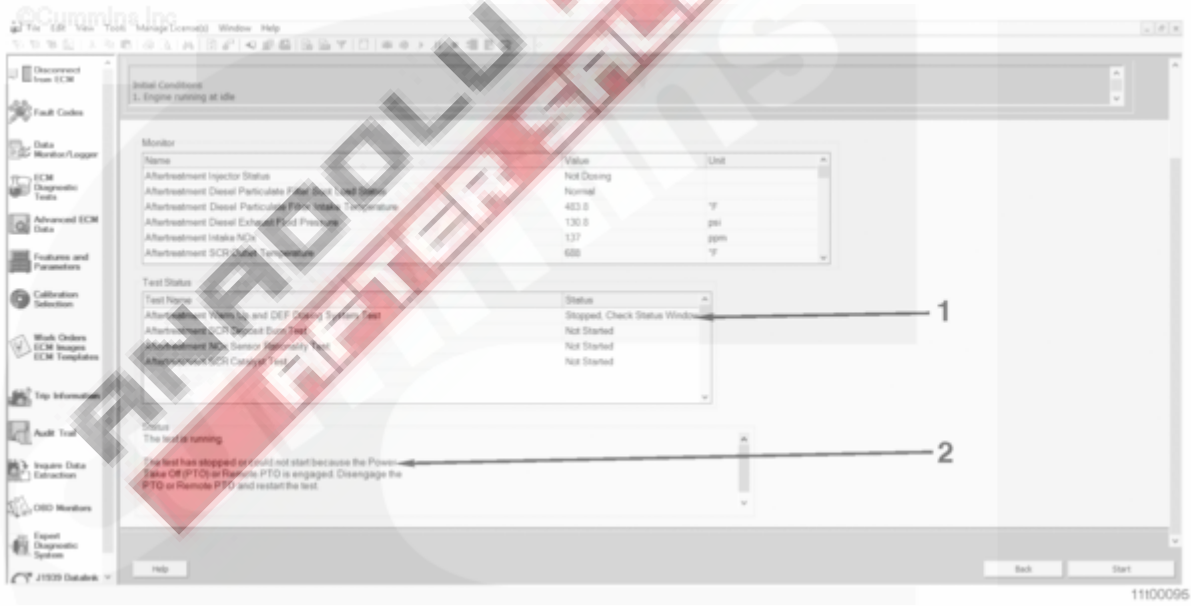
If the SCR system test aborts or will **not** activate, a message will be displayed. Correct the issue identified before proceeding. For more information on abort messages and associated repair action, see the Troubleshooting section of this procedure.

Troubleshooting

General Information

This section is used to assist troubleshooting abort messages from the Main Status Window.

INSITE™ Eletronic Service Tool



1. The “Stopped, Check Status Window” message will be displayed by the subtest that was running when the abort occurred. All other subtests will retain their current messages until a key cycle.
2. Abort Message in Main Status Window. The most recent message will appear at the bottom.

Some messages were modified between INSITE™ electronic service tool version 8.1.1 and INSITE™ electronic service tool version 8.1.2 and later. Use the appropriate table below for the version of INSITE™ electronic service tool being used.

ANADOLU ISUZU AFTER SALES

INSITE™ 8.1.1 Status Messages

Main Status Message	Action
The test has stopped.	None
The test is running.	None
The number of allowed attempts for this key cycle has been reached. Key OFF, allow the ECM to completely power down, key ON, and restart the test.	Cycle the keyswitch and restart the test.
The ECM has detected a condition in which it will not allow the Aftertreatment SCR System test to run.	The ECM is prohibiting the test from running. • Follow the appropriate technical escalation process.
The test has completed. Please cycle the keyswitch and restart the engine to restart the test.	If all the subtests have passed, the test is complete. If a subtest has failed, see the subtest message in the “Analyzing the Data” section in this procedure.
The test has stopped or could not start because the parking brake is not engaged. Exit the test, correct the issue and restart the test.	• Verify that the parking brake is set. See equipment manufacturer service information. • Review features and parameters using INSITE™ electronic service tool. The parking brake switch is defaulted to Enable. If the parking brake status is **not** transmitted to the ECM this parameter should be set to Disabled for the SCR System Test to run properly. • Check the parking brake switch and circuit.
The test has stopped or could not start because the accelerator pedal or throttle position is greater than zero. Be sure the accelerator pedal or throttle is released and restart the test.	• Verify the engine brake is OFF. • Check for foot pedal restriction. • Check the accelerator pedal or lever position sensor and circuit. Refer to Procedure 019-085 in Section 19 (/qs3/pubsys2/xml/en/procedures/99/99-019-085.html).
The test has stopped or could not start because the transmission is in gear or a command on the data link is preventing the test. Place the transmission in Park or Neutral and restart the test.	• Verify that the transmission is in Park, if applicable, otherwise in Neutral. See equipment manufacturer service information.

ANADOLU ISUZU AFTER SALES

Main Status Message	Action
The test has stopped or could not start because the Power Take Off (PTO) or Remote PTO is engaged. Disengage the PTO or Remote PTO and restart the test.	• Verify the PTO is disengaged. • Check the Cruise Control/PTO selector switch and circuit. Refer to Procedure 019-021 in Section 19. (/qs3/pubsys2/xml/en/procedures/99/99-019-021.html) Refer to Procedure 019-022 in Section 19. (/qs3/pubsys2/xml/en/procedures/99/99-019-022.html)
The test has stopped or could not start because the original equipment manufacturer (OEM) sensor ambient conditions are out of range. Check the OEM ambient sensor values and be sure they are in normal operating range, cycle the keyswitch, and restart the test.	The status of one or both of the nitrogen oxides (NOx) sensors is continuously invalid. • Check for active NOx sensor fault codes. • Be sure the NOx sensors are reaching initializing temperature, above 200°C [392°F]. Use INSITE™ electronic service tool to monitor exhaust gas temperature. • Restart the test. • If the error message persists, follow the appropriate technical escalation process.
The test has stopped or could not start because the vehicle is moving or a vehicle speed sensor fault code is active. Stop the vehicle, verify no vehicle speed sensor fault codes are active, cycle the keyswitch, and restart the test.	• Be sure the vehicle is **not** moving and is properly secured. • Troubleshoot any active vehicle speed sensor faults. • Check that the vehicle speed sensor is **not** loose. • Check the vehicle speed sensor for poor grounding or electrical interference.
The test has stopped or could not start because a command on the data link is preventing the test. Check all the devices on the data link, troubleshoot any active fault codes, cycle the keyswitch, and restart the test.	The anti-lock braking system (ABS) module is sending a data link message to disable the engine brake. This message is causing the ECM to abort the test. • Be sure the engine brake is turned OFF. • Troubleshoot any fault codes from the ABS module.
The test has stopped or could not start because of an EGR or turbocharger issue. Troubleshoot any active fault codes, cycle the keyswitch, and restart the test.	• Troubleshoot any active turbocharger or exhaust gas recirculation (EGR) fault codes.

ANADOLU ISUZU GUNCEL SATIS

Main Status Message	Action
The test has stopped or could not start because the current engine operating state is hindering the test. Determine the engine state, correct any issues, cycle the keyswitch, and restart the test.	Another component or feature is taking control of engine speed. • Check that OEM or customer-selected inhibit features are **not** active. • Check that programmable parameters or selected features are correct. Refer to Procedure 019-078 in Section 19 (/qs3/pubsys2/xml/en/procedures/99/99-019-078.html). Also refer to the service bulletin Multiplexing Troubleshooting, Bulletin 4021378 (/qs3/pubsys2/xml/en/bulletin/4021378.html). • Check that the vehicle speed sensor is **not** loose • Check the vehicle speed sensor for poor grounding or electrical interference.
The test has stopped or could not start because an Engine Protection derate is active. Troubleshoot any active fault codes, cycle the keyswitch, and restart the test.	• Troubleshoot active fault codes.
The test has stopped or could not start because the clutch or service brake is depressed. Release the clutch or service brake pedal and restart the test.	• Check the clutch switch adjustment, switch, and circuit. Refer to Procedure 019-009 in Section 19 (/qs3/pubsys2/xml/en/procedures/99/99-019-009.html). Refer to Procedure 019-010 in Section 19 (/qs3/pubsys2/xml/en/procedures/99/99-019-010.html). • Check the vehicle brake switch and the circuit. Refer to Procedure 019-088 in Section 19 (/qs3/pubsys2/xml/en/procedures/99/99-019-088.html). Refer to Procedure 019-089 in Section 19 (/qs3/pubsys2/xml/en/procedures/99/99-019-089.html).
The test has stopped or could not start because the engine coolant temperature is too low. Continue to run the engine to raise the coolant temperature, cycle the keyswitch, and restart the test.	The coolant temperature warm-up period has timed out. • Cycle the keyswitch and restart the test.

ANADOLU ISUZU DEALER

Main Status Message	Action
The test has stopped because the exhaust volumetric flow rate is out of range.	The ECM detected the exhaust flow rate estimate is out of range. • Troubleshoot active engine fault codes. • Perform the following checks in the Engine Performance Troubleshooting Tree in Section TT. • Step 6 - EGR system checks. • Step 5 - Air handling checks.
The test has stopped because the barometric air pressure or OEM ambient air temperature is low.	Move the vehicle to a warmer location or lower altitude.
The aftertreatment DPF regeneration has timed out. Cycle the keyswitch and select Start to restart the test.	Cycle the keyswitch and restart the test.
The ECM has detected a fault condition. Check for active faults, troubleshoot fault codes, key OFF, allow the ECM to completely power down, key ON, and restart the test.	An active fault code is preventing the test from running. Troubleshoot active fault codes.
The test has stopped because the test engine speed is out of the expected range.	This message indicates engine speed was higher or lower than the commanded value. If engine speed is low: • Troubleshoot the engine for low power or the inability to reach rated speed. See Section TT. If engine speed is high: • Troubleshoot the engine for surges at low or high idle or surges under load. See Section TT.

ANADOLU ISUZU AFTER SALES

Main Status Message	Action
The test has stopped because the DPF outlet temperature is out of the expected range.	This message indicates the DPF outlet temperature is above the maximum or below the minimum temperature during the test. If DPF outlet temperature is too high a fault code will be set. • Troubleshoot the active fault code. If DPF outlet temperature is too low: • Refer to the “Stationary Regeneration - Will Not Complete” symptom tree found in Section TS of this manual. Do **not** refer to the “Stationary Regeneration - Will Not Activate” TS tree. All the conditions/malfunctions in the “Stationary Regeneration - Will Not Activate” TS tree have specific messages in this test.
The test has stopped or could not start because the DEF tank level is low. Fill the tank to the proper level and restart the test.	• Fill the DEF tank.
The test could not start because the DEF in the tank may be frozen or is too cold to dose. Raise the tank temperature prior to restarting the test.	• Troubleshoot any active faults or malfunctioning DEF system heating components. • Allow the DEF system to thaw.
The test has stopped because the NOx levels could not be modulated.	Another component or feature is taking control of engine speed and preventing the test from modulating NOx to the desired level. • Check that OEM or customer-selected inhibit features are **not** active. • Check that programmable parameters or selected features are correct. Refer to Procedure 019-078 in Section 19 (/qs3/pubsys2/xml/en/procedures/99/99-019-078.html). Also refer to the service bulletin Multiplexing Troubleshooting, Bulletin 4021378 (/qs3/pubsys2/xml/en/bulletin/4021378.html). • Check that the vehicle speed sensor is **not** loose. • Check the vehicle speed sensor for poor grounding or electrical interference.

ANADOLU ISUZU AFTER SALES

INSITE™ 8.1.2 and Later Status Messages

Main Status Message	Action
The test has stopped.	None
The test is running.	None
Test did not start because a key cycle is needed. Key cycle and restart test.	Cycle the keyswitch and restart the test.
The ECM has detected a condition in which it will not allow the Aftertreatment SCR System test to run.	The ECM is prohibiting the test from running. • Follow the appropriate technical escalation process.
The test has completed. Please cycle the keyswitch and restart the engine to restart the test.	If all the subtests have passed, the test is complete. If a subtest has failed, refer to the subtest message in the “Analyzing the Data” section in this procedure.
The test has stopped or could not start because the parking brake is not engaged. Exit the test, correct the issue and restart the test.	• Verify that the parking brake is set. See equipment manufacturer service information. • Review features and parameters using INSITE™ electronic service tool. The parking brake switch is defaulted to Enable. If the parking brake status is **not** transmitted to the ECM, this parameter should be set to Disabled for the SCR system test to run properly. • Check the parking brake switch and circuit.
The test has stopped or could not start because the accelerator pedal or throttle position is greater than zero. Correct the issue, key OFF, allow the ECM to completely power down, key ON, and restart the test.	• Verify the engine brake is OFF. • Check for foot pedal restriction. • Check the accelerator pedal or lever position sensor and circuit. Refer to Procedure 019-085 in Section 19 (/qs3/pubsys2/xml/en/procedures/99/99-019-085.html).
The test has stopped or could not start because the Transmission is in gear or a command on the data link is preventing the test. Correct the issue, key OFF, allow the ECM to completely power down, key ON, and restart the test.	• Verify that the transmission is in Park, if applicable, otherwise in Neutral. See equipment manufacturer service information.

ANADOLU ISUZU AFTER SALES

Main Status Message	Action
The test has stopped or could not start because the (PTO) or Remote PTO is engaged. Correct the issue, key OFF, allow the ECM to completely power down, key ON, and restart the test.	• Verify the PTO is disengaged. • Check the Cruise Control/PTO selector switch and circuit. Refer to Procedure 019-021 in Section 19 (/qs3/pubsys2/xml/en/procedures/99/99-019-021.html). Refer to Procedure 019-022 in Section 19 (/qs3/pubsys2/xml/en/procedures/99/99-019-022.html).
The status of one or both of the NOx sensors is continuously invalid. Correct the issue, key OFF, allow the ECM to completely power down, key ON, and restart the test.	The status of one or both of the NOx sensors is continuously invalid. • Check for active NOx sensor fault codes. • Be sure the NOx sensors are reaching initializing temperature, above 200°C [392°F]. Use INSITE™ electronic service tool to monitor exhaust gas temperature. • Restart the test. • If the error message persists, follow the appropriate technical escalation process.
The test has stopped or could not start because the vehicle is moving or a vehicle speed sensor fault code is active. Correct the issue, key off, allow the ECM to completely power down, key ON, and restart the test.	• Be sure the vehicle is **not** moving and is properly secured. • Troubleshoot any active vehicle speed sensor faults. • Check that the vehicle speed sensor is **not** loose. • Check the vehicle speed sensor for poor grounding or electrical interference.
The test has stopped or could not start because an engine brake disable request was received on the data link. Correct the issue, key OFF, allow the ECM to completely power down, key ON, and restart the test.	The ABS module is sending a data link message to disable the engine brake. This message is causing the ECM to abort the test. • Be sure the engine brake is turned OFF. • Troubleshoot any fault codes from the ABS module.

ANADOLU ISUZU GUC SATIS

Main Status Message	Action
The test has stopped or could not start because of an EGR or turbocharger issue. Correct the issue, key OFF, allow the ECM to completely power down, key ON, and restart the test.	• Troubleshoot any active turbocharger or EGR fault codes.
The test has stopped or could not start because another feature is controlling the engine speed. Correct the issue, key OFF, allow the ECM to completely power down, key ON, and restart the test.	Another component or feature is taking control of engine speed. • Check that OEM or customer-selected inhibit features are **not** active. • Check that programmable parameters or selected features are correct. Refer to Procedure 019-078 in Section 19 (/qs3/pubsys2/xml/en/procedures/99/99-019-078.html). Also refer to the service bulletin Multiplexing Troubleshooting, Bulletin 4021378 (/qs3/pubsys2/xml/en/bulletin/4021378.html). • Check that the vehicle speed sensor is **not** loose. • Check the vehicle speed sensor for poor grounding or electrical interference.
The test has stopped or could not start because an Engine Protection derate is active. Correct the issue, key OFF, allow the ECM to completely power down, key ON, and restart the test.	• Troubleshoot active fault codes.
The test has stopped or could not start because the clutch or service brake is depressed. Correct the issue, key OFF, allow the ECM to completely power down, key ON, and restart the test.	• Check the clutch switch adjustment, switch, and circuit. Refer to Procedure 019-009 in Section 19 (/qs3/pubsys2/xml/en/procedures/99/99-019-009.html). Refer to Procedure 019-010 in Section 19 (/qs3/pubsys2/xml/en/procedures/99/99-019-010.html). • Check the vehicle brake switch and the circuit. Refer to Procedure 019-088 in Section 19 (/qs3/pubsys2/xml/en/procedures/99/99-019-088.html). Refer to Procedure 019-089 in Section 19 (/qs3/pubsys2/xml/en/procedures/99/99-019-089.html).

ANADOLU ISUZU AFTER SALES

Main Status Message	Action
The test has stopped or could not start because the engine coolant temperature is too low. Key OFF, allow the ECM to completely power down, key ON, and restart the test.	The coolant temperature warm-up period has timed out. • Cycle the keyswitch and restart the test.
The test has stopped because the exhaust flow rate is out of range. Correct the issue, key OFF, allow the ECM to completely power down, key ON, and restart the test.	The ECM detected the exhaust flow rate estimate is out of range. • Troubleshoot active engine fault codes. • Perform the following checks in the Engine Performance Troubleshooting Tree. See Section TT. • Step 6 - EGR system checks. • Step 5 - Air handling checks.
The test has stopped because the barometric air pressure or ambient air temperature is low. Correct the issue, key OFF, allow the ECM to completely power down, key ON, and restart the test.	Move the vehicle to a warmer location or lower altitude.
The aftertreatment DPF regeneration has timed out. Key OFF, allow the ECM to completely power down, key ON, and restart the test.	Cycle the key, Restart the test.
The ECM has detected a fault condition. Correct the issue, key OFF, allow the ECM to completely power down, key ON, and restart the test.	An active fault code is preventing the test from running. Troubleshoot active fault codes.
The test has stopped because engine speed is out of the desired range. Correct the issue, key OFF, allow the ECM to completely power down, key ON, and restart the test.	This message indicates engine speed was higher or lower than the commanded value. If engine speed is low: • Troubleshoot the engine for low power or the inability to reach rated speed. See Section TT. If engine speed is high: • Troubleshoot the engine for surges at low or high idle or surges under load. See Section TT.

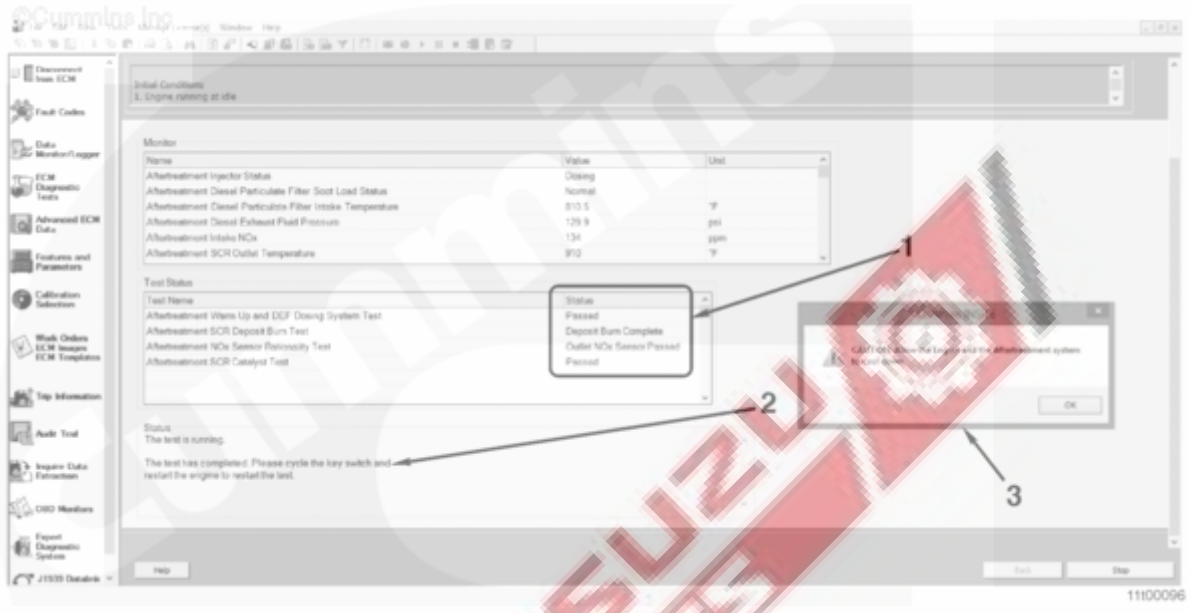
ANADOLU ISUZU PARTS SALES

Main Status Message	Action
The test has stopped because the DPF outlet temperature is out of the desired range. Correct the issue, key OFF, allow the ECM to completely power down, key ON, and restart the test.	This message indicates the DPF outlet temperature is above the maximum or below the minimum temperature during the test. If DPF outlet temperature is too high, a fault code will be set. • Troubleshoot the active fault code. If DPF outlet temperature is too low: • See the “Stationary Regeneration - Will Not Complete” symptom tree found in section TS of this manual. Do **not** reference the “Stationary Regeneration - Will Not Activate” TS tree. All the conditions/malfunctions in the “Stationary Regeneration - Will Not Activate” TS tree have specific messages in this test.
DEF tank level is too low. Fill tank with DEF, cycle key and restart test	• Fill the DEF tank.
The test could not start because the DEF in the tank may be frozen or is too cold to dose. Correct the issue, key OFF, allow the ECM to completely power down, key ON, and restart the test.	• Troubleshoot any active faults or malfunctioning DEF system heating components. • Allow the DEF system to thaw.
The test has stopped because the engine out NOx levels could not be modulated to the desired range. Correct the issue, key OFF, allow the ECM to completely power down, key ON, and restart the test.	Another component or feature is taking control of engine speed and preventing the test from modulating NOx to the desired level. • Check that OEM or customer-selected inhibit features are **not** active. • Check that programmable parameters or selected features are correct. Refer to Procedure 019-078 in Section 19 (/qs3/pubsys2/xml/en/procedures/99/99-019-078.html). Also refer to the service bulletin Multiplexing Troubleshooting, Bulletin 4021378 (/qs3/pubsys2/xml/en/bulletin/4021378.html). • Check that the vehicle speed sensor is **not** loose. • Check the vehicle speed sensor for poor grounding or electrical interference.

ANADOLU ISUZU AFTER SALES

Analyzing the Data

General Information



Aftertreatment SCR System Test Screen (INSITE™ eletronic service tool)

1. Subtest status - all passed
2. Main status window shows test complete
3. Pop-up message appears when test is complete.

Aftertreatment Warm Up and DEF Dosing System Test

Subtest Status Message	Action
Test Not Available	None, this subtest is **not** available for this engine or application.
Stopped, Check Status Window	The test has aborted. Follow instruction from main test status window.
Not Started	None, this portion of the test is **not** currently running.
Warmup in Progress	None
DEF Doser Test Running	None
Passed	None, the test will automatically continue to the next subtest.

Subtest Status Message	Action
Failed	• Check the DEF for proper concentration and for contamination. • Perform the DEF Dosing Unit Override Test. Refer to Procedure 011-063 in Section 11 (/qs3/pubsys2/xml/en/procedures/425/425-011-063.html). If the DEF system passes the Dosing Unit Override Test perform the following: • Inspect the DEF dosing unit intake fitting for debris. Refer to Procedure 011-058 in Section 11. (/qs3/pubsys2/xml/en/procedures/425/425-011-058.html) • If debris is found in the intake fitting, replace the fitting and perform the DEF dosing unit airless flush. Refer to Procedure 011-058 in Section 11. (/qs3/pubsys2/xml/en/procedures/425/425-011-058.html) Also drain and flush the DEF tank and intake line. See equipment manufacturer service information. • If debris is **not** found in the intake fitting replace the DEF dosing unit. Refer to Procedure 011-058 in Section 11. (/qs3/pubsys2/xml/en/procedures/425/425-011-058.html) Re-run the Aftertreatment SCR System Test once the issue is corrected, to validate the repair.

ANADOLU ISUZU AFTER SALES

Aftertreatment SCR Deposit Burn Test

Subtest Status Message	Action
Test Not Available	None, this subtest is **not** available for this engine or application.
Stopped, Check Status Window	The test has aborted. Follow instruction from main test status window.
Not Started	None, this portion of the test is **not** currently running.
Running	None

Subtest Status Message	Action
Deposit Burn Complete	None
Deposit Burn Failed	None, the test will continue to run. No repair or inspection will be required unless the Aftertreatment NOx Sensor Rationality Subtest fails.

Aftertreatment NOx Sensor Rationality Test

Subtest Status Message	Action
Test Not Available	None, this subtest is **not** available for this engine or application.
Stopped, Check Status Window	The test has aborted. Follow instruction from main test status window.
Not Started	None, this portion of the test is **not** currently running.
Running	None
Outlet NOx Sensor Passed	Both NOx sensors have passed. Test will automatically continue to the next subtest.
Intake NOx Sensor Failed	• Replace the aftertreatment intake NOx sensor. Re-run the Aftertreatment SCR System Test, once the issue is corrected, to validate the repair.
Inspect Outlet NOx Sensor	• Check the decomposition tube for DEF deposits. • Run the DEF System Leak Test. Monitor the DEF dosing valve nozzle for leaks. Refer to Procedure 011-080 in Section 11 (/qs3/pubsys2/xml/en/procedures/425/425-011-080.html). • If no DEF deposits are present and the DEF dosing valve is **not** leaking, replace the outlet NOx sensor. Re-run the Aftertreatment SCR System Test once the issue is corrected, to validate the repair.

ANADOLU ISUZU AFTER SALES

Subtest Status Message	Action
Inspect Both NOx Sensors	• Check the decomposition tube for DEF deposits. • Run the DEF system leak test. Monitor the DEF dosing valve nozzle for leaks. Refer to Procedure 011-080 in Section 11 (/qs3/pubsys2/xml/en/procedures/425/425-011-080.html). • If no DEF deposits are present and the DEF dosing valve is **not** leaking, replace both NOx sensors. Re-run the Aftertreatment SCR System Test once the issue is corrected, to validate the repair.

Aftertreatment SCR Catalyst Test

Subtest Status Message	Action
Not Supported	None, this subtest is **not** supported for this engine or application.
Stopped, Check Status Window	The test has aborted. Follow instruction from main test status window.
Not Started	None, this portion of the test is **not** currently running.
Running	None
Passed	None
Failed	• Replace the aftertreatment SCR catalyst. Re-run the Aftertreatment SCR System Test once the issue is corrected, to validate the repair.

Finishing Steps

- Do **not** turn the keyswitch OFF until the test has completed and the results are displayed.
- Check to make sure the CHECK ENGINE lamp and/or malfunction indicator lamp (MIL) lamp are **not** illuminated.

- Check for any active fault codes. If active fault codes are present, use EDS or Section TF for fault code troubleshooting.
- Use the recommended Cummins® electronic service tool or equivalent to clear all inactive fault codes.

Last Modified: 23-Jun-2020

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Select Service Tools

Recommended Cummins® Service Tools

- Clean Care Kit, Part Number 4919073
- Cylinder Diagnostic Kit, Part Number 5394335
- Compression and Leak Down Test Adapter Kit, Part Number 5394350
- Engine barring adapter, Part Number 3824591.

Additional Service Items

- Shop air supply (689 kPa [100 psi] or higher preferred).

General Information

All internal combustion engines require a certain amount of compression to allow ignition of the fuel/air mixture. To make sure of compression, cylinder **must not** have high leakage. High leakage has a negative impact on cylinder and engine performance.

Checking cylinder leakage is a quick way to help determine the mechanical health of a cylinder. This check is most effective when performed as part of a series of symptom-directed diagnostic procedures including (but **not** limited to):

- Crankcase Blowby Check
- Combustion Gas in Coolant Check
- Cylinder Leakage Check
- Chassis & Engine Load Checks.

High leakage can be caused by (but not limited to):

Part	**Possible Root Causes**
Piston Rings	Worn, broken, incorrect, or missing rings
Piston	Cracked piston or hole in piston
Cylinder Bore	Worn or polished bore, crack or hole in bore, out of round, incorrect liner protrusion
Cylinder Head Gasket	Leaking head gasket
Cylinder Head	Cracked head, warped head, bent valves, broken valves, worn or damaged valve seats
Camshaft	Worn camshaft lobes, incorrect part

Part	Possible Root Causes
Valve Train	Damaged rockers, damaged tappets, damaged or bent push rods, damaged valve springs, dropped valve

Evaluating cylinder leakage check results can be done in two ways:

- Cylinder-to-cylinder or engine to engine comparison
- Comparison against a published specification.

See engine specifications in the Engine Testing specifications of Section V for engine-specific leakage values, if available.

A leakage check should be performed on an engine at room temperature (20°C, [68°F]) for best results.

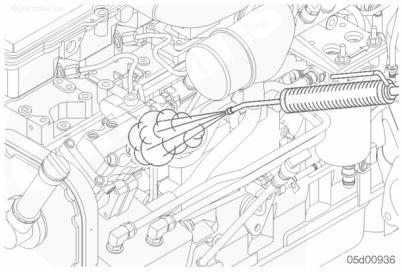
Note : Make sure the overhead is properly set before attempting a leakage check. Improper overhead settings could be the root cause of drivability complaints and could invalidate leakage check results. If settings are not within specification, adjust the overhead and road test. If drivability complaints persist after road test, proceed with the leakage test.

This check will be performed with the engine static.

Preparatory Steps

⚠ WARNING ⚠

Wear safety glasses or a face shield, as well as protective clothing, to prevent personal injury when using a steam cleaner or high-pressure water.



⚠ WARNING ⚠

Wear appropriate eye and face protection when using compressed air. Flying debris and dirt can cause personal injury.

⚠ CAUTION ⚠

Clean all fittings before disassembly. Dirt or contaminants can damage the fuel system.

Before servicing **any** fuel system components, (such as fuel lines, fuel pump, injectors, etc.) which would expose the fuel system or internal engine components to potential contaminants prior to disassembly, clean the fittings,

ANADOLU ISUZU PARTS SALES

mounting hardware, and the area around the component to be removed. Dirt, paint, or other contaminants can be introduced into the fuel system and engine if the surrounding areas are **not** cleaned, resulting in damage to the fuel system and engine.

Remove debris on adjacent chassis frame rails and between the fuel pump heads. Use shop air.

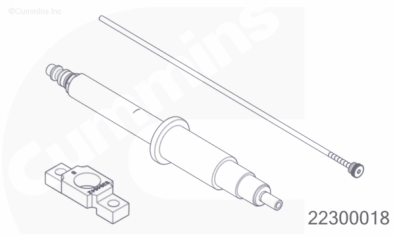
To prevent damage from debris and contamination, cover, cap, or plug any openings as soon as possible when servicing the fuel system. Caps and plugs can be found in Clean Care Kit, Part Number 4919073.

- Relieve the high-pressure fuel from the fuel rail. Refer to Procedure 006-081 in Section 6. (/qs3/pubsys2/xml/en/procedures/425/425-006-081.html)
- Remove all fuel injectors. Refer to Procedure 006-026 in Section 6. (/qs3/pubsys2/xml/en/procedures/425/425-006-026.html)

Note : Some diesel engines will require the removal of overhead components to allow removal of the fuel injector.

Setup

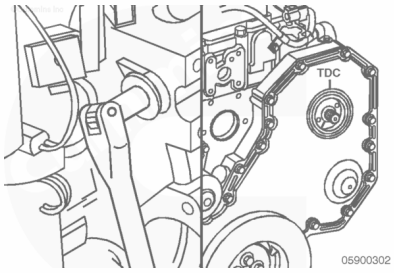
- Install the compression and leak down check adapter into the cylinder being evaluated. These adapters simulate fuel injectors and are retained in the same manner. In most cases, production hardware is reused for the adapter, but some adapters come with their own retaining hardware.
- Remove all liquid from inside the cylinders. Use a vacuum method.



Test

⚠ WARNING ⚠

Wear appropriate eye and face protection when using compressed air. Flying debris and dirt can cause personal injury.



Rotate the crankshaft with the barring tool until the cylinder being evaluated is beginning the compression stroke. Both intake and exhaust valves for the cylinder being evaluated will be fully closed under spring pressure at this point and the rockers of both these valves will have some free clearance (due to overhead lash settings).

Continue rotating the engine until the piston **approaches but does not pass** top dead center (TDC) for the cylinder being evaluated. Some diesel leak down adapters include a TDC indicator gauge. Using the gauge, **stop rotation immediately** when the gauge stops moving upward with crankshaft rotation. On diesel adapters, if the gauge is **not** included with the adapter being used, a slender rod can be used as a substitute. On gas engines, there are no provisions for using a gauge. Approximate TDC is determined using the complimentary cylinder valve overlap method.

For the best results, the piston should **not** be traveling downward when rotation is stopped. If the piston crosses past TDC and starts traveling downward, the piston rings will unseat in the piston ring lands slightly, causing a potential source of measurement error. If the piston starts traveling downward, reverse the barring rotation and rotate the crankshaft until the piston crosses back past TDC in reverse plus 1/3 of a crankshaft rotation. Bar the engine in the normal rotation and try again. Mechanical Diagnostic Kit, Part Number 5395335, includes two leakage testers. See the chart below to make sure the correct one is used.

Note : Use of the incorrect leakage test will generate measurement error.

Leakage Tester Part Number	Bore Size
5394340	Less than 127 mm [5 in]
5394360	Equal to or greater than 127 mm [5 in]

Connect the leakage tester to the compression and leak down check adapter.

Note : Applying air pressure to the test cylinder can cause the engine to attempt to rotate. The engine **must no t** rotate during testing.

Connect shop air to leakage tester. 689 kPa [100 psi] is preferred, but the measurement process will work with lower pressure.

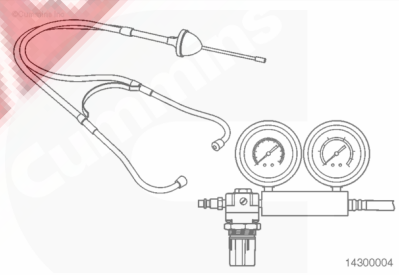
Open the leakage tester pressure regulator. Adjust until the gauge closest to the pressure regulator (reference gauge) reads 100 psi (or maximum available pressure).

Allow the system pressure to stabilize. Record pressure on the gauge farthest from the pressure regulator (cylinder gauge). Record the pressures.

To determine cylinder leakage as a percent, use the following formula: **((Reference Gauge value – Cylinder Gauge value) / Reference Gauge value) x 100 = Cylinder Leakage %**

Repeat test for all remaining cylinders, as necessary.

If one cylinder leakage is higher compared to other cylinders, similar engines, or published specifications, use stethoscope, Part Number 5394338, from Mechanical Diagnostic Kit, Part Number 5394335, to try to determine where the cylinder is leaking when pressurized.



Air Escape Point	Likely Cause of Leakage
Intake Manifold	Intake vale or valve seat, cracked head
Exhaust Manifold or Turbocharger	Exhaust valve or valve seat, cracked head
Coolant System	Cylinder head gasket, cracked head
Engine Crankcase	Piston, piston rings, cylinder bore

Remove the cylinder head. Inspect suspect components further to determine the root cause. See engine-specific procedures.

If all cylinder leakages are uniform compared to each other, but high compared to a similar engine or published specification, the engine can be in need of a full or partial overhaul. Inspect all suspect parts per engine-specific procedures and established reuse guidelines.

Finishing Steps

Note : Bleeding air from the fuel system is an important step. Air in the fuel will make the engine hard to start or not start.

- Remove the compression and leak down check adapter.
- Install the fuel injectors. Refer to Procedure 006-026 in Section 6. (/qs3/pubsys2/xml/en/procedures/425/425-006-026.html)
- Bleed air from the fuel system. See the Prime step in the following procedure. Refer to Procedure 005-234 in Section 5. (/qs3/pubsys2/xml/en/procedures/425/425-005-234-tr.html)
- Operate the engine to check for leaks.

Last Modified: 04-Mar-2020

ANADOLU ISUZU AFTER SALES

General Information

The SAE J1939 Datalink Control Test is used to selectively block datalink control devices while troubleshooting performance issues. Blocking a datalink device removes the restriction enforced by the device on engine speed, power, and torque. The test is located in the recommended Cummins® electronic service tool or equivalent under the diagnostic tests tab.

The SAE J1939 Datalink Control Test has the option to block one to four devices at a time or block all devices at a time.

The SAE J1939 Datalink Control Test can be performed while engine is ON and can be stopped at any time.

The SAE J1939 Datalink Control Test will display the status of each of the devices in the status window. Reference Figure 1 below.

Note : It is not recommended to drive the vehicle while performing the J1939 Datalink Control Test unless directed by published troubleshooting.



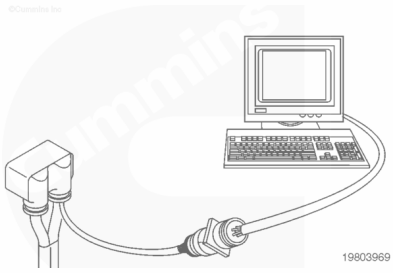
Figure 1, SAE J1939 Datalink Control Test

1. Test Instructions Window
2. Test Status Window
3. Supported Devices Window.

System Requirements

The SAE J1939 Datalink Control Test requires:

- Personal computer with Windows™ 7, or later, software.
- Recommended Cummins® electronic service tool or equivalent.



Preparatory Steps

Connect recommended Cummins® electronic service tool or equivalent and check for active fault codes. Troubleshoot any active fault codes prior to performing this test.

Do **not** perform the SAE J1939 Datalink Control Test unless guided to do so by a service procedure and/or published troubleshooting.



Test

To perform the SAE J1939 Datalink Control Test, complete the steps listed below:

- 1. Begin the SAE J1939 Datalink Control Test.
  - Use recommended Cummins® electronic service tool or equivalent to initiate the SAE J1939 Datalink Control Test.
  - Follow the on-screen instructions.
  - Once the faulty device has been detected, the test may be stopped.

Note : If the connection between recommended Cummins® electronic service tool or equivalent and the engine control module (ECM) is lost for any reason, a pop-up message will appear. When this occurs, the test will automatically abort. The test can be restarted after cycling the keyswitch OFF for 90 seconds and then back ON.

- 2. Monitor the area.
  - Make sure that the vehicle and surrounding area are monitored during the SAE J1939 Datalink Control Test. If any unsafe condition occurs, stop the test immediately.
  - Turn the keyswitch to the OFF position.

Turning the key to the OFF position will cause the test to stop.

Test progress can be monitored using the Test Status window.

Test results will be displayed as each device’s ECM status is changed.

ARABOLU ISUZU SPARE SALES

Note : If the connection between recommended Cummins® electronic service tool or equivalent and the engine control module (ECM) is lost for any reason, a pop-up message will appear. When this occurs, the test will automatically abort. The test can be restarted after cycling the keyswitch OFF for 90 seconds and then back ON.

The SAE J1939 Datalink Control Test will **not** start or will be aborted if:

- Another diagnostic test is running.
- Battery voltage is low.

If the SAE J1939 Datalink Control Test aborts or will **not** activate, a message will be displayed. Correct the issue identified before proceeding. For more information on abort messages and associated repair actions, reference the Troubleshooting section of this procedure.

Finishing Steps

- Turn the keyswitch to the OFF position for 90 seconds.
- Do **not** turn the keyswitch OFF until the test has completed and the results are displayed.



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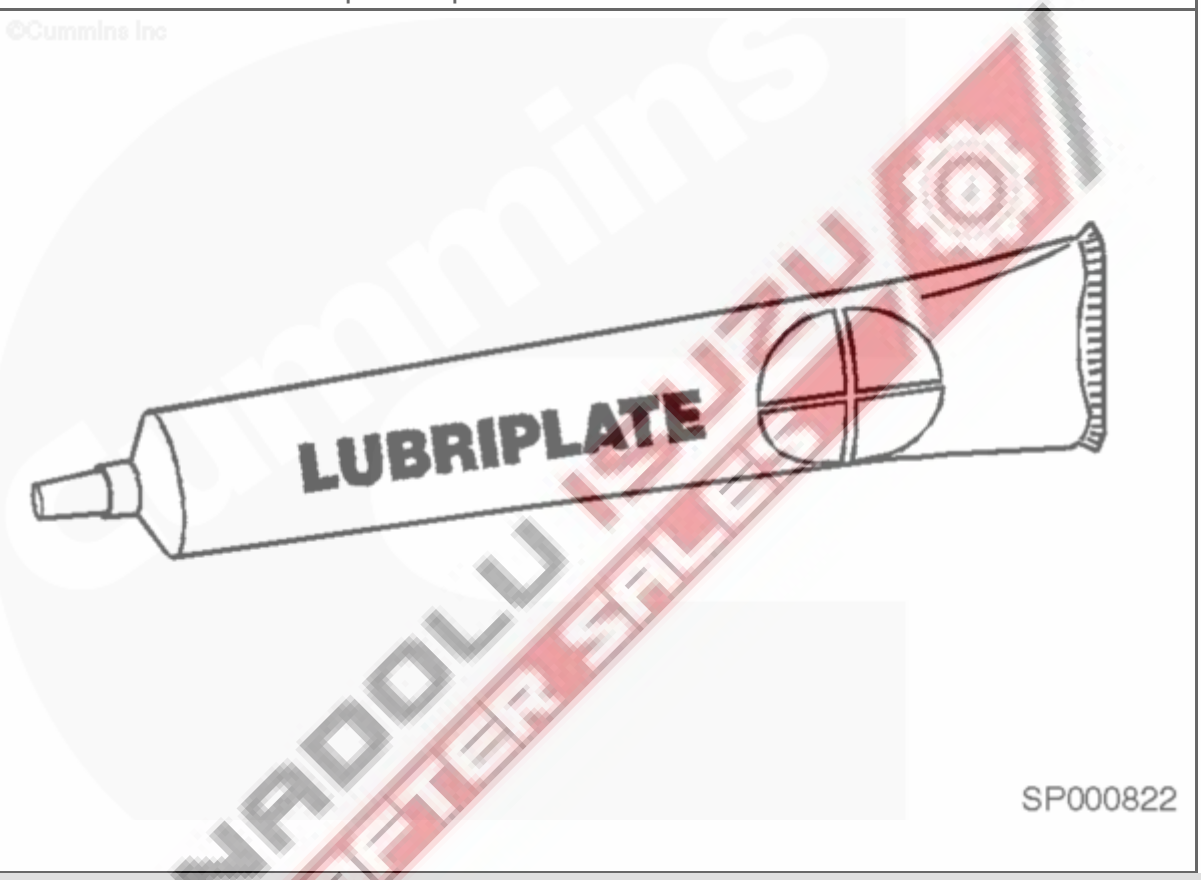
Last Modified: 29-May-2020

Mounting Adaptations

Tool Number
3163087
Assembly Lubricant
Used for lubricant for component parts.
 SP000822

Tool Number
3163720
Dowel Pin Extractor Kit
This puller kit contains various size collets to remove crosshead guides or dowels throughout the engine.

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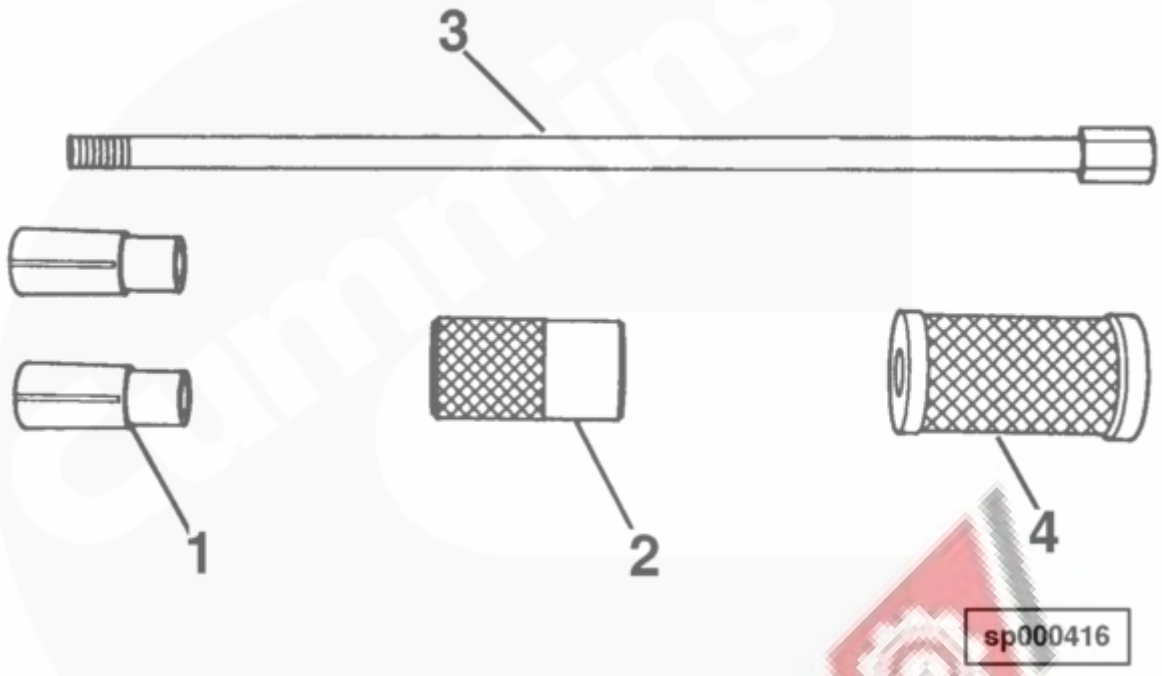

Tool Number

3163934

Guide Pin

These are miscellaneous size guide pins used to guide various engine parts during assembly or disassembly.

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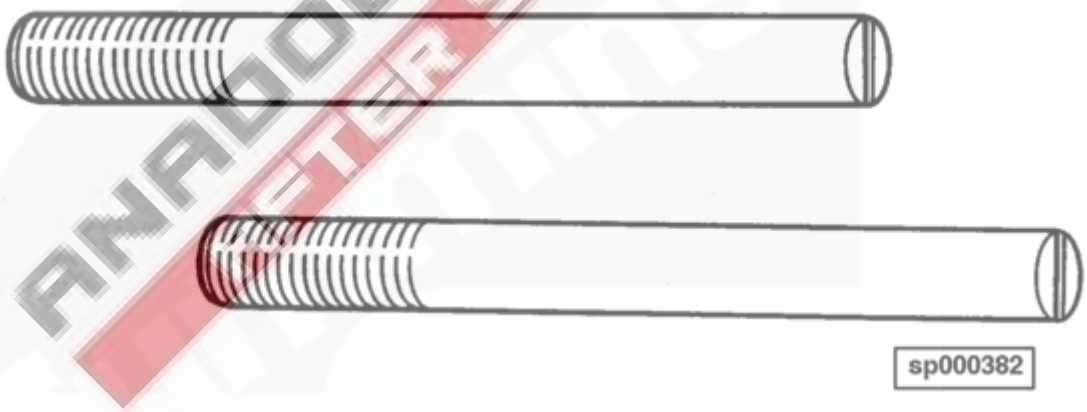

Tool Number

3164067

Loctite® 5999

Loctite® 5699 Grey RTV silicone sealant (1)(2) is very durable and was released to be used for multiple applications. It can provide a seal in the T-gasket joint on oil pan gaskets.

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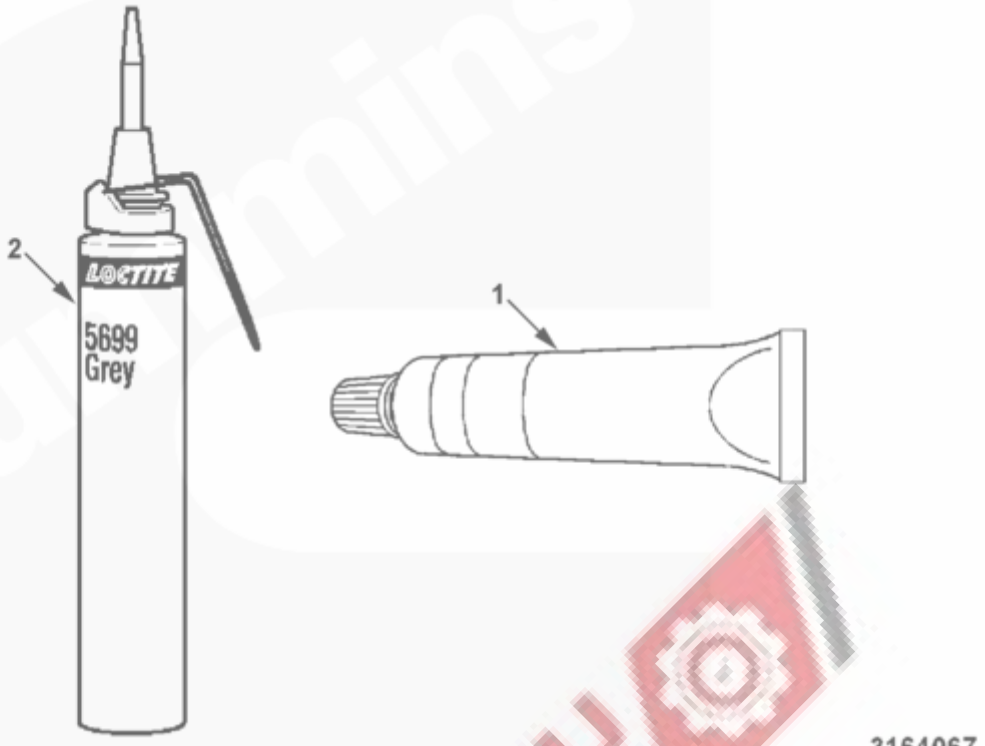
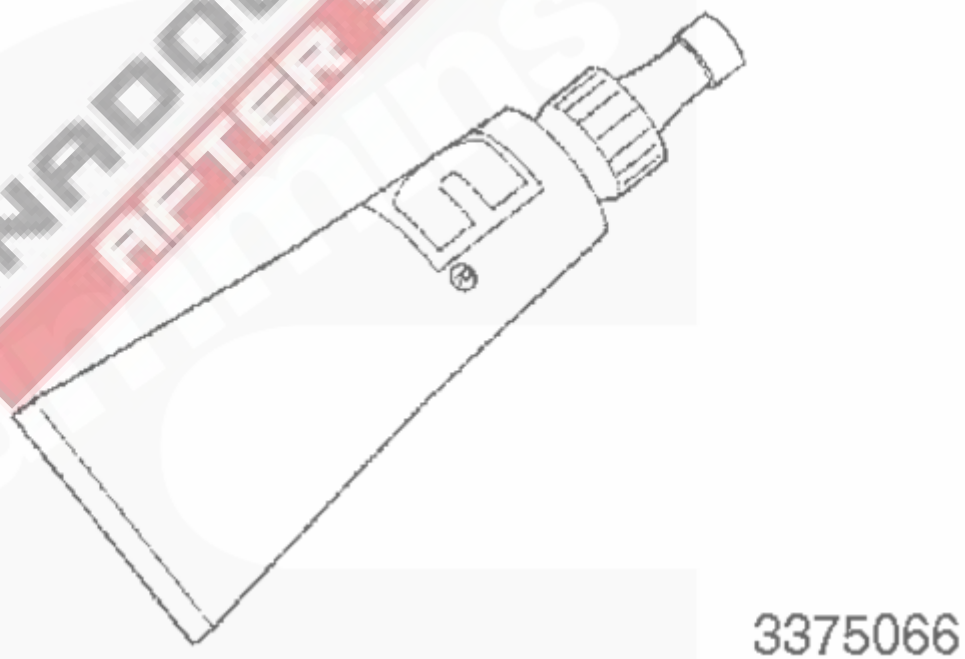


Tool Number
3375066
Pipe Sealant
Used on capscrew threads and pipe plugs.



Tool Number
3375068
Cup Plug Sealant

Used when installing cup plugs.



Tool Number

3375432

Crack Detection Kit

Used to detect cracks.

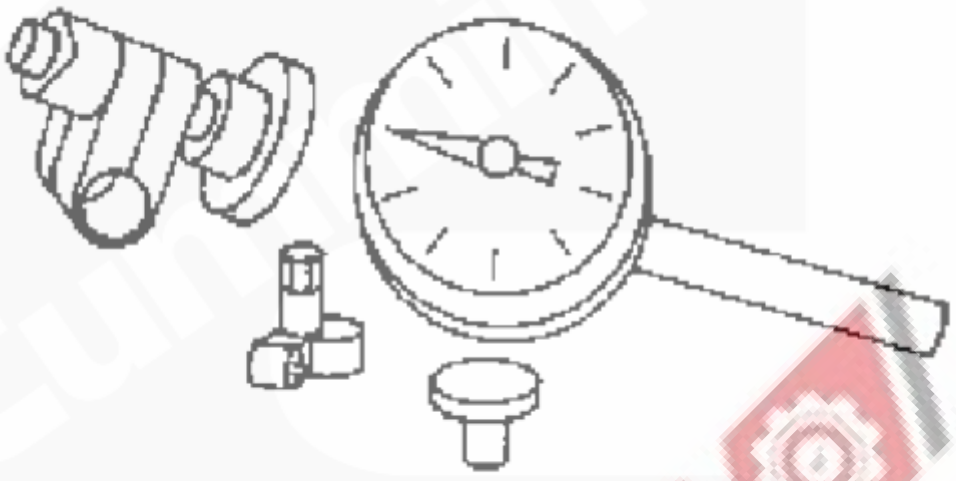


Tool Number

3376050

Dial Indicator and Sleeve Assembly

Used with dial gauge attachment, Part Number ST 1325, to measure flywheel and flywheel housing run-out.

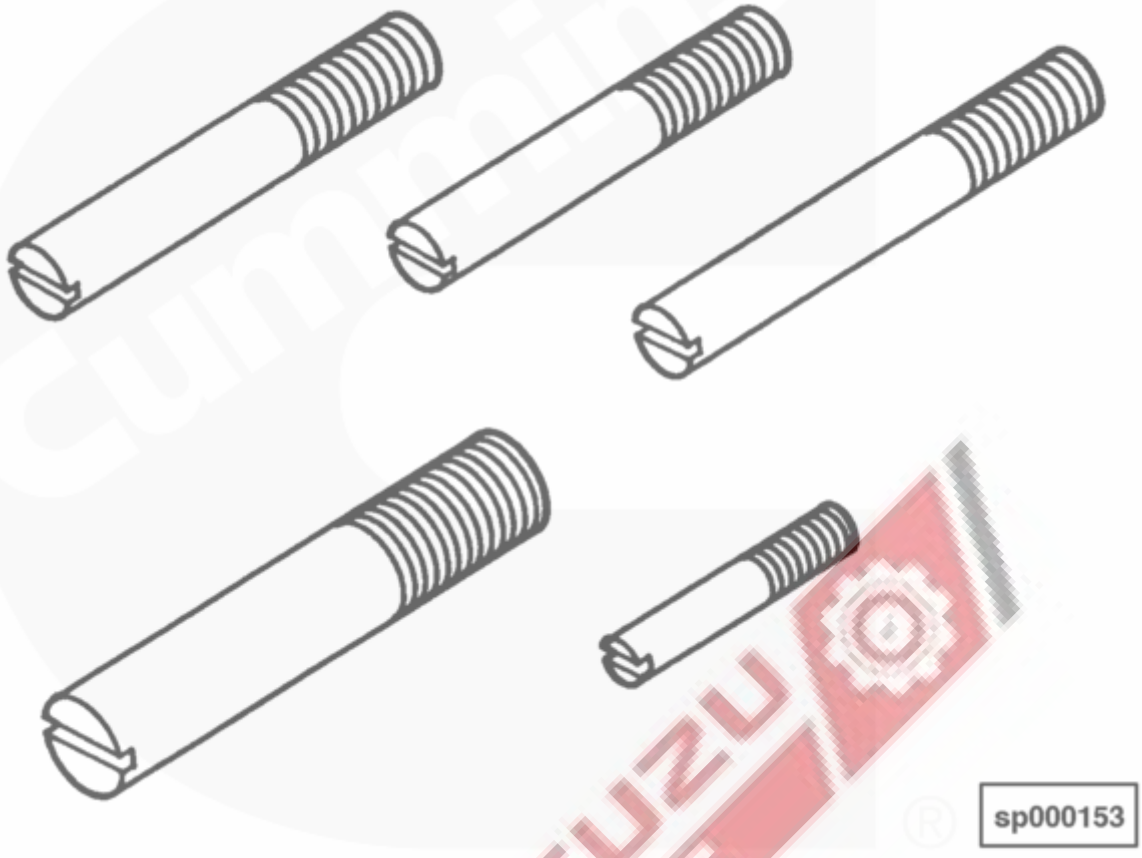


Tool Number

3376638

Guide Pin M12 X 1.25 x 150

These various size guide pins are used during assembly and/or disassembly to align parts and aid in the control of the parts. The use of one or more guide pins can `free-up' a hand to turn capscrews etc.



Tool Number

3376812

Cup Plug Driver

Used to install cup plugs in flywheel housings.

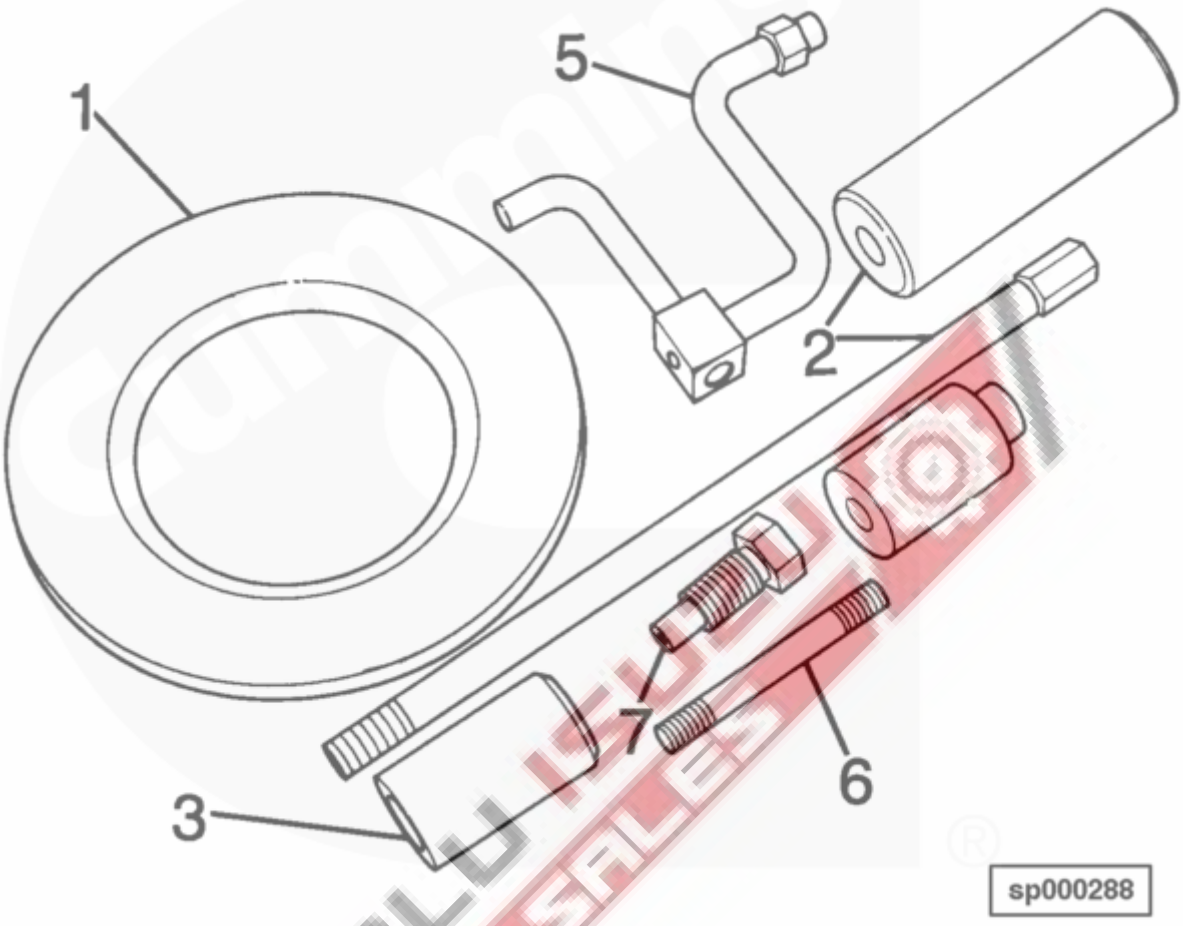


Tool Number

3822784

Gear Locator Stud

This kit is used to install the rear engine power takeoff for engines equipped with the Knowles rear engine power takeoff. The gear locator stud is number 6.

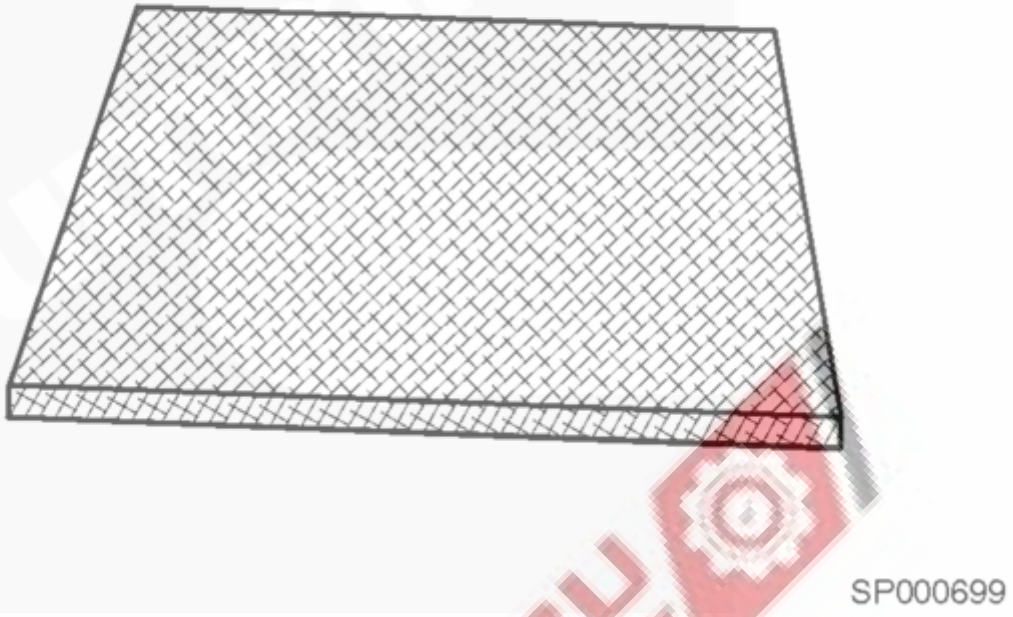


Tool Number

3823258

Abrasive Pad

These pads are used to clean carbon from the upper liner bores, removing rust, and corrosion from the engine block and parts, scuffing surfaces prior to painting, and removing burrs from aluminum and other soft metals. These hand cleaning pads are superior to emery cloth or sandpaper, which can inadvertently embed in the metal parts being cleaned.

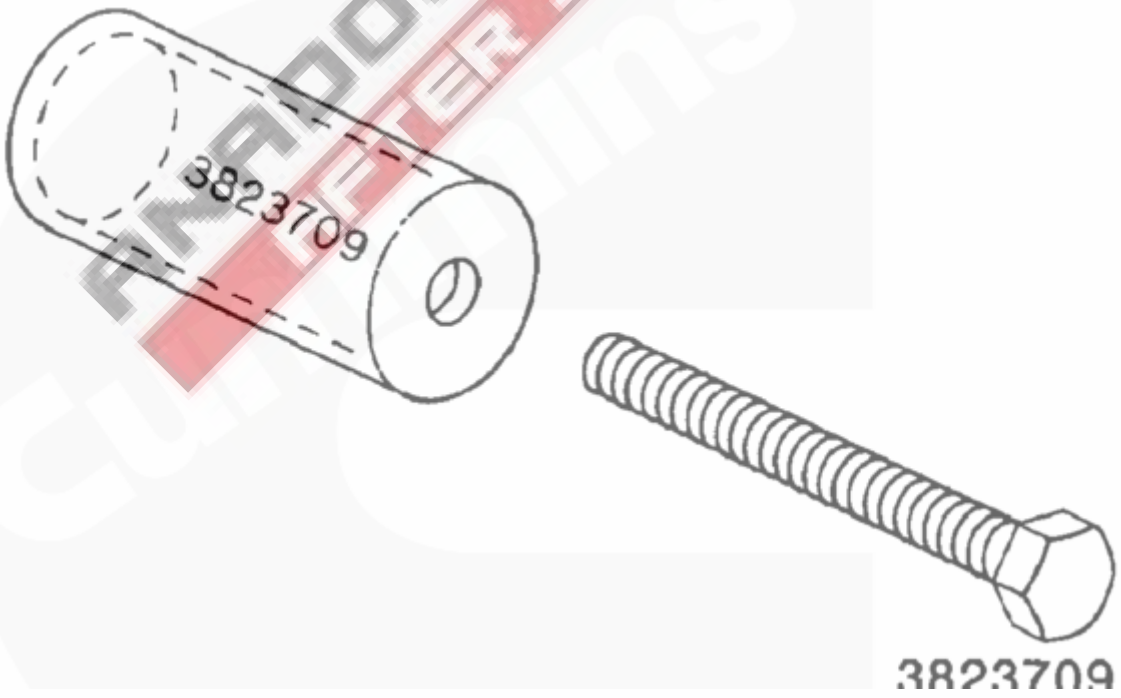


Tool Number

3823709

Idler Shaft Puller and Capscrew

Used to remove the idler shaft from the idler gear and flywheel housing.



Tool Number

3823710

Cup Plug Driver

The cup plug driver (3) is used to install cup plug(s).

GRAPHIC NOT FOUND

Tool Number

3823891

Gear Locking Tool

Used to prevent rotation of the power takeoff output shaft while tightening the output flange capscrew.



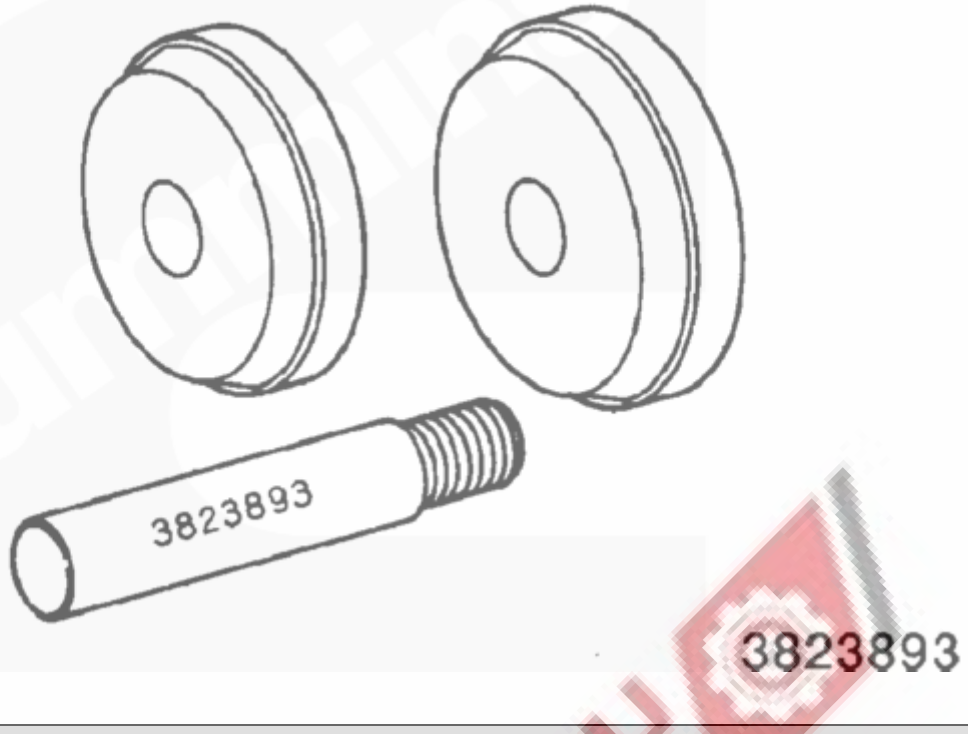
3823891

Tool Number

3823893

Bearing Race Driver

Used to install output shaft bearing races.



Tool Number

3824928

Offset Wrench (C-Series Engine)

Used to tighten the hidden capscrews in the rear engine power takeoff flywheel housing.

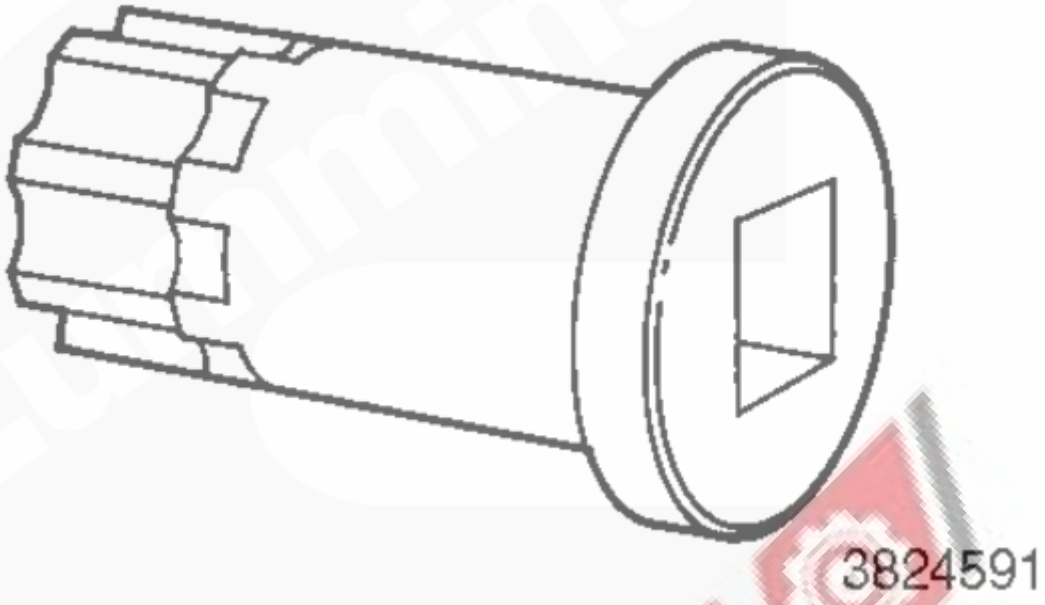


Tool Number

5299073

Barring Tool

Used to engage the flywheel ring gear to rotate the crankshaft.

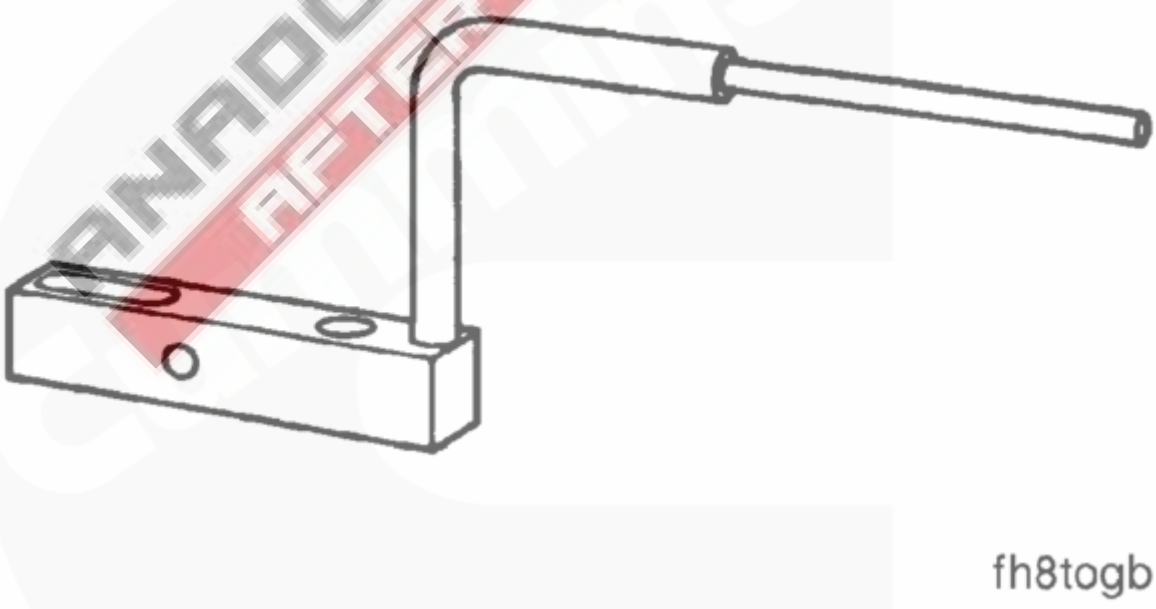


Tool Number

ST 1325

Dial Indicator Attachment

Attaches to the crankshaft flange to provide measurement of flywheel and flywheel housing runout with a dial bore gauge.



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AFTER SALES

Select Service Tools

Recommended Cummins® Service Tools

- No Cummins® Service Tools required.

Additional Service Items

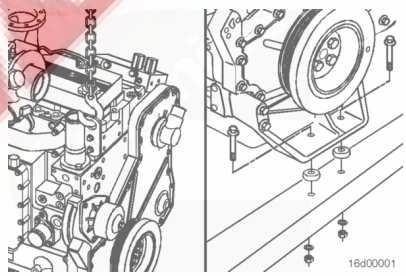
- Hoist or lifting fixture

Remove

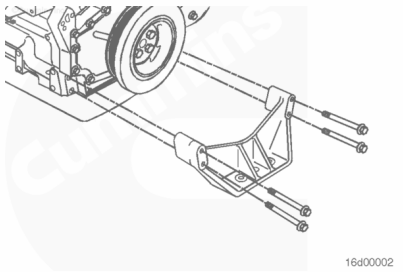
Note : Make sure to save any shims or spacers removed and record their location.

Use a hoist or lifting fixture to support the front of the engine.

Remove the capscrews from the front engine mount.



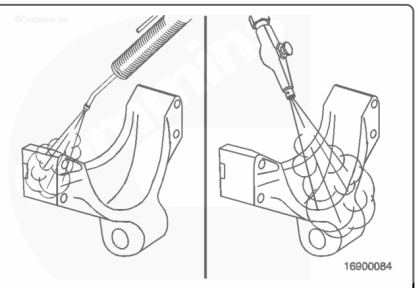
Remove the four mounting capscrews and front engine support.



Clean and Inspect for Reuse

⚠ WARNING ⚠

When using solvents, acids, or alkaline materials for cleaning, follow the manufacturer's recommendations for use. Wear goggles and protective clothing to reduce the possibility of personal injury.



ANADOLU ISUZU AFTER SALES

⚠ WARNING ⚠

When using a steam cleaner, wear safety glasses or a face shield, as well as protective clothing. Hot steam can cause serious personal injury.

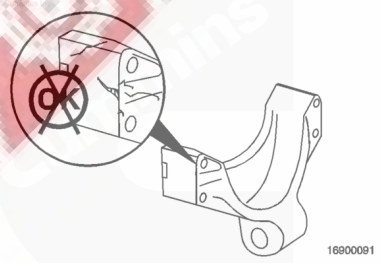
⚠ WARNING ⚠

Wear appropriate eye and face protection when using compressed air. Flying debris and dirt can cause personal injury.

Clean the front engine support. Use steam or solvent. Dry with compressed air.

Inspect the support for cracks or other damage.

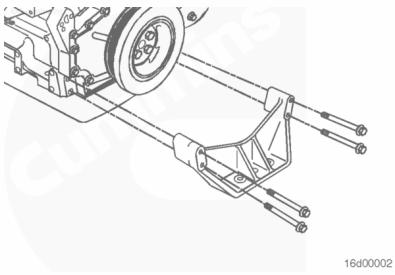
If the support is cracked or otherwise damaged, it **must** be replaced.



Install

Install the front support and mounting capscrews.

Torque Value: 112 n•m [83 ft-lb]



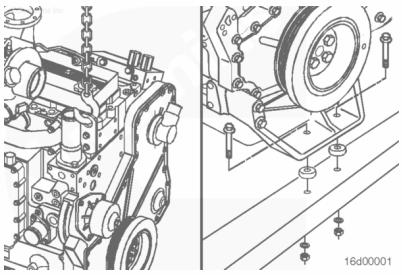
Note : Make sure to install any shims or spacers in the same location as removed.

Lower the front of the engine.

Install the front engine mount capscrews.

Tighten the capscrews to manufacturer specifications.

Remove the lifting fixture or hoist from the front of the engine.



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Last Modified: 05-Aug-2016



Select Service Tools

Recommended Cummins® Service Tools

- No Cummins® Service Tools required.

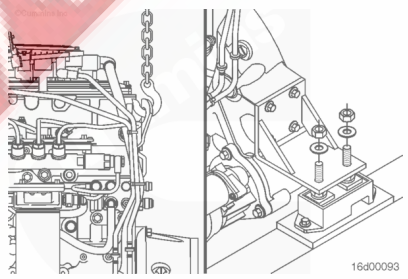
Additional Service Items

- Hoist or lifting fixture

Remove

⚠ WARNING ⚠

The engine lifting equipment must be designed to lift the engine and transmission as an assembly without causing personal injury.

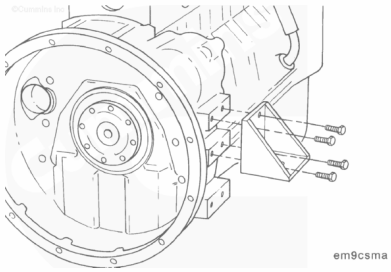


Note : Make sure to install any shims or spacers in the same location as removed.

Use a hoist or lifting fixture to support the rear of the engine.

Remove the capscrew from the rear engine mount.

Remove the four capscrews and rear support bracket.

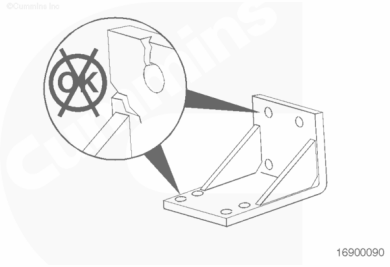


Clean and Inspect for Reuse

⚠ WARNING ⚠

ANADOLU ISUZU AFTER SALES

When using solvents, acids, or alkaline materials for cleaning, follow the manufacturer's recommendations for use. Wear goggles and protective clothing to reduce the possibility of personal injury.



⚠ WARNING ⚠

When using a steam cleaner, wear safety glasses or a face shield, as well as protective clothing. Hot steam can cause serious personal injury.

⚠ WARNING ⚠

Wear appropriate eye and face protection when using compressed air. Flying debris and dirt can cause personal injury.

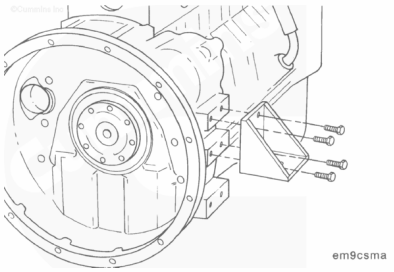
Clean the rear engine support. Use solvent or steam. Dry with compressed air.

Inspect the support bracket for cracks or damage. If the support bracket is cracked, it **must** be replaced.

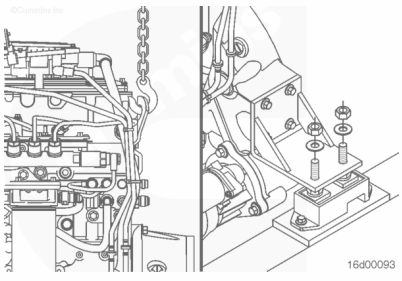
Install

Install the support bracket and mounting capscrews.

Torque Value: 71 n•m [52 ft-lb]



Note : Make sure to install any shims or spacers in the same location as removed.



Lower the rear of the engine.

Install the rear engine mount capscrews.

Tighten to the manufacturer's specifications.

Remove the lifting fixture or hoist from the rear of the engine.

ANADOLU ISUZU AFTER SALES

Last Modified: 05-Aug-2016



Select Service Tools

Recommended Cummins® Service Tools

- No Cummins® Service Tools required.

Additional Service Items

- No additional service items required.

Preparatory Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

⚠ WARNING ⚠

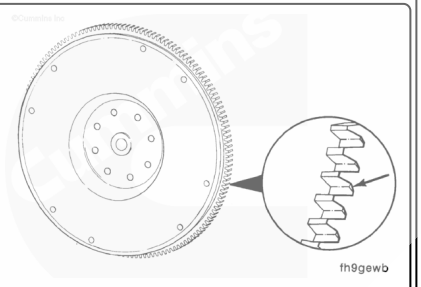
This component or assembly weighs greater than 23 kg [50 lb]. To prevent serious personal injury, be sure to have assistance or use appropriate lifting equipment to lift this component or assembly.

- Disconnect the batteries. See equipment manufacturer service information.
- Remove the transmission and related components. See equipment manufacturer service information.

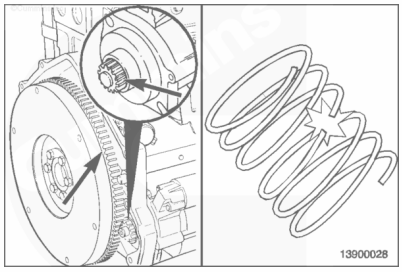
Initial Check

Inspect the flexplate ring gear teeth for damage.

If the flexplate ring gear is damaged, make sure to evaluate the following possible causes prior to replacing the flexplate.



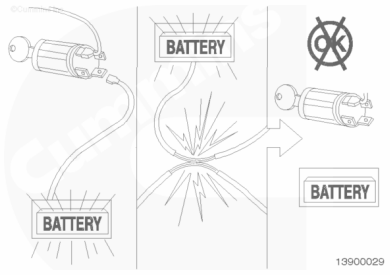
Mechanical



A mechanical issue can typically be identified by seeing damage to the ring gear of the flexplate in three distinct locations for 6 cylinder engines (commonly called 120 degree milling), and two locations for 4 cylinder engines (commonly called 180 degree milling). The following can be causes for mechanical issues:

1. The possibility of improper starter motor spacing. Refer to Procedure 013-020 in Section 13. (/qs3/pubsys2/xml/en/procedures/425/425-013-020-tr.html)
2. The interference between the ring gear land area and starting motor pinion. The wrong starting motor might be installed, seee original equipment manufacturer (OEM) specifications.
3. The possibility of a damaged starter motor pinion. Inspect the pinion for nicks and burrs. If replacement of the starting motor is necessary. Refer to Procedure 013-020 in Section 13. (/qs3/pubsys2/xml/en/procedures/425/425-013-020-tr.html)
4. The torque converter/transmission is damaged or incorrectly mounted. See equipment manufacturer service information.
5. Incorrect starting motor pinion to flexplate ring gear pitch and teeth match. See equipment manufacturer service information.

Electrical



An electrical issue can typically be identified by seeing damage to the ring gear of the flexplate 360 degrees around the circumference of the ring gear (commonly called 360 degree milling). The following can be causes for electrical issues:

1. The operator is attempting to start engine while engine is already running. Check if a starter lockout feature is available through the OEM (activated with INSITE™ electronic service tool) or starting motor manufacturer.
2. The keyswitch is causing intermittent starting motor engagement when the engine is running. Inspect the key switch. Refer to Procedure 013-020 in Section 13.

ANADOLU ISUZU

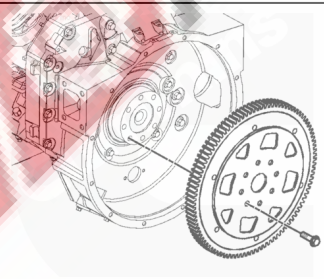
(/qs3/pubsys2/xml/en/procedures/425/425-013-020-tr.html)

3. The orientation of the starter relay, where in the direction of the pull contact is in the direction of vehicle travel. This results in intermittent starter motor engagement when the engine is running. Relocate the starter relay. See equipment manufacturer service information.
4. Intermittent starter motor wiring issues. See equipment manufacturer service information.

Remove

Note : Some flexplates require mounting plates and/or adapters. It can be necessary to remove any mounting plates and/or adapters prior to or with the flexplate. Make sure to note the location of any mounting plates and/or adapters for later installation.

Remove the flexplate capscrews and flexplate.

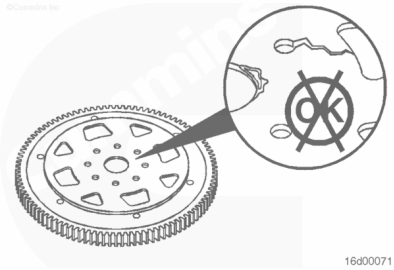


Inspect for Reuse

Inspect the teeth of the ring gear for chips or uneven wear.

Check the flexplate for cracks.

Replace the flexplate if any damage is found.



Install

Note : Some flexplates require mounting plates and/or clamp rings. It can be necessary to install any mounting plates and/or clamp rings prior to or with the flexplate as noted during removal.

Install the flexplate and flexplate capscrews. Tighten.

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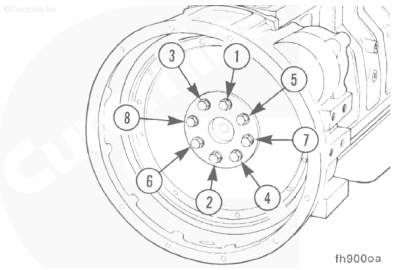
Torque Value:

Flexplate Capscrews

1. 30 n•m [22 ft-lb]
2. Plus 60 degree turn.



Finishing Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

⚠ WARNING ⚠

This component or assembly weighs greater than 23 kg [50 lb]. To prevent serious personal injury, be sure to have assistance or use appropriate lifting equipment to lift this component or assembly.

- Connect the batteries. See equipment manufacturer service information.
- Install the transmission and related components. See equipment manufacturer service information.
- Operate the engine and check for noise or vibration.

ANADOLU ISUZU AFTER SALES

Last Modified: 05-Aug-2016

Select Service Tools

Recommended Cummins® Service Tools

- Barring tool, Part Number 3824591
- Abrasive pad, Part Number 3823258, or equivalent
- Crack Detection Kit, Part Number 3375432, or equivalent
- Barring tool, Part Number 5299073
- Dial indicator gauge, Part 3376050, or equivalent
- Dial gauge attachment, Part Number ST 1325

Additional Service Items

- M12 x 1.25 x 90 mm guide pin - Quantity 2
- Mandrel
- Hammer

Preparatory Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

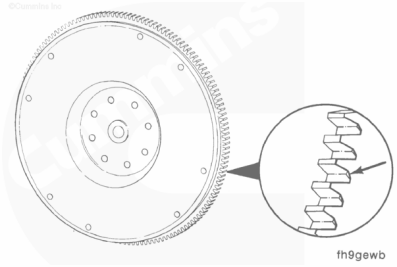
Note : Use a container that can hold at least 28 liters [30 US qt] of lubricating oil.

- Disconnect the batteries. See equipment manufacturer service information.
- If equipped with a wet flywheel housing, drain the oil from the flywheel housing by removing the plug in the bottom of the flywheel housing.
- Remove the transmission and all related components, if equipped. See equipment manufacturer service information.

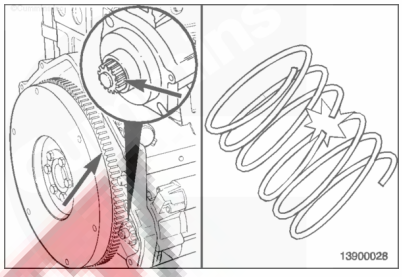
Initial Check

Inspect the flywheel ring gear teeth for damage.

If the flywheel ring gear is damaged make sure to inspect the following possible causes prior to replacing the flexplate.



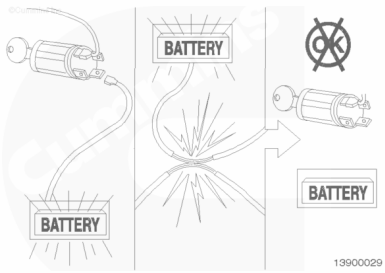
Mechanical



A mechanical issue can typically be identified by seeing damage to the ring gear of the flywheel in three distinct locations for 6 cylinder engines (commonly called 120 degree milling). The following could be causes for mechanical issues:

- Upon installation of the flywheel, make sure to check for proper starter motor spacing. Refer to Procedure 013-020 in Section 13. (/qs3/pubsys2/xml/en/procedures/425/425-013-020-tr.html)
- Interference between the ring gear land area and starting motor pinion. The wrong starting motor may be installed. See equipment manufacturer service information.
- The starter motor pinion could possibly be damaged. Inspect the pinion for nicks and burrs, replace if necessary. Refer to Procedure 013-020 in Section 13. (/qs3/pubsys2/xml/en/procedures/425/425-013-020-tr.html)
- The flywheel face runout may be out of specification. See the Measure section of this procedure.
- Incorrect starting motor pinion to flywheel ring gear pitch/teeth match. See equipment manufacturer service information.

Electrical



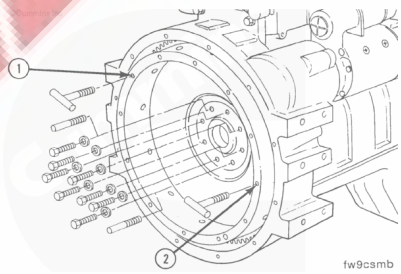
An electrical issue can typically be identified by seeing damage to the ring gear of the flywheel 360 degrees around the circumference of the ring gear (commonly called 360 degree milling). The following could be causes for electrical issues:

- Operator is attempting to start engine while engine is already running. Check if a starter lockout feature is available through the original equipment manufacturer

(OEM) (activated with INSITE™ electronic service tool) or starting motor manufacturer.
- Keyswitch causing intermittent starting motor engagement when the engine is running. Inspect the keyswitch.
- Orientation of the starter relay so the direction of the pull contact is in the direction of vehicle travel. This results in intermittent starter motor engagement when the engine is running. Relocate the starter relay. See equipment manufacturer service information.
- Intermittent starter motor wiring issues. See equipment manufacturer service information.

Remove

Note : Use barring tool, Part Number 3824591, to hold the flywheel to prevent rotation.



Remove two capscrews 180 degrees apart.

Install two M12 x 1.25 x 90 mm guide pins.

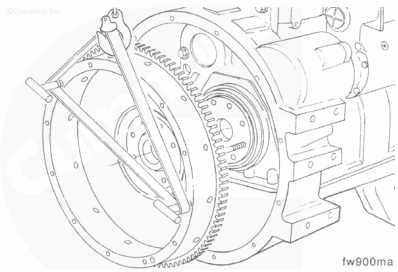
Note : If a clutch is used in the equipment, the threads in the clutch pressure plate mounting capscrew holes can be metric or standard. Make sure to use the correct capscrews.

Determine the capscrew thread design and size. Install two T-handles in the flywheel at points (1) and (2).

Remove the remaining six flywheel mounting capscrews.

⚠ WARNING ⚠

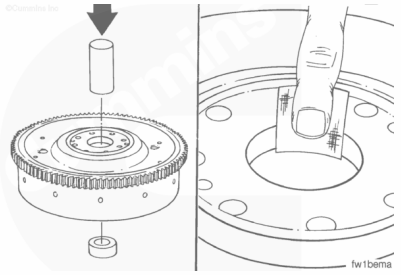
This component or assembly weighs greater than 23 kg [50 lb]. To prevent serious personal injury, be sure to have assistance or use appropriate lifting equipment to lift this component or assembly.



Remove the flywheel from the guide pins.

Disassemble

Note : Removal of the pilot bearing is only necessary if damaged or when installing a new or rebuilt clutch.



If equipped, remove the pilot bearing.

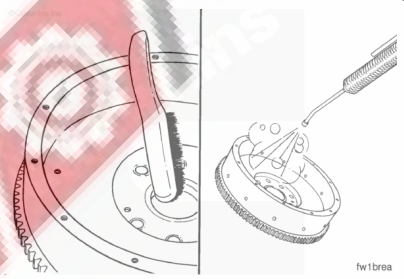
Use a mandrel and hammer to remove the pilot bearing.

Use abrasive pad, Part Number 3823258, or equivalent, to clean the pilot bore.

Clean and Inspect for Reuse

⚠ WARNING ⚠

When using a steam cleaner, wear safety glasses or a face shield, as well as protective clothing. Hot steam can cause serious personal injury.



⚠ WARNING ⚠

Wear appropriate eye and face protection when using compressed air. Flying debris and dirt can cause personal injury.

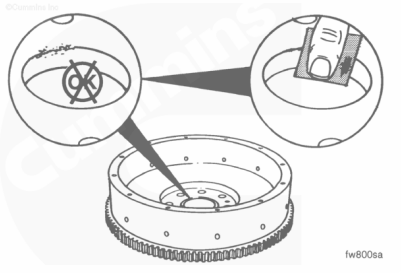
⚠ WARNING ⚠

When using solvents, acids, or alkaline materials for cleaning, follow the manufacturer's recommendations for use. Wear goggles and protective clothing to reduce the possibility of personal injury.

If the pilot bearing was removed, use a wire brush to clean the crankshaft pilot bore.

Clean the flywheel. Use steam or solvent. Dry with compressed air.

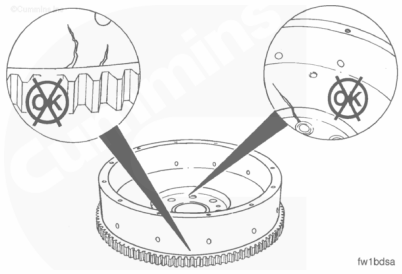
Inspect the flywheel for nicks or burrs.



Remove small nicks and burrs. Use abrasive pad, Part Number 3823258, or equivalent.

⚠ WARNING ⚠

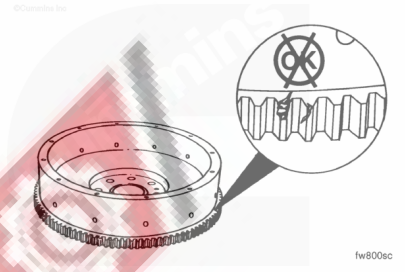
Do not use a cracked flywheel. A cracked flywheel can break and cause personal injury or property damage.



Use Crack Detection Kit, Part Number 3375432, or equivalent, to check for cracks in the flywheel. Follow the instructions provided with the kit.

Inspect the flywheel ring gear teeth for cracks and chips.

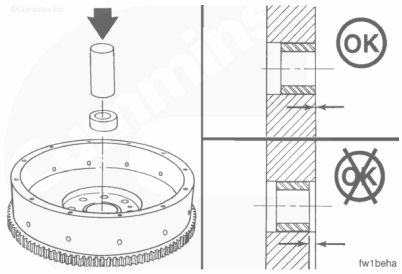
Note : If the ring gear teeth are cracked or broken, the ring gear **must** be replaced. Refer to Procedure 016-008 in Section 16. (/qs3/pubsys2/xml/en/procedures/425/425-016-008.html)



Assemble

If removed, install a new pilot bearing.

Use a mandrel and hammer to install the pilot bearing. The pilot bearing **must** be installed evenly with the pilot bore surface.

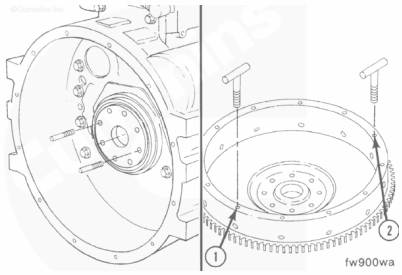


Install

Install two M12 x 1.25 x 90 mm guide pins into the crankshaft flange 180 degrees apart.

Note : If a clutch is used in the equipment, the threads in the clutch pressure plate mounting capscrew holes can be metric or standard. Make sure to use the correct capscrews.

Determine the capscrew thread design and size. Install two T-handles into the flywheel at points (1) and (2).



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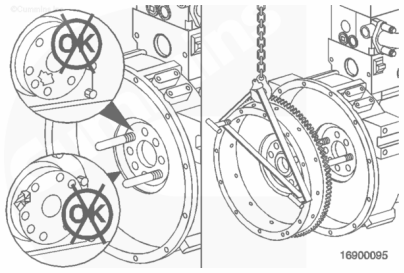
AFTER SALES

⚠ WARNING ⚠

This component or assembly weighs greater than 23 kg [50 lb]. To prevent serious personal injury, be sure to have assistance or use appropriate lifting equipment to lift this component or assembly.



Inspect the rear face of crankshaft and flywheel mounting flange for cleanliness and nicks or burrs.

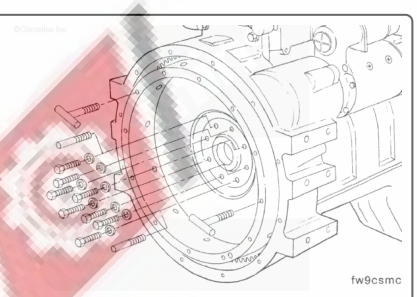
Install the flywheel on the guide pins.

Lubricate the threads of the capscrews and the surface of the washers. Use clean lubricating engine oil.

Install the six capscrews.

Remove the T-handle and guide pins.

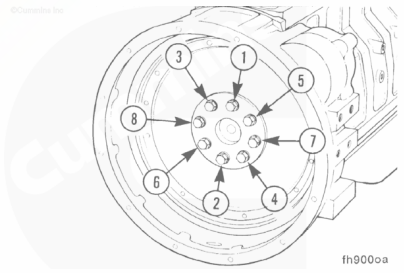
Install the remaining capscrews into the holes from where the guide pins were removed.



Hold the crankshaft when tightening the flywheel capscrews, use barring tool, Part Number 5299073.

Tighten the capscrews in a star pattern.

Torque Value: 137 n•m [101 ft-lb]



Measure

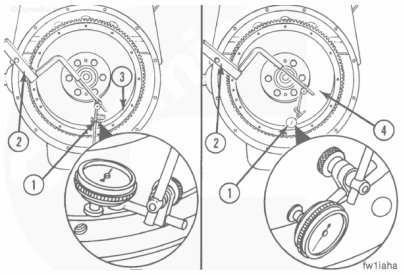
Bore Runout

Use dial indicator gauge (1), Part Number 3376050, or equivalent, and dial gauge attachment (2), Part Number ST 1325, to inspect the flywheel bore (3) and the surface (4) runout.

Install the attachment to the flywheel housing.

Install the gauge on the attachment.

Install the contact tip of the indicator against the inside diameter of the flywheel bore. Set the dial indicator at zero.



ANADOLU ISUZU
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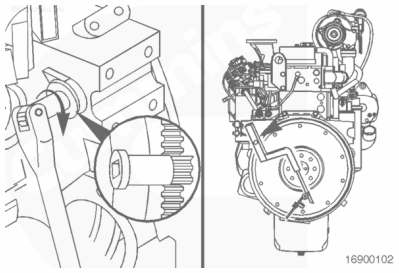
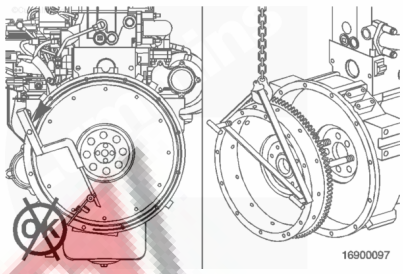
Use barring tool, Part Number 5299073, to rotate the crankshaft one complete revolution.

Flywheel Total Indicator Reading		
mm		in
0.127	MAX	0.0050



⚠ WARNING ⚠

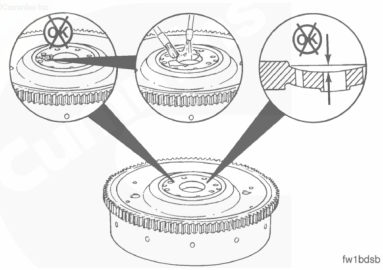
This component or assembly weighs greater than 23 kg [50 lb]. To prevent serious personal injury, be sure to have assistance or use appropriate lifting equipment to lift this component or assembly.



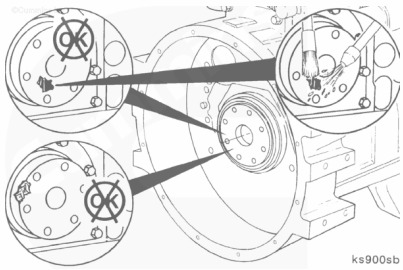
Note : If the total indicator reading (TIR) is greater than the specification, do the following:

Remove the flywheel.

Inspect the flywheel mounting surface for dirt or damage.

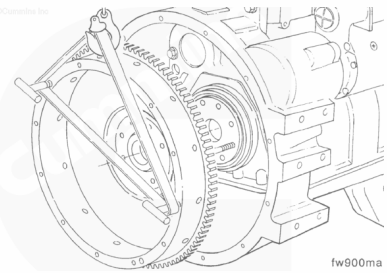


Inspect the crankshaft for dirt or damage.



Install the flywheel.

Inspect the bore runout.



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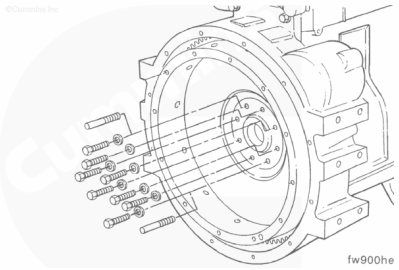
Replace the flywheel if the runout does **not** meet specifications.

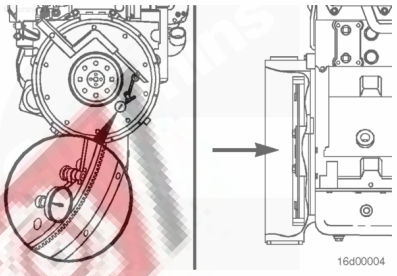


Face Runout

Install the contact tip of the indicator against the flywheel face.

When locating the contact tip, see the Flywheel Face Runout Total Indicator Reading Table later in this procedure. Locate the contact tip so it corresponds with a radius listed in the table, but is still as close to the outside diameter of the flywheel as possible, to inspect the flywheel face (1) runout.

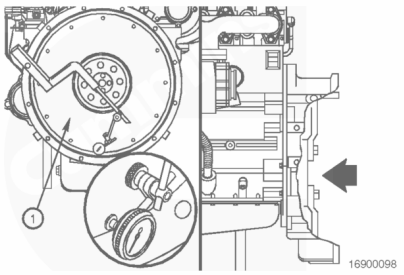
Push the flywheel forward to remove the crankshaft end clearance. Adjust the dial on the indicator until the needle points to zero.



Install the contact tip of the indicator against the flywheel face.

When locating the contact tip, see the Flywheel Face Runout Total Indicator Reading Table later in this procedure. Locate the contact tip so it corresponds with a radius listed in the table, but is still as close to the outside diameter of the flywheel as possible, to inspect the flywheel face (1) runout.

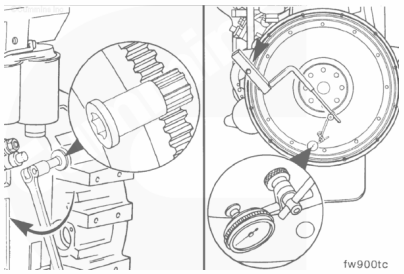
Push the flywheel forward to remove the crankshaft end clearance. Adjust the dial on the indicator until the needle points to zero.



Use barring tool, Part Number 5299073, or equivalent, to rotate the crankshaft one complete revolution. Measure and record the flywheel runout at four equal points on the flywheel.

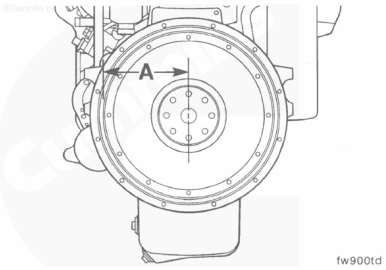
The flywheel **must** be pushed toward the front of the engine to remove the crankshaft end clearance each time a point is measured.

Determine the TIR.



TIR is determined by calculating the difference between the highest and lowest measurement from the four locations measured.

Measure the distance from the center of the flywheel to the contact tip of the indicator (A). Use this measurement to determine which specification to use from the table below.

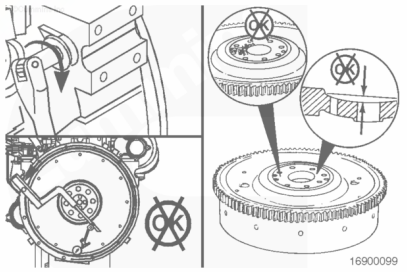


The total indicator reading **must not** exceed the following specifications:

Flywheel Radius (A)		Maximum Total Indicator Reading of Flywheel Face	
mm	**in**	**mm**	**in**
203	8	0.203	0.008
254	10	0.254	0.010
305	12	0.305	0.012
356	14	0.356	0.014
406	16	0.406	0.016

If the flywheel face runout is **not** within specifications, remove the flywheel. Check for nicks, burrs, or foreign material between the flywheel mounting surface and crankshaft flange.

Replace the flywheel if the runout is **not** within specification.



Finishing Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

- Install the transmission and all related components, if equipped. See equipment manufacturer service information.
- If equipped with a wet flywheel housing, fill the flywheel housing with oil. See equipment manufacturer service information.
- Connect the batteries. See equipment manufacturer service information.

- Operate the engine. Check for noise or vibration.

Last Modified: 01-Nov-2016

ANADOLU ISUZU
AFTER SALES

Select Service Tools

Recommended Cummins® Service Tools

- Pipe sealant, Part Number 3375066, or equivalent
- Assembly lubricant, Part Number 3163087
- Sealant, Part Number 3164067
- Guide pin, Part Number 3163934 - Quantity 2
- Dial indicator gauge, Part Number 3376050
- Mounting tool, Part Number ST 1325
- Barring tool, Part Number 5299073
- Dowel pin extractor, Part Number 3163720

Additional Service Items

- Container suitable for lubricating oil
- Hoist or lifting fixture
- Rubber hammer
- Three-Bond™, or equivalent
- Pry bar
- Straightedge

ANADOLU ISUZU PARTS SALES

Preparatory Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

⚠ WARNING ⚠

This component or assembly weighs greater than 23 kg [50 lb]. To prevent serious personal injury, be sure to have assistance or use appropriate lifting equipment to lift this component or assembly.

⚠ WARNING ⚠

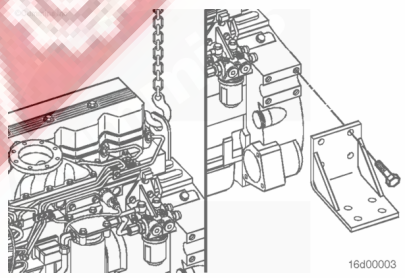
Support the rear of the engine using the rear support attached to the cylinder head. Failure to support the engine can cause personal injury.

- Disconnect the batteries. See equipment manufacturer service information.
- If equipped with a wet flywheel housing, drain the oil from the flywheel housing by removing the plug in the bottom of the flywheel housing. Use a container that can hold at least 28 liters [30 qt] of lubricating oil.
- Remove the transmission, clutch, and all related components, if equipped. See equipment manufacturer service information.
- Remove any original equipment manufacturer (OEM) attached components (mufflers, shift mechanisms, air filters, etc.) to the flywheel housing. See equipment manufacturer service information.

Remove

⚠ WARNING ⚠

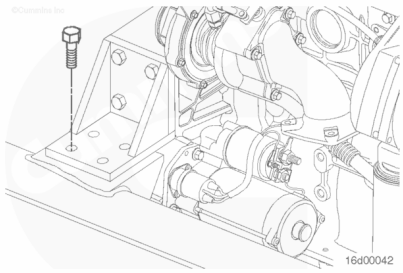
The engine lifting equipment must be designed to lift the engine and transmission as an assembly without causing personal injury.



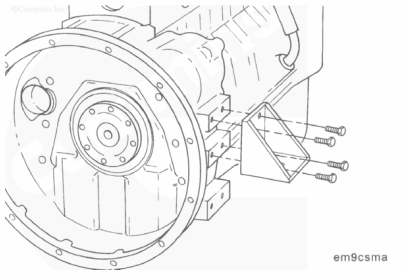
Use a hoist or lifting fixture to support the rear of the engine.

Note : When removing the rear engine mount fasteners, keep track of the location of any shims or spacers used.

Remove the engine mount fasteners.



Remove the rear support capscrews and bracket.

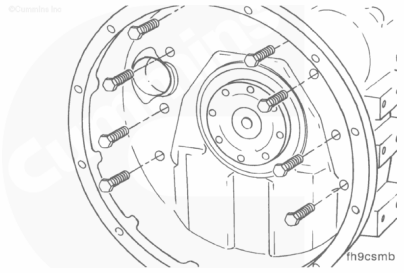


⚠ WARNING ⚠

This component or assembly weighs greater than 23 kg [50 lb]. To prevent serious personal injury, be sure to have assistance or use appropriate lifting equipment to

lift this component or assembly.

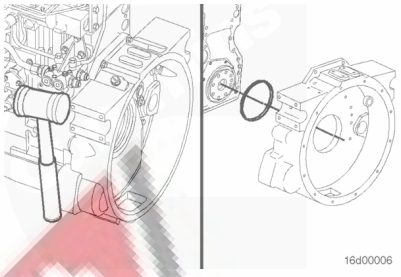
While supporting the flywheel housing, remove the mounting capscrews.



Note : When removing the flywheel housing, note the location of any locating dowel rings.

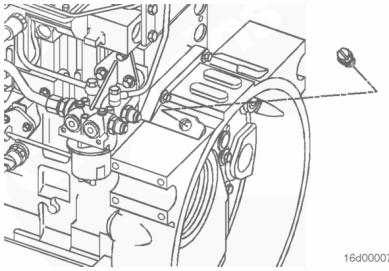
While supporting the flywheel housing, use a rubber hammer to loosen the flywheel housing.

Remove the flywheel housing.

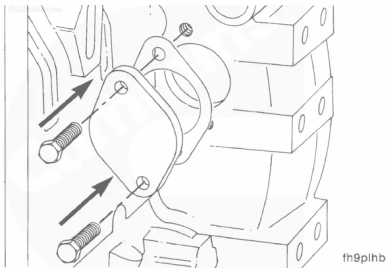


Disassemble

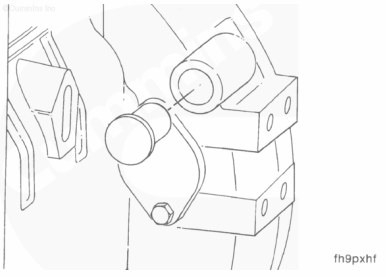
Remove and note the location of any threaded plugs in the flywheel housing.



Remove the access plate and, if equipped, the gasket.



Remove the plug from the barring gear hole.

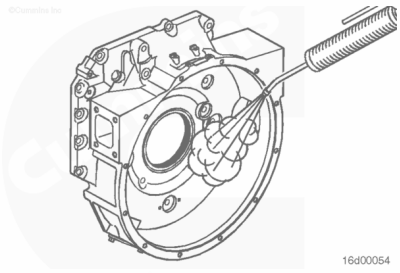


ANADOLU ISUZU AFTER SALES

Clean and Inspect for Reuse

⚠ WARNING ⚠

When using a steam cleaner, wear safety glasses or a face shield, as well as protective clothing. Hot steam can cause serious personal injury.



⚠ WARNING ⚠

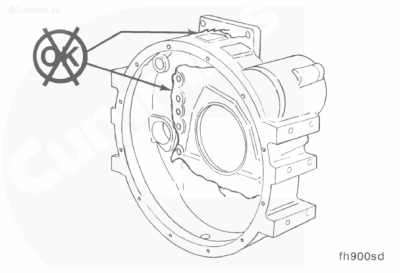
When using solvents, acids, or alkaline materials for cleaning, follow the manufacturer's recommendations for use. Wear goggles and protective clothing to reduce the possibility of personal injury.

⚠ WARNING ⚠

Wear appropriate eye and face protection when using compressed air. Flying debris and dirt can cause personal injury.

Clean the flywheel housing. Use steam or solvent. Dry with compressed air.

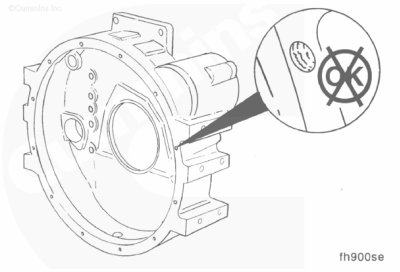
Inspect the flywheel housing for cracks, especially in the area of the flywheel housing that mounts to the cylinder block or rear gear housing.



Note : Helicoils are available to repair damaged threads.

Inspect the flywheel housing transmission/drive unit mounting surface for cracks.

Also inspect for damaged threads commonly caused by cross-threaded capscrews or installing an incorrect capscrew.

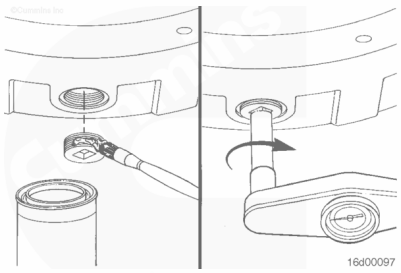


ANADOLU ISUZU AFTER SALES

Assemble

For wet flywheel housings, apply pipe sealant, Part Number 3375066, or equivalent, to any threaded plugs previously removed.

Install and tighten the plugs. Refer to Procedure 017-007 in Section 17. (/qs3/pubsys2/xml/en/procedures/99/99-017-007.html)

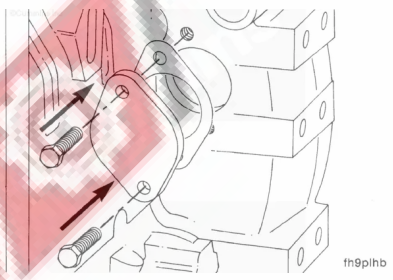


Install the access plate and new gasket.

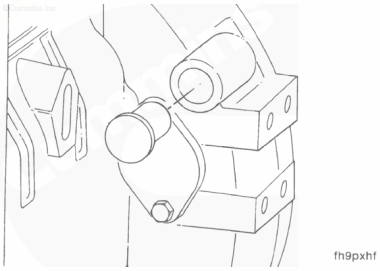
Install the capscrews. Tighten.

Torque Value: 24 n•m [212 in-lb]

Note : If a gasket was **not** previously installed, apply sealant, Part Number 3164067, to the perimeter of the access plate.



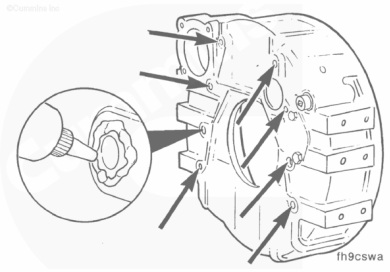
Install a new o-ring. Install the barring gear hole plug.



Install

Wet Flywheel Applications

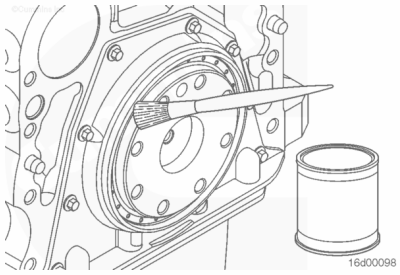
Apply a continuous bead of Three-Bond™, or equivalent, around all capscrew holes on the mounting surface of the flywheel housing.



Note : Before installing the flywheel housing, make sure any locating dowel rings are in the same position as when the flywheel housing was removed.

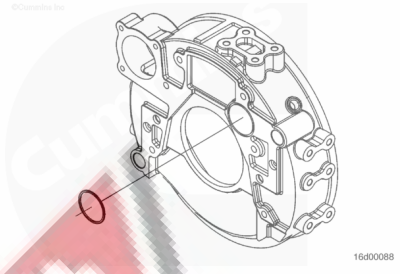
ANADOLU ISUZU AFTER SALES

Install a new rectangular seal on the rear seal carrier. Apply assembly lubricant, Part Number 3163087.



If previously equipped, install a new rectangular seal for the camshaft journal bore to the back side of the flywheel housing.

Apply a small amount of sealant, Part Number 3164067, to hold the seal in place until the flywheel housing is installed.

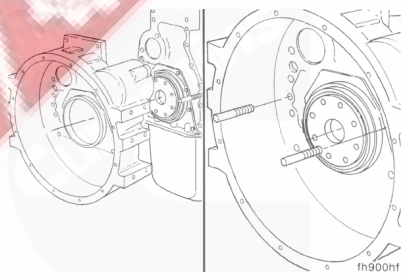


Inspect the rear face of the cylinder block and flywheel housing mounting surface for cleanliness and raised nicks or burrs.

Install two guide pins, Part Number 3163934.

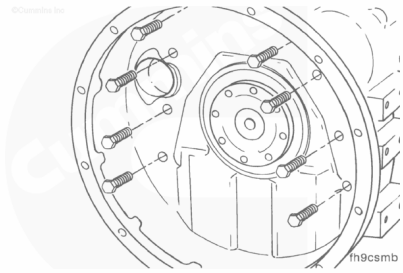
Install the flywheel housing over the guide pins, making sure the flywheel housing is located on the dowel rings.

Note : Make sure the sealing ring is **not** damaged during installation.



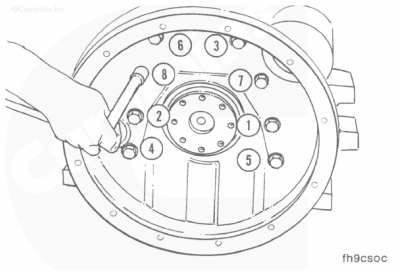
Remove the guide pins.

Install the mounting capscrews.



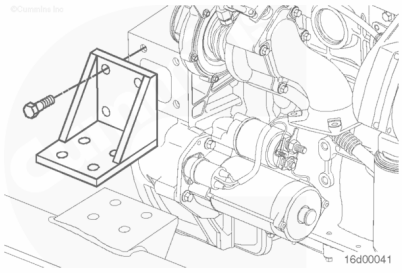
Tighten the flywheel housing capscrews in the sequence shown.

Torque Value: 77 n•m [57 ft-lb]

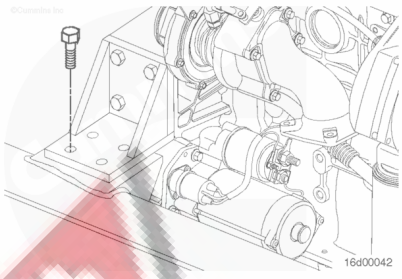


ANADOLU ISUZU AFTER SALES

Install the rear engine support bracket and mounting capscrews. Refer to Procedure 016-003 in Section 16. (/qs3/pubsys2/xml/en/procedures/425/425-016-003.html)



Note : Make sure to install any shims or spacers in the same location as removed.



Lower the rear of the engine.

Install the rear engine mount fasteners.

Tighten to the OEM specification.

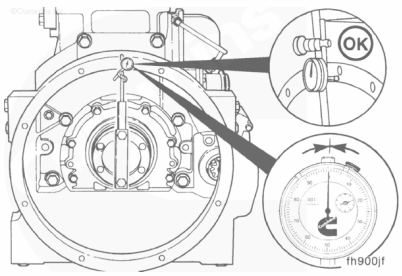
Remove the lifting fixture or hoist from the rear of the engine.

Measure

Face Alignment

⚠ CAUTION ⚠

The dial indicator tip must not enter the capscrew holes, or the gauge will be damaged.



Face alignment is determined by calculating the total indicator reading (TIR).

Attach dial indicator gauge, Part Number 3376050, to the crankshaft. Use mounting tool, Part Number ST 1325, to attach the dial indicator to the crankshaft as illustrated.

Note : The dial indicator can be mounted by any method that holds the extension bar of the indicator rigid, so it does **not** sag. If the bar sags or the indicator slips, the readings obtained will **not** be accurate.

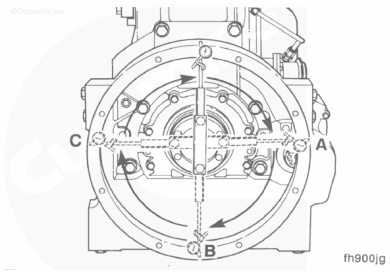
Position the indicator at the 12 o'clock position, and zero the gauge.

Note : The crankshaft **must** be pushed toward the front of the engine to remove the crankshaft end clearance each time a position is measured.

Use barring tool, Part Number 5299073, to slowly rotate the crankshaft.

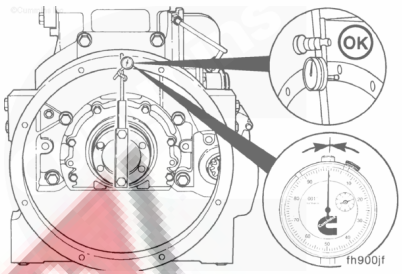
Record the readings at the 3 o'clock (A), 6 o'clock (B) , and 9 o'clock positions (C).

The values for A, B, and C could be positive or negative.



Continue to rotate the crankshaft until the indicator is at the 12 o'clock position.

Check the indicator to make sure the needle points to zero. If it does **not**, the readings will be incorrect and the procedure will have to be redone.



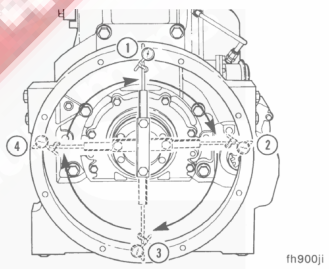
Determine the TIR.

TIR is determined by calculating the difference between the highest and lowest measurement from the four locations measured.

As the example below illustrates, the TIR would be:

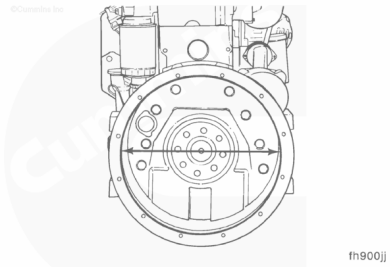
+ 0.08 mm - (-0.05 mm) = 0.13 mm

[+.003 in - (-0.002 in) = 0.005 in]



Example:		
12 o'clock	0.00 mm	[0.000 in]
3 o'clock	+0.08 mm	[+0.003 in]
6 o'clock	- 0.05 mm	[- 0.002 in]
9 o'clock	+0.08 mm	[+0.003 in]
Equals TIR	0.13 mm	[0.005 in]

The maximum allowable TIR is determined by the diameter of the housing bore. If out of specifications, replace the housing.



Flywheel Housing Bore and Face Runout				
SAE	**Bore Diameter**	**Total Indicator Reading Maximum**		
Number	**mm**	**in**	**mm**	**in**
00	784.15 to 784.65	30.990 to 31.010	0.25	0.01

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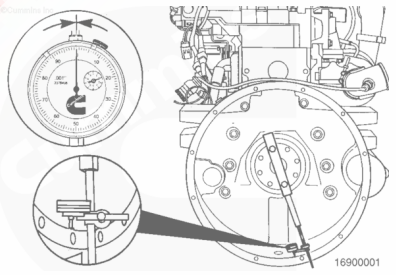
Flywheel Housing Bore and Face Runout				
SAE	Bore Diameter	Total Indicator Reading Maximum		
Number	mm	in	mm	in
0	657.45 to 647.95	25.490 to 25.510	0.28	0.011
1/2	584.00 to 584.40	22.992 to 23.008	0.30	0.012
1	510.98 to 511.38	20.117 to 20.133	0.36	0.014
2	447.55 to 447.81	17.620 to 17.630	0.41	0.016
3	409.45 to 409.71	16.120 to 16.130	0.48	0.019

Bore Alignment

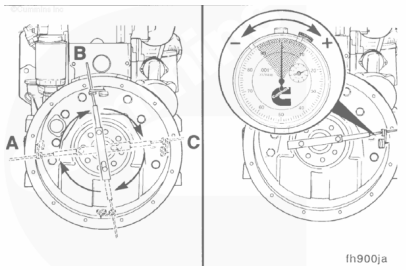
Attach dial indicator gauge, Part Number 3376050, to the crankshaft. Use mounting tool, Part Number ST 1325, to attach the dial indicator to the crankshaft as illustrated.



Note : The dial indicator can be mounted by any method that holds the extension bar of the indicator rigid, so it does **not** sag. If the bar sags or the indicator slips, the readings obtained will **not** be accurate.

Position the indicator in the 6 o'clock position. Zero the gauge.

Slowly rotate the crankshaft. Record the readings obtained at the 9 o'clock, 12 o'clock, and 3 o'clock positions as A, B, and C in the concentricity work sheet.

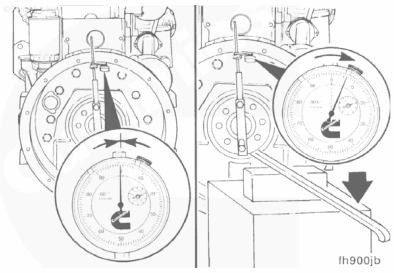


Recheck zero at the 6 o'clock position. If it does **not**, the readings will be incorrect and the procedure will have to be redone.

The values for A, B, and C could be positive or negative. See the accompanying figure to determine the correct sign when recording these values.

⚠ CAUTION ⚠

Do not force the crankshaft beyond the point where the bearing clearance has been removed. Do not pry against the flywheel housing. These actions could cause false bearing clearance readings and result in engine damage.



Rotate the crankshaft until the dial indicator is at the 12 o'clock position. Zero the gauge.

Use a pry bar to raise the rear of the crankshaft to its upper limit. Record the value as D on the concentricity work sheet. This is the vertical bearing clearance adjustment, which will **always** be positive.

Create a concentricity work sheet as illustrated to determine the values for the “total vertical” and “total horizontal” values.

Concentricity Worksheet

9 o'clock 3 o'clock	a = 0.004 c = -0.002
Total Horizontal	a – c = .006
12 o'clock Bearing Clearance	b = .003 d = .002
Total Vertical	b + d = .005

oi900vf

Note : The values listed in the concentricity work sheet illustrated are for example only and are listed in inches. The actual numbers measured can differ.

Input the values recorded for A, B, C and D into the concentricity work sheet.

The total horizontal is the 9 o'clock reading, A, minus the 3 o'clock reading, C.

The total vertical is the 12 o'clock reading, B, plus the bearing clearance, D.

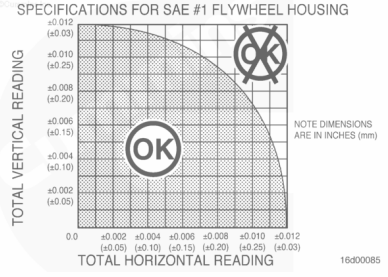
Example:

- 6 o'clock = reference = 0.
- 9 o'clock = (a) = 0.004.
- 12 o'clock = (b) = 0.003.
- 3 o'clock = (c) = (-0.002).

Using the work sheet and numbers from the example, the total horizontal value equals 0.006 and the total vertical value equals 0.005.

Note : Use the corresponding chart for the Society of Automotive Engineers (SAE) 1, 2, or 3 flywheel housings being measured.

Use the illustration to mark the total horizontal value on the horizontal side of the chart and the total vertical on the vertical side of the chart.



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Use a straightedge to find the intersection point of the total horizontal and total vertical values. The intersection point **must** fall within the shaded area for the flywheel housing concentricity to be within specification.

Use the total horizontal and total vertical values from the previous example to the intersection point falls within the shaded area. Therefore, the flywheel housing concentricity is within specification.

Note : Make sure to use the correct TIR specifications for the flywheel housing being measured when comparing measurements.

Chart for an SAE 2 flywheel housing.

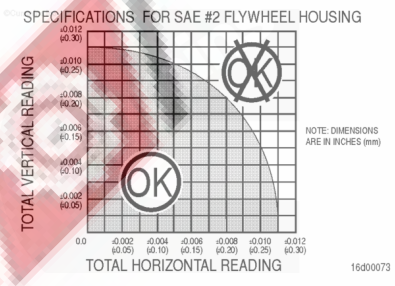
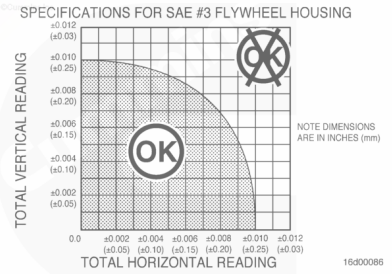


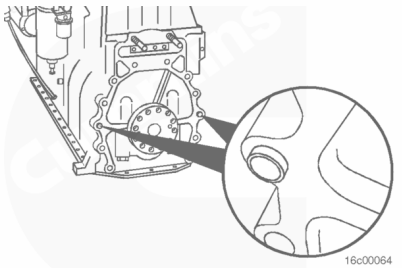
Chart for an SAE 3 flywheel housing.



If the bore alignment is out of specification:

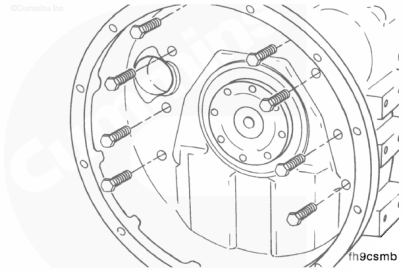
The ring dowels **must** be removed and the flywheel housing repositioned.

Use dowel pin extractor, Part Number 3163720, to remove the dowel pins from the block.



Note : The ring dowels are **not** required to maintain concentricity of the housing; the clamping force of the capscrews holds the housing in place.

After the ring dowels are discarded, install the flywheel housing on the engine following the Install Step of this procedure, but do **not** torque the capscrews. Tighten the capscrews enough to hold the flywheel housing in place, but loose enough to allow small movement when struck lightly with a rubber mallet.



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Recheck the bore alignment. When bore alignment is within specification, tighten the capscrews to the specified torque value outlined in the Install Step of this procedure.

Finishing Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

- Install the flexplate, if required. Refer to Procedure 016-004 in Section 16. (/qs3/pubsys2/xml/en/procedures/425/425-016-004.html)
- Install the flywheel, if required. Refer to Procedure 016-005 in Section 16. (/qs3/pubsys2/xml/en/procedures/425/425-016-005.html)
- Install the starting motor. Refer to Procedure 013-020 in Section 13. (/qs3/pubsys2/xml/en/procedures/425/425-013-020-tr.html)
- Install the clutch, transmission, and all related components, if equipped. See equipment manufacturer service information.
- Install the transmission and related components, if equipped. See equipment manufacturer service information.
- If equipped with a wet flywheel housing, fill the flywheel housing with oil. See equipment manufacturer service information.
- If previously removed, attach any OEM components (mufflers, shift mechanisms, air filters, etc.) to the flywheel housing. See equipment manufacturer service information.
- Connect the batteries. See equipment manufacturer service information.
- Operate the engine. Check for leaks or vibration.

ANADOLU ISUZU DIESEL

Select Service Tools

Recommended Cummins® Service Tools

- Cranksahft locator stud, Part Number 3822784, or equivalent - Quantity 2
- Idler shaft puller, Part Number 3823709
- Guide pin, Part Number 3376638 - Quantity 2
- Offset wrench, Part Number 3823892
- Gear locking tool, Part Number 3823891
- Assembly lubricant, Part Number 3163087, or equivalent
- Driver, Part Number 3823893
- Driver, Part Number 3893893
- Pipe sealant, Part Number 3375066, or equivalent
- RTV sealant, Part Number 3164067, or equivalent
- Cup plug sealant, Part Number 3375068, or equivalent
- Driver, Part Number 3823710

Additional Service Items

- Drift
- Rawhide hammer
- Dent puller
- Long mandrel

ANADOLU ISUZU AFTER SALES

Exploded View

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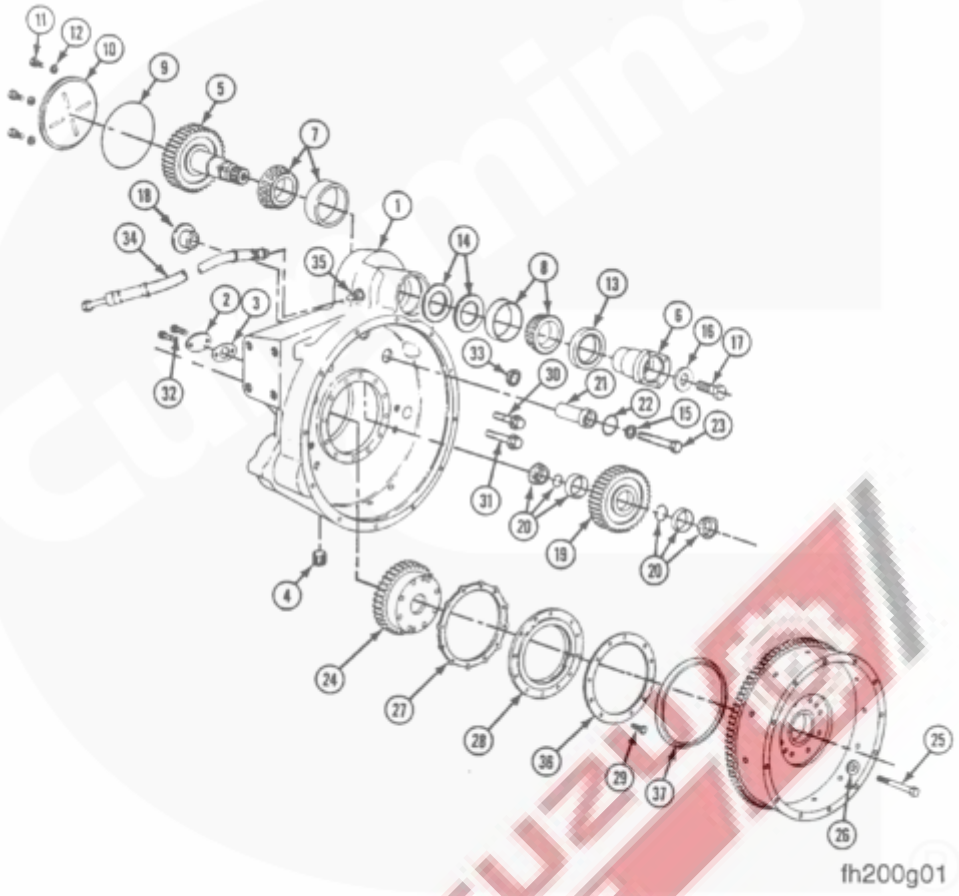


Rear Engine Power Takeoff

1. Housing, flywheel - 1
2. Cover, access hole - 1
3. Gasket, cover plate - 1
4. Plug, threaded drain - 1
5. Shaft, accessory drive output - 1
6. Flange, power takeoff - 1
7. Bearing, roller (large) - 1
8. Bearing, roller (medium) - 1
9. Seal, rectangular ring (tetra) - 1
10. Plate, cover (ribbed) - 1
11. Capscrew - 4
12. Washer, plain - 4
13. Seal, oil (output shaft) - 1
14. Shims (see next page)
15. Washer, plain - 1
16. Washer, plain power takeoff (PTO) flange) - 1
17. Screw, hexagon head cap - 1
18. Retainer, shaft - 1
19. Gear, idler - 1
20. Assembly, bearing and race - 2
21. Shaft, idler - 1

22. Seal, o-ring - 2
23. Screw, hexagon head cap - 1
24. Gear, crankshaft - 1
25. Screw, hexagon head cap - 8
26. Washer, plain - 8
27. Gasket, carrier - 1
28. Kit, seal - 1
29. Screw, captive washer cap - 12
30. Screw, hexagon head cap - 5
31. Screw, hexagon head cap - 7
32. Screw, hexagon head cap - 2
33. Plug, expansion - 1
34. Hose, flexible oil supply - 1
35. Connection, mate oil supply - 1
36. Ring, clamping - 1
37. Seal, dust - 1.

Note : There are seven shims available. A given rear engine power takeoff (REPTO) can have any combination of these shims.

Reference Number	Description	mm	in
14	Shim	0.127	0.005
14	Shim	0.254	0.010
14	Shim	0.381	0.015
14	Shim	0.051	0.002
14	Shim	0.076	0.003
14	Shim	0.508	0.020
14	Shim	1.016	0.040

Preparatory Steps

⚠ WARNING ⚠

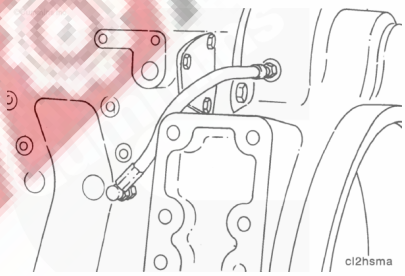
Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

- Disconnect the batteries. See equipment manufacturer service information.
- Remove the transmission, clutch, and all related components, if equipped. See equipment manufacturer service information.

- Remove the flexplate, if installed. Refer to Procedure 016-004 in Section 16. (/qs3/pubsys2/xml/en/procedures/425/425-016-004.html)
- Remove the flywheel, if installed. Refer to Procedure 016-005 in Section 16. (/qs3/pubsys2/xml/en/procedures/425/425-016-005.html)
- Adequately support the engine to prevent damage.
- Remove the starting motor. Refer to Procedure 013-020 in Section 13. (/qs3/pubsys2/xml/en/procedures/425/425-013-020-tr.html)
- Remove both rear engine mounts. Refer to Procedure 016-003 in Section 16. (/qs3/pubsys2/xml/en/procedures/425/425-016-003.html)

Remove

Remove the REPTO oil supply line.



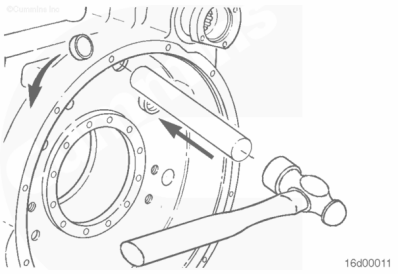
Remove the oil seal capscrews, oil seal, and gasket.

GRAPHIC NOT FOUND

To gain access to the housing capscrews, use a drift to drive the cup plugs straight through into the housing.

Retrieve the plugs from inside the housing.

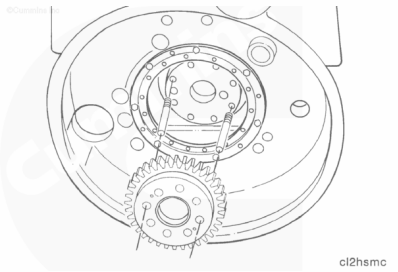
Do **not** attempt to back the plugs out or rotate the plugs out of the housing. The cup plug bore will be damaged and oil leakage will occur.



Install two crankshaft locator studs, Part Number 3822784, or equivalent, into the crankshaft flywheel mounting flange, 180 degrees apart.

Thread two 100 mm [3.94 in] or longer M10 x 1.5 capscrews into the holes of the gear not used by the flywheel. Use these capscrews to evenly press the gear off the crankshaft.

Remove the crankshaft drive gear.

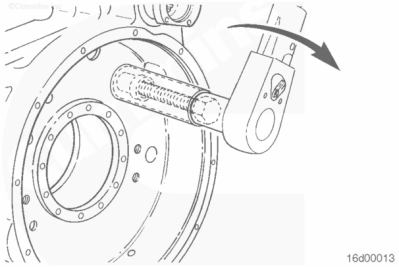


⚠ CAUTION ⚠

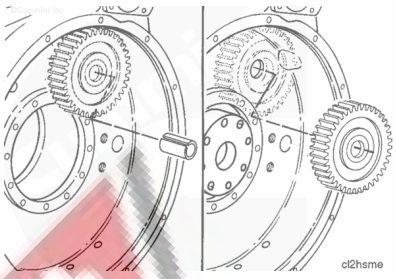
ANADOLU ISUZU PARTS

The idler gear will fall when the shaft is removed.

Use idler shaft puller, Part Number 3823709, to remove the idler shaft.

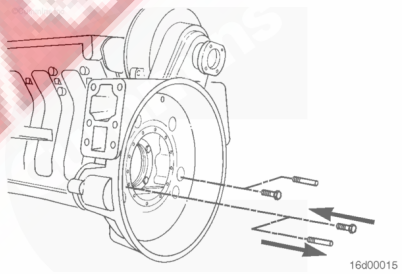


Remove the idler gear to gain access to the rest of the housing capscrews.



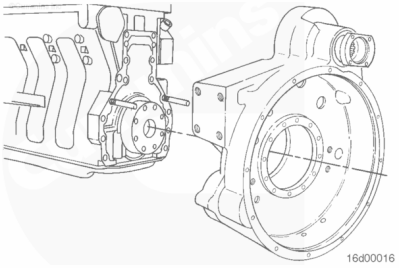
Remove two of the capscrews. Install two guide pins, Part Number 3376638, to support the housing during removal.

Use offset wrench, Part Number 3823892, to remove the capscrews **not** visible.



⚠ WARNING ⚠

This component or assembly weighs greater than 23 kg [50 lb]. To prevent serious personal injury, be sure to have assistance or use appropriate lifting equipment to lift this component or assembly.



Remove the remaining capscrews. Use a rubber hammer to loosen the housing.

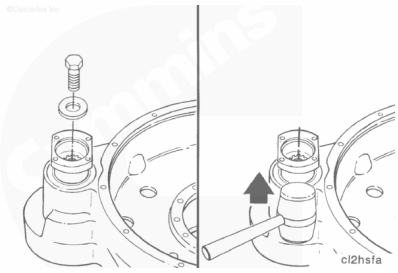
Remove the housing.

Disassemble

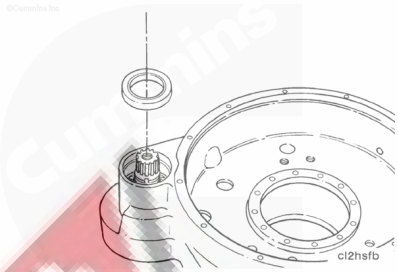
Use gear locking tool, Part Number 3823891, to prevent the output shaft from turning when removing the retainer capscrew.

Remove the capscrew and washer that secures the output flange to the output shaft.

Use a rawhide hammer to remove the output flange and flat washer from the output shaft.



Use a dent puller to remove the seal. Do **not** damage the surface of the housing or seal bore.

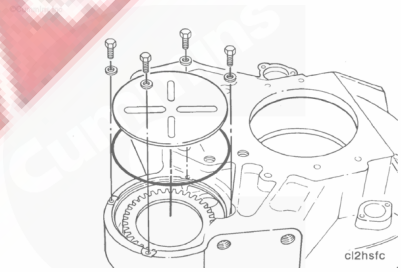


When the housing is turned over, the bearing will fall out. Do **not** allow the bearing to be damaged.

Turn the housing over so the four cover plate capscrews are accessible. Be careful **not** to damage the output shaft.

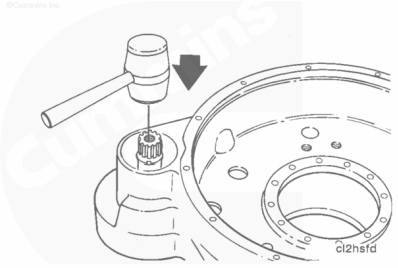
Remove the capscrews and ribbed cover plate from the output gear housing.

Remove and discard the square cut o-ring.

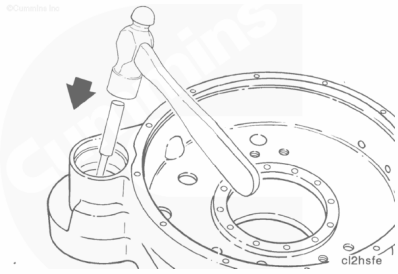


Save the original shims for rebuild purposes. They will be used to set the proper end clearance on the output shaft and bearing assembly.

Turn the housing over. Use a rawhide hammer to hit the end of the output shaft to remove the output shaft sub-assembly from the REPTO housing.



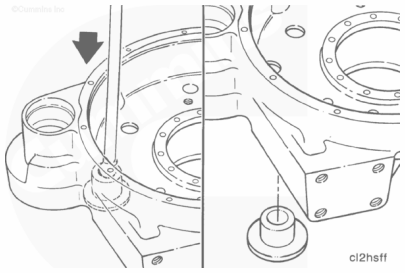
With the housing positioned so the cylinder block mating surface is down, use a hammer and brass punch to drive the bearing outer races out of the output shaft housing bore.



Support the housing in a press with the cylinder block mating surface down.

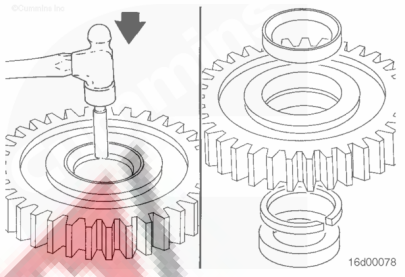
With a long mandrel, press out the idler shaft bushing.

Remove and discard the o-ring.



Use a hammer and brass drift to remove the two bearing outer races from the bore of the idler gear. Discard the outer races.

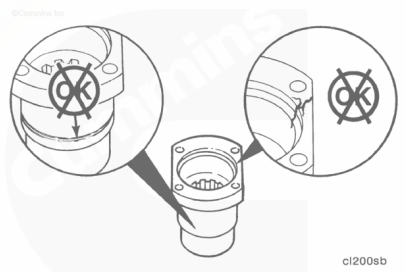
Remove the large spacer ring from the center groove of the gear. Discard the spacer ring.



Clean and Inspect for Reuse

⚠ WARNING ⚠

When using a steam cleaner, wear safety glasses or a face shield, as well as protective clothing. Hot steam can cause serious personal injury.



Clean all areas of the idler gear. Use a steam cleaner.

Inspect the output shaft and bearings for wear.

Inspect the output gear for damage.

Inspect the output flange for damage or wear grooves from the oil seal.

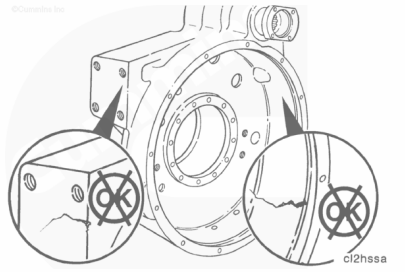
Replace if necessary.

Inspect the REPTO housing for cracks at the rear engine mounting surfaces and flywheel bore.

Replace the housing if cracked.

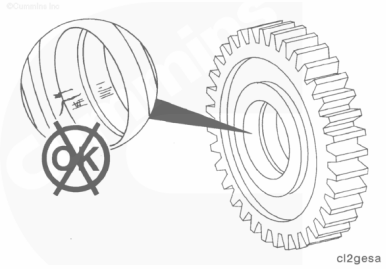
Inspect the idler shaft bushing for wear.

Replace the bushing if worn.



Inspect the bore, side faces, and teeth of the idler gear.

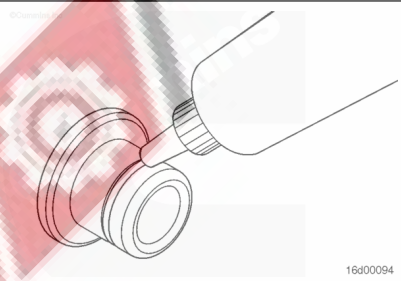
Replace the gear if there are cracks or discoloration from heat damage, or any other damage.



Assemble

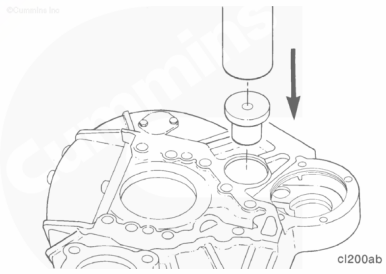
Install a new o-ring on the idler shaft bushing.

Use assembly lubricant, Part Number 3163087, or equivalent, to lubricate the o-ring.



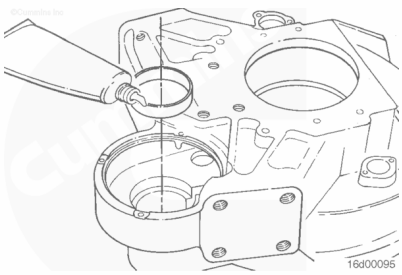
Support the housing evenly with the engine mating surface up.

Press the new bushing into the housing until it is below the surface of the cylinder block mating surface.



Use assembly lubricant, Part Number 3163087, or equivalent, to lubricate the larger bearing race.

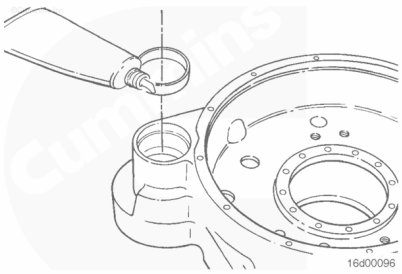
Use the larger end of driver, Part Number 3823893, to press the bearing race to the shoulder in the housing.



Turn the housing over. Support it evenly in the press.

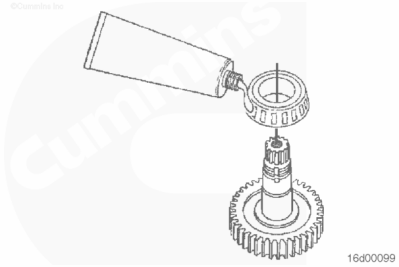
Use assembly lubricant, Part Number 3163087, or equivalent, to lubricate the smaller bearing race.

Use the smaller end of driver, Part Number 3893893, to press the bearing race to the shoulder in the housing.



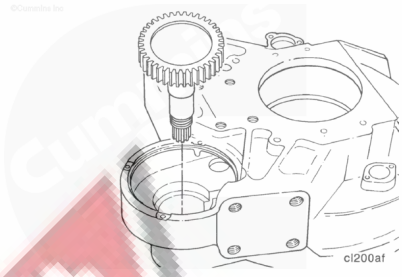
Use assembly lubricant, Part Number 3163087, or equivalent, to lubricate the output shaft and larger bearing.

Install the larger bearing onto the output shaft.



Position the housing on the table so the cylinder block mating surface is up.

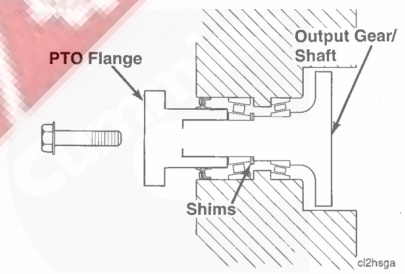
Install the output shaft assembly into the housing.



The correct end clearance (rolling resistance) is determined by the number and thickness of shims used between the two bearings.

When the shim thickness is increased, there is more shaft end clearance and less rolling resistance.

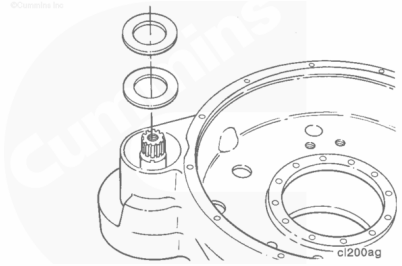
When the shim thickness is decreased, there is less shaft end clearance and more rolling resistance.



Turn the housing over with the engine mating surface down, while holding the output shaft and gear in place.

If the original thickness of shims is **not** available for reuse, a beginning thickness of 1.47 mm [0.058 in] can be used as a starting point.

Install the original thickness of shims.



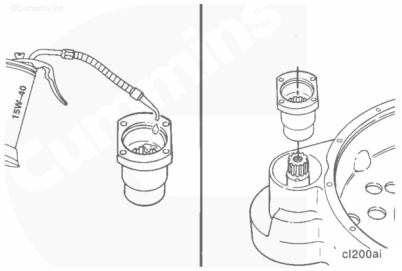
Use assembly lubricant, Part Number 3163087, or equivalent, to lubricate the smaller bearing.

Install the smaller bearing onto the shaft.

GRAPHIC NOT FOUND

Temporarily install the output flange before installing the oil seal.

Use clean 15W-40 engine oil to lubricate the splines.



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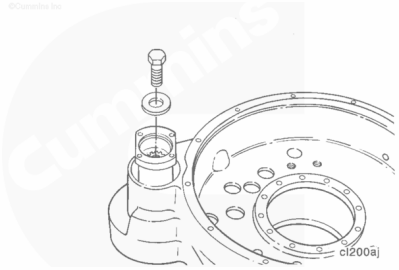
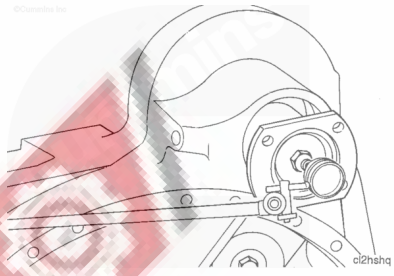
Install the flat washer and capscrew. Use gear locking tool, Part Number 3823891, to hold the output shaft while tightening the capscrew.

Torque Value: 205 n•m [151 ft-lb]



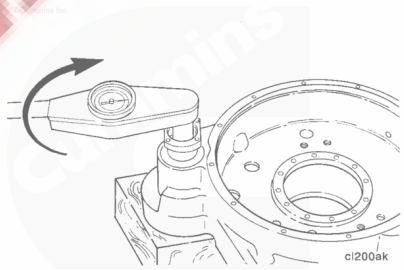
Measure the shaft end clearance.

Shaft End Clearance		
mm		in
0.0	MIN	0.0
0.03	MAX	0.001



Check the output shaft rolling resistance with a torque wrench.

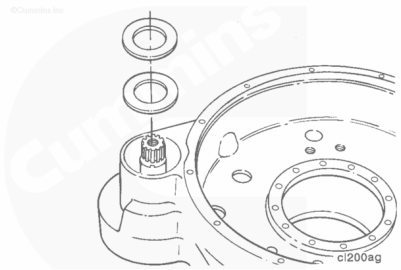
Measurements		
	n.m	in-lb
Rolling Resistance	0.6 to 1.1	5 to 10



If the rolling resistance is **not** within specification, remove the output flange and smaller bearing.

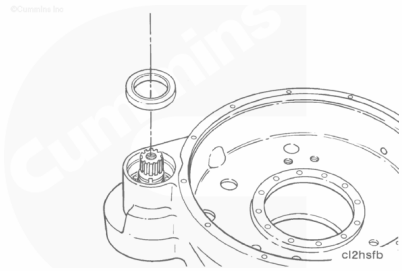
Add or subtract shims to obtain the correct rolling resistance.

Adding more shims will decrease the resistance and removing shims will increase resistance. Any combination of shims can be used.



Once the correct rolling resistance is obtained, remove the output flange and install a new oil seal.

Press the oil seal flush with the housing surface.



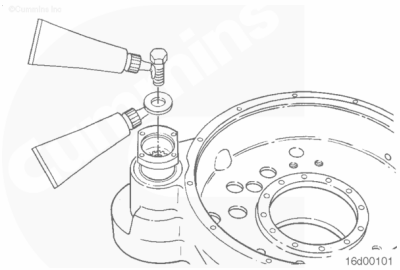
ANADOLU ISUZU PARTS SALES

Apply pipe sealant, Part Number 3375066, or equivalent, to the output flange capscrew and under the washer.

Install the output flange flat washer and capscrew.

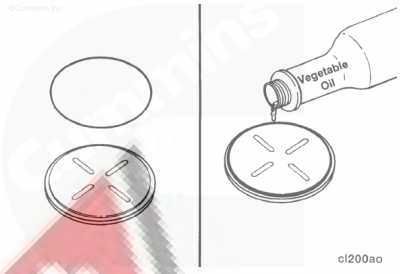
Tighten the capscrew.

Torque Value: 205 n•m [151 ft-lb]



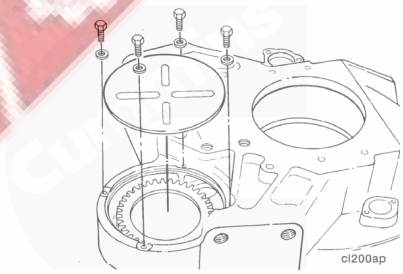
Install a new o-ring on the bearing housing cover.

Use clean vegetable oil to lubricate the o-ring.



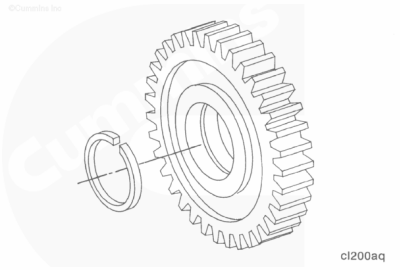
Install and tighten the cover and four capscrews.

Torque Value: 18 n•m [159 in-lb]



Insert a new spacer ring into the bore of the idler gear.

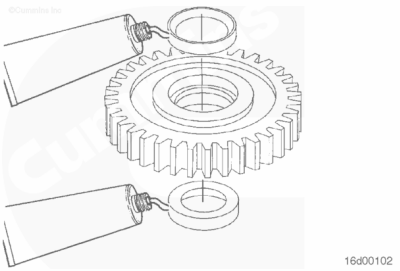
Push until it snaps into place in the center groove.



Use assembly lubricant, Part Number 3163087, or equivalent, to lubricate the bearing outer races.

Press the two new bearing outer races into the bore of the idler gear.

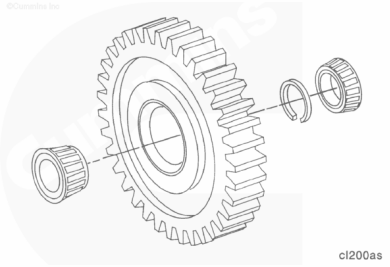
The larger side of the taper **must** face toward the outside of the gear.



Do **not** interchange individual parts that make up the idler gear bearing assembly. Rebuild the idler gear with bearings that are packaged together.

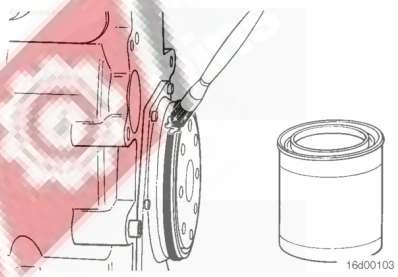
ANADOLU ISUZU AFTER SALES

Keep the two roller bearing assemblies and spacer ring with the idler gear.

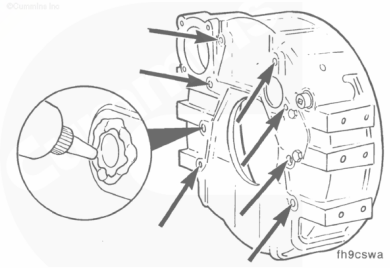


Install

Install the rectangular seal on the rear seal carrier. Lubricate with assembly lubricant, Part Number 3163087, or equivalent.

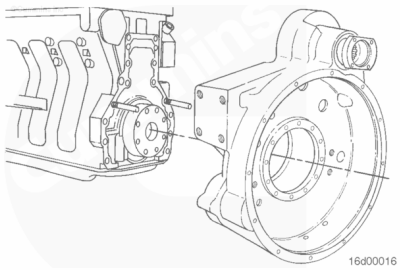


Apply a continuous bead of RTV sealant, Part Number 3164067, or equivalent, around all capscrew holes on the mounting surface of the flywheel housing.



⚠ WARNING ⚠

This component or assembly weighs greater than 23 kg {50 lb]. To prevent serious personal injury, be sure to have assistance or use appropriate lifting equipment to lift this component or assembly.



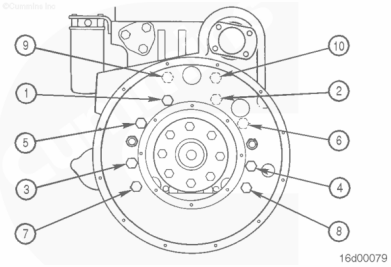
Inspect the rear face of the cylinder block and flywheel housing mounting surface for cleanliness and nicks or burrs.

Install the flywheel housing over the two ring dowels.

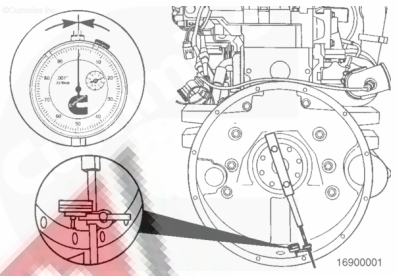
Make sure the sealing ring is **not** damaged during installation.

Install the capscrews. Tighten in the sequence shown. Use offset wrench, Part Number 3823892, for capscrews hidden from view.

Torque Value: 77 n•m [57 ft-lb]



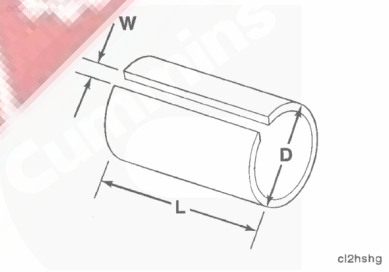
Before installing the idler gear, measure the flywheel housing bore and face alignment. Refer to Procedure 016-006 in Section 16. (/qs3/pubsys2/xml/en/procedures/425/425-016-006.html)



Fabricate a sleeve from 38.10 mm [1.50 in] PVC, or equivalent, to the following dimensions:

Length: 25.4 mm [1.0 in]

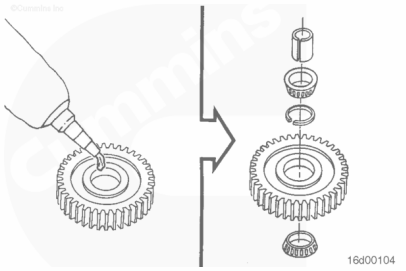
Slot: 12.70 mm [0.50 in]



The outer bearing races of new replacement gears are already pressed into the gear.

Apply a thin film of assembly lubricant, Part Number 3163087, or equivalent, on the outer races and bearings.

Install the bearing and spacer into the idler gear. Use the fabricated PVC, or equivalent, sleeve to hold the bearing assembly together when installing the idler gear assembly.

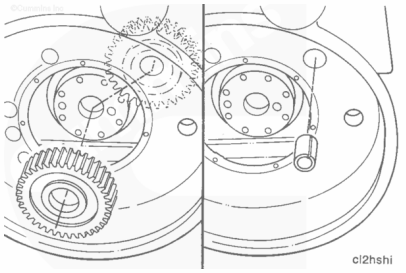


Apply a thin film of assembly lubricant, Part Number 3163087, or equivalent, into the idler shaft bore of the housing and on the idler shaft.

Note : For idler scissor gears, loosen the screws in the scissor gear by turning **counterclockwise** until they will no longer turn. The screws will **not** come out of the gear

Install the idler gear assembly with snap ring facing out into the flywheel housing.

Hold the idler gear and bearing in place. Remove the plastic sleeve.

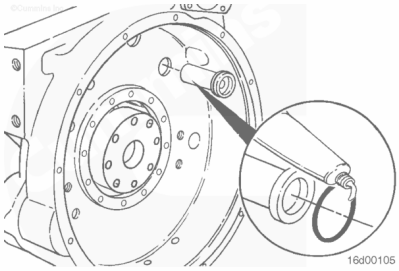


ARABOLU ISUZU DIESEL SALES

Use clean assembly lubricant, Part Number 3163087, or equivalent, to lubricate the idle shaft o-ring and install the o-ring into the shaft.

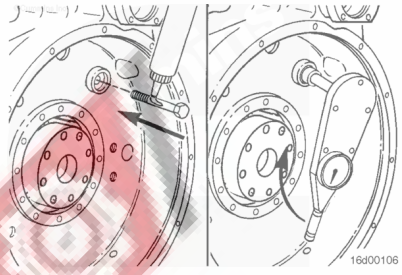
Hold the gear assembly in place. Insert the idler shaft through the housing and idler gear bearings.

Do **not** use a hammer when installing the idler shaft and capscrew or the part can be damaged.



Apply assembly lubricant, Part Number 3163087, or equivalent, under the head of the idler shaft capscrew. Insert the capscrew through the idler shaft. Tighten the installation capscrew with a torque wrench.

The torque needed to draw the idler shaft in place **must not** exceed 88 N•m [65 ft-lb]. If installation torque exceeds this amount, it is an indication of misalignment between the bore and shaft. Remove the idler shaft and install it again.



When the idler shaft has been seated, remove the capscrew.

GRAPHIC NOT FOUND

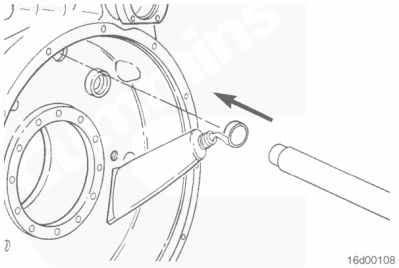
Apply pipe sealant, Part Number 3375066, to the threads of the idler shaft capscrew. Apply assembly lubricant, Part Number 3163087, or equivalent, under the head of the capscrew. Tighten to the final torque value.

Torque Value: 105 n•m [77 ft-lb]

Apply a film of cup plug sealant, Part Number 3375068, or equivalent, to the outside diameter of the cup plugs.

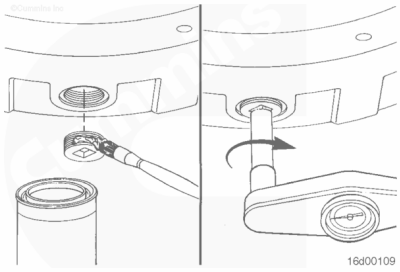
Use driver, Part Number 3823710, to install the cup plugs into the housing, as illustrated.

When installing cup plugs, make sure they are flush with the spot face on the flywheel housing and are **not** cocked.

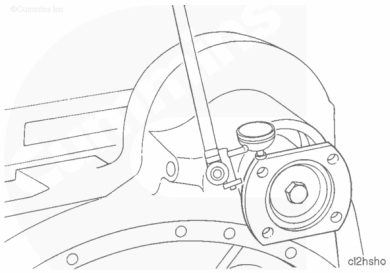


Coat the flywheel housing drain plug with pipe sealant. Install it in the hole in the bottom of the flywheel housing.

Tighten the plug. Refer to Procedure 017-007 in Section 17. (/qs3/pubsys2/xml/en/procedures/99/99-017-007.html)



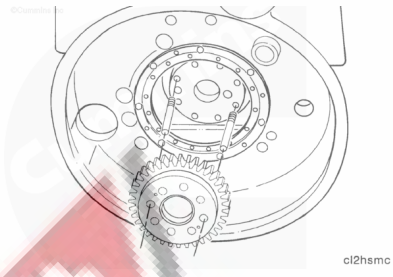
Turn the output flange so the flat sides are on the top and bottom. This prevents any interference when the transmission is installed onto the housing.



Install two crankshaft locator studs, Part Number 3822784, or equivalent, into the crankshaft flywheel mounting flange 180 degrees apart.

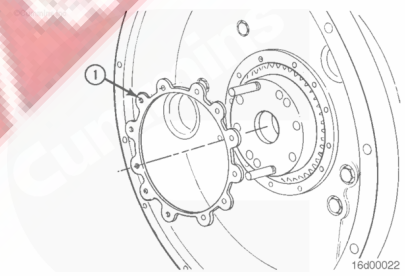
Make sure the crankshaft and crankshaft gear are clean.

Install the crankshaft gear in the locator studs.



Do **not** use any lubricant to install the seal. The oil seal **must** be installed with the crankshaft gear seal contact surface and the lip of the seal clean and dry to provide a proper oil sealing surface.

Install a new gasket (1) in the flywheel housing.



Install a new seal over the crankshaft gear seal contact surface.

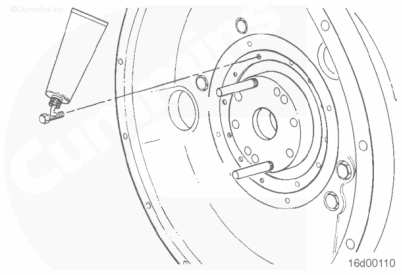
GRAPHIC NOT FOUND

Apply sealant, Part Number 3375066, or equivalent, to seal the retainer capscrews.

Install the capscrews. Tighten in a star pattern.

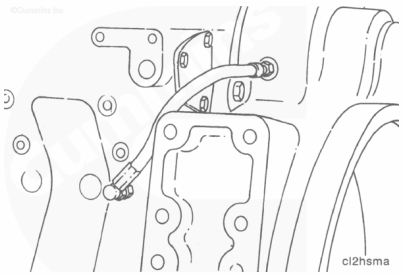
Torque Value:

1. 7 n•m [62 in-lb]
2. 19 n•m [168 in-lb]



Install the REPTO oil supply line.

Torque Value: 12 n•m [106 in-lb]



ANADOLU ISUZU
DIESEL SALES

Finishing Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

- Install the starting motor. Refer to Procedure 013-020 in Section 13. (/qs3/pubsys2/xml/en/procedures/425/425-013-020-tr.html)
- Install the rear engine mounts. Refer to Procedure 016-003 in Section 16. (/qs3/pubsys2/xml/en/procedures/425/425-016-003.html)
- Install the flexplate, if requried. Refer to Procedure 016-004 in Section 16. (/qs3/pubsys2/xml/en/procedures/425/425-016-004.html)
- Install the flywheel, if required. Refer to Procedure 016-005 in Section 16. (/qs3/pubsys2/xml/en/procedures/425/425-016-005.html)
- Install the transmission, clutch, and all related components, if equipped. See equipment manufacturer service information.
- Connect the batteries. See equipment manufacturer service information.
- Operate the engine. Check for leaks.

ANADOLU ISUZU AFTER SALES

Last Modified: 05-Aug-2016

Select Service Tools

Recommended Cummins® Service Tools

- No Cummins® service tools required.

Additional Service Items

- No additional service items required.

General Information

Prior to removing the damaged flywheel ring gear, first check if:

1. The ring gear is removable/replaceable.
2. A replacement ring gear is available.

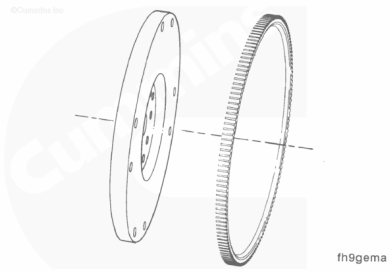
It can be necessary to replace the entire flywheel assembly.

Note : The ring gear on a flexplate is **not** replaceable. If the ring gear is damaged on a flexplate, the flexplate **must** be replaced as an assembly.

Disassemble

⚠ WARNING ⚠

To reduce the possibility of personal injury, wear goggles and protective clothing.



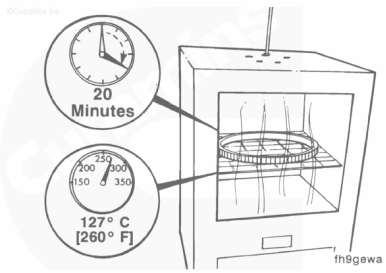
⚠ CAUTION ⚠

Do not use a steel drift pin or damage to the component can occur.

Use the brass drift pin to drive the ring gear from the flywheel.

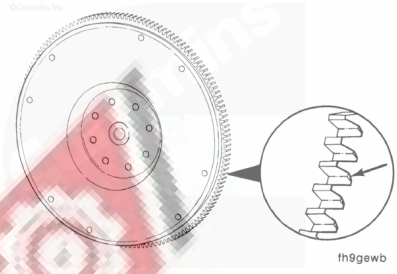
Assemble

Heat the new ring gear for 20 minutes in an oven preheated to 127°C [260°F].



⚠ WARNING ⚠

To reduce the possibility of personal injury, wear protective gloves when handling parts that have been heated.



The ring gear **must** be installed so the bevel on the teeth is toward the crankshaft side of the flywheel.

Install the ring gear.

ANADOLU ISUZU AFTER SALES

Last Modified: 01-Nov-2016

Select Service Tools

Recommended Cummins® Service Tools

- No Cummins® service tools required.

Additional Service Items

- Hoist or lifting fixture

General Information

Some vibration exists in all piston type engines, due to the pulsating power inputs and reciprocating components. Some of these vibrations are internal to the engine and are compensated, or balanced, by opposing forces within the engine structure. These are generally **not** of interest to vibration isolation designs. The vibrations that are offset or balanced internally will cause shaking moments and forces that **must** be reacted to by the engine mounts. If these moments and forces are **not** adequately reduced by the engine mounting and isolation systems, they can cause customer dissatisfaction and/or damage, due to component fatigue.

The effectiveness of an engine mounting system in isolating the vehicle structure from engine vibration depends on the relationship between the frequency of the vibration coming from the engine and the natural frequency of the engine mounting system. The mounting system effectiveness is commonly measured with the term “transmissibility”. Transmissibility is the amount of engine vibration which is transmitted through the mounting system to the vehicle structure.

Transmissibility values greater than one indicate the engine mounting system is actually transmitting more vibration into the vehicle structure than is coming from the engine. This is possible if the natural frequency of the mounting system is close to the frequency of the engine vibration. This can result in the mounting system operating at or near resonance, with a resulting magnification of the input vibration. This is obviously an undesirable situation.

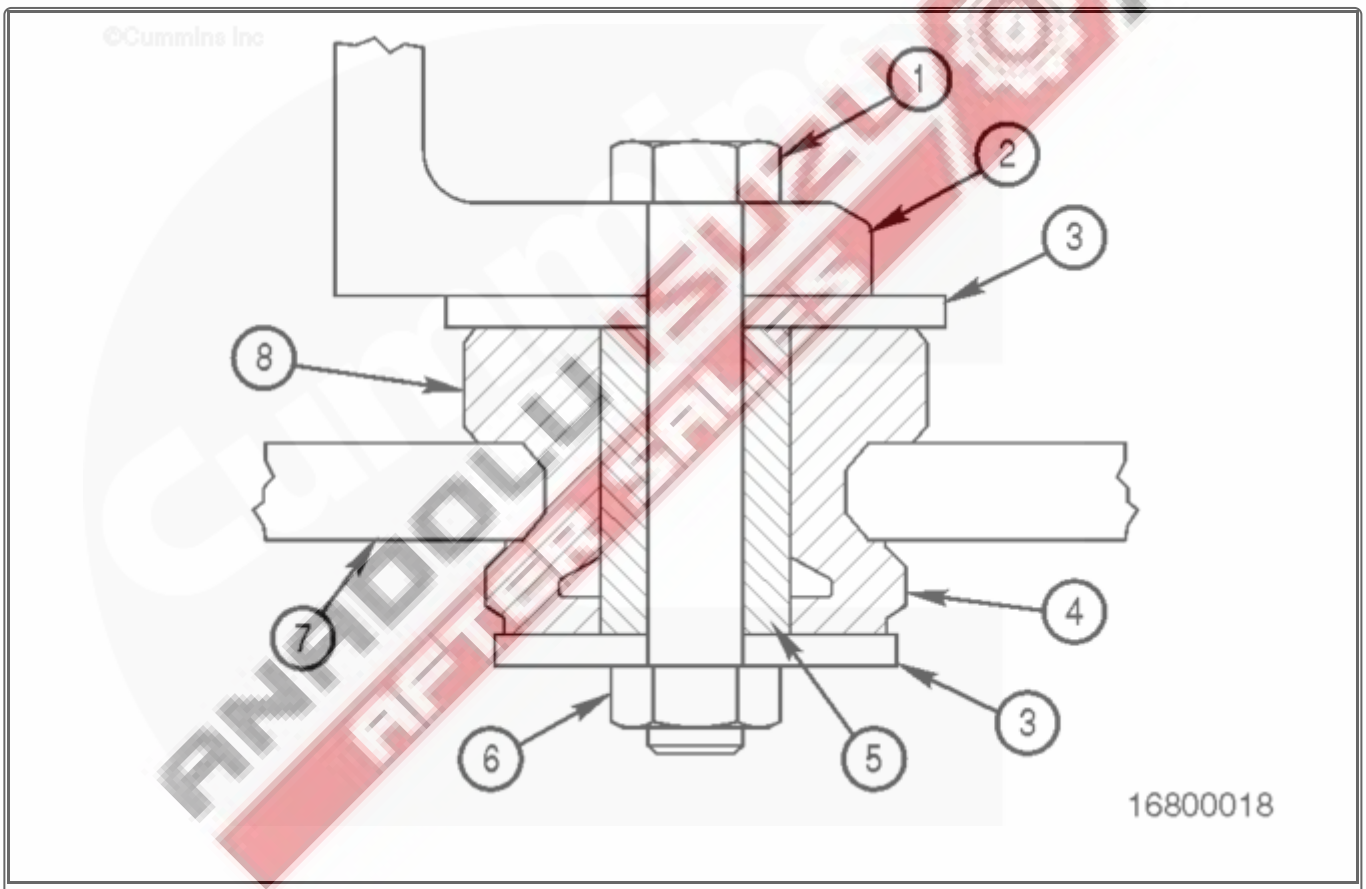
Transmissibility values of less than one indicate the mounting system is transmitting **only** a fraction of the vibration input from the engine, thus isolating the vehicle from engine vibration. Good engine mounts will reduce the amount of engine vibration transmitted to the chassis frame by at least 50 percent at idle.

Stiffness (durometer) and size of the isolator, along with the weight of the engine or component applied, are the determining factors when designing a mounting system. An isolator that is correct for one engine may **not** be right for another. Likewise, because of

weight differential, a particular isolator designed for the rear of an engine probably will **not** be ideal for the front. Hard engine mounts will give little or no isolation, and can actually magnify the vibration transmitted to the chassis.

The following are illustrations of typical FRONT engine mounts.

1. Bolt
2. Supported member
3. Snubbing washer (or flat bracket surface of equal diameter
4. Rebound tail
5. Bonded metal center
6. Locknut
7. Supporting member
8. Rubber mount.



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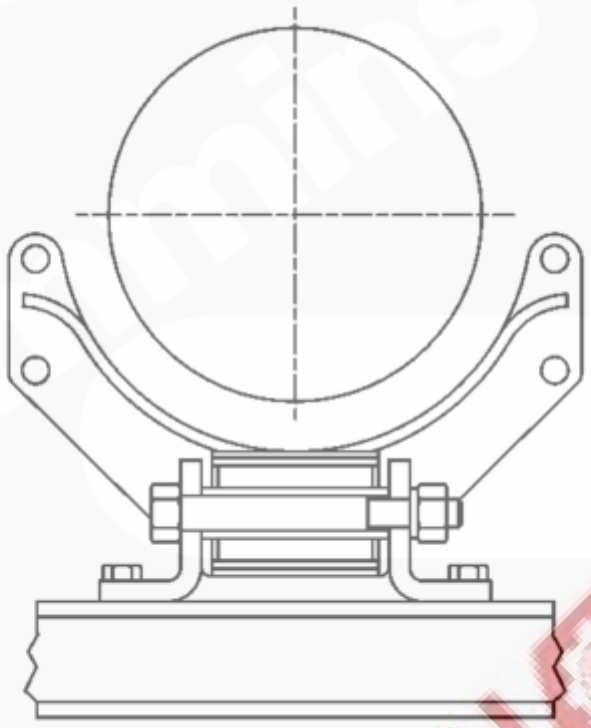

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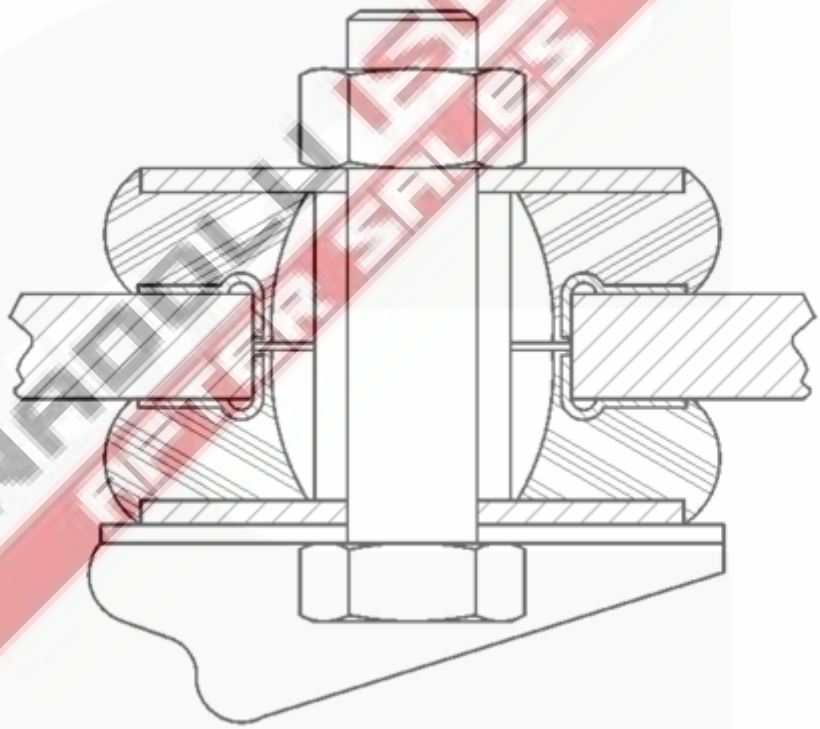

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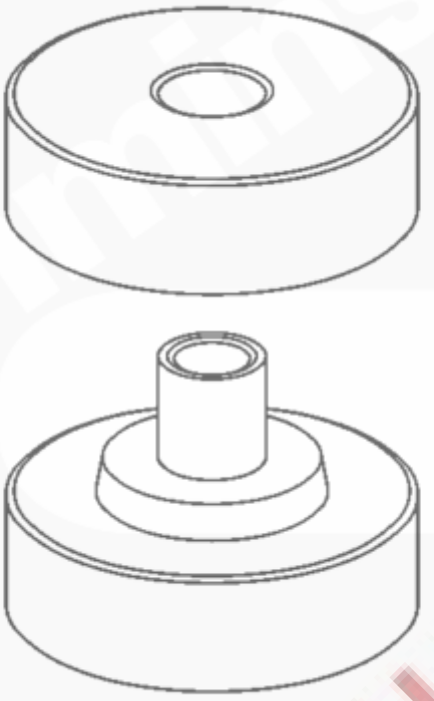

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The following are illustrations of typical REAR engine mounts.



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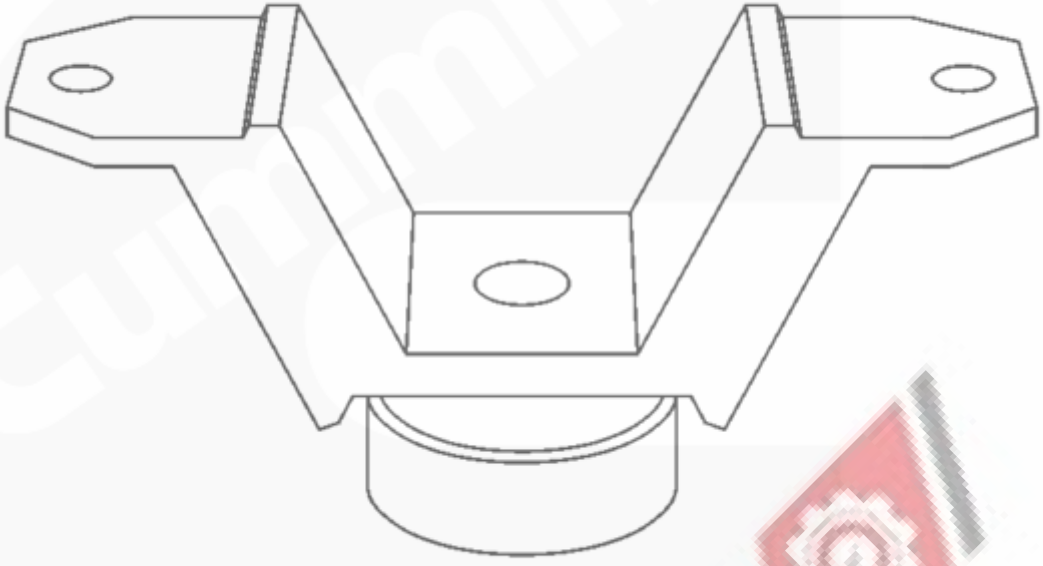

16800023

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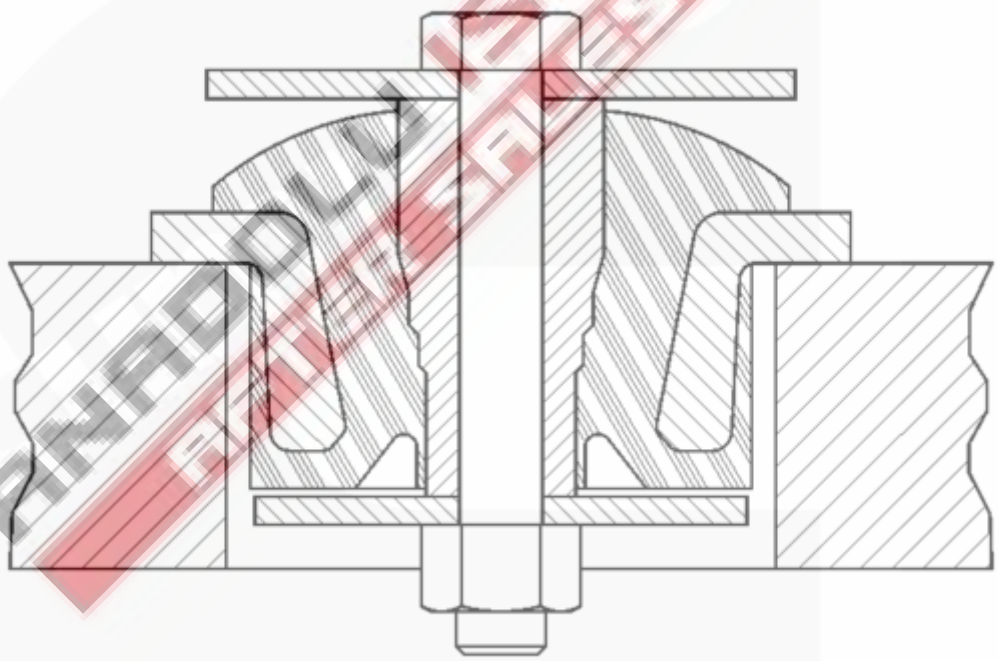
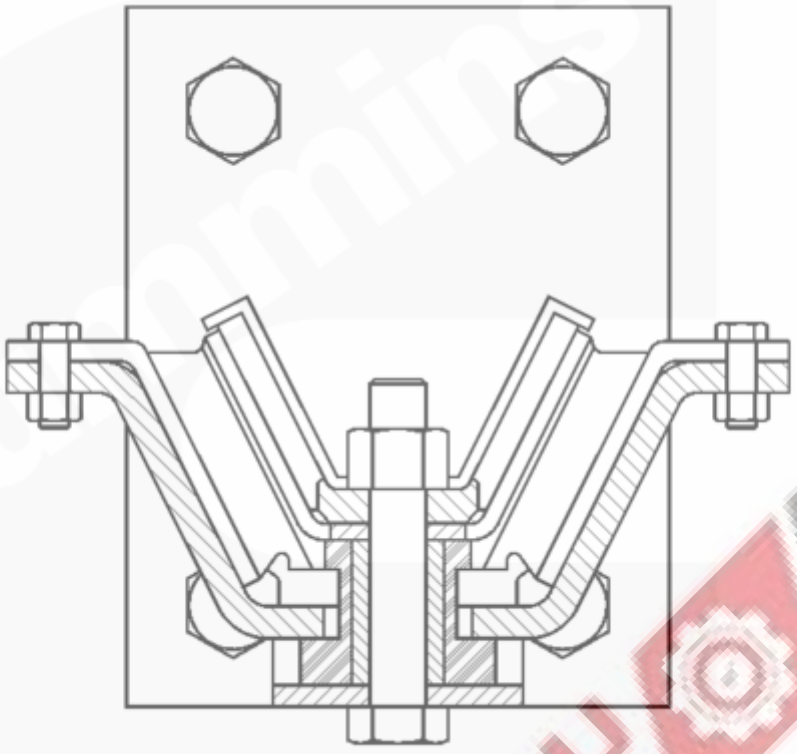


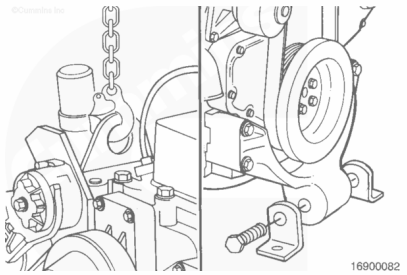
16800024



Remove

⚠ WARNING ⚠

The engine lifting equipment must be designed to lift the engine and transmission as an assembly without causing personal injury.



⚠ WARNING ⚠

This component or assembly weighs greater than 23 kg [50 lb]. To prevent serious personal injury, be sure to have assistance or use appropriate lifting equipment to lift this component or assembly.

Use a hoist or lifting fixture to support the engine.

Note : When removing the engine mount fasteners, note the location of any shims or spacers used.

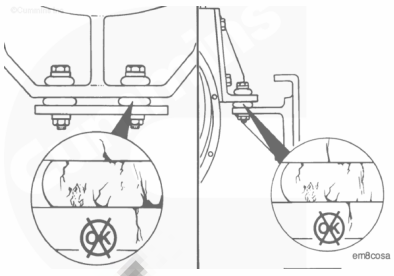
Remove the capscrews from the engine mounts.

Note : Certain applications will require loosening of the rear engine mount fasteners to allow removal of the front engine support bracket.

Inspect for Reuse

⚠ CAUTION ⚠

Damaged engine mounts and brackets can cause engine misalignment. Drivetrain component damage can result in excessive vibration complaints.



Inspect all rubber-cushioned mounts for cracks and other damage. Look for interference or contact between metal components.

Inspect all mounting brackets for cracks and damaged bolt holes.

Inspect the mounting capscrew to make sure it is **not** too long, which will **not** provide enough preload on the mount.

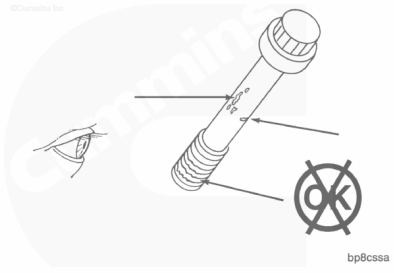
Replace any damaged parts as necessary.

Note : Damaged engine mounts, brackets, and mounting hardware can cause the engine to move out of alignment and damage the driveline components in the equipment. This can result in vibration complaints.

Inspect the capscrew for the following:

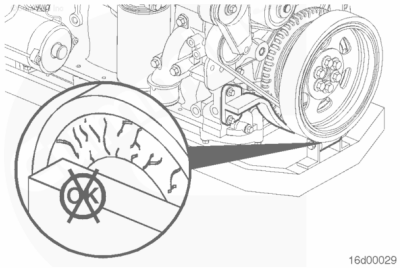
- Damaged threads
- Rust or corrosion-caused pitting
- Nicked, bent, stretched, or galled.

The capscrew **must** be replaced if it has any of the listed damages.



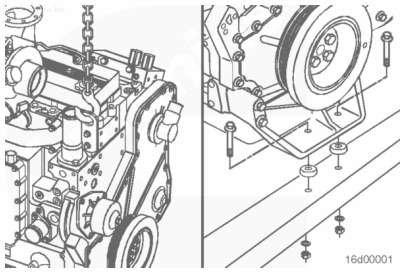
For barrel mounts, inspect for signs of contact between the side brackets and the front engine support bracket.

Contact between the engine mount and side brackets can cause vibration complaints. If contact is found, replace the front engine support bracket.



Install

Note : Make sure to install any shims or spacers in the same location as removed.



Align the engine in the chassis.

Install the engine mount fasteners and tighten. See equipment manufacturer service information for torque specifications.

Remove the lifting fixture or hoist from the engine lifting brackets.

Connect all engine and chassis mounted accessories removed.

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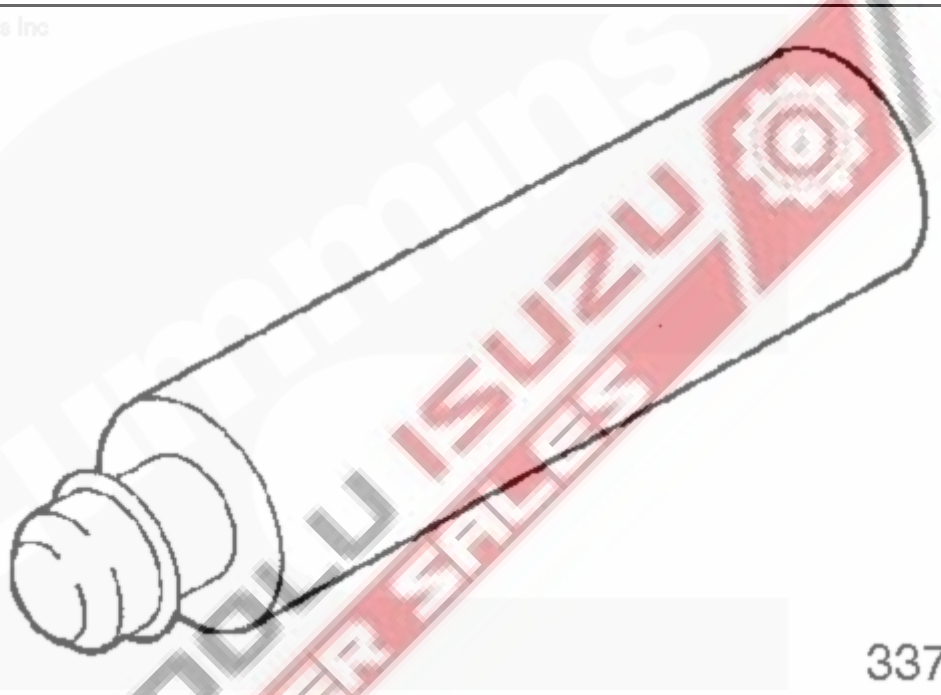
Last Modified: 24-Oct-2016

Miscellaneous

Tool Number
3164085
Cup Plug Driving Tools (universal handle) Required use with driver heads to install new cup plugs to their proper depth, plus avoiding damage to the cup plug and the surrounding area.
 3376795

Tool Number
3375066
Pipe Plug Sealant Used when installing pipe plugs to reduce the possibility of leaks.

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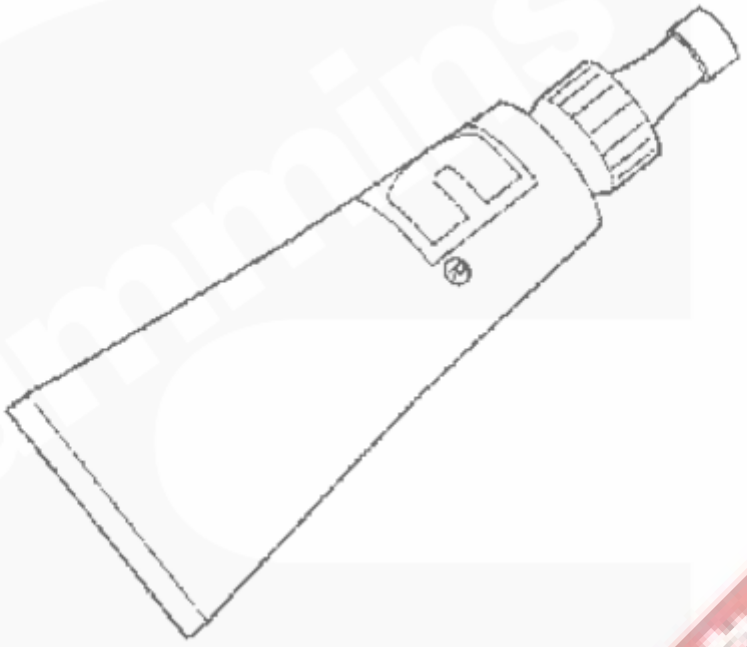


Tool Number

3375068

Cup Plug Sealant

Used when installing cup plugs to reduce the possibility of leaks.

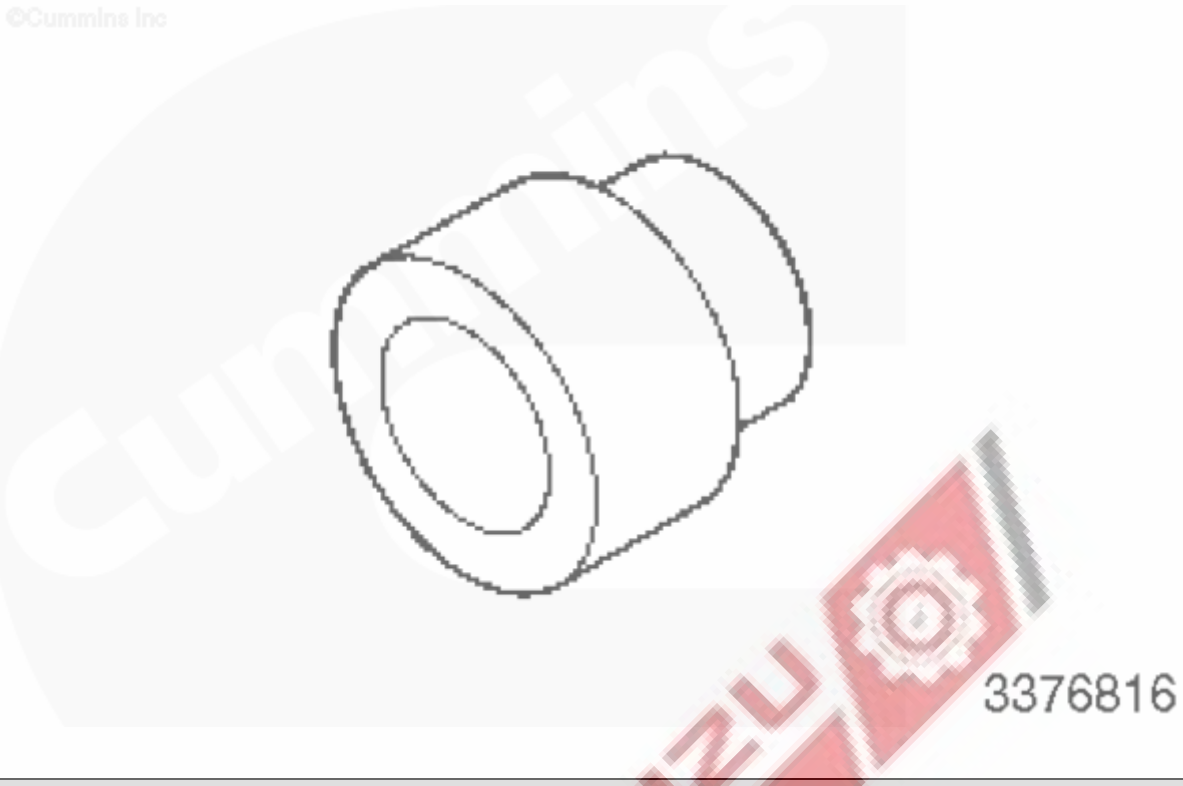


Tool Number

3376816

Cup Plug Driving Tools (driver head, 1 inch nominal)

Required to install new cup plugs to their proper depth, plus avoiding damage to the cup plug and the surrounding area.

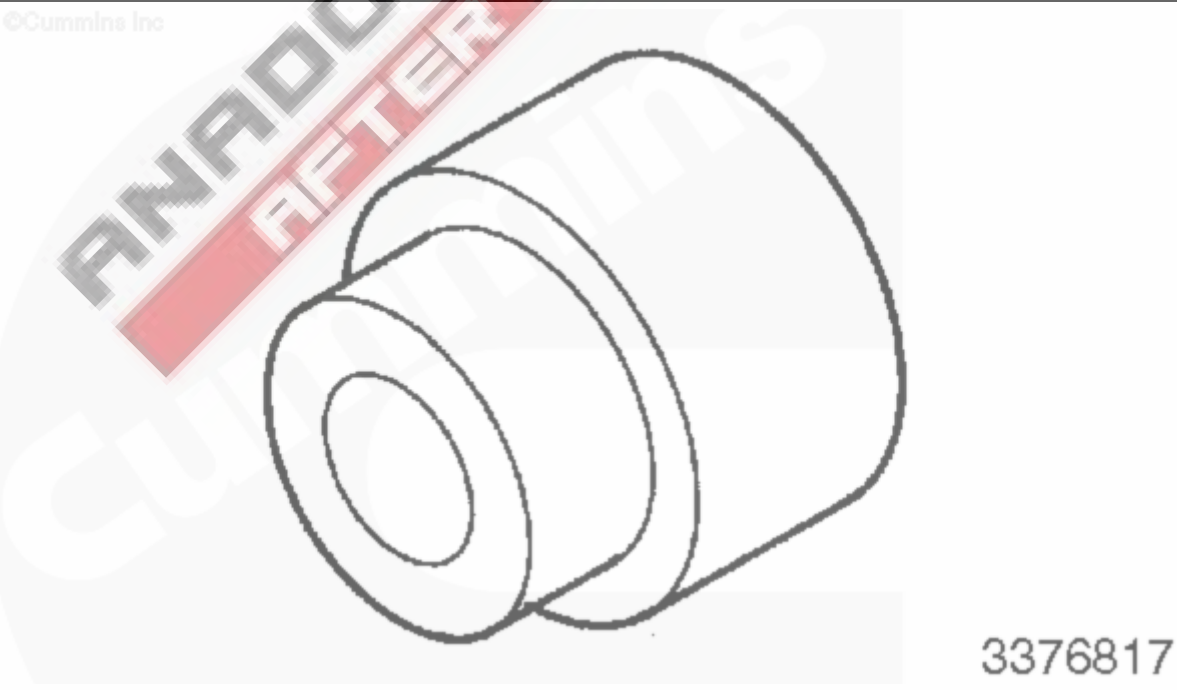


Tool Number

3376817

Cup Plug Driving Tools (driver head, 1-1/4 inch nominal)

Required to install new cup plugs to their proper depth, plus avoiding damage to the cup plug and the surrounding area.

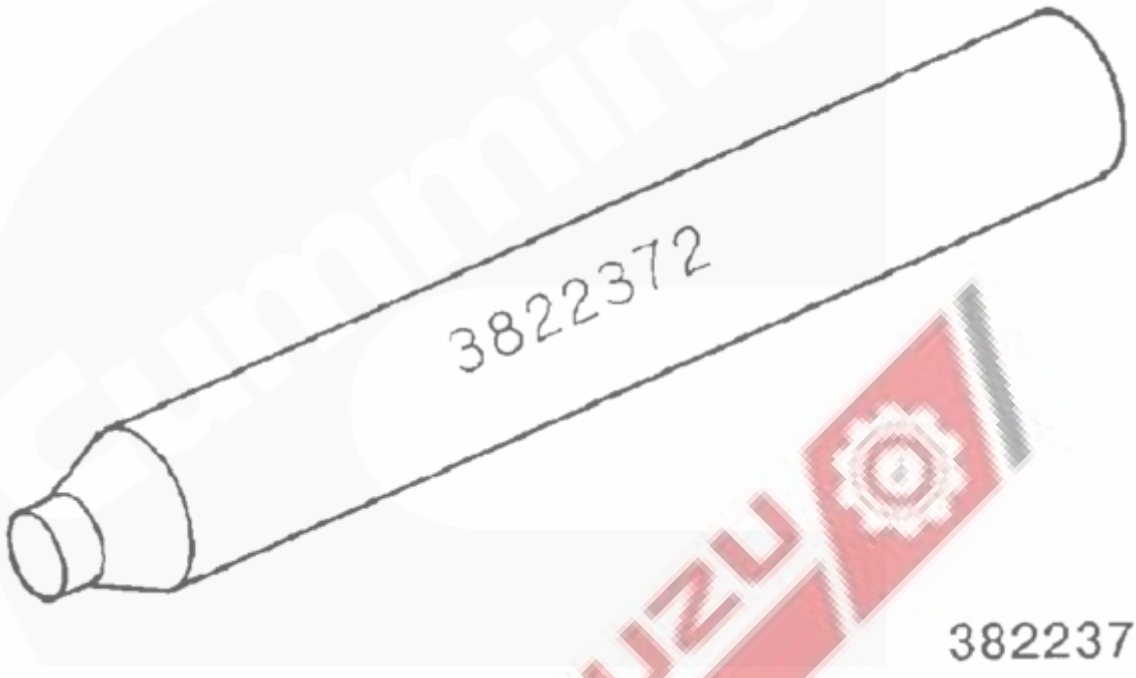


Tool Number

3822372

Cup Plug Driving Tools

Required to install new cup plugs to their proper depth, plus avoiding damage to the cup plug and the surrounding area.

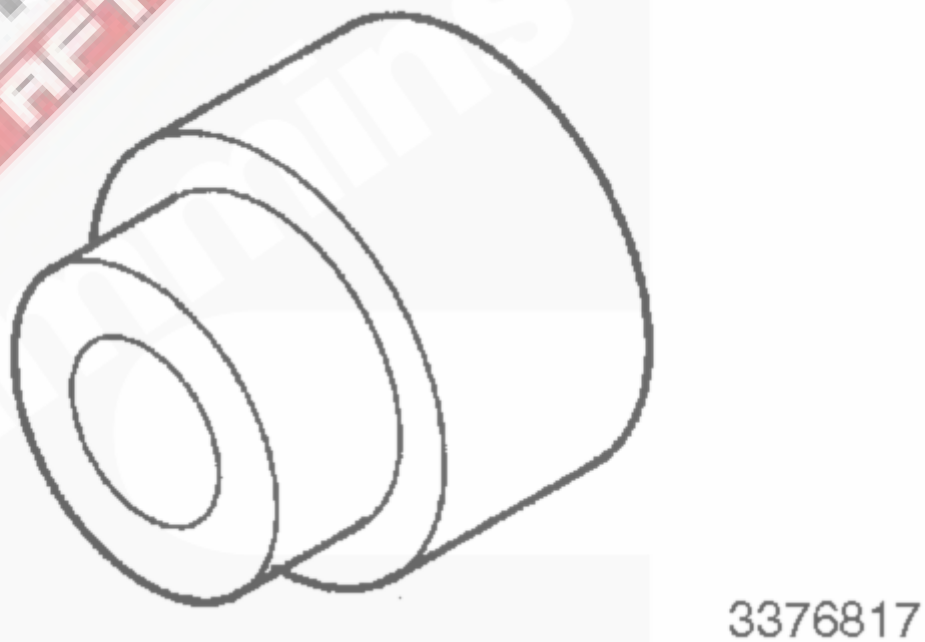


Tool Number

3823520

Cup Plug Driving Tools (driver head, 11/16-inch nominal)

Required to install new cup plugs to their proper depth, plus avoiding damage to the cup plug and the surrounding area.

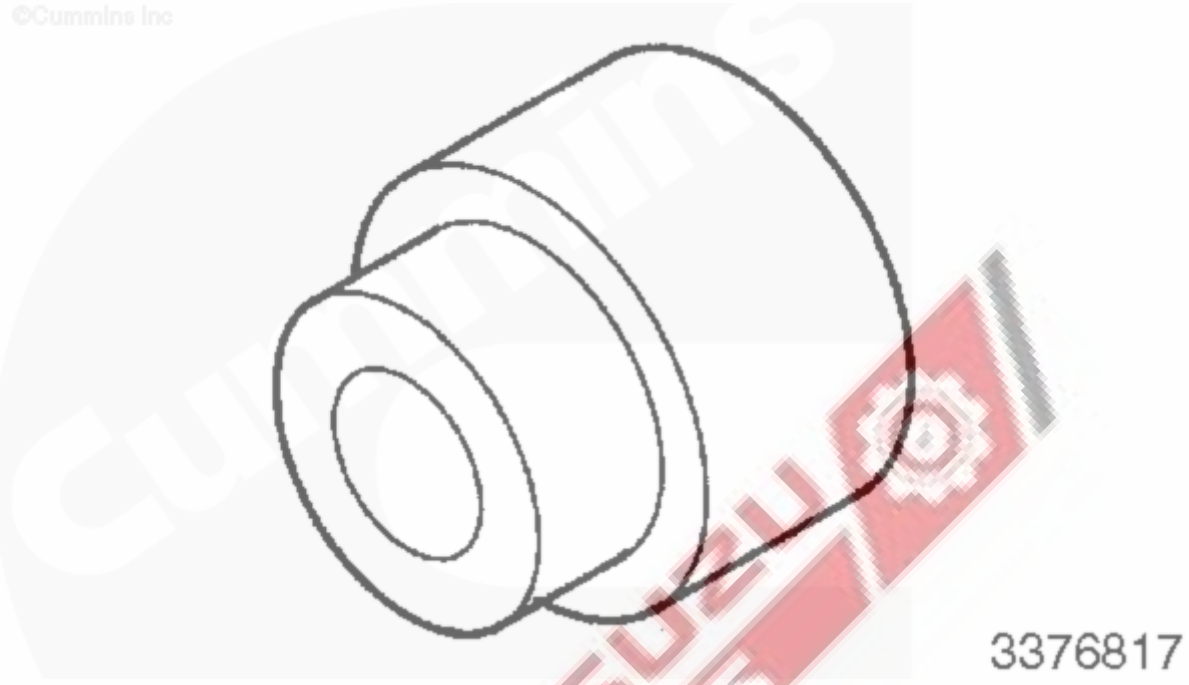


Tool Number

3823524

Cup Plug Driving Tools (driver head, 2-1/4-inch nominal)

Required to install new cup plugs to their proper depth, plus avoiding damage to the cup plug and the surrounding area.



Tool Number

3824510

QD Spray Cleaner

Used to clean cup plug openings.

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Last Modified: 10-Aug-2016

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Select Service Tools

Recommended Cummins® Service Tools

- Spray cleaner, Part Number 3375433, or equivalent
- Cup plug sealant, Part Number 3375068, or equivalent

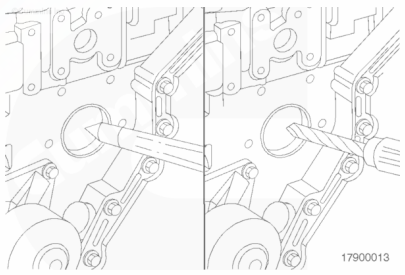
Additional Service Items

- Center punch
- Dent puller
- Scotch-Brite™, or equivalent

Remove

⚠ CAUTION ⚠

Do not allow metal shavings to fall in the engine when drilling a hole in the cup plug. Damage to engine components can occur.

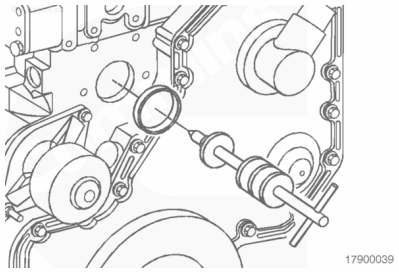


Use a center punch to mark the cup plug for drilling.

Drill an 1/8 inch hole into the cup plug.

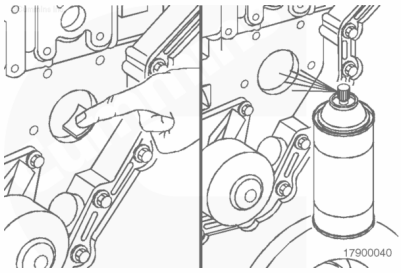
Use a dent puller to remove the plug.

Discard all used cup plugs. Do **not** use them again.

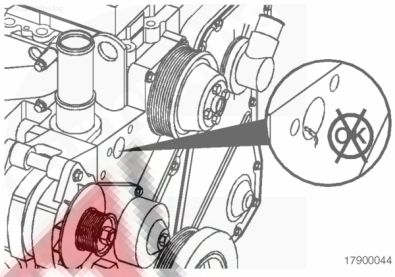


Clean and Inspect for Reuse

Thoroughly clean the cup plug hole using Scotch-Brite™, or equivalent. Use spray cleaner, Part Number 3375433, or equivalent, to perform a final clean of the bore.



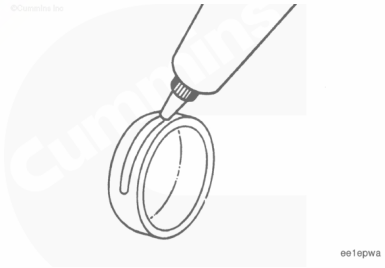
Inspect the cup plug bores for damage.



Install

⚠ CAUTION ⚠

Excessive sealant can run back into the engine and cause damage to other components. Allow the sealant to dry for a minimum of 2 hours before operating the engine. The plug can come out of the bore if the sealant is not dry.



Apply a 2 mm [1/16 in] bead of cup plug sealant, Part Number 3375068, or equivalent, to the outside circumference of the cup plug and the inside diameter of cup plug bore.

Note : Do **not** install a used cup plug. Discard all plugs after removal.

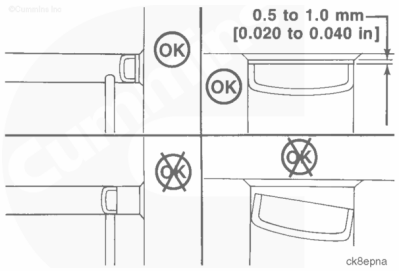
Install the cup plug with the appropriate cup plug driver. See the Service Tools Catalog, Bulletin Number 3377710.

GRAPHIC NOT FOUND

⚠ CAUTION ⚠

Do not install the cup plug too deeply. If the cup plug is not installed straight and flat, it must be replaced with a new cup plug.

The cup plug **must** be installed with the edge of the cup plug 0.5 to 1.0 mm [0.020 to 0.040 in] deeper than the leading chamber of the bore.



Last Modified: 05-Aug-2016

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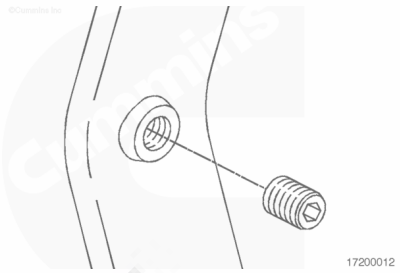
AFTER SALES

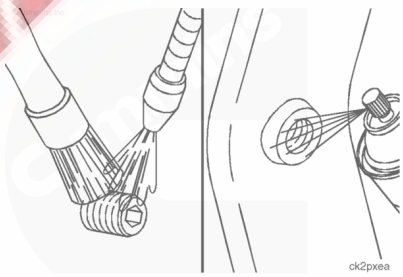
Remove

Select the appropriate size Allen wrench and remove the pipe plug.



Clean and Inspect for Reuse

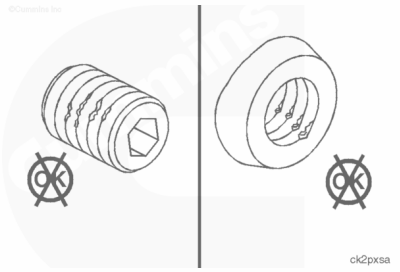
Use spray cleaner, Part No. 3823717 or equivalent, to clean the threads of the pipe plugs and threaded bores.



Inspect the threads of the pipe plugs for mutilation or damage.

Inspect the threaded bores for damage.

Repair the bores, if necessary. Refer to the L10 Alternative Repair Manual, Bulletin No. 3810310.

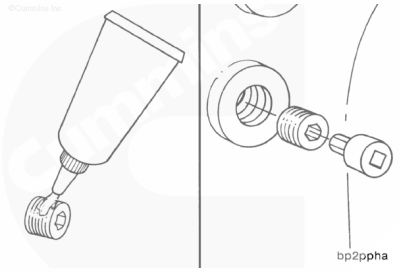


Install

Apply a film of pipe plug sealant, Part No. 3375066 or equivalent, to the threads.

Install and tighten the pipe plugs.

Refer to the following chart for torque values:



ANADOLU ISUZU PARTS SALES

Tighten pipe plugs to the appropriate torque values.

Pipe Plug Torque Values

Size			Torque		Torque	
Thread	Actual Thread O.D.		In Aluminum Components		In Cast Iron or Steel Components	
in.	mm	[in]	N•m	[ft-lbs]	N•m	[ft-lbs]
1/16	8.1	[0.32]	5	[45 in-lb]	15	[10]
1/8	10.4	[0.41]	15	[10]	20	[15]
1/4	13.7	[0.54]	20	[15]	25	[20]
3/8	17.3	[0.68]	25	[20]	35	[25]
1/2	21.6	[0.85]	35	[25]	55	[40]
3/4	26.7	[1.05]	45	[35]	75	[55]
1	33.5	[1.32]	60	[45]	95	[70]
1¼	42.2	[1.66]	75	[55]	115	[85]
1½	48.3	[1.90]	85	[65]	135	[100]

ck8ppoa

Last Modified: 12-May-2003

ANADOLU ISUZU AFTER SALES

Select Service Tools

Recommended Cummins® Service Tools

- Spray cleaner, Part Number 3375433, or equivalent

Additional Service Items

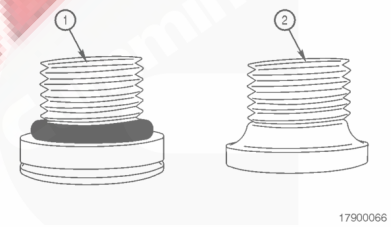
- Allen wrench or socket

General Information

Two types of straight thread plugs are used:

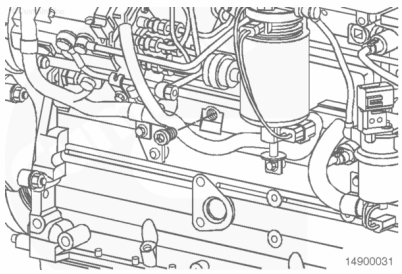
1. Straight thread plug with o-ring
2. Straight thread plug with formed-in-place sealant.

The two plugs are interchangeable and reusable. The **only** difference between the two plugs is the installation torque value. See the install step of this procedure.



Remove

Select the appropriate size Allen wrench or socket, and remove the plug.

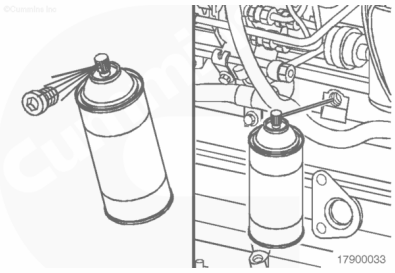


Clean and Inspect for Reuse

⚠ WARNING ⚠

ANADOLU ISUZU
DEALER SALES

When using solvents, acids, or alkaline materials for cleaning, follow the manufacturer's recommendations for use. Wear goggles and protective clothing to reduce the possibility of personal injury.



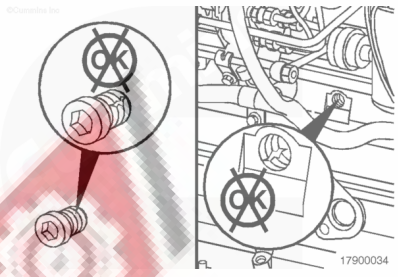
Use spray cleaner, Part Number 3375433, or equivalent, to clean the threads of the straight-thread plugs and threaded bores.

Inspect the threads of the pipe plugs for mutilation or damage.

Replace the plugs, if damaged.

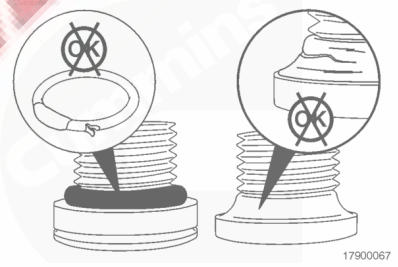
Inspect the threaded bores for damage.

Repair the bores, if necessary.



For straight thread plugs with an o-ring, inspect the o-ring for cuts, tears, or deformation. Replace the o-ring if necessary.

For straight thread plugs with formed in-place sealant, inspect the sealant for damage. If damaged, replace the entire plug.

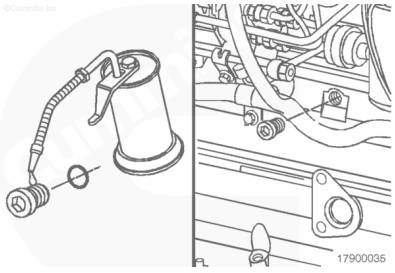


Install

If equipped with a straight thread plug with o-ring, install a new o-ring on the straight-thread plug, if required.

Lubricate the o-ring with clean engine oil.

Install and tighten the plug.



Torque Value:
M10 10 n•m [89 in-lb]

Torque Value:
M12 20 n•m [177 in-lb]

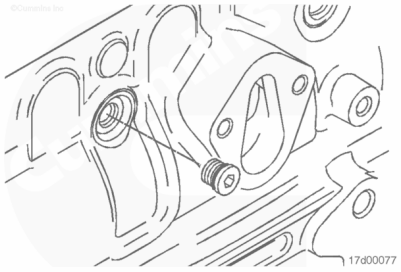
Torque Value:
M14 25 n•m [221 in-lb]

Torque Value:
M16 35 n•m [25 ft-lb]

ANADOLU ISUZU AFTERSALES

Torque Value:
M18 45 n•m [33 ft-lb]

If equipped with a straight thread plug with formed in-place sealant, install and tighten the plug.



Torque Value:
M10 18 n•m [160 in-lb]

Torque Value:
M12 25 n•m [221 in-lb]

Torque Value:
M14 30 n•m [22 ft-lb]

Torque Value:
M16 40 n•m [30 ft-lb]

Torque Value:
M18 50 n•m [37 ft-lb]

ANADOLU ISUZU AFTER SALES

Last Modified: 05-Apr-2017

Select Service Tools

Recommended Cummins® Service Tools

- Spray cleaner, Part Number 3375433, or equivalent

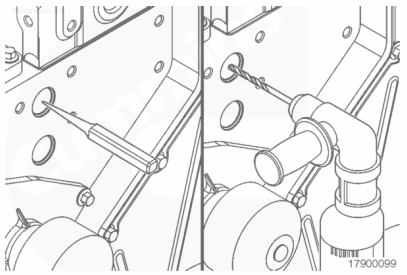
Additional Service Items

- Center punch
- Dent puller
- Scotch-Brite™, or equivalent
- Hammer
- Flat driver

Remove

⚠ CAUTION ⚠

Do not allow metal shavings to fall in the engine when drilling a hole in the expansion plug. Damage to engine components can occur.

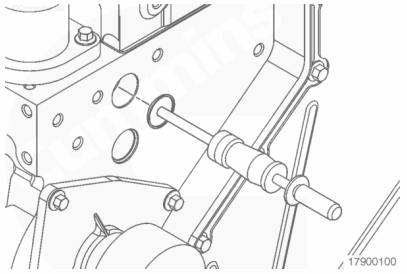


Use a center punch to mark the expansion plug for drilling.

Drill an 1/8 inch hole into the expansion plug.

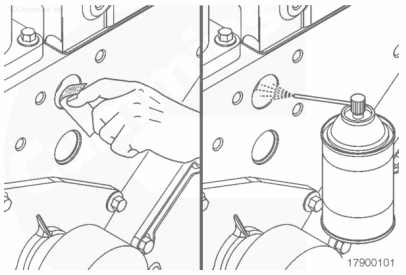
Use a dent puller to remove the plug.

Discard all used expansion plugs and expansion plug o-rings. Do **not** use them again.

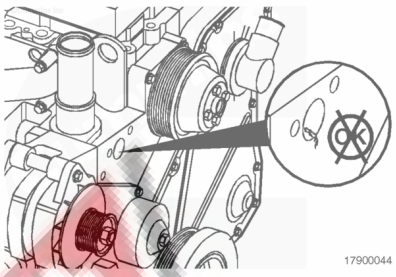


Clean and Inspect for Reuse

Thoroughly clean the expansion plug hole. Use Scotch-Brite™, or equivalent. Use spray cleaner, Part Number 3375433, or equivalent, to perform a final cleaning of the bore.



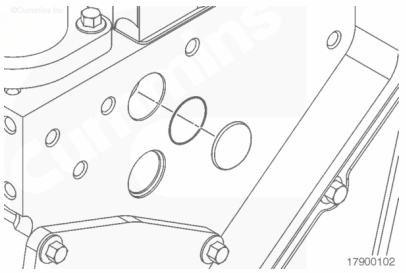
Inspect the expansion plug bores for damage.



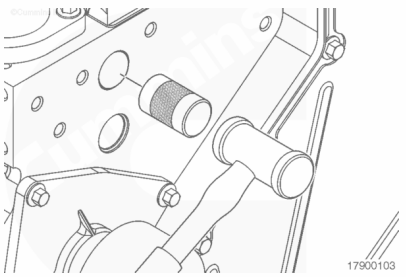
Install

Install the expansion plug o-ring into the bore.

Install the expansion plug with the convex side facing out.

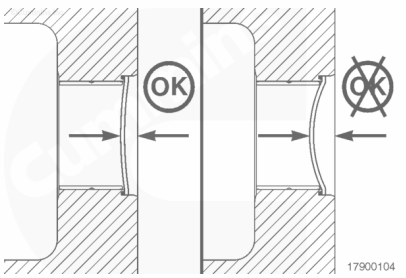


Use a hammer and a flat driver to strike the expansion plug twice to flatten the plug against the o-ring.



Check the plug for proper installation.

- The installed plug **must not** protrude above the edge of the bore.
- The installed plug **must not** be more than 1 to 3.5 mm [0.04 to 0.14 in] below the edge of the bore.



ANADOLU ISUZU
DEALER SALES

Last Modified: 05-Aug-2016



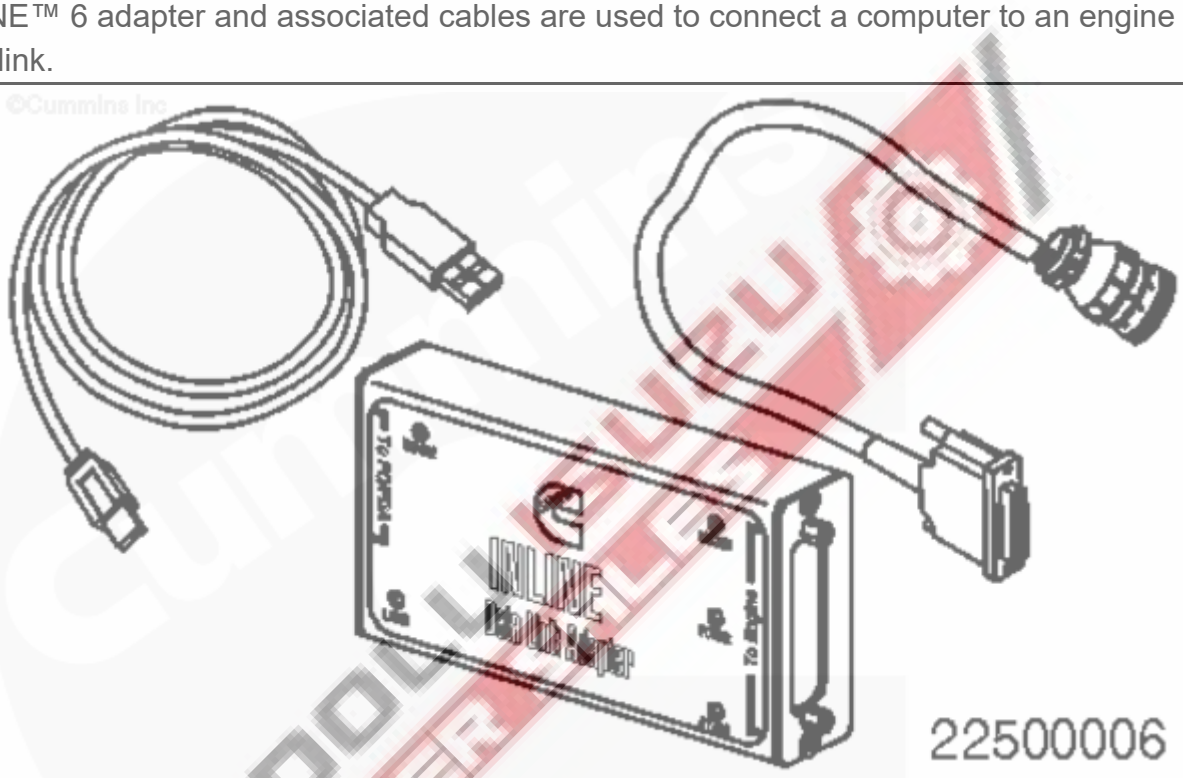
Electronic Engine Controls

Tool Number

2892092

Data Link Adapter Kit

INLINE™ 6 adapter and associated cables are used to connect a computer to an engine data link.

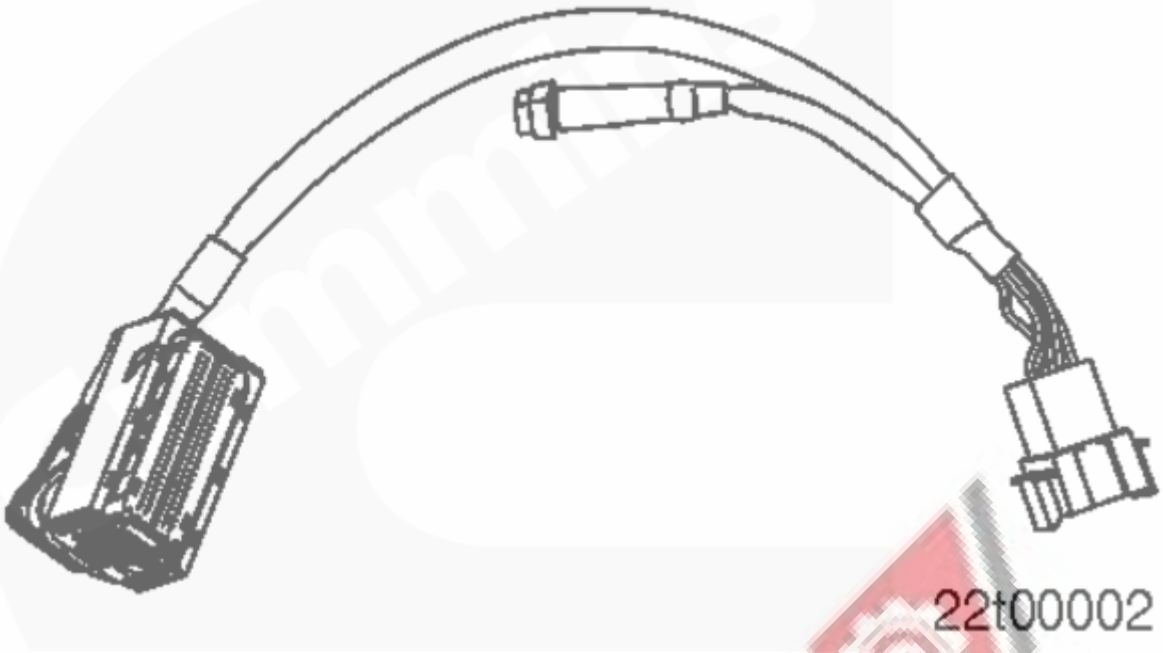


Tool Number

2892289

ECM Bench Top Calibration Harness Adapter

Used to calibrate CM2350 electronic control modules off of the engine. Use with base harness, Part Number 3163151. Reference Service Tool Instruction, Bulletin 3377791, for additional information.

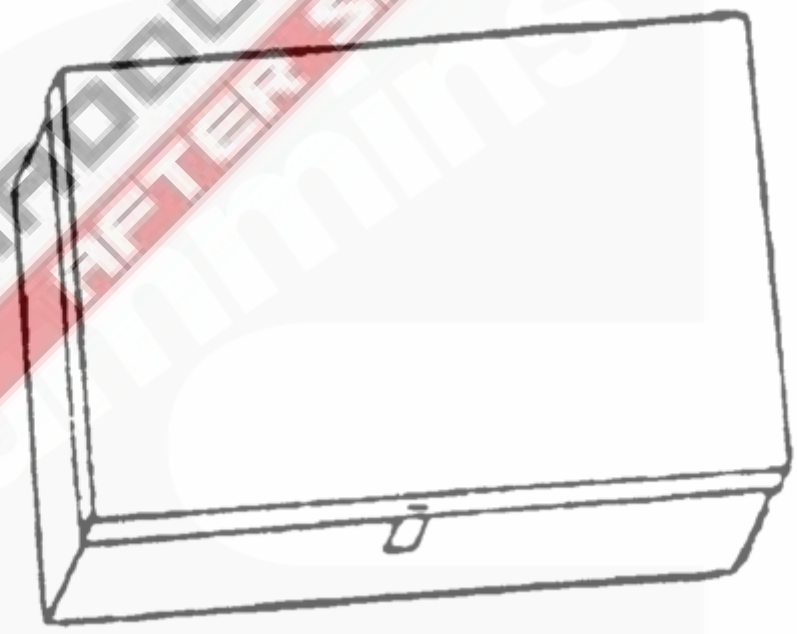


Tool Number

2892512

CM2350 ECM Connector Repair Kit

Contains the following service tools: Pinout Connector Tool, Part Number 2892510, Test Leads (2), Part Number 3164113, Delphi Retainer Removal Tool, Part Number 4918921. Reference Service Tool Instruction, Bulletin 3400414, for additional information.

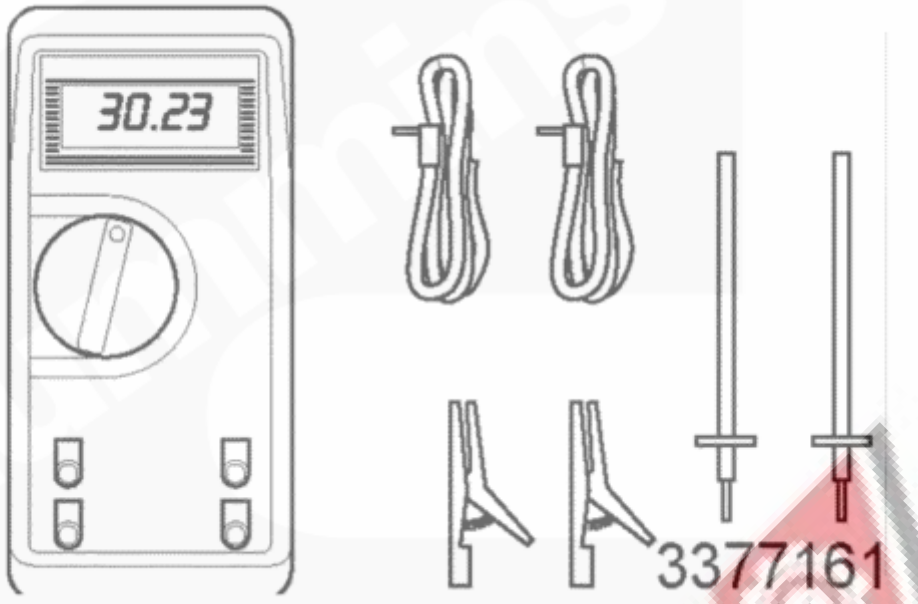


Tool Number

3164489

Digital Multimeter (Standard Multimeter)

Automotive multimeter with built-in temperature adapter and tachometer.

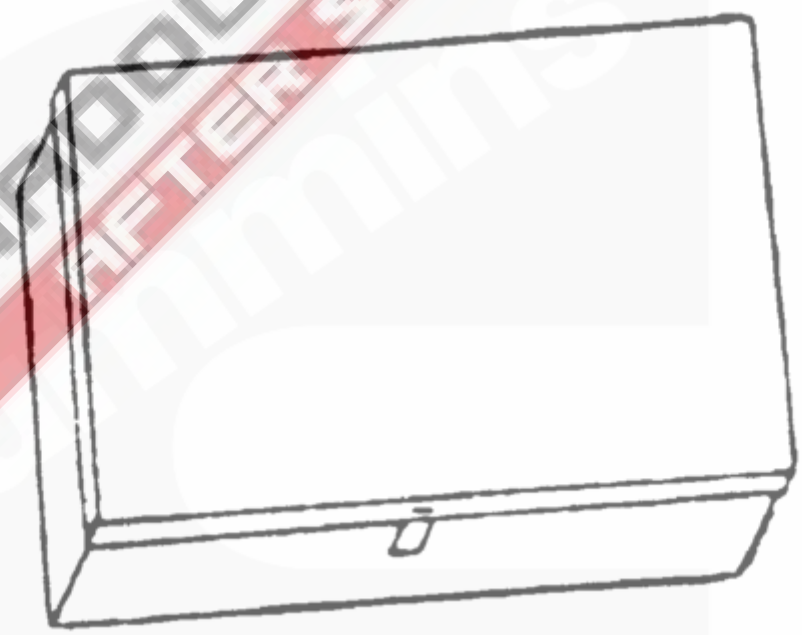


Tool Number

3400280

Cummins® Wiring Repair Service Tools Bulletin

Contains information on a variety of service tools available for connector and wiring harness repair.

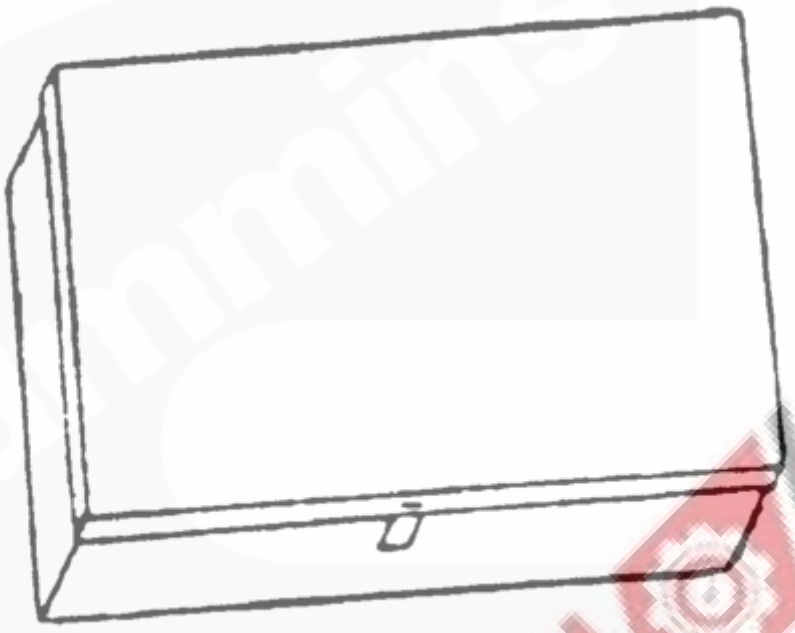


Tool Number

4919115

Electrical Test Lead Kit

Contains various test leads for testing electrical circuits. Reference Service Tool Instruction, Bulletin 3400282, for kit contents.

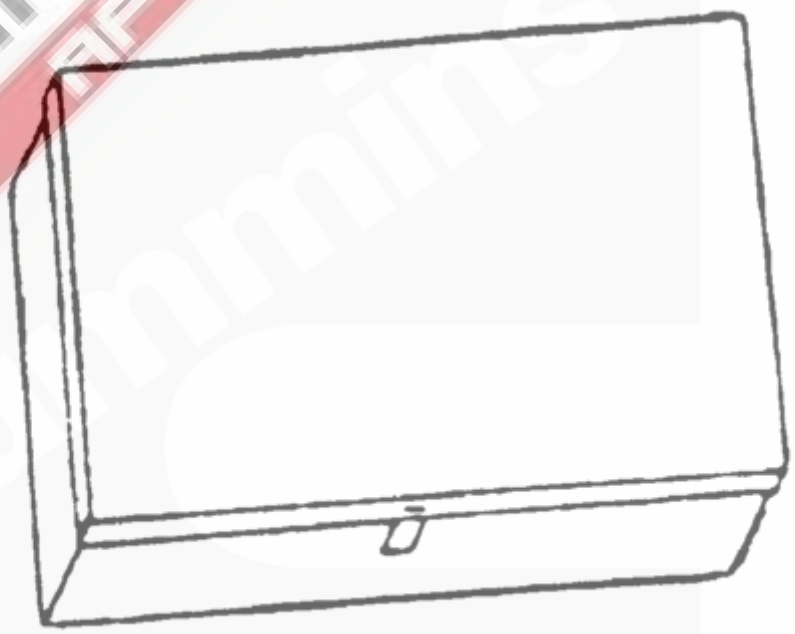


Tool Number

5298734

CM2350 Wiring Harness Repair Kit

Contains the following service tools: Backshell Locking Assembly, Part Number 4918925; Retainer, Red Locking Comb, Part Number 4918926; Terminal 20 AWG Grey Wire, Part Number 2892507; Terminal 16 AWG Grey/Red Stripe Wire, Part Number 4918916; Wire Ties, Part Number 3822924; engine control module (ECM) Cable Hold-Down Clamp, Part Number 5298539; and ECM Connector Dust Boot, Part Number 3688983. Reference Service Tool Instruction, Bulletin 3400445, for additional information.

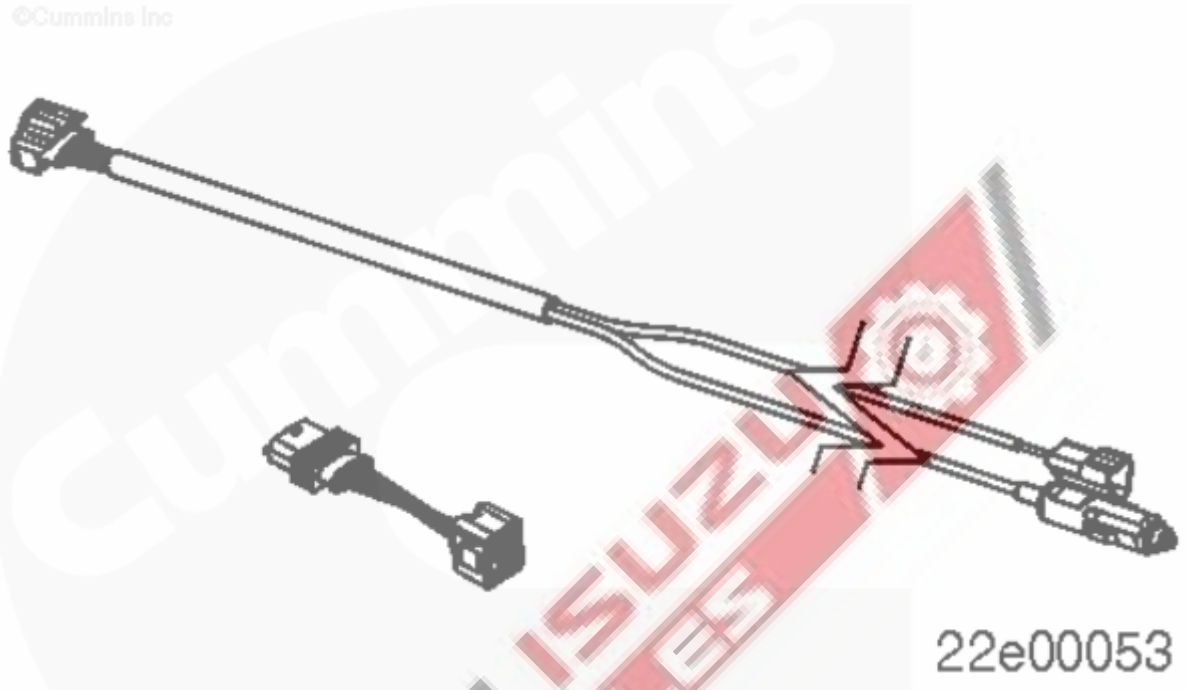


Tool Number

5298821

NOx Sensor Service Tool: 2013 Engines

The harness allows the inlet and/or outlet NOx sensor to be isolated from the engine wiring harness and/or the original equipment manufacturer (OEM) wiring harness for testing on 2013 engines.



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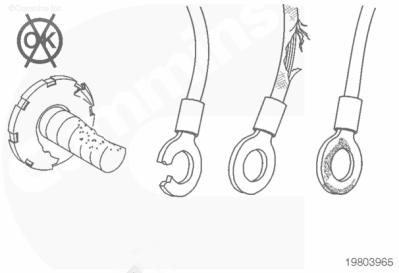
AFTER SALES

Last Modified: 10-Aug-2016

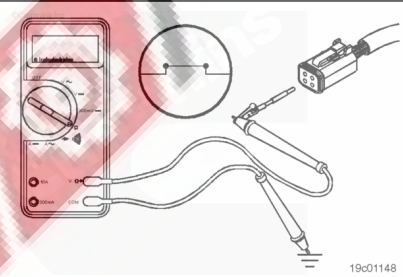
Resistance Check

Check the Original Equipment Manufacturer harness ground connection for loose, corroded, or broken connections.



⚠ CAUTION ⚠

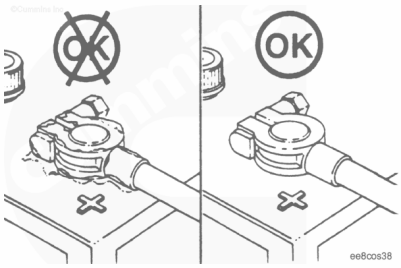
The leads must fit tightly in the connector without expanding the pins in the connector otherwise the connector will be damaged.



Measure the resistance between the battery supply negative (-) pin of the Original Equipment Manufacturer harness control module connector(s) and engine block ground or chassis ground for each control module. Reference the wiring diagram for connector pin identification. The resistance **must** be 10 ohms or less.

If the resistance value is **not** correct, check the batteries, cables, and cable connections.

Repair or replace the parts as required.



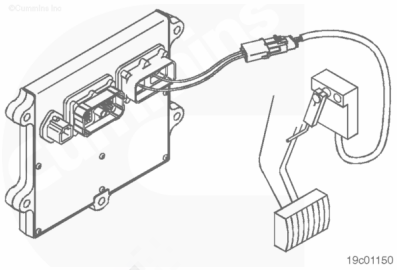
ANADOLISUZU PARTS

Last Modified: 21-Mar-2012

General Information

The clutch pedal position switch circuit is used to disable the PTO and cruise control features.

The circuit consists of an open control switch, a clutch pedal position switch signal wire, and a switch return. When the clutch pedal position switch is installed and adjusted, the contact points are held closed. When the clutch pedal is depressed, the clutch pedal position switch is in its normally open position. This will disable the PTO or cruise control operation.



Resistance Check

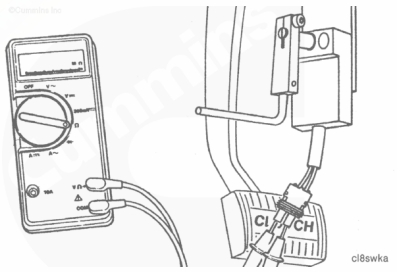
If an electronic service tool is available, monitor the clutch switch for proper operation. If **not**, follow the troubleshooting procedures in this section.

Find the clutch pedal position switch. The location will depend on the OEM installation procedures.

Disconnect the wiring harness attached to the switch terminals.

Adjust the multimeter to measure resistance.

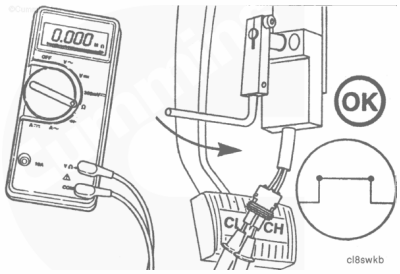
Touch the probes of a multimeter to the two terminals in the connector of the clutch pedal position switch.



Release the clutch pedal. The multimeter **must** show a closed circuit (10 ohms or less).

If the switch is **not** closed when the clutch is fully engaged, adjust the clutch switch trip lever. If the switch is **not** closed after adjusting the trip lever, the switch has failed. Refer to the OEM troubleshooting and repair manual for the replacement procedures.

Depress the clutch pedal. The clutch pedal position switch **must** open. The multimeter **must** show an open circuit (100k ohms or more).

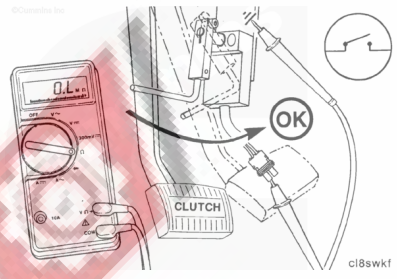


If the switch is **not** open when the clutch is fully engaged, adjust the clutch switch trip lever. If the switch is **not** open after adjusting the trip lever, the switch has failed. Refer to the OEM troubleshooting and repair manual for the replacement procedures.

Check for Short Circuit to Ground

Remove one multimeter probe from the clutch pedal position switch connector and touch the probe to the chassis ground. The multimeter **must** show an open circuit (100k ohms or more) when the clutch pedal is released. If the circuit is closed, replace the clutch pedal position switch.

Refer to the OEM troubleshooting and repair manual.



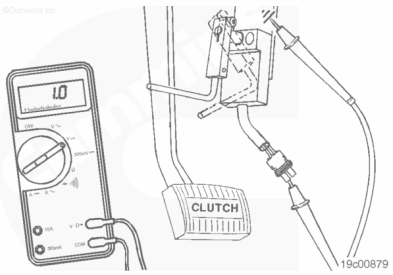
Check for Short Circuit to External Voltage Source

Turn the keyswitch to the ON position.

Adjust the multimeter to measure VDC.

Insert one of the multimeter probes into the clutch pedal position switch connector.

Touch the other multimeter probe to the engine block ground and measure the voltage. The voltage **must** be 1.5 VDC or less with the clutch pedal released and depressed.

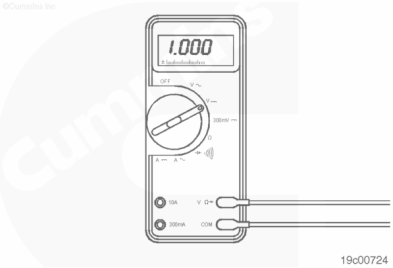


If the voltage value is more than 1.5 VDC, there is a short circuit to an external voltage source.

Note : An external voltage source is any wire in the OEM harness wiring that carries the voltage.

Remove the external voltage source.

If the clutch pedal position switch passed all previous checks, connect the switch to the wiring harness. The clutch pedal position switch circuit **must** be checked.



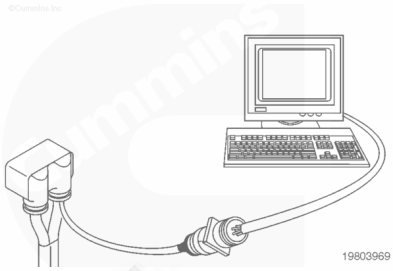
Last Modified: 22-Jun-2015



Resistance Check

⚠ CAUTION ⚠

Proper leads and/or a Cummins® approved circuit testing tool must be used when working with electrical connectors to prevent pin expansion and damage to the connector.



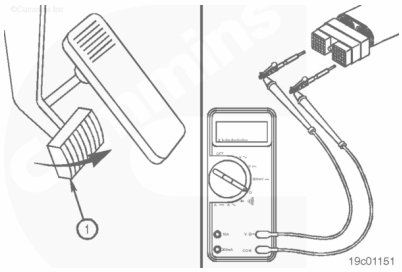
If electronic service tool is available, monitor the clutch pedal position switch circuit for proper operation. If **not**, follow the troubleshooting procedures in this section.

Disconnect the original equipment manufacturer (OEM) harness engine interface connector. To determine the location of the connector, see the corresponding engine wiring diagram.

Insert a test lead into the clutch pedal position switch return pin depending on the OEM application of the OEM connector. Insert the other test lead into the clutch pedal position switch signal pin of the OEM connector.

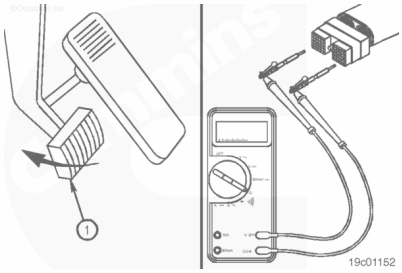
Connect the alligator clips to the two probes of the multimeter. Adjust the multimeter to measure resistance.

The multimeter **must** show a closed circuit (10 ohms or less) when the clutch pedal (1) is released.



Depress the clutch pedal (1). The multimeter **must** show an open circuit (100k ohms or more). If the resistance values are **not** correct, the clutch pedal position switch signal wire and the return wire **must** be checked for an open circuit, provided the clutch pedal position switch was previously checked.

If the values are correct, the circuit **must** still be checked for a short circuit to ground, a short circuit from pin to pin, and a short circuit to an external voltage source.



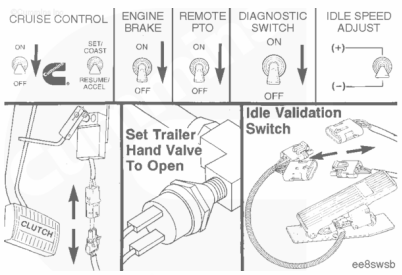
ANADOLU ISUZU GENUINE PARTS

Check for Short Circuit to Ground

To isolate the clutch pedal position switch circuit when checking for a short circuit to ground, turn all cab panel switches to the OFF or neutral position.

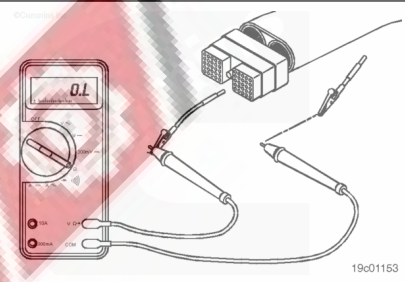
Set the service brake using the trailer brake hand valve.

Disconnect the clutch pedal position switch, the idle validation switch, and the throttle pedal.



Remove the test lead from the switch return pin.

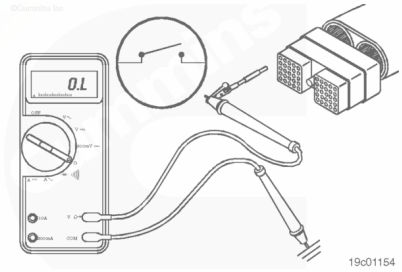
Disconnect the multimeter probe from the alligator clip.



Touch the other multimeter probe to the engine block ground. Measure the resistance. The multimeter **must** show an open circuit (100k ohms or more). If the circuit is **not** open, there is a short circuit to ground in the clutch pedal position switch circuit.

Repair or replace the wire connected to the clutch pedal position switch signal pin in the OEM harness according to the vehicle manufacturer's procedures.

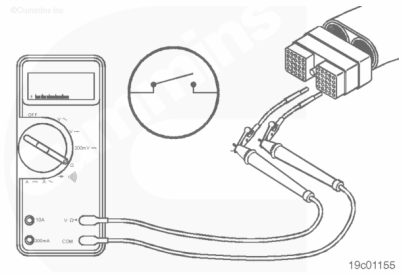
Connect all components when the repair is complete.



Check for Short Circuit from Pin to Pin

Isolate the clutch pedal position switch circuit as described in previous step. Set all cab panel switches to the OFF or neutral position, and disconnect the clutch pedal position switch and the throttle pedal.

Adjust the multimeter to measure resistance. Then insert one test lead into the clutch pedal position switch signal pin of the OEM harness connector. Insert the other test lead into



the clutch pedal position switch return pin. Connect the alligator clips to the multimeter probes.

Measure the resistance. The multimeter **must** show an open circuit (100k ohms or more).

With the first test lead still touching the clutch pedal position switch signal pin, remove the test lead from the clutch pedal position switch return pin and touch it to all other pins, one at a time. The multimeter **must** show an open circuit (100k ohms or more) at all pins.

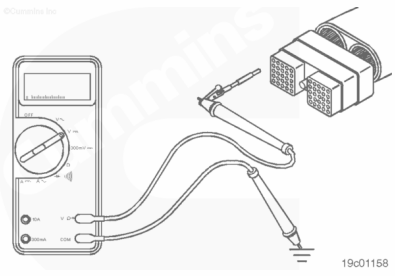
If the circuit is **not** open, there is a short circuit between the wire connected to the clutch pedal position switch signal pin and any pin that shows a closed circuit. Repair or replace the wires in the OEM harness according to the vehicle manufacturer's procedures.

Remove the test lead from the clutch pedal position switch signal pin and touch it to the clutch pedal position switch return pin. Touch the other test lead to all other pins, one at a time. Measure the resistance. The multimeter **must** show an open circuit (100k ohms or more), except for the clutch pedal position switch return pin.

If the circuit is **not** open, there is a short circuit between the wire connected to the clutch pedal position switch return wire and any pin that measured a closed circuit. Repair or replace the wires in the OEM harness according to the vehicle manufacturer's procedures.

Check for Short Circuit to External Voltage Source

Isolate the clutch pedal position switch circuit as described in the previous steps. Set the cab panel switches to the OFF or neutral position, and disconnect the clutch pedal position switch and the throttle pedal. Turn the keyswitch to the ON position. Adjust the multimeter to measure VDC.



Insert test lead connected to the positive multimeter probe into the clutch pedal position switch signal pin. Disconnect the negative multimeter probe from the test lead and touch it to the engine block ground. Measure the voltage. The voltage **must** be 1.5 VDC or less.

Note : An external voltage source is any wire in the OEM wiring that carries voltage.

If the voltage value is more than 1.5 VDC, there is a short circuit between the wire connected to the clutch pedal position switch signal pin and a wire carrying power in the OEM harness. Repair the OEM harness according to the vehicle manufacturer's procedures.

Remove the test lead from clutch pedal position switch signal pin and insert it into the clutch pedal position switch return pin. With the multimeter probe still touching the engine block ground, measure the voltage. The voltage **must** be 1.5 VDC or less. If the voltage value is **not** correct, there is a short circuit between the wire connected to the clutch pedal position switch return and a wire carrying power in the OEM harness. Repair the OEM harness according to the vehicle manufacturer's procedures.

Connect all components after completing the repairs.

ANADOLU ISUZU AFTER SALES

Last Modified: 22-Jun-2015

Select Service Tools

Recommended Cummins® Service Tools

- No Cummins® Service Tools required.

Additional Service Items

- No additional service items required.

Preparatory Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

⚠ WARNING ⚠

Do not remove the pressure cap from a hot engine. Wait until the coolant temperature is below 50°C [120°F] before removing the pressure cap. Heated coolant spray or steam can cause personal injury.

⚠ WARNING ⚠

Coolant is toxic. Keep away from children and pets. If not reused, dispose of in accordance with local environmental regulations.

- Disconnect the batteries. See equipment manufacturer service information.
- Remove the radiator cap.
- Drain enough coolant from the cooling system to empty the radiator top tank. Refer to Procedure 008-018 in Section 8. (/qs3/pubsys2/xml/en/procedures/425/425-008-018-tr.html)

Initial Check

⚠ CAUTION ⚠

Engine coolant level sensor can be damaged when removed. It should not be removed unless it is being replaced. Leave engine coolant level sensor installed during functional test.



The vehicle can be equipped with dual coolant level sensors. INSITE™ electronic service tool can be used to monitor the coolant level sensors during troubleshooting. See the parameter names "Engine Coolant Level" and "Engine Coolant Level 2", if equipped.

Verify there are no fault codes present. If Fault Codes 195, 196, 1695, 1696, 4865, and 4866 or any other fault codes are present, troubleshoot the fault codes.

Inspect the original equipment manufacturer (OEM) harness and engine coolant level sensor connector pins for the following:

- Loose connector
- Corroded pins
- Bent or broken pins
- Pushed back or expanded pins
- Moisture in or on the connector
- Missing or damaged connector seals
- Dirt or debris in or on the connector pins
- Connector shell broken
- Wire insulation damage
- Damaged connector locking tab.

Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19. (/qs3/pubsys2/xml/en/procedures/99/99-019-361.html)

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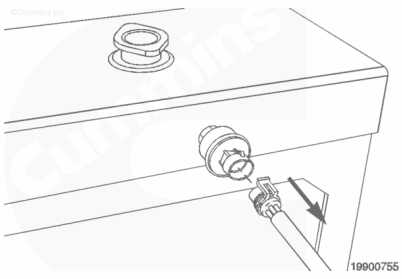
With the keyswitch in the OFF position, disconnect the electrical connector(s) from the coolant level sensor(s). With the engine coolant level sensor disconnected from the OEM harness, keyswitch ON, wait 30 seconds and check for active Fault Code 195. If Fault Code 195 is **not** active, there is a problem with either the OEM harness or the engine control module (ECM).

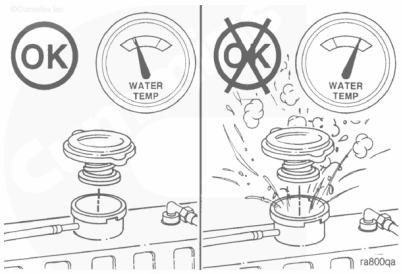


If the vehicle is equipped with dual coolant level sensors, Fault Code 195 will set for the lowest mounted coolant level sensor in the tank and Fault Code 4865 will set for the high mounted coolant level sensor in the tank when unplugged.

Test

⚠ CAUTION ⚠

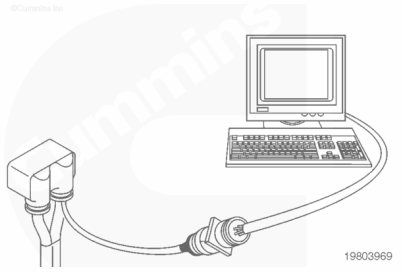
Engine coolant level sensor can be damaged when removed. It should not be removed unless it is being replaced. Leave engine coolant level sensor installed during functional test.



First check the function of the ECM and the OEM wiring harness. See the Initial Check section.

With coolant full (above coolant level sensor, key ON, wait 30 seconds and check for active Fault Codes 197 and/or 2448. If these fault codes become active, a damaged engine coolant level sensor has been detected and needs to be replaced. See the Remove and Install sections in this procedure.

Drain the coolant level below the engine coolant level sensor, see the Preparatory Steps section in this procedure. Key ON, wait for 60 seconds and check to see if Fault Codes 197 and/or 2448 become active. If Fault Codes 197 and/or 2448 do **not** become active, a damaged engine coolant level sensor has been detected and needs to be replaced. See the Remove and Install sections in this procedure.



INSITE™ can be used to monitor the coolant level sensors during troubleshooting. See the parameter names "Engine Coolant Level" and, "Engine Coolant Level 2", if equipped.

While monitoring "Engine Coolant Level" with INSITE™ electronic service tool:

- When the coolant level is correct, the parameter name will display "normal".
- When the coolant is low, the parameter name will display "low or below normal".

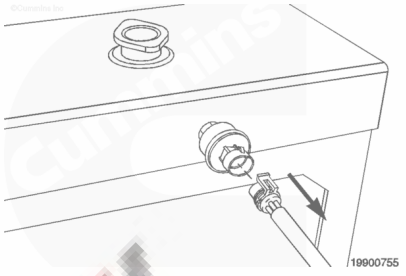
While monitoring "Engine Coolant Level 2" with INSITE™ electronic service tool:

- When the coolant level is correct, the parameter name will display "normal".
- When the coolant is low, the parameter name will display "low coolant".

Remove

Disconnect the electrical connector from the coolant level sensor.

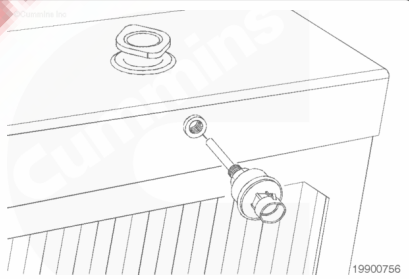
Remove the sensor.



Install

Install and tighten the new sensor according to the vehicle manufacturer's instructions.

Push the electrical connectors together until they lock.



Finishing Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

- Connect the batteries. See equipment manufacturer service information.
- Fill the cooling system. Refer to Procedure 008-018 in Section 8. (/qs3/pubsys2/xml/en/procedures/425/425-008-018-tr.html)
- Operate the engine. Check for leaks.

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Select Service Tools

Recommended Cummins® Service Tools

- No Cummins® Service Tools required.

Additional Service Items

- No additional service items required.

General Information

The coolant temperature sensor is used to measure the temperature of the engine coolant.

The coolant temperature sensor is located on the exhaust side of the engine, near the thermostat.

Use the following procedure for a detailed component location view. Refer to Procedure 100-002 in Section E. (/qs3/pubsys2/xml/en/procedures/425/425-100-002.html)

Preparatory Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

⚠ WARNING ⚠

Do not remove the pressure cap from a hot engine. Wait until the coolant temperature is below 50°C [120°F] before removing the pressure cap. Heated coolant spray or steam can cause personal injury.

⚠ WARNING ⚠

Coolant is toxic. Keep away from children and pets. If not reused, dispose of in accordance with local environmental regulations.

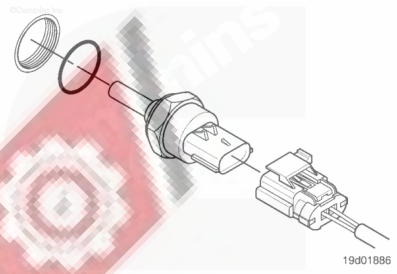
ANADOLU ISUZU AFTER SALES

- Disconnect the batteries. See equipment manufacturer service information.
- Drain the coolant. Refer to Procedure 008-018 in Section 8. (/qs3/pubsys2/xml/en/procedures/425/425-008-018-tr.html)
- Clean the area around the coolant temperature sensor.

Remove

Disconnect the coolant temperature sensor from the engine harness.

Remove the coolant temperature sensor from the engine.

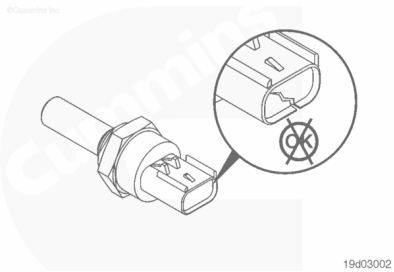


Inspect for Reuse

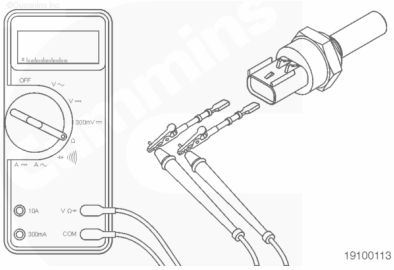
Inspect the engine harness connector and coolant temperature sensor for the following:

- Cracked or broken connector shell
- Missing or damaged connector seals
- Dirt, debris, or moisture in or on the connector pins
- Corroded, bent, broken, pushed back, or expanded pins
- Chipped, cracked, extruded, or sensor damage.

Repair or replace parts, as necessary.



Measure the resistance across the sensor signal and return terminals to make sure they are within the specifications listed in the table below. If the sensor ambient conditions change, the resistance values should be measured **only** after 2.5 minutes of the ambient change.



Temperature (°C)	Temperature (°F)	Resistance (ohms)
0	32	30k to 37k
25	77	9.3k to 10.7k
50	122	3.2k to 3.8k

Temperature (°C)	Temperature (°F)	Resistance (ohms)
80	176	1.1k to 1.3k
100	212	605 to 669

Install

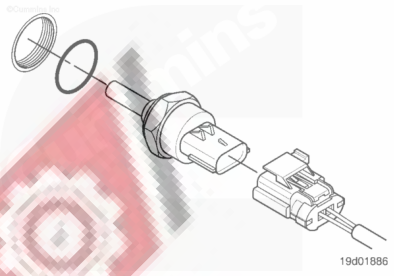
Check to make sure the sensor has an o-ring installed.

Install the sensor into the engine.

Tighten the sensor.

Torque Value: 18 n•m [159 in-lb]

Connect the engine harness connector to the sensor.



Finishing Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

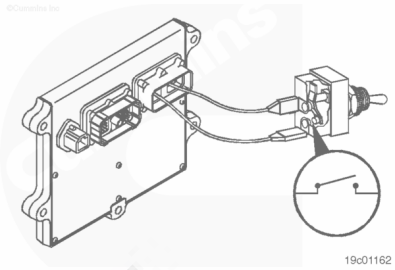
- Fill the cooling system coolant. Refer to Procedure 008-018 in the Section 8. (/qs3/pubsys2/xml/en/procedures/425/425-008-018-tr.html)
- Connect the batteries. See equipment manufacturer service information.
- Operate the engine. Check for leaks.

ANADOLU ISUZU Parçaları

Last Modified: 05-Aug-2016

General Information

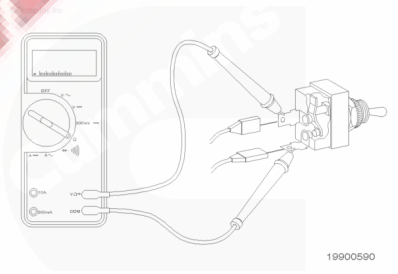
The ON/OFF toggle switch is used to activate or disable the cruise control operation and PTO operation. The cruise control/PTO ON/OFF switch circuit consists of the cruise control ON/OFF switch signal, the switch return, and the OEM cab-mounted toggle switch.



Resistance Check

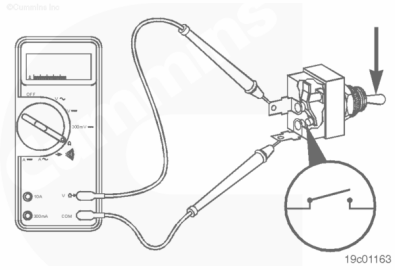
If an electronic service tool is available, monitor the switch for proper operation. If **not**, follow the troubleshooting procedures in this section.

Locate the desired ON/OFF toggle switch. Remove and tag the two connectors from the terminals on the switch. Touch the multimeter probes to the terminals on the switch.



Move the switch to the OFF position and measure the resistance. The multimeter **must** show an open circuit (100k ohms or more).

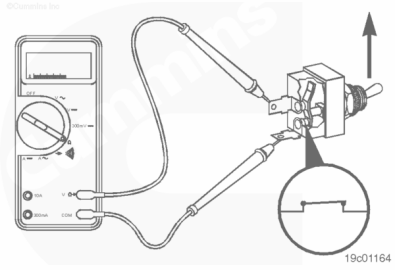
If the circuit is **not** open, the switch has failed. Refer to the OEM troubleshooting and repair manual for the replacement procedures.



Move the switch to the ON position and measure the resistance. The multimeter **must** show a closed circuit (10 ohms or less).

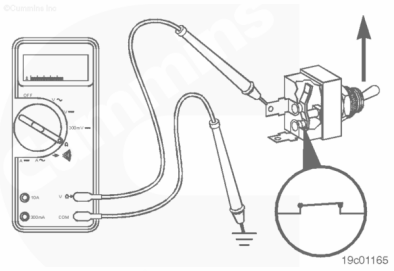
If the circuit is **not** closed, the switch has failed. Refer to the OEM troubleshooting and repair manual for the replacement procedures.

If the resistance value is correct, the switch **must** still be checked for a short circuit to ground.



Check for Short Circuit to Ground

Touch one of the multimeter probes to one of the switch terminals. Touch the other probe to chassis ground. Move the switch to the ON position and measure the resistance. The multimeter **must** show an open circuit (100k ohms or more). If the circuit is **not** open, the switch has failed. Refer to the OEM troubleshooting and repair manual for replacement procedures. If the switch passes all of the previous checks, the circuit **must** be checked for an open circuit, a short circuit to ground, a short circuit from pin to pin, and a short circuit to an external voltage source.



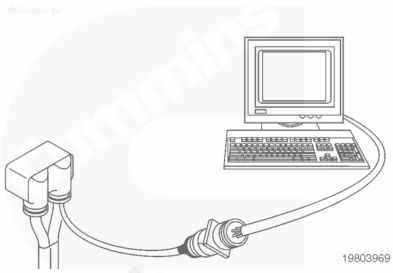
Last Modified: 22-Jun-2015

ANADOLU ISUZU AFTER SALES

Resistance Check

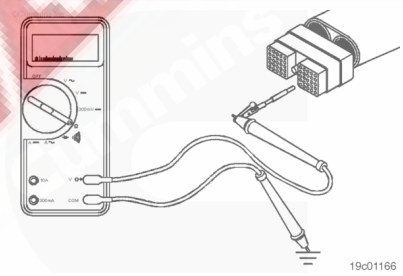
⚠ CAUTION ⚠

Proper leads and/or a Cummins® approved circuit testing tool must be used when working with electrical connectors to prevent pin expansion and damage to the connector.



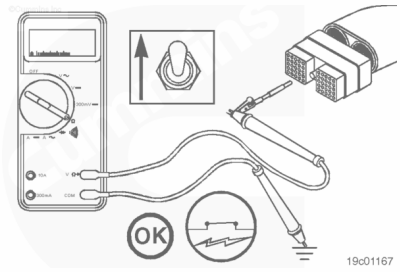
If electronic service tool is available, monitor the switch circuit for proper operation. If **not**, follow the troubleshooting procedures in this section.

Disconnect the original equipment manufacturer (OEM) harness engine interface connector. To determine the location of the connector, see the corresponding engine wiring diagram.



Insert the test lead into the cruise control ON/OFF switch signal pin of the original equipment manufacturer (OEM) harness connector and attach it to the multimeter probe. Touch the other probe to the engine block ground.

Move the ON/OFF switch to the ON position. The multimeter **must** show a closed circuit (10 ohms or less). If the circuit is **not** closed, inspect the cruise control ON/OFF switch input for an open circuit. Refer to the OEM troubleshooting and repair manual.



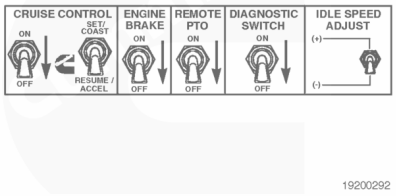
If the resistance is within specification, the cruise control ON/OFF switch input **must** be checked for a short circuit to ground, a short circuit from terminal to terminal, and a short circuit to an external voltage source.

Check for Short Circuit to Ground

To isolate the cruise control circuit when checking for a short circuit, disconnect the OEM harness connector from the ECM and the OEM harness from the cruise control switch.

Disconnect the clutch pedal position switch, idle validation on/off switch, and the accelerator pedal position switch. Set all cab panel switches to the OFF or neutral position.

Set the service brake using the trailer brake hand valve.

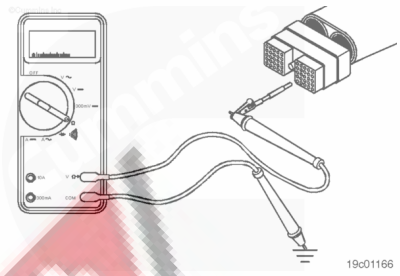


Adjust the multimeter to measure resistance. Insert a test lead into the cruise control ON/OFF switch input of the OEM harness connector and attach it to a multimeter probe. Remove the other multimeter probe from the alligator clip and touch it to the engine block ground.

Measure the resistance.

The multimeter **must** show an open circuit (100k ohms or more). If the circuit is **not** open, there is a short circuit to ground in the cruise control circuit, provided that the switch has been previously checked.

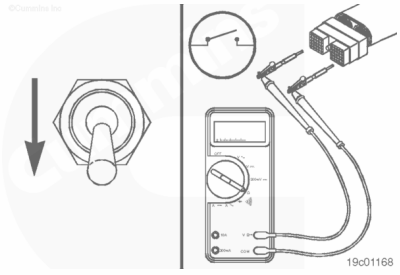
Repair or replace the wire connected to the cruise control ON/OFF switch input in the OEM harness according to the vehicle manufacturer's procedures.



Check for Short Circuit from Pin to Pin

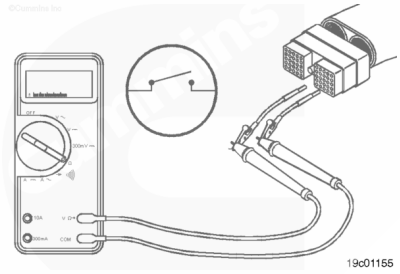
Check for a short circuit from pin-to-pin. Isolate the cruise control circuit by setting the switches as in the previous section. Set the cruise control/PTO ON/OFF switch to the OFF position. Insert the lead into the cruise control ON/OFF switch input. Connect the alligator clip to the multimeter. With the other lead inserted into the switch return wire(s), measure the resistance.

The multimeter **must** show an open circuit (100k ohms or more).



Remove the lead from the cruise control ON/OFF switch input and check all other pins. Measure the resistance. The multimeter **must** show an open circuit (100k ohms or more).

If the circuit is **not** open, there is a short circuit between the cruise control ON/OFF switch input circuit and any pin that shows a closed circuit, provided the switch has previously

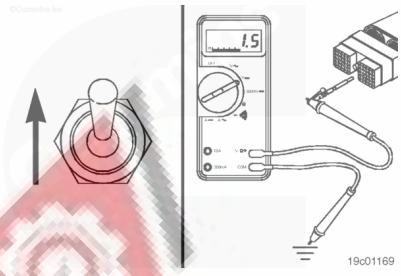


been checked.

Repair or replace the wires in the OEM harness according to the vehicle manufacturer's procedures.

Check for Short Circuit to External Voltage Source

Turn the vehicle keyswitch to the ON position. Set the cruise control/PTO ON/OFF switch to ON. Adjust the multimeter to measure VDC. Insert a test lead into the cruise control ON/OFF switch input and attach it to a multimeter probe. Disconnect the other multimeter probe from the other lead and touch it to the engine block ground. Measure the voltage. The voltage **must** be 1.5 VDC or less.



If the voltage is **not** correct, there is an external voltage source connected to the circuit, or there is a short circuit between the cruise control/PTO ON/OFF switch circuit and a wire carrying power in the OEM harness. Remove the voltage source or repair the wiring in the OEM harness according to the vehicle manufacturer's procedures. Connect all components after completing the repair.

Note : If the cruise control/PTO ON/OFF switch circuit was approved in all of the previous tests, it is functioning correctly.

ANADOLU REFERANS

Last Modified: 25-Jun-2015

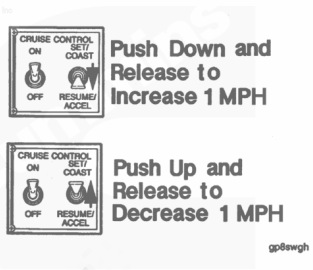
General Information

The cruise control/PTO set/resume select switch has two positions: SET/COAST and RESUME/ACCEL.

The switch can be used for: Cruise Control SET/COAST and RESUME/ACCEL, PTO INCREASE/DECREASE, IDLE INCREASE/DECREASE, ROAD SPEED GOVERNOR INCREASE/DECREASE, DIAGNOSTIC FAULT CODE INCREASE/DECREASE. For additional information, see Section F.

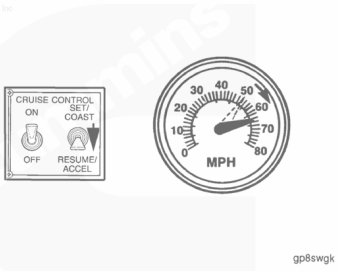
The operator can set the vehicle cruising speed when the switch is in the SET/COAST position. The SET/COAST position can also be used to reduce the vehicle cruising speed. Hold the switch in the SET/COAST position and the vehicle will coast down to a lower speed. When the select switch is released, the cruising speed will be reset.

Note : Some OEM's have switches labeled SET/ACCEL and RESUME/COAST.

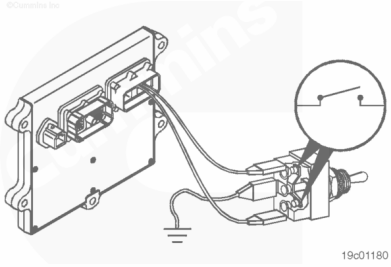


The operator can resume cruise control, after clutching or braking, by moving the switch to RESUME/ACCEL. The vehicle speed will return to the last set mph.

The RESUME/ACCEL position can also be used to increase the vehicle cruising speed. Hold the select switch in the RESUME/ACCEL position and the vehicle will increase in speed. When the switch is released, the cruising speed will be reset.



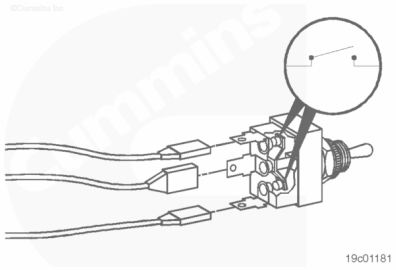
The cruise control/PTO set/resume switch circuit consists of the switch return, the cruise control/PTO resume/accel switch signal, cruise control/PTO set/coast switch signal and the vehicle mounted switch.



Resistance Check

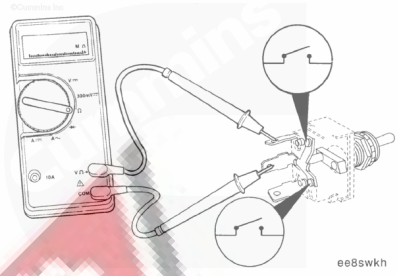
If an electronic service tool is available, monitor the cruise control/PTO set/resume select switch for proper operation. If **not**, follow the troubleshooting procedures in this section.

Label the wires with the location on the switch or the wire number. Remove the three electrical connectors from the switch.



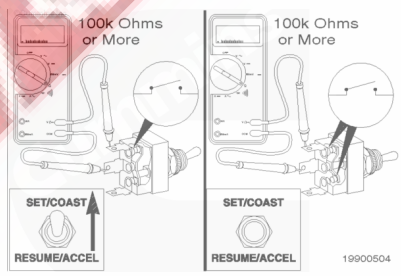
Adjust the multimeter to measure resistance.

Touch one multimeter probe to the center terminal of the switch. Touch the other multimeter probe to the RESUME/ACCEL terminal of the switch.

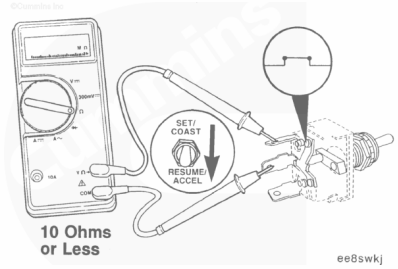


Hold the switch in the SET/COAST position. The multimeter **must** show an open circuit (100k ohms or more) when the switch is held in the SET/COAST position and after it is released. If the circuit is **not** open, the switch has failed.

Refer to the OEM troubleshooting and repair manual for replacement procedures.



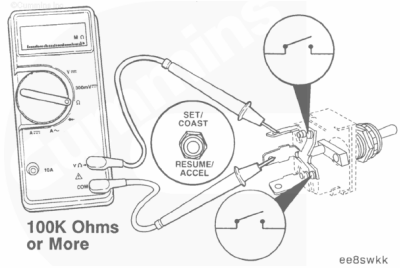
Hold the switch in the RESUME/ACCEL position. The multimeter **must** show a closed circuit (10 ohms or less) when the switch is held in the RESUME/ACCEL position.



When the switch is released, the multimeter **must** show an open circuit (100k ohms or more). If the multimeter does **not** show the correct values in either test, the switch has failed.

Refer to the OEM troubleshooting and repair manual for replacement procedures.

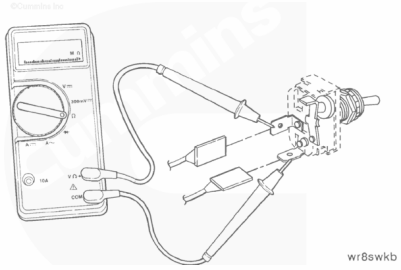
If the resistance value is correct, the switch **must** still be checked for a short circuit to ground.



Touch one multimeter probe to the center terminal of the switch. Touch the other multimeter probe to the SET/COAST terminal of the switch.

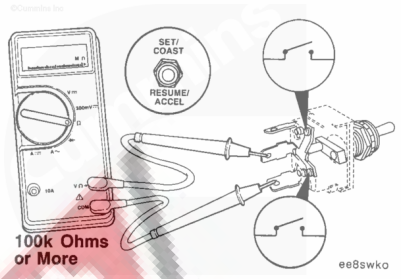
Hold the switch in the SET/COAST position.

The multimeter **must** show a closed circuit (10 ohms or less) while the switch is held to the SET/COAST position.



When the switch is released, the multimeter **must** show an open circuit (100k ohms or more). If the multimeter does **not** show the correct values in either test, the switch has failed.

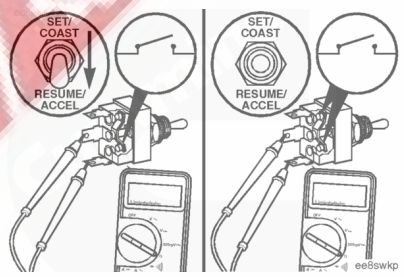
Refer to the OEM troubleshooting and repair manual for replacement procedures.



Move the switch to the RESUME/ACCEL position.

The multimeter **must** show an open circuit (100k ohms or more) when the switch is held in the RESUME/ACCEL position and when it is released. If the circuit is **not** open, the switch has failed.

Refer to the OEM troubleshooting and repair manual for replacement procedures.

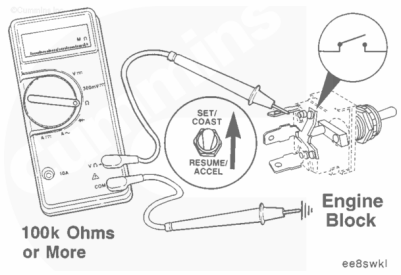


Check for Short Circuit to Ground

Adjust the multimeter to measure resistance.

Touch one multimeter probe to the RESUME/ACCEL terminal of the switch. Touch the other multimeter probe to the chassis ground. Move the switch to the SET/COAST position then to the RESUME/ACCEL position. Measure the resistance.

The multimeter **must** show an open circuit (100k ohms or more) when the switch is in all positions. If the circuit is **not** open, the switch has failed. Refer to the OEM troubleshooting and repair manual for replacement procedures.



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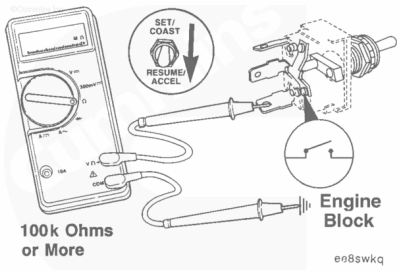
Touch one multimeter probe to the SET/COAST terminal of the switch. Touch the other multimeter probe to chassis ground. Move the switch to the RESUME/ACCEL position, then to the SET/COAST position. Measure the resistance.

The multimeter **must** show an open circuit (100k ohms or more) when the switch is in all positions. If the circuit is **not** open, the switch has failed. Refer to the OEM troubleshooting and repair manual for replacement procedures.

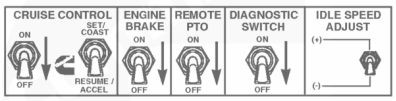


Last Modified: 22-Jun-2015

ANADOLU ISUZU
AFTER SALES

General Information

In addition to cruise control functions, the cruise control select switch also provides for increasing/decreasing idle speed, PTO speed, fault code flashout, and road speed governor limit.

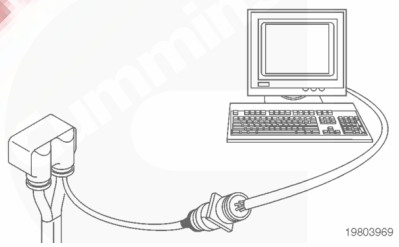


19200292

Resistance Check

⚠ CAUTION ⚠

Proper leads and/or a Cummins® approved circuit testing tool must be used when working with electrical connectors to prevent pin expansion and damage to the connector.

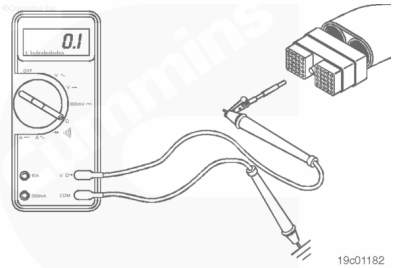

19803969

If electronic service tool is available, monitor the cruise control/PTO set/resume select switch circuit for proper operation. If **not**, follow the troubleshooting procedures in this section.

Disconnect the original equipment manufacturer (OEM) harness engine interface connector. To determine the location of the connector, see the corresponding engine wiring diagram.

Insert a test lead into the cruise control/PTO set/coast switch signal of the OEM harness connector and connect the alligator clip to the multimeter probe.

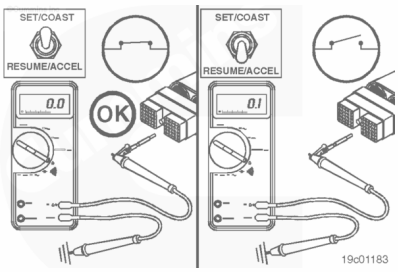
Touch the other probe to engine block ground.



19c01182

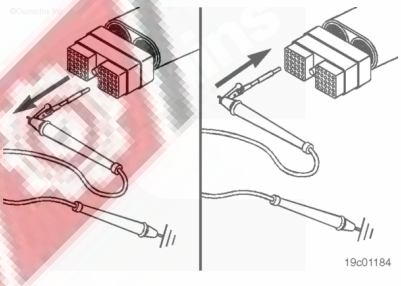
Hold the cruise control select switch in the SET/COAST position. The multimeter **must** show a closed circuit (10 ohms or less) while holding the switch in the SET/COAST position and return to an open circuit (100k ohms or more)

when the switch is released. The circuit **must** remain an open circuit (100k ohms or more) when the switch is in the RESUME/ACCEL position.



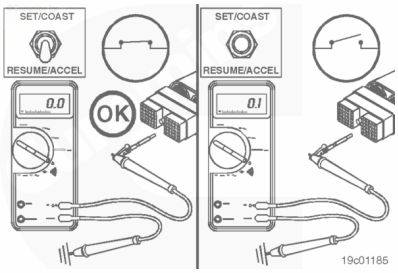
If the resistance values are **not** correct, make sure the cruise control/PTO set/coast input and the cruise control/PTO resume/accel input wires are properly installed on the cruise control select switch. If both control wires are correctly installed, inspect the cruise control/PTO set/coast input and the cruise control/PTO resume/accel wires for an open circuit, provided the cruise control select switch has been previously checked.

Remove the lead from the cruise control/PTO set/coast switch signal and insert it into the cruise control/PTO resume/accel switch signal.



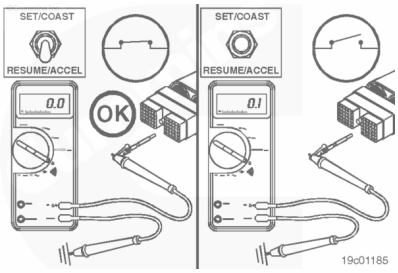
Hold the cruise control select switch in the RESUME/ACCEL position. The multimeter **must** show a closed circuit (10 ohms or less) when the switch is in the RESUME/ACCEL position and an open circuit (100k ohms or more) when the switch is released.

The circuit **must** remain an open circuit (100k ohms or more) when the switch is held in the SET/COAST position.

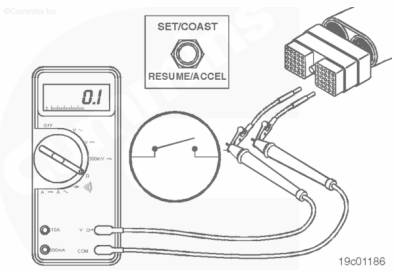


If the resistance values are **not** correct, make sure the cruise control/PTO resume/accel wire is properly installed on the cruise control select switch. If the cruise control/PTO resume/accel wire is properly installed on the cruise control select switch, inspect the cruise control/PTO resume/accel signal for an open circuit, provided the cruise control select switch has been previously checked.

If the resistance values are correct in the previous checks, the cruise control/PTO set/coast signal and cruise control/PTO resume/accel signal **must** still be checked for a short circuit to ground, a short circuit from pin to pin, and a short circuit to an external voltage source.



Check for Short Circuit from Pin to Pin



Isolate the cruise control/PTO set/resume select switch circuit as described in the previous section. Insert a test lead into the cruise control/PTO set/coast switch signal pin of the OEM harness connector. Insert the other lead into the first pin in the connector. Connect the alligator clips to the multimeter probes. Measure the resistance.

The multimeter **must** show an open circuit (100k ohms or more).

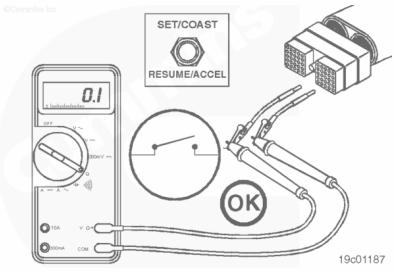
Remove the lead from the first pin in the connector and check all other pins. The multimeter **must** show an open circuit (100k ohms or more).

If the circuit is **not** open, there is a short circuit from the wire connected to the cruise control/PTO set/coast switch signal pin and any pin that measured less than 100k ohms.

Repair or replace the wires in the OEM harness. Refer to Procedure 019-071 (/qs3/pubsys2/xml/en/procedures/99/99-019-071.html).

Remove the lead from the cruise control/PTO set/coast signal pin and insert it into the cruise control/PTO resume/accel switch signal pin. Insert the other lead into the first pin in the connector.

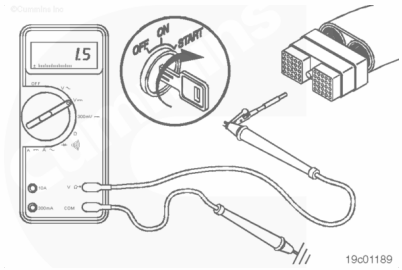
Measure the resistance. The multimeter **must** show an open circuit (100k ohms or more).



Remove the lead from the first pin in the connector and measure the resistance to all other pins. The multimeter **must** show an open circuit (100k ohms or more). If the circuit is **not** open, there is a short circuit between the wire connected to the cruise control/PTO resume/accel switch signal pin and any pin that measured less than 100k ohms.

Repair or replace the wires in the OEM harness. Refer to Procedure 019-071 (/qs3/pubsys2/xml/en/procedures/99/99-019-071.html).

Check for Short Circuit to External Voltage Source



Isolate the cruise control/PTO resume/accel switch circuit as described in the previous section. Turn the vehicle keyswitch to the ON position. Adjust the multimeter to measure VDC. Insert a test lead into the cruise control/PTO resume/accel switch signal of the OEM harness connector. Connect the test lead alligator clip to the positive (+) multimeter probe. Touch the negative (-) multimeter probe to the engine block ground and measure the voltage. The multimeter **must** show less than 1.5 VDC.

If the voltage value is **not** correct, there is an external voltage source short circuit to the cruise control/PTO set/coast switch signal in the OEM harness. Remove the voltage source. Repair or replace the wire in the OEM harness. Refer to Procedure 019-071 (/qs3/pubsys2/xml/en/procedures/99/99-019-071.html).

Remove the lead from the cruise control/PTO set/coast switch input pin and insert it into the cruise control/PTO resume/accel switch input pin. Touch the negative multimeter probe to the engine block ground and measure the voltage. The multimeter **must** show less than 1.5 VDC.

If the voltage value is **not** correct, there is an external voltage source short circuit to the cruise control/PTO resume/accel switch input pin in the OEM harness. Remove the voltage source. Repair or replace the wire in the OEM harness. Refer to Procedure 019-071 (/qs3/pubsys2/xml/en/procedures/99/99-019-071.html).

Connect all components after completing the repair.

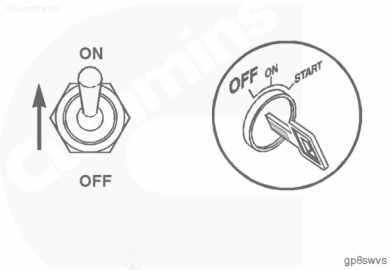
ANADOLU İSUZU AFTERSALES

Last Modified: 25-Jun-2015

General Information

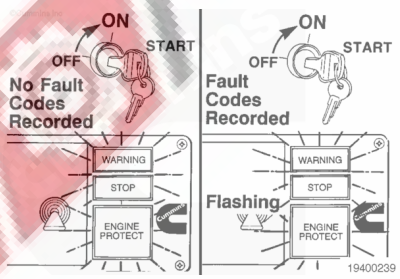
The diagnostic ON/OFF switch circuit signals the system that the operator is requesting to read any active fault code recorded in the ECM.

Note : Some OEM's use a shorting plug rather than a switch.



When the ECM receives the signal from the diagnostic ON/OFF switch, the yellow and red warning lights will come on and start flashing if any active fault code is recorded in the ECM. If both warning lights remain on and do **not** flash, there are no active fault codes present.

Note : The equipment **must** be stationary. If road speed is detected, the flashing sequence will **not** occur.

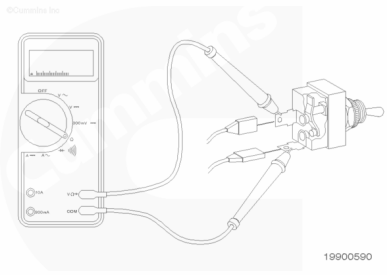


Resistance Check

If an electronic service tool is available, monitor the switch for proper operation. If **not**, follow the troubleshooting procedures in this section.

Locate the desired ON/OFF toggle switch. Remove and tag the two connectors from the terminals on the switch.

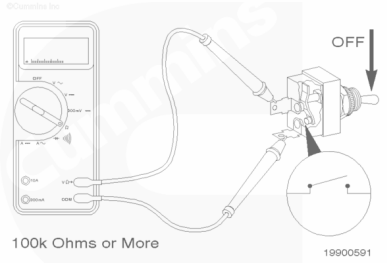
Touch the multimeter probes to the terminals on the switch.



Move the switch to the OFF position and measure the resistance. The multimeter **must** show an open circuit (100k ohms or more).

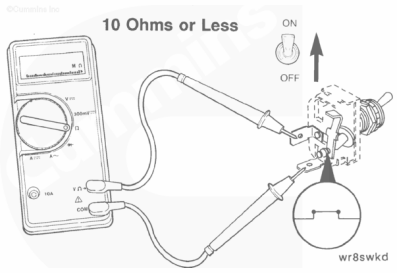
If the circuit is **not** open, the switch has failed.

Refer to the OEM troubleshooting and repair manual for the replacement procedures.



ANADOLU ISUZU
SPARE PARTS

Move the switch to the ON position and measure the resistance. The multimeter **must** show a closed circuit (10 ohms or less). If the circuit is **not** closed, the switch has failed.

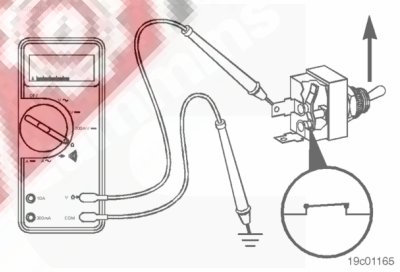


Refer to the OEM troubleshooting and repair manual for the replacement procedures.

If the resistance value is correct, the switch **must** still be checked for a short circuit to ground.

Check for Short Circuit to Ground

Touch one of the multimeter probes to one of the switch terminals. Touch the other probe to chassis ground. Move the switch to the ON position and measure the resistance. The multimeter **must** show an open circuit (100k ohms or more). If the circuit is **not** open, the switch has failed. Refer to the OEM troubleshooting and repair manual for replacement procedures. If the switch passes all of the previous checks, the circuit **must** be checked for an open circuit, a short circuit to ground, a short circuit from pin to pin, and a short circuit to an external voltage source.



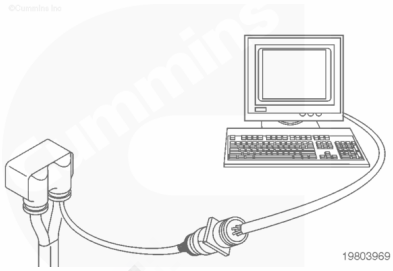
ANADOLU ISUZU AFTER SALES

Last Modified: 22-Jun-2015

Resistance Check

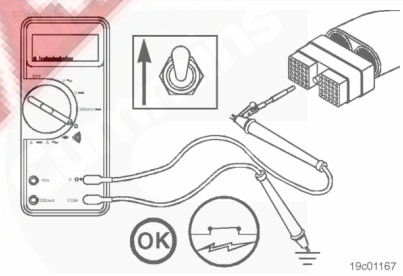
⚠ CAUTION ⚠

Proper leads and/or a Cummins® approved circuit testing tool must be used when working with electrical connectors to prevent pin expansion and damage to the connector.



If electronic service tool is available, monitor the switch circuit for proper operation. If **not**, follow the troubleshooting procedures in this section.

Disconnect the original equipment manufacturer (OEM) harness engine interface connector. To determine the location of the connector, see the corresponding engine wiring diagram. Insert the test lead into the diagnostic test mode switch signal pin in the OEM harness connector and connect it to the multimeter probe.



Touch the other probe to the engine block or chassis ground.

Move the ON/OFF switch to the ON position.

If the OEM wired the switch return to chassis ground, the multimeter **must** show a closed circuit (10 ohms or less). If the circuit is **not** closed, inspect the diagnostic test mode switch signal wire for an open circuit.

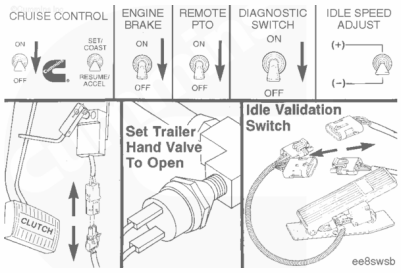
If the OEM wired the switch return to the OEM wire harness, the multimeter **must** show an open circuit (100k ohms or more). If the circuit is **not** open, inspect the diagnostic test mode switch signal wire for a closed circuit.

Refer to the OEM troubleshooting and repair manual.

If the resistance is within specification, the diagnostic test mode switch signal wire **must** be checked for a short circuit to ground, a short circuit from terminal to terminal, and a short circuit to an external voltage source.

Check for Short Circuit to Ground

To isolate the diagnostic test mode switch signal circuit when checking for an electrical short, turn all cab panel switches to the OFF or neutral position.



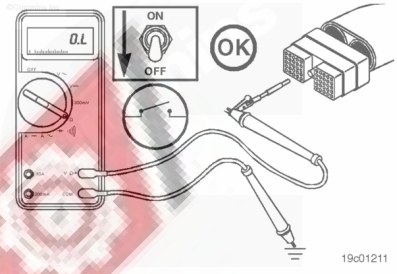
Set the service brake using the trailer brake hand valve.

Disconnect the clutch pedal position switch.

Disconnect the idle validation switch.

Note : Some equipment may vary, depending on OEM application.

Disconnect the OEM harness connector from the electronic control unit. Set the diagnostic test mode switch to the OFF position.



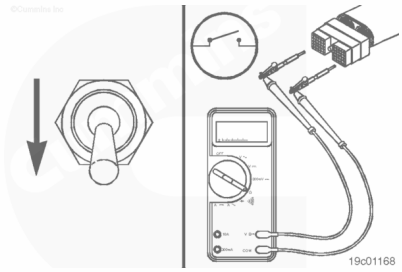
Insert one of the test leads into the diagnostic test mode switch signal pin of the OEM harness connector and connect it to a multimeter probe.

Touch the other probe to engine block or chassis ground.

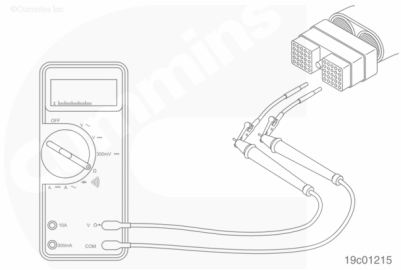
The multimeter **must** show an open circuit (100k ohms or more).

Check for Short Circuit from Pin to Pin

Check for a short circuit from pin-to-pin. Isolate the switch circuit by setting the cab panel switches as described in the previous section. Set the diagnostic test mode switch to the OFF position. Insert a test lead into the switch return pin of the OEM harness connector and connect it to the multimeter probe. With the other lead inserted into the diagnostic test mode switch signal pin of the connector, measure the resistance. The multimeter **must** show an open circuit (100k ohms or more).



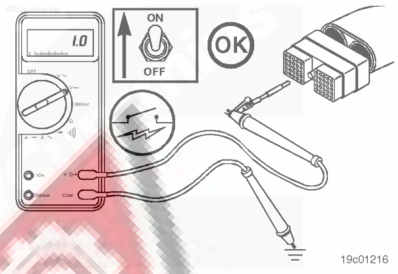
Remove the lead from the switch return and test all pins in the connector. Measure the resistance. The multimeter **must** show an open circuit (100k ohms or more).



If the circuit is **not** open, there is a short circuit between the switch circuit and any pin that shows a closed circuit, provided the switch has previously been checked. Repair or

replace the wires in the OEM harness. Refer to Procedure 019-071 (/qs3/pubsys2/xml/en/procedures/99/99-019-071.html).

Check for Short Circuit to External Voltage Source



Turn the vehicle keyswitch to the ON position. Set the diagnostic test mode switch to ON. Adjust the multimeter to measure VDC. Insert a test lead into the diagnostic test mode switch signal pin of the OEM harness connector. Touch the other lead to the engine block or chassis ground. Measure the voltage. The voltage **must** be 1.5 VDC or less.

If the voltage is **not** correct, there is an external voltage source connected to the circuit or there is a short circuit between the switch circuit and a wire carrying power in the OEM harness. Remove the voltage source or repair the wiring in the OEM harness. Refer to Procedure 019-071 (/qs3/pubsys2/xml/en/procedures/99/99-019-071.html).

Connect all components after completing the repair.

ANADOLU ISUZU AFTER SALES

Last Modified: 25-Jun-2015

Select Service Tools

Recommended Cummins® Service Tools

- Electrical contact cleaner, Part Number 3824510

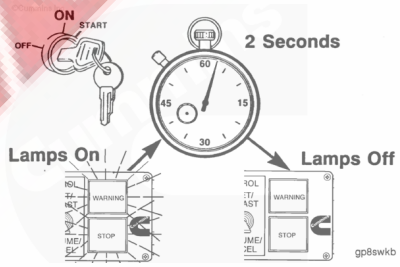
Additional Service Items

- No additional service items required.

Initial Check

Turn the keyswitch to the ON position while monitoring the fault lamps. The fault lamps **must** illuminate for 2 to 3 seconds.

If the lamps do **not** illuminate, check for burned out bulbs.



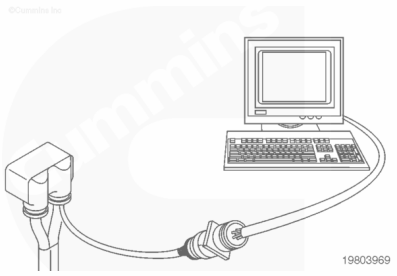
Turn the keyswitch to the OFF position.

Connect an electronic service tool to the vehicle data link.

Turn the keyswitch to the ON position.

Select the monitor mode on the electronic service tool. The electronic service tool **must** be able to communicate with the engine control module (ECM). If the ECM will **not** communicate with the service tool, see the Communication Error - Electronic Service Tool or Control Device symptom tree in Section TS.

Record the values of ECM Distance Offset, ECM Time Offset, Engine Distance Offset, and Engine Time Offset prior to replacement or calibration of the ECM. These parameters can be found in the Trip Information section of Features and Parameters.



Preparatory Steps

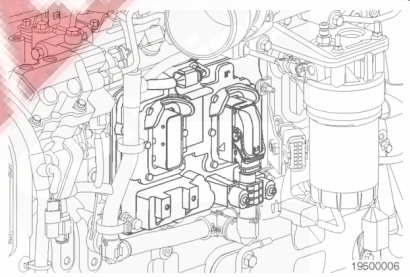
⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

- Disconnect the batteries. See equipment manufacturer service information.

Remove

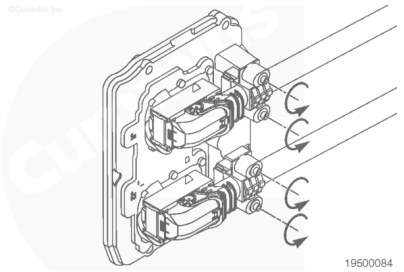
The ECM is located at the middle of the engine block on the cold side of the engine.



Note : Record all programmable parameters, features, and calibration information from the old ECM before disconnecting the harness connectors. This information will be needed to program the new ECM.

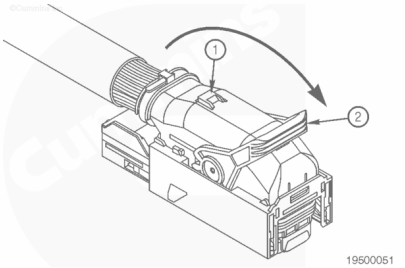
Note : Do **not** remove the wire ties attaching the hold-down clamps to the wire harness.

Remove the wire harness hold down clamps from the ECM.



⚠ CAUTION ⚠

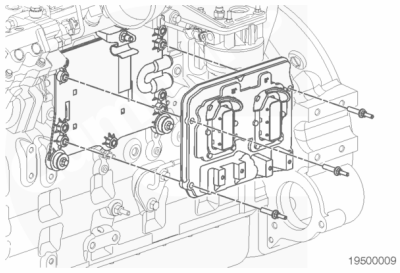
Do NOT close the lever after the connector has been removed from the ECM. Attempting to do so will cause damage to the connector.



Remove the original equipment manufacturer (OEM) connector and engine harness connector from the ECM by pressing down on the locking tab (1) and pulling up on the lever (2).

Remove the capscrews that secure the ECM to the ECM mounting plate.

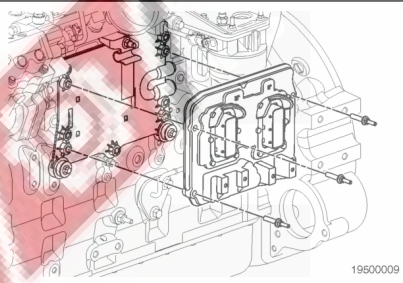
Remove the ECM.



Install

⚠ CAUTION ⚠

Do not paint the back side of the ECM. Make sure no grease or dirt is between the ECM and the mounting plate.



⚠ CAUTION ⚠

Make sure the ECM ground strap is attached to the lower-left ECM mounting capscrew. Failure to install this ground strap can cause damage to the ECM.

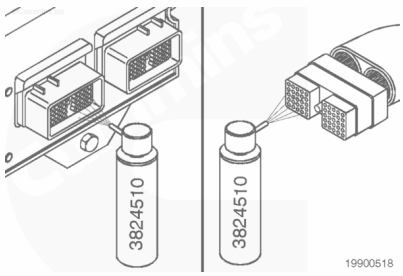
Install the new ECM to the mounting plate.

Tighten the capscrews.

Torque Value: 18 n•m [159 in-lb]

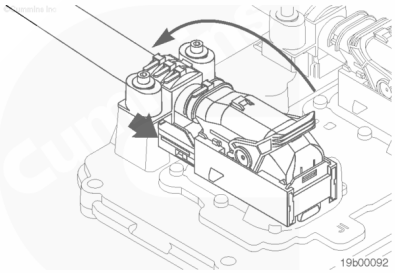
⚠ CAUTION ⚠

Do not blow compressed air into the ECM ports or connectors. Compressed air can contain moisture due to condensation.



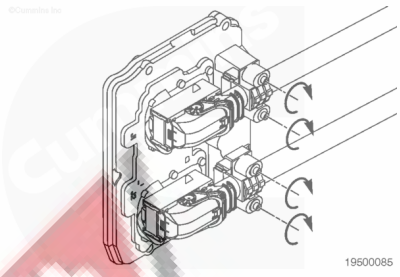
Remove all dirt and moisture from the ECM connector ports and harness connectors. Use quick-dry electrical contact cleaner, Part Number 3824510.

Connect the harness to the ECM by placing the harness connector into the ECM header. Pull back on the locking lever until the connector is fully seated and the lever locking tab is engaged.



⚠ CAUTION ⚠

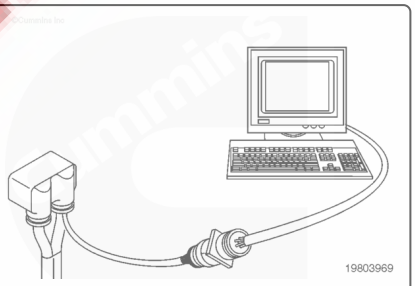
Do not overtighten the harness hold down clamp mounting screws or damage to the ECM will occur.



Install the wire harness hold-down clamps.

Use the following procedure for engine wiring harness torque. Refer to Procedure 019-043 in Section 19. (/qs3/pubsys2/xml/en/procedures/425/425-019-043.html)

Note : When an ECM is replaced, the new ECM **must** be calibrated. Refer to Procedure 019-032 in Section 19. (/qs3/pubsys2/xml/en/procedures/105/105-019-032.html)



Adjust the values of ECM Distance Offset, ECM Time Offset, Engine Distance Offset, and Engine Time Offset after calibrating the ECM. These parameters can be found in the Trip Information section of Features and Parameters

Finishing Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

- Connect the batteries. See equipment manufacturer service information.
- Operate the engine. Check for loose components.

Last Modified: 05-Aug-2016



Select Service Tools

Recommended Cummins® Service Tools

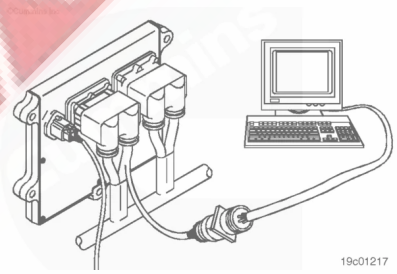
- Cummins® Electronic Service Tool or equivalent

Additional Service Items

- No additional service items required.

General Information

Note : Due to the number of various engine control module (ECM) configurations, this procedure has been written to be common. **Not** all illustrations within this procedure will represent the application that is being worked on.



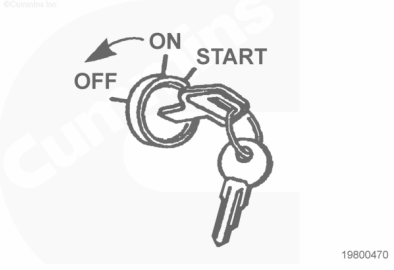
ECM calibrations can be performed by the recommended Cummins® electronic service tool or equivalent.

After an ECM is replaced or calibrated, the actual engine hours / distance **must** be entered correctly into the ECM.

Record the values of ECM Distance Offset, ECM Time Offset, Engine Distance Offset, and Engine Time Offset prior to replacement or calibration of the ECM. These parameters can be found in the Trip Information section of Features and Parameters.

Initial Check

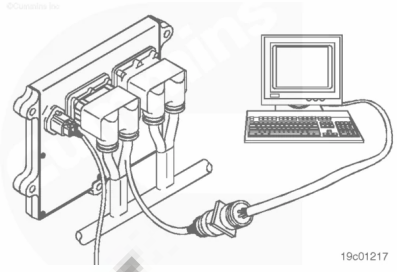
Note : If the tool will **not** communicate with the keyswitch in the ON position, cycle the keyswitch and try again.



The ECM calibration process occurs with the keyswitch turned ON. **Always** follow the instructions on the service tool screens.

Preparatory Steps

Connect the electronic service tool to the service tool data link, which is located on the engine or in the cab.



After an ECM is replaced or calibrated, the actual engine hours / distance **must** be entered correctly into the ECM.

Input the values of ECM Distance Offset, ECM Time Offset, Engine Distance Offset, and Engine Time Offset prior to replacement or calibration of the ECM. These parameters can be found in the Trip Information section of Features and Parameters.

Verify vehicle odometer is equal to the value recorded before ECM removal. Contact OEM service location if values are incorrect.

Following calibration download, if new fault codes or fault conditions exist, perform the following steps in order to understand if the calibration is working correctly and is the appropriate calibration for the application.

If it is suspected that the calibration is **not** working correctly, make sure that the appropriate calibration was loaded for the engine, equipment, and application.

If no issues are found, no further action is required.

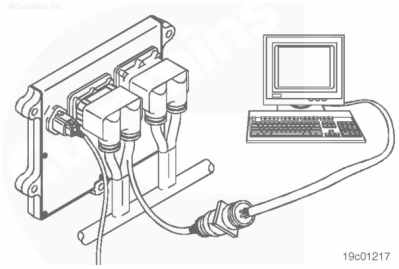
Inspect

Establish if the suspected feature creating the problem is operating correctly. Reference the relevant “Electronic Controlled Fuel System” (Procedure 101-007) in Section 1 of the appropriate Operation and Maintenance Manual.

Note : To access the “Adjustable Engine Features” section, either select Help -> Contents from the menu

bar, or press F1 with an individual feature within the Features and Parameters section in the electronic service tool.

Review the "Adjustable Engine Features” section to determine if the suspected error is due to an incorrectly set adjustable engine feature.

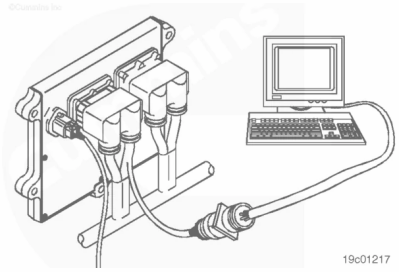


Use QuickServe™ Online to inspect the calibraton revision history.

1. Log into QuickServe™ Online
2. Select "My Applications"
3. Select "ECM Calibraton Revisions"
4. Enter the calibration code and select "Search"
5. Review the calibration revision information.

Note : The calibration revision history provides information relating to changes made to a calibration each time a new revision is released. This information can be used to establish if there is a commonality between changes made to the calibration and the symptoms being observed. The calibration revision history can also be downloaded in Excel format by selecting “Spreadsheet” in the record filter box.

Note : The greater the number of parameters, the slower the rate at which they can be logged. Therefore, **only** log the minimum number of parameters if sample rate is important.



If no issue can be identified using the steps listed above, the following information should be collected to allow the issue to enter the technical escalation chain:

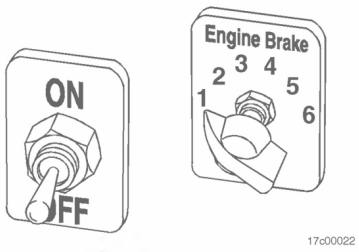
1. Engine specifics engine serial number (ESN), application, rating, engine hours, maintenance history, etc.)
2. ECM codes (the codes before and after, including revision numbers)
3. ECM images (before and after calibration downloads)
4. Data logs (utilize existing, pre-defined parameter groups, or use the relevant wiring diagram to identify if multiple circuits utilize a common supply or ground, or monitor parameters which logically would be linked - i.e. User Fuelling State, Engine Speed, Commanded Fuel Rail Pressure, Measured Fuel Rail Pressure, etc.).

Last Modified: 07-Aug-2020



General Information

The engine brake ON/OFF switch circuit signals the system that the operator is requesting the engine brake system to be activated. The engine brake level switch determines what percentage of engine braking power will be used for engine braking. Three inputs to the electronic control module (ECM) from the engine brake level switch are used to communicate the setting to the ECM. Engine brake selector number 1 signal, engine brake selector number 2 signal, and engine brake selector number 3 signal in the original equipment manufacturer (OEM) connector are used. Various combinations of the three wires are used to represent the six switch positions.



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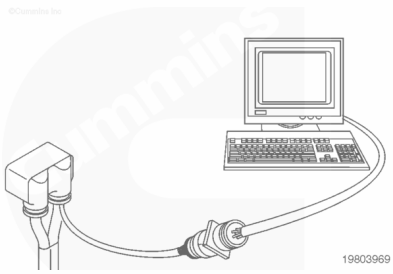
After the ECM receives the signal from the engine brake ON/OFF switch and all other engine braking preconditions are met (engine RPM and road speed limits), the ECM will supply 12 VDC to the appropriate engine brake solenoids depending on how the 3 or 6 position engine brake level switch is set.

Resistance Check

If an electronic service tool is available, monitor the engine brake ON/OFF switches for proper operation. If **not**, follow the troubleshooting procedures in this section.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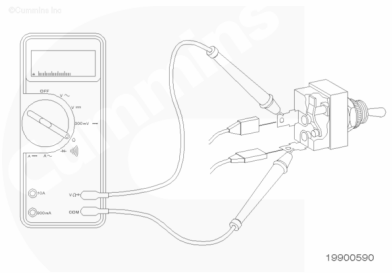
Locate the engine brake ON/OFF switch. Remove the electrical connectors from the switch.

Label the wires with the location on the switch or the wire number. Remove the electrical connectors from the switch.

Adjust the multimeter to measure resistance.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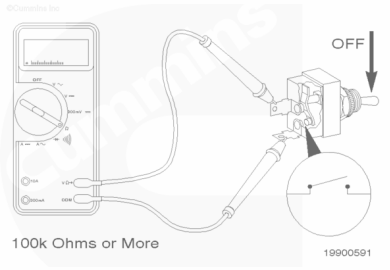
Touch one multimeter probe to one of the terminals of the switch. Touch the other multimeter probe to the other terminal of the switch.

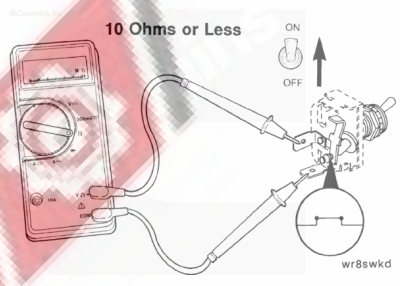
Move the switch to the OFF position. The multimeter **must** show an open circuit (100k ohms or more). If the circuit is **not** open, the switch has failed.

Refer to the OEM troubleshooting and repair manual for replacement procedures.



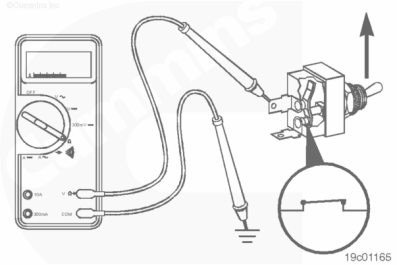
Place the switch in the ON position. The multimeter **must** show a closed circuit (10 ohms or less). If the circuit is **not** closed, the switch has failed.

Refer to the OEM troubleshooting and repair manual for replacement procedures.



Check for Short Circuit to Ground

Touch one of the multimeter probes to one of the switch terminals. Touch the other probe to chassis ground. Move the switch to the ON position and measure the resistance. The multimeter **must** show an open circuit (100k ohms or more). If the circuit is **not** open, the switch has failed. Refer to the OEM troubleshooting and repair manual for replacement procedures. If the switch passes all of the previous checks, the circuit **must** be checked for an open circuit, a short circuit to ground, a short circuit from pin-to-pin, and a short circuit to an external voltage source.

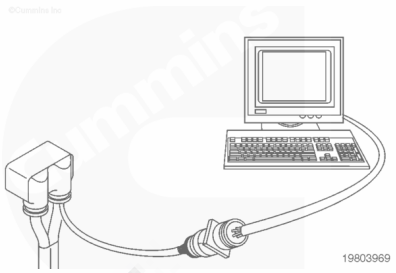


Last Modified: 29-Jun-2015

Resistance Check

⚠ CAUTION ⚠

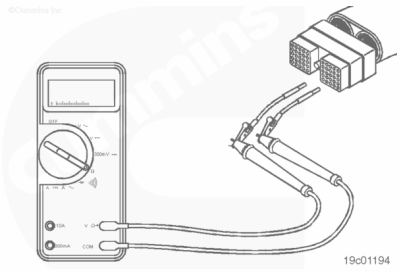
Proper leads and/or a Cummins® approved circuit testing tool must be used when working with electrical connectors to prevent pin expansion and damage to the connector.



If electronic service tool is available, monitor the engine brake switch circuit for proper operation. If **not**, follow the troubleshooting procedures in this section.

Disconnect the original equipment manufacturer (OEM) harness engine interface connector. To determine the location of the connector, see the corresponding engine wiring diagram.

Insert one of the test leads into the switch return of the OEM harness connector and connect the alligator clip to the multimeter probe. Insert the other lead into engine brake selector signal number 1 of the OEM harness connector and connect the alligator clip to the other multimeter probe.



Move the engine brake ON/OFF switch to the ON position. Move the engine brake level switch to position number 1 for a six-position switch or to position number 2 for a three-position switch. The multimeter **must** show a closed circuit (10 ohms or less). If the circuit is **not** closed, inspect the switch return and engine brake selector signal number 1 for an open circuit, provided that the switch has been previously checked. Refer to the OEM troubleshooting and repair manual for repair procedures. If the resistance is within the specification, the switch return and engine brake selector signal number 1 **must** be checked for a short circuit to ground, a short circuit from pin to pin, and a short circuit to an external voltage source.

Remove the lead from engine brake selector signal number 1 and insert it into engine brake selector signal number 2 of the OEM harness connector.

Move the engine brake ON/OFF switch to the ON position. Move the engine brake level switch to position number 2 for a six-position switch or to position number 1 for a three-

position switch.

The multimeter **must** show a closed circuit (10 ohms or less). If the circuit is **not** closed, inspect engine brake selector signal number 2 wire for an open circuit, provided that the switch has been previously checked. Refer to the OEM troubleshooting and repair manual for repair procedures.

If the resistance is within the specification, engine brake selector signal number 2 wire **must** be checked for a short circuit to ground, a short circuit from pin to pin, and a short circuit to an external voltage source.

Remove the lead from engine brake selector signal number 2 and insert it into engine brake selector signal number 3 of the OEM harness.

Move the engine brake ON/OFF switch to the ON position. Move engine brake level switch to position number 3.

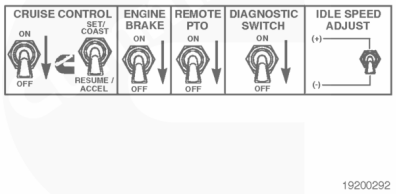
The multimeter **must** show a closed circuit (10 ohms or less). If the circuit is **not** closed, inspect the engine brake selector signal number 3 wire for an open circuit, provided that the switch has been previously checked. Refer to the OEM troubleshooting and repair manual for repair procedures.

If the resistance is within the specification, the engine brake selector signal number 3 wire **must** be checked for a short circuit to ground, a short circuit from pin to pin, and a short circuit to an external voltage source.

Connect all components after completing the repair.

Check for Short Circuit to Ground

To isolate the engine brake circuit when checking for an electrical short, turn all cab panel switches to the OFF or neutral position.



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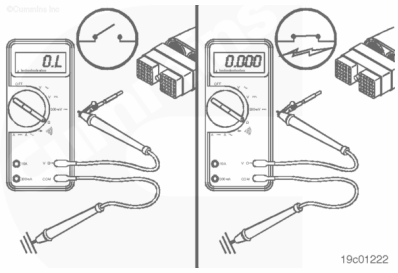
Move the engine brake level switch to position number 1 for a six-position switch or position number 2 for a three-position switch.



Insert a test lead into engine brake selector signal number 1 pin of the OEM harness connector and connect it to a multimeter probe.

Touch the other multimeter probe to the engine block ground.

Switch the engine brake ON/OFF switch to the OFF position.

Measure the resistance.

The multimeter **must** show an open circuit (100k ohms or more). If the circuit is **not** open, there is a short circuit to ground in the engine brake circuit, provided the engine brake ON/OFF switch and engine brake selector switch have been previously checked.

Repair or replace the wire connected to the switch return or engine brake selector signal number pin 1 in the OEM harness connector according to the vehicle manufacturer's procedures.

Remove the lead from engine brake selector signal number 1 pin and insert it into engine brake selector signal number 2 pin of the OEM harness connector.

Move engine brake level switch to position number 2 for a six-position switch or to position number 1 for a three-position switch.

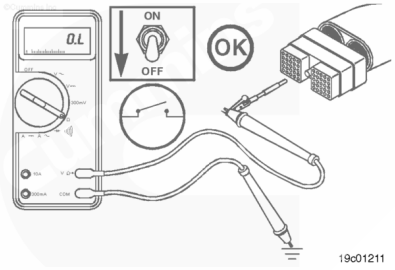
Switch the engine brake ON/OFF switch to OFF.

Measure the resistance.

The multimeter **must** show an open circuit (100k ohms or more). If the circuit is **not** open, there is a short circuit to ground in the engine brake circuit, provided the engine brake ON/OFF switch has been previously checked.

Repair or replace the wire connected to engine brake selector signal number 2 pin in the OEM harness according to the vehicle manufacturer's procedures.

Remove the lead from engine brake selector signal number 2 pin and insert it into engine brake selector signal number 3 pin of the OEM harness connector.



Move engine brake level switch to position number 3.

Switch the engine brake ON/OFF switch to the OFF position.

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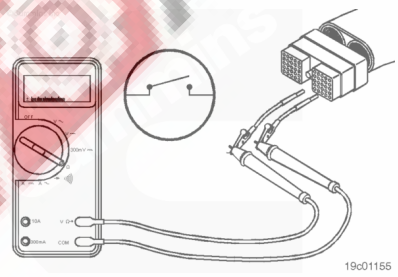
Measure the resistance with the multimeter.

The multimeter **must** show an open circuit (100k ohms or more). If the circuit is **not** open, there is a short circuit to ground in the engine brake circuit, provided the engine brake ON/OFF switch has been previously checked.

Repair or replace the wire connected to engine brake selector signal number 3 pin in the OEM harness according to the vehicle manufacturer's procedures.

Check for Short Circuit from Pin to Pin



Isolate the circuit by setting the cab panel switches as described in the previous section. Set the engine brake ON/OFF switch to the ON position. Place engine brake level to position number 6 for a six-position switch or position number 3 for a three-position switch.

Insert a test lead into the switch return of the OEM harness connector and check all pins except the switch return, engine brake selector signal number 1 pin, and engine brake selector signal number 3 pin.

Measure the resistance. The multimeter **must** show an open circuit (100k ohms or more).

Remove the lead from the switch return and insert it into engine brake selector signal number 2 pin. Check all pins except the switch return engine, brake selector signal number 1 pin and engine brake selector signal number 3 pin. Measure the resistance.

The multimeter **must** show an open circuit (100k ohms or more).

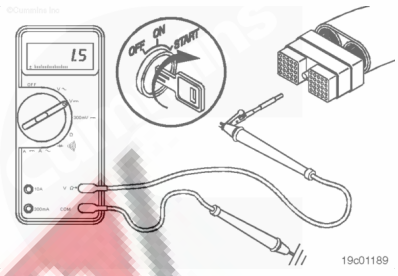
Remove the lead from engine brake selector signal number 2 pin and insert it into engine brake selector signal number 3 pin. Check all pins except the switch return. Measure the resistance.

The multimeter **must** show an open circuit (100k ohms or more).

Remove the lead from the engine brake selector signal number 3 pin and inert it in the engine brake selector signal number 1 pin. Check all pins except the switch return. Measure the resistance.

The multimeter **must** show an open circuit (100k ohms or more).

Check for Short Circuit to External Voltage Source



Turn the vehicle keyswitch to the ON position. Set the engine brake ON/OFF switch to the ON position.

Adjust the multimeter to measure the VDC.

Insert a test lead into the switch signal pin of the OEM harness connector.

Disconnect the multimeter probe from the test lead and touch it to the engine block ground. Measure the voltage. The voltage **must** be 1.5 VDC or less.

If the voltage is **not** correct, there is an external voltage source connected to the circuit, or there is a short circuit between the engine brake on/off circuit and a wire carrying power in the OEM harness. Remove the voltage source or repair the wiring in the OEM harness according to the vehicle manufacturer's procedures.

Connect all components after completing the repair.

ANADOLU ISUZU AFTER SALES

Last Modified: 25-Jun-2015

Select Service Tools

Recommended Cummins® Service Tools

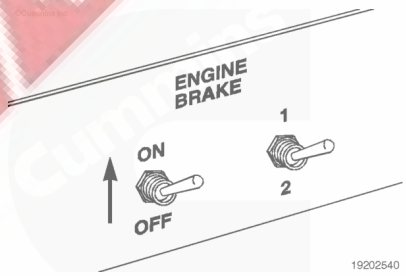
- No Cummins® Service Tools required.

Additional Service Items

- Multimeter

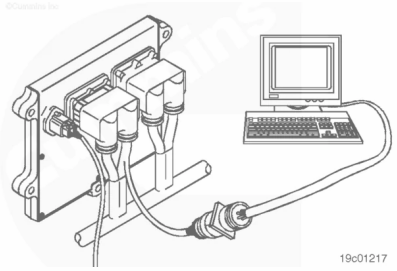
General Information

The engine brake level switch determines the percentage of engine braking power applied when the engine brakes are activated. The engine brake ON/OFF switch needs to be turned ON to activate the engine brake system. Vehicles can be wired with a 2 or 3 position switch.



Resistance Check

If INSITE™ electronic service tool is available, monitor the engine brake selector switch for proper operation. If INSITE™ electronic service tool is **not** available then follow the troubleshooting procedures for this section.



Label the wires with the location on the switch or the wire number. Disconnect the three electrical connectors from the switch.

Adjust the multimeter to measure resistance

Three Position Switch		
Switch Position	Terminal A - Engine Brake Selector Signal Number 1	Terminal B - Engine Brake Selector Signal Number 2
1	Closed	Open

Three Position Switch		
1	Open	Closed
2	Open	Closed
2	Closed	Open
3	Closed	Closed
Two Position Switch		
Switch Position	Terminal A - Engine Brake Selector Signal Number 1	Terminal A - Engine Brake Selector Signal Number 2
1	Closed	Open
1	Open	Closed
2	Closed	Closed

Check the resistance for each position of the 2 or 3 position switch. An open circuit **must** have a resistance greater than 100k ohms. A closed circuit **must** have a resistance of 10 ohms or less.

If the multimeter does **not** show the correct values in both tests, the switch has malfunctioned. See equipment manufacturer service information for replacement procedures.

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Last Modified: 05-Aug-2016

Select Service Tools

Recommended Cummins® Service Tools

- No Cummins® Service Tools required.

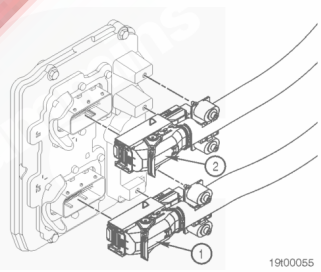
Additional Service Items

- No additional service items required.

General Information

The engine uses two separate wiring harnesses to control the engine and some vehicle operations. Shown are the engine control module (ECM) ports for the following connectors:

1. 96 pin original equipment manufacturer (OEM) harness connector
2. 96 pin engine harness connector.



Preparatory Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

- Disconnect the batteries. See equipment manufacturer service information.
- Disconnect the 14 pin connector OEM crossover connector.

Remove

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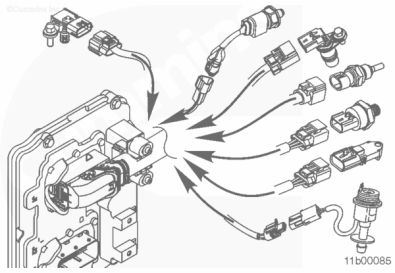
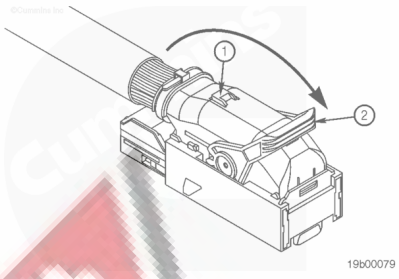
Disconnect the engine harness from the sensors and switches.



⚠ CAUTION ⚠

Do NOT close the lever after the connector has been removed from the ECM. Attempting to do so will cause damage to the connector.



Remove the wire harness hold-down clamps from the ECM.

Note : Do **not** remove the wire ties attaching the hold-down clamps to the wire harness.

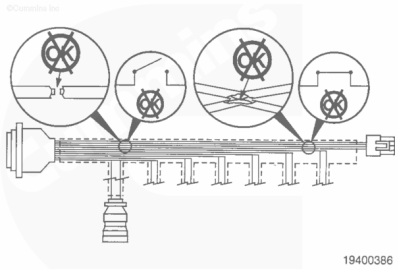
Remove the OEM connector and engine harness connector from the ECM by pressing down on the locking tab (1) and pulling up on the lever (2).

Note the engine harness routing and location of the wire ties and mounting clips holding the engine harness before removal. It can be helpful to take pictures and/or add tags to help rout the harness properly during assembly

Inspect for Reuse

Inspect the engine wiring harness. If there is an open circuit or short circuit, determine the location of the damaged wiring.

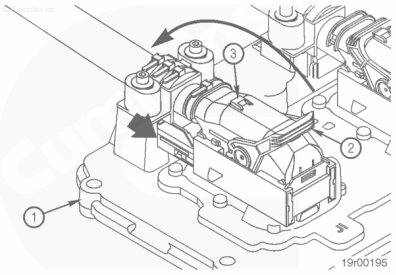
Wiring inside the protective covering can be repaired.



Install

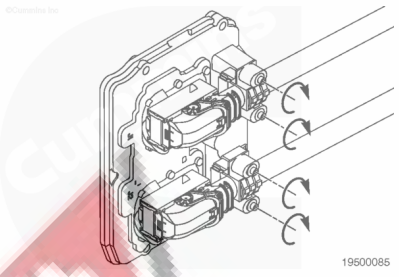
Install the connector to the ECM by placing the connector into the ECM receptacle (1) and pulling back on the locking lever (2) until the connector is fully seated and the lever locking tab (3) is engaged.

If the wire tie securing the wiring harness to the ECM connector backshell was removed, install a new wire tie.



⚠ CAUTION ⚠

Failure to correctly install the engine wiring harness hold-down clamp can lead to wiring harness failure.



Note : If the engine wiring harness hold-down clamp has been removed, install the hold-down clamp. Use the following steps.

Loosely attach the hold-down clamp to the wiring harness using wire ties. Do **not** tighten the wire ties at this time.

Install the harness hold-down clamp onto the ECM.

Tighten the capscrews.

Torque Value: 8 to 10 n•m [71 to 89 in-lb]

Orient the harness so there are no stretched or pinched wires.

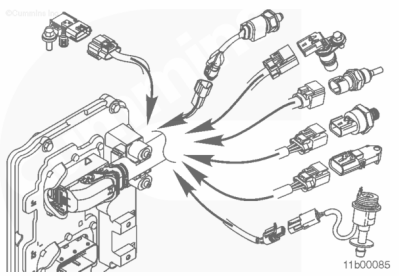
Tighten the wire ties.

Trim any excess length from the wire ties.

The harness should be routed as far away from hot components as possible.

Make sure all mounting clips and wire ties are reused or replaced to prevent the harness from rubbing on other components.

Connect the sensors and switches to the engine harness.



ANADOLU ISUZU OPTER SALES

Finishing Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

- Connect the 14 pin OEM cross-over connector.
- Connect the batteries. See equipment manufacturer service information.
- Operate engine. Check for loose wires and proper operation.

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ANADOLU ISUZU AFTER SALES

Select Service Tools

Recommended Cummins® Service Tools

- Engine control module (ECM) connector break-out header, Part Number 2892510
- Test lead, Part Number 3164113

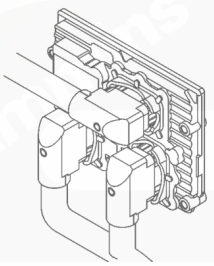
Additional Service Items

- No additional service items required.

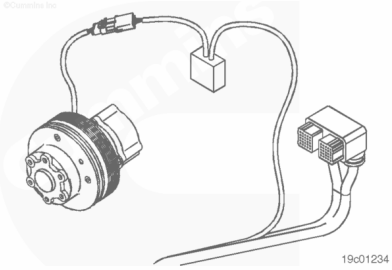
General Information

The CM2350 control system can control the fan clutch activation. The ECM energizes the air valve solenoid or an electric fan clutch.

See equipment manufacturer service information for more information on the fan clutch wiring.



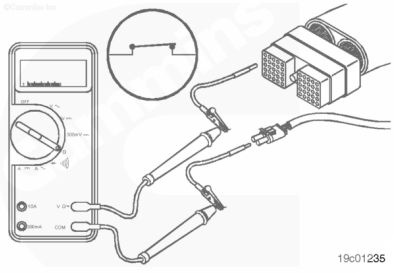
The fan control circuit resides in the OEM harness. The fan control signal wire is in the OEM connector on the ECM. The fan control signal wire leads to the fan clutch air solenoid through the OEM wiring harness. The fan control signal is grounded through the clutch body/engine block ground.



Resistance Check

⚠ CAUTION ⚠

Do NOT insert test leads into the ECM connector terminals. Doing so may cause terminals to spread and cause intermittent electrical connnections. To perform



pin-out diagnostic checks, use ECM connector break-out header, Part Number 2892510, and test lead, Part Number 3164113.

Disconnect the OEM harness connector from the ECM connector. Disconnect the OEM wiring at the fan control solenoid.

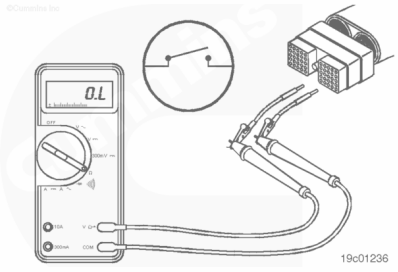
Insert a test lead into the fan control signal pin of the OEM harness connector. Connect it to the multimeter probe.

Touch the other multimeter probe to the connector terminal of the fan clutch solenoid. Make sure the fan clutch solenoid is disconnected.

Measure the resistance.

The multimeter **must** show a closed circuit (10 ohms or less). If the circuit is closed, it **must** still be checked for a short circuit to ground and a short circuit from pin-to-pin. If the circuit is **not** closed, there is a connection problem or an open circuit in the wiring harness.

Check for Short Circuit from Pin to Pin



Check for a short circuit between the fan control signal pin and all of the other pins in the OEM harness. Make sure the fan control solenoid is disconnected. Make sure the battery voltage supply is disconnected.

Insert a test lead into the fan control signal pin of the OEM harness connector. Insert the other test lead into all of the other pins of the OEM harness connector, one at a time.

Measure the resistance.

The multimeter **must** show an open circuit (more than 100k ohms).

If the circuit is **not** open, there is a short circuit between the fan control signal pin and any pins that measured a closed circuit.

Repair or replace the OEM wiring harness.

Refer to Procedure 019-043 in Section 19. (/qs3/pubsys2/xml/en/procedures/425/425-019-043.html)

Refer to Procedure 019-071 in Section 19.
(/qs3/pubsys2/xml/en/procedures/99/99-019-071.html)

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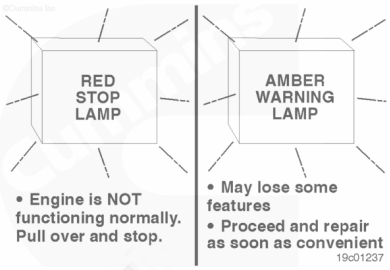
General Information

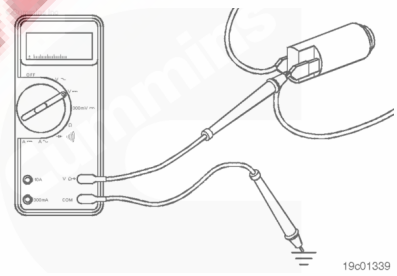
The fault code warning lamps let the operator know when a part or a system fault is detected. The amber lamp can have the word WARNING printed on it. The red lamp can have the word STOP printed on it

The fault code lamp circuits consist of the light bulb, lamp signal output, and VDC supply from the keyswitch circuit.



Voltage Check

Measure the voltage between each fault lamp and ground.



Turn the keyswitch to the ON position.

Touch the positive (+) multimeter probe to the amber warning lamp signal terminal.

Touch the negative (-) multimeter probe to the chassis ground. Measure the voltage.

Repeat this check for the other terminal of the amber fault lamp. The multimeter **must** show the battery voltage.

Touch the positive (+) multimeter probe to the red stop lamp signal terminal.

Touch the negative (-) multimeter probe to chassis ground.

Measure the voltage.

Repeat this check for the other terminal of the red fault lamp. The multimeter **must** show battery voltage.

If battery voltage is **not** present, there is a problem with the keyswitch line or the lamp has failed. Refer to the OEM troubleshooting and repair manual for repair procedures.

Connect all components after the repair is complete.

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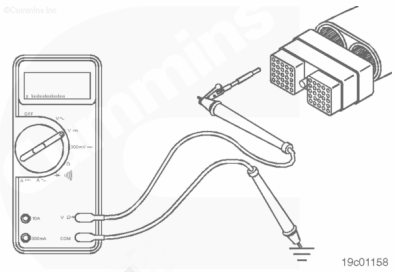
AFTER SALES

Voltage Check

⚠ CAUTION ⚠

Proper leads and/or a Cummins® approved circuit testing tool must be used when working with electrical connectors to prevent pin expansion and damage to the connector.



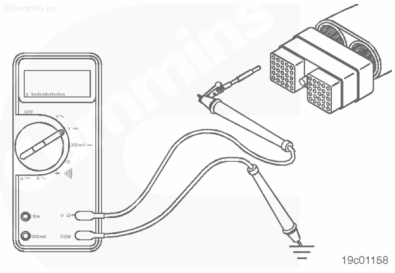
Disconnect the original equipment manufacturer (OEM) harness engine interface connector. To determine the location of the connector, see the corresponding engine wiring diagram.

Turn the keyswitch to the ON position. Adjust the multimeter to measure VDC. Insert the multimeter lead into the amber warning lamp signal pin and attach it to the multimeter probe. Touch the other multimeter probe to the engine block. Read the display on the multimeter.

The multimeter **must** show battery voltage. If battery voltage is **not** present, there is a problem with an OEM harness wire, provided the amber warning lamp has previously been checked.

Refer to the OEM troubleshooting and repair manual for repair procedures.

Remove the lead from the amber warning lamp signal pin and insert it into the malfunction indicator lamp (MIL) signal pin. Touch the other multimeter probe to the engine block.



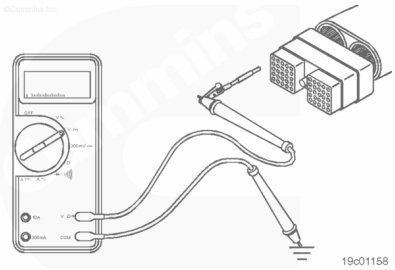
The multimeter **must** show battery voltage. If battery voltage is **not** present, there is a problem with the malfunction indicator lamp (MIL) OEM harness wire, provided the malfunction indicator lamp (MIL) has been previously checked.

Refer to the OEM troubleshooting and repair manual for repair procedures.

Remove the lead from the malfunction indicator lamp (MIL) signal pin and insert it into the red stop lamp signal pin. Touch the other multimeter probe to the engine block.

The multimeter **must** show battery voltage. If battery voltage is **not** present, there is a problem with the red stop lamp OEM harness wire, provided the red stop lamp has been previously checked. Refer to the OEM troubleshooting and repair manual for repair procedures.

Connect all components after completing the repair.

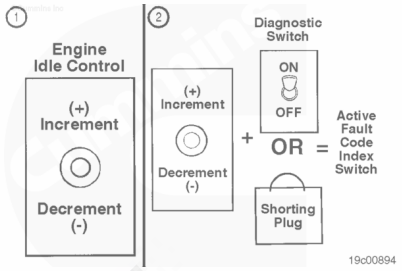


Last Modified: 29-Jun-2015

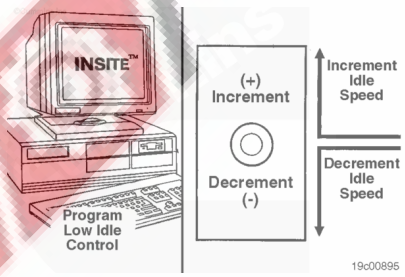
ANADOLU ISUZU
AFTER SALES

General Information

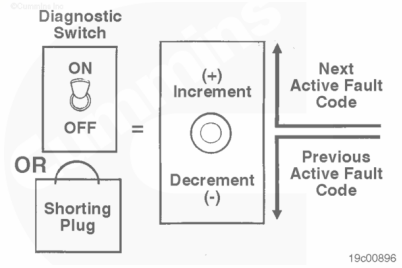
The idle adjustment feature is a part of the cruise control set/resume multi-functionality switch. Moving the switch to the set position increases the low idle speed and moving the switch to the resume position decreases the low idle speed.



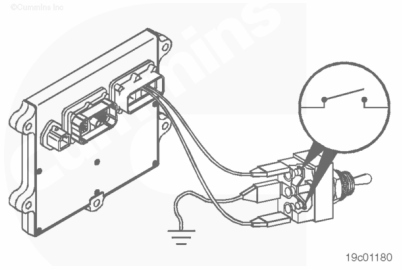
Depending on how the switch is configured, moving the switch in one direction will increase the low idle speed.



Push the diagnostic switch to the ON position or install the shorting plug. After the first active fault code has flashed out, push the idle adjust switch positive (+) up to advance to the next active fault code. Push the switch again until all of the active fault codes have been recorded.



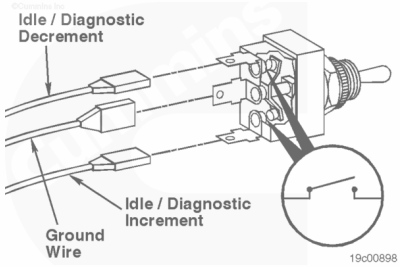
The idle adjust switch circuit consists of the idle/diagnostics increment signal, the idle/diagnostics decrement signal, the return wire, and the two-position switch located in the vehicle.



Resistance Check

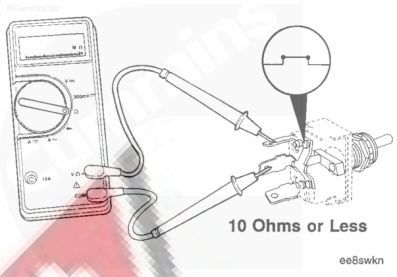
If an electronic service tool is available, monitor the idle adjust switch for proper operation. If **not,** follow the troubleshooting procedures in this section.

Remove the three electrical connectors from the switch. Label the wires with the switch location and the circuit name.



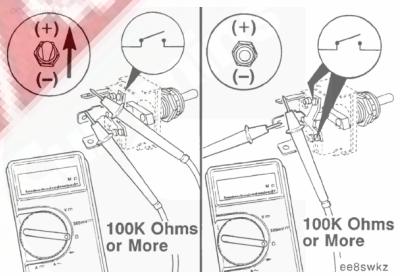
Touch one probe of the multimeter to the center terminal of the switch.

Touch the other probe to the cruise control/PTO resume/accelerate switch signal terminal of the switch.



Hold the idle adjust switch in the positive (+) increment position. The multimeter **must** show an open circuit (100k ohms or more) when the switch is held in the positive (+) increment position and after it is released. If the circuit is **not** open, the switch has failed.

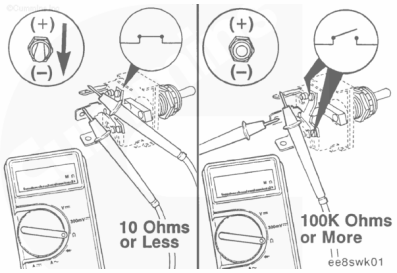
Refer to the OEM troubleshooting and repair manual for the replacement procedures.



Hold the switch in the negative (-) decrement position. The multimeter **must** show a closed circuit (10 ohms or less) when the switch is held in the negative (-) decrement position.

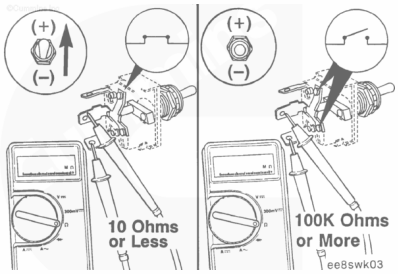
When the switch is released, it **must** show an open circuit (100k ohms or more). If the multimeter does **not** show the correct values, the switch has failed.

Refer to the OEM troubleshooting and repair manual for the replacement procedures.



Move the electrical lead from the cruise control/PTO resume/accelerate switch signal terminal to the cruise control/PTO set/coast switch signal terminal.

Hold the idle adjust switch in the positive (+) increment position. The multimeter **must** show a closed circuit (10 ohms or less) while the switch is held in the positive (+) increment position.



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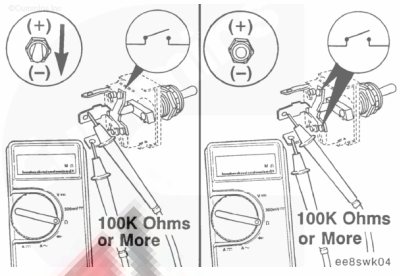
When the switch is released, the multimeter **must** show an open circuit (100k ohms or more). If the multimeter does **not** show the correct values, the switch has failed.

Refer to the OEM troubleshooting and repair manual for the replacement procedures.

Move the idle adjust switch to the negative (-) decrement position. The multimeter **must** show an open circuit (100k ohms or more) when the switch is held in the negative (-) decrement position and when it is released. If the circuit is **not** open, the switch has failed.

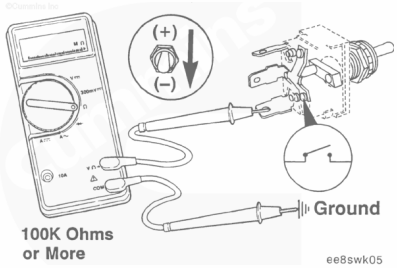


Refer to the OEM troubleshooting and repair manual for the replacement procedures.

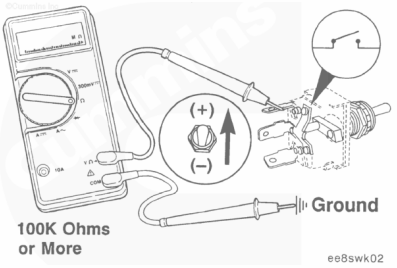
If the resistance value is correct, the switch **must** still be checked for a short circuit to ground.

Check for Short Circuit to Ground

Touch one multimeter probe to the cruise control PTO set/coast switch signal terminal of the switch and touch the other multimeter probe to chassis ground. Move the idle adjust switch to the negative (-) decrement position then to the positive (+) increment position. Measure the resistance. The multimeter **must** show an open circuit (100k ohms or more) when the switch is in all positions. If the circuit is **not** open, the switch has failed. Refer to the OEM troubleshooting and repair manual for the replacement procedures.



Check for a short circuit to ground. Remove the multimeter probe from the cruise control/PTO set/coast switch signal terminal and touch it to the cruise control/PTO resume/accelerate switch signal terminal of the switch. Keep the other multimeter touching chassis ground. Move the switch to the positive (+) increment position then to the negative (-) decrement position. Measure the resistance. The multimeter **must** show an open circuit (100k ohms or more) when the switch is in all positions. If the circuit is **not** open, the switch has failed. Refer to the OEM



troubleshooting and repair manual for the replacement procedures. If the switch passes all of the previous checks, the switch circuit **must** be checked.

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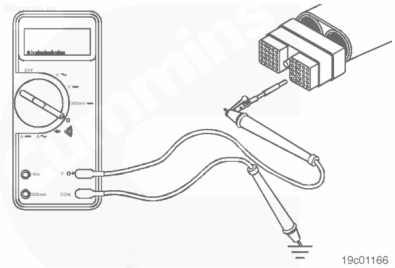
Resistance Check

⚠ CAUTION ⚠

Proper leads and/or a Cummins® approved circuit testing tool must be used when working with electrical connectors to prevent pin expansion and damage to the connector.



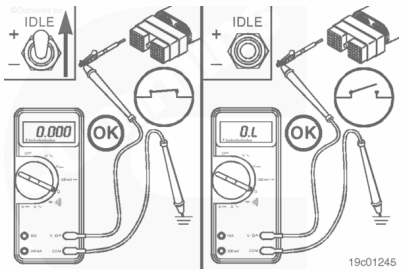
Note : The idle/diagnostic increment/decrement switch is the cruise control/PTO/set/resume select switch.

If electronic service tool is available, monitor the idle adjust switch circuit for proper operation. If **not,** follow the troubleshooting procedures in this section.

Disconnect the original equipment manufacturer (OEM) harness engine interface connector. To determine the location of the connector, see the corresponding engine wiring diagram.

Insert the pin of the test lead into the cruise control/PTO set/coast switch signal in the OEM harness connector. Measure the resistance from the cruise control/PTO set/coast switch signal to the engine block.

Hold the idle adjust switch in the positive (+) increment position.

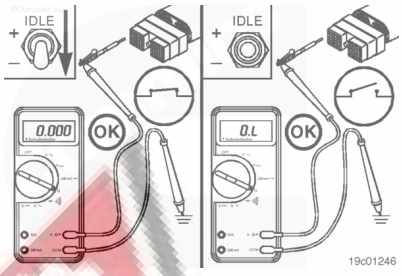


If the OEM connected the return wire to chassis ground the multimeter **must** show a closed circuit (10 ohms or less) while holding the switch on and return to an open circuit (100K ohms or more) when the switch is released. The circuit **must** remain an open circuit when the switch is in the decrement negative (-) position.

If the OEM connected the return wire to the ECM OEM connector the multimeter **must** show an open circuit (100k ohms or more) while holding the switch on and return to a closed circuit (10 ohms or less) when the switch is released. The circuit **must** remain a closed circuit when the switch is in the decrement negative (-) position.

If the resistance values are **not** correct, make sure the return wire and the cruise control/PTO set/coast switch signal wire are properly installed on the idle adjust switch. If both wires are correctly installed, inspect the return wire and the cruise control/PTO set/coast switch signal wire for open circuits, provided the idle adjust switch has been previously checked for short circuits to ground.

Remove the lead from the cruise control/PTO set/coast switch signal and insert it into the cruise control/PTO resume/accelerator switch signal.

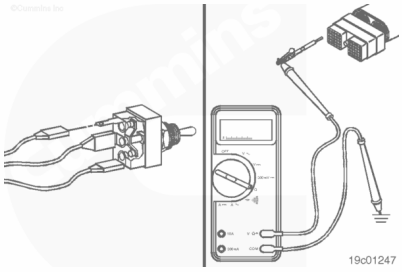


Hold the idle adjust switch in the negative (-) decrement position. The multimeter **must** show a closed circuit (10 ohms or less) when the switch is held in the decrement position and an open circuit (100K ohms or more) when the switch is released. The circuit **must** remain an open circuit when the switch is in the positive (+) increment position.

If the resistance values are **not** correct, make sure the cruise control/PTO resume/accelerator switch signal wire is properly installed on the idle adjust switch. If the cruise control/PTO resume/accelerator switch signal wire is properly installed on the idle adjust switch, inspect the cruise control/PTO resume/accelerator switch signal wire for an open circuit, provided the idle adjust switch has been previously checked for short circuits to ground.

Check for Short Circuit to Ground

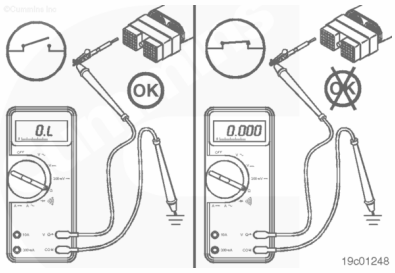
Disconnect the idle/diagnostic decrement wire (attached to the cruise control/PTO resume/ accelerator switch signal) from the switch.



Measure the resistance from the cruise control/PTO resume/accelerator switch signal of the OEM harness connector to the engine block.

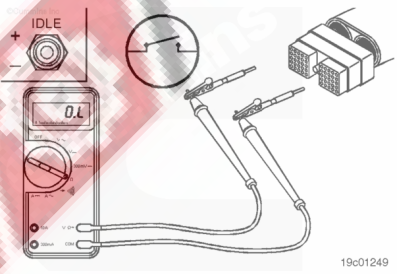
The multimeter **must** show an open circuit (100K ohms or more). If the circuit is **not** open, there is a short circuit to ground in the cruise control/PTO resume/accelerator switch signal circuit, provided the idle adjust switch has been previously checked.

Repair or replace the wire connected to the cruise control/PTO resume/accelerator switch signal in the OEM harness according to the vehicle manufacturer's instructions.



To check the idle/diagnostic increment wire (attached the to cruise control/PTO set/coast switch signal) for short circuits to ground, follow the same procedure as described above for the idle/diagnostic decrement wire.

Check for Short Circuit from Pin to Pin



Measure the resistance from the cruise control/PTO resume/accelerator switch signal of the OEM harness connector to all other pins in the connector. The multimeter **must** show an open circuit (100k ohms or more).

If the circuit is **not** open, there is a short circuit between the wire connected to the cruise control/PTO resume/accelerator switch signal and any pin that measured less than 100k ohms.

Repair or replace the wires in the OEM harness according to the vehicle manufacturer's instructions.

Remove the lead from the cruise control/PTO resume/accelerator switch signal of the OEM harness connector and insert it into the cruise control/PTO set/coast switch signal of the connector. Measure the resistance from the cruise control/PTO set/coast switch signal to all other pins in the connector. The multimeter **must** show an open circuit (100k ohms or more).

If the circuit is **not** open, there is a short circuit between the wire connected to the cruise control/PTO set/coast switch signal and any pin that measured less than 100k ohms, provided the idle adjust switch has been previously checked.

Repair or replace the wires in the OEM harness according to the vehicle manufacturer's instructions.

Connect all components after completing the repair.

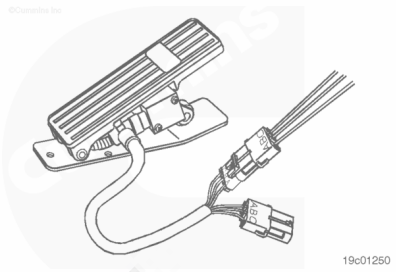
ANADOLU ISUZU AFTERSALES


ANADOLU ISUZU
AFTER SALES

General Information

The idle validation switch will vary with OEM. Refer to vehicle manufacturer's manual for the specific troubleshooting and repair procedures.

The idle validation switch, on the accelerator pedal assembly, is used to detect when the accelerator pedal is at idle. The idle validation circuit consists of the idle validation switch, switch return wire, on-idle switch input, and off-idle switch input.



ANADOLU ISUZU
AFTER SALES

Last Modified: 03-Apr-2003

Select Service Tools

Recommended Cummins® Service Tools

- No Cummins® Service Tools required.

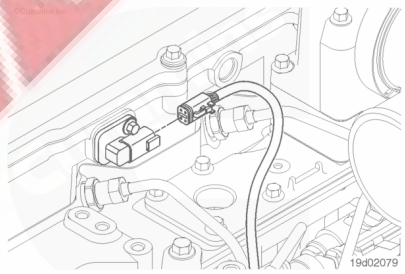
Additional Service Items

- No additional service items required.

Preparatory Steps

⚠ WARNING ⚠

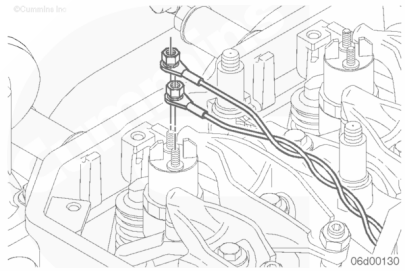
Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.



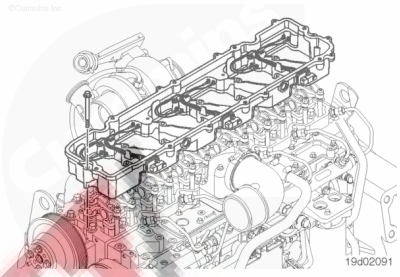
- Disconnect the three Deutsch™ 4 pin connectors on the engine harness from the pass-through connector.
- Remove the crankcase breather tube. Refer to Procedure 003-018 in Section 3. (/qs3/pubsys2/xml/en/procedures/425/425-003-018.html)
- Remove the rocker lever cover. Refer to Procedure 003-011 in Section 3. (/qs3/pubsys2/xml/en/procedures/425/425-003-011.html)

Remove

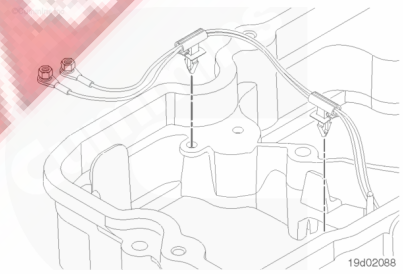
Remove the pigtail nuts from all injector solenoids.



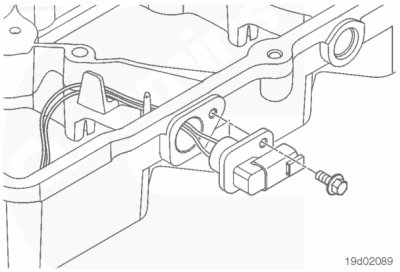
Remove the rocker housing. Refer to Procedure 003-013 in Section 3. (/qs3/pubsys2/xml/en/procedures/425/425-003-013.html)



Remove the internal injector harness and plastic clips from the rocker lever housing.



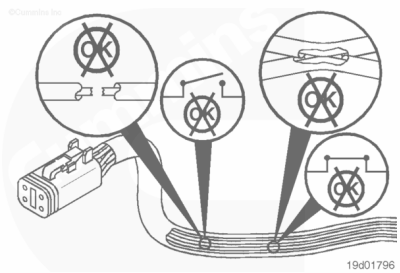
Remove the pass-through connector from the rocker housing.



Inspect for Reuse

Inspect for damaged or exposed wires, bent or broken pins, or damaged connectors.

Replace, if necessary.

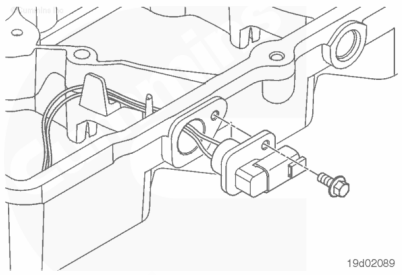


ANADOLU ISUZU AFTER SALES

Install

Install the pass-through connector into the rocker housing.

Torque Value: 10 n•m [89 in-lb]



Route the injector wiring around the metal tabs to the injectors.

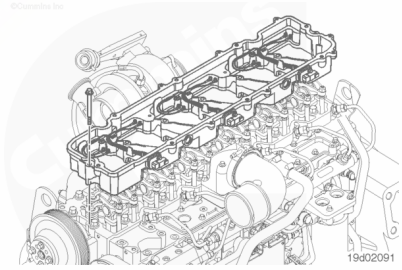
Install new plastic clips into the rocker housing.



Install the rocker housing. Refer to Procedure 003-013 in Section 3. (/qs3/pubsys2/xml/en/procedures/425/425-003-013.html)

Note : Verify the internal injector harness does **not** rest on any sharp corners.

Note : Verify the pigtail wires are **not** “crossed over” to the wrong injectors.



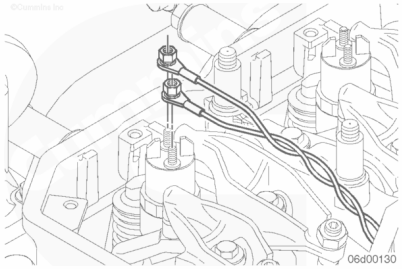
Install the pigtail nuts on injectors.

Torque Value: 2 n•m [18 in-lb]

Note : Polarity of the wiring is **not** significant. The signal and return wires can be connected to either injector terminal.

Note : Orient the injector wires so they will **not** interfere with a rocker lever or engine brake housing. If the rocker lever is able to come into contact with the injector harness, it will rub through the wire insulation and cause injector circuit fault codes.

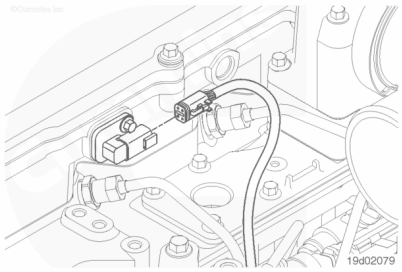
Connect the engine harness to the pass-through connector.



Finishing Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.



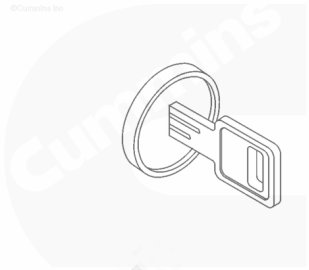
- Connect the three Deutsch™ 4 pin connectors on the engine harness to the pass-through connector.
- Install the crankcase breather tube. Refer to Procedure 003-018 in Section 3. (/qs3/pubsys2/xml/en/procedures/425/425-003-018.html)
- Install the rocker lever cover. Refer to Procedure 003-011 in Section 3. (/qs3/pubsys2/xml/en/procedures/425/425-003-011.html)
- Operate the engine. Check for proper operation.

ANADOLU ISUZU AFTER SALES

Last Modified: 05-Aug-2016

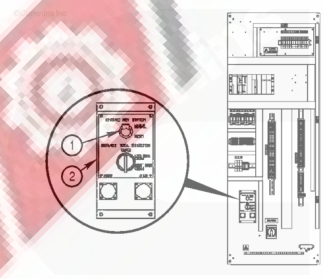
Voltage Check

The vehicle keyswitch supplies an input signal to the electronic control module (ECM) which turns the ECM on or off.

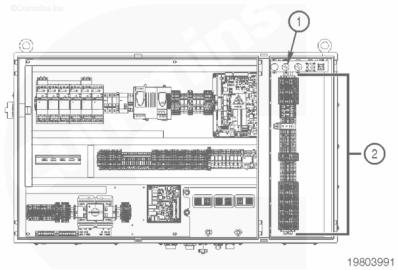


The Generator Set ECM Keyswitch supplies an input signal to all generator set electronic control modules (ECMs) which turns to ECM on or off.

For generator sets using the PowerCommand Supervisor 3100 mounted in the Generator Control Panel (GCP), the ECM keyswitch (1) is mounted on the Service Tool Connector Panel (2), located inside the main panel.



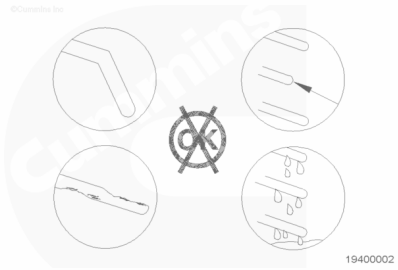
For generator sets using the PowerCommand Supervisor 3300 mounted in the Generator Interface Box, the ECM keyswitch (1) is mounted within the customer terminal box above the customer connection terminal connection strip (2).



Turn the keyswitch to the OFF position.

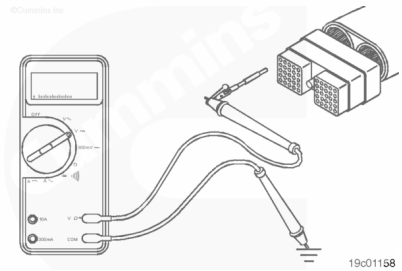
Disconnect the Actuator harness connector from the ECM.

Inspect the connector pins.



⚠ CAUTION ⚠

Proper leads and/or a Cummins® approved circuit testing tool must be used when working with electrical connectors to prevent pin expansion and damage to the connector.



ANADOLU ISUZU MOTOR PARTS

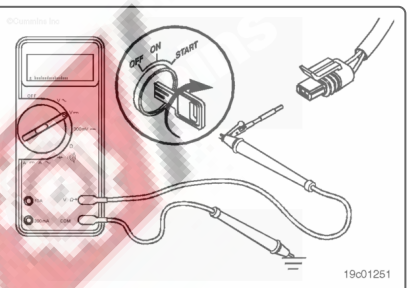
Adjust the multimeter to measure VDC.

Insert a test lead into the keyswitch input signal pin of the Actuator connector. Connect the lead to the multimeter probe. Touch the other probe to a clean, unpainted surface on the engine block ground.

Turn the keyswitch to the ON position.

The measured voltage **must** show battery voltage. If the measured voltage is more than 0.5 VDC below battery voltage, continue with the next step.

Disconnect the bulkhead connector.



Inspect the connector pins. Refer to the OEM troubleshooting and repair manual for the proper procedure.

Measure the voltage. Refer to the OEM troubleshooting and repair manual for the proper procedure.

The measured voltage **must** show battery voltage. If the voltage is **not** correct, there is a problem with the keyswitch input signal wire, keyswitch, or battery connection.

Repair or replace the wiring harness, keyswitch, or check the battery connections. Refer to the OEM troubleshooting and repair manual for the proper procedures.

ANADOLU ISUZU AFTER SALES

Last Modified: 06-Nov-2015

Select Service Tools

Recommended Cummins® Service Tools

- No Cummins® Service Tools required.

Additional Service Items

- No additional service items required.

General Information

The engine oil pressure sensor is located on the intake side of the engine, near the flywheel housing.

Use the following procedure for a detailed component location view. Refer to Procedure 100-002 in Section E. (/qs3/pubsys2/xml/en/procedures/425/425-100-002.html)

Preparatory Steps

⚠ WARNING ⚠

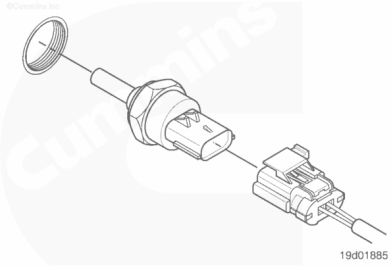
Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

- Disconnect the batteries. See equipment manufacturer service information.
- Clean the area around the engine oil pressure sensor.

Remove

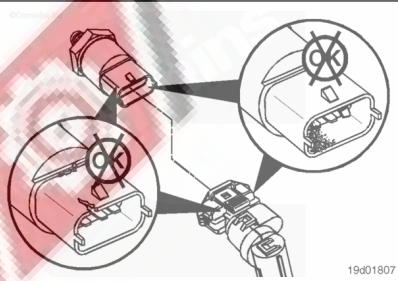
Disconnect the engine oil pressure sensor from the engine harness.

Remove the engine oil pressure sensor.



Clean and Inspect for Reuse

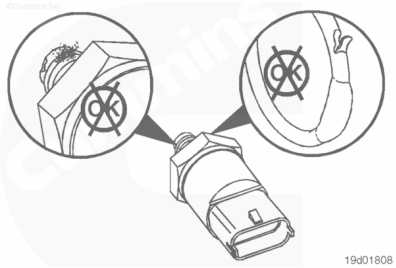
Inspect the engine harness connector and the engine oil pressure sensor for the following:



- Cracked or broken connector shell
- Missing or damaged connector seals
- Dirt, debris, or moisture in or on the connector pins
- Corroded, bent, broken, pushed back, or expanded pins.

Repair or replace the engine harness connector as needed.

Inspect the engine oil pressure sensor for the following:



- Damaged seal surface in the rail
- Damaged seal surface on the sensor
- Damaged sensor hex surfaces
- Corrosion on the sensor mounting threads.

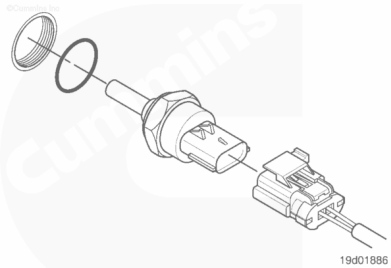
Replace the engine oil pressure sensor if damage is found.

Install

Check to make sure the sensor has an o-ring installed.

Install the engine oil pressure sensor.

Torque Value: 14 n•m [124 in-lb]



Connect the engine oil pressure sensor to the engine harness.

ANADOLU ISUZU
AUTHORISED

Finishing Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

- Connect the batteries. See equipment manufacturer service information.
- Operate the engine. Check for leaks.

ANADOLU ISUZU AFTER SALES

Last Modified: 10-Aug-2016

General Information

The original equipment manufacturer (OEM) harness is supplied and installed by the equipment manufacturer. If repair or replacement is required, see equipment manufacturer service information.



ck800wa

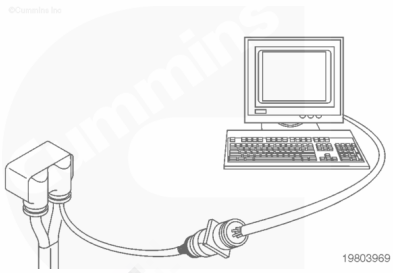
Last Modified: 12-Jan-2016

ANADOLU ISUZU AFTER SALES

General Information

This procedure was developed due to the increasing number of parameters and features offered which can affect vehicle performance. Use the following table to troubleshoot performance complaints by locating the appropriate symptom in the left column. Then follow the probable cause and corrective action in the adjacent columns.

Adjust the features or parameters with the recommended Cummins® electronic service tool or equivalent.



Adjust

Programmable Feature/Parameters Not Correct		
Symptom	**Probable Cause**	**Correction**
Exceeding road speed governor set speed down hills	Cruise control or road speed governor lower droop is set too high.	Change the cruise control or road speed governor lower droop to a lower value. If the problem continues, change the cruise control engine brake activation to a lower value.
Poor acceleration up hills	Cruise control and/or road speed governor upper droop is set too high.	Change the cruise control or road speed governor upper droop to a lower value.
Cruise control turns on automatically.	Cruise control auto-resume feature is enabled.	Turn off the cruise control auto-resume feature.
Exhaust brakes turn on automatically.	Cruise control auto engine brake feature is enabled or exhaust brake switch is failed.	Turn off the cruise control auto engine brake feature or repair the switch.
Unable to obtain maximum vehicle speed.	Gear-down protection feature is enabled.	Turn off or adjust the gear-down protection parameters.

ANADOLU ISUZU GENUINE SALES

Programmable Feature/Parameters Not Correct		
Symptom	**Probable Cause**	**Correction**
Poor clutch engagement	The low idle speed is set too low for the application.	Increase the low-idle speed using the idle adjust switch. Refer to Procedure 019-052 (/qs3/pubsys2/xml/en/procedures/99/99-019-052.html). Increase the low-idle speed parameter.
Speedometer on the dashboard is **not** correct or vehicle exceeding road speed governor set speed.	Vehicle speed parameters are **not** set properly.	Make sure the following are correct: tire size, rear axle ratio, vehicle speed sensor type, and gear teeth per revolution.
Trip information mileage readings are **not** correct.	The tire size parameter was changed without resetting the trip information system.	Set the trip information system again whenever the tire size parameter is changed.
Can **not** obtain maximum vehicle speed with semiautomatic transmission.	The gear-down protection parameters are **not** set properly.	Change the top gear ratio parameter to be equal to the first gear-down ratio, **not** the top gear ratio. For example, on a transmission with a 0.75, 0.87, and 1.0 ratio set, the top gear ratio parameter **must** be set to 0.87.
Engine won't start.	Antitheft password is active.	Enter antitheft personal identification number (PIN) using RoadRelay™ or delete password with Zap-It.
Low power in lower gears or top gear	Power train protection parameters are set too low.	Change power train protection torque limits to match torque capability of the vehicle's transmission.
Semiautomatic transmission will **not** shift into top gear.	Top gear ratio setting does **not** match top gear of transmission.	Set the proper top gear ratio.
Centinel™ feature has been turned on but vehicle has a Spicer Top 2™ transmission.	Feature and parameters are **not** set properly.	Turn off the Centinel™ feature and turn on the Top 2 feature.
Engine recently started overheating because the fan will **not** turn on.	Fan control feature is **not** set properly.	Verify all fan control feature parameters are properly set for the vehicle.

ANADOLU ISUZU AFTER SALES

Programmable Feature/Parameters Not Correct		
Symptom	**Probable Cause**	**Correction**
Fan will **not** turn off.	Fan control feature is **not** set properly.	Verify all fan control feature parameters are properly set for the vehicle.
Fan control switch will **not** turn on the fan.	Fan control 1 accessory switch control is turned off.	Turn on fan control 1 accessory switch control.
Unable to obtain maximum vehicle speed.	Cruise control maximum vehicle speed or accelerator maximum vehicle speed is **not** set high enough.	Verify or change settings.
Driver reward system is penalizing the driver with reduced top vehicle speed or cruise control maximum speed for poor fuel economy or extended idle time.	Driver is unfamiliar with feature or feature and parameters are **not** set properly.	Explain feature to the driver or change parameter settings to more appropriate values.
Accelerator pedal has no effect on engine speed.	Vehicle is in PTO mode and PTO accelerator override is turned on in the ECM.	Turn off PTO accelerator override.
Accelerator pedal has no effect on engine speed.	Vehicle has a multiplexed throttle pedal and the multiplexing feature is turned off.	Verify that the throttle pedal is multiplexed. Turn on the multiplexing feature for the throttle pedal.
Remote accelerator control has no effect on engine speed.	Remote accelerator feature is turned off.	Turn on the remote accelerator feature.
Remote accelerator control has no effect on engine speed.	Vehicle has a multiplexed remote accelerator control and the multiplexing feature is turned off.	Verify that the remote accelerator control is multiplexed. Turn on the multiplexing feature for the remote throttle control.
Lamps do **not** operate.	Fuse is failed.	Check fuses and verify the ECM is getting power on the keyswitch wire.
Lamps do **not** operate.	Vehicle has multiplexed lamps and the multiplexing feature is turned off.	Verify that the lamps are multiplexed. Turn on the multiplexing feature for the lamps.

Programmable Feature/Parameters Not Correct		
Symptom	**Probable Cause**	**Correction**
Engine brakes do **not** operate.	Vehicle has multiplexed engine brake switches and the multiplexing feature is turned off.	Verify that the engine brake switches are multiplexed. Turn on the multiplexing feature for the engine brake switches.
Engine will **not** respond to one or all of the operator's switch(es).	Vehicle has multiplexed switches and the multiplexing feature is turned off.	Verify that the switches are multiplexed. Turn on the multiplexing feature for the switches.

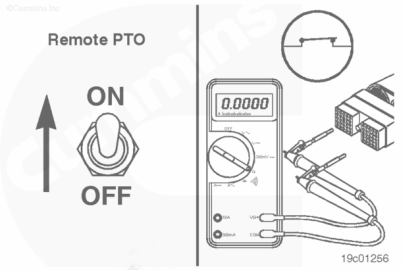
Last Modified: 28-Feb-2020

ANADOLU ISUZU AFTER SALES

Resistance Check

⚠ CAUTION ⚠

Proper leads and/or a Cummins® approved circuit testing tool must be used when working with electrical connectors to prevent pin expansion and damage to the connector.



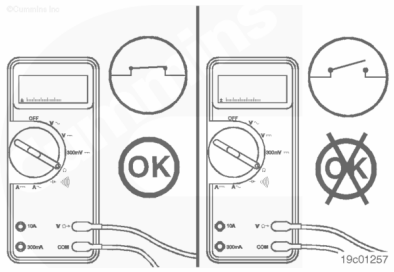
Disconnect the original equipment manufacturer (OEM) harness engine interface connector. To determine the location of the connector, see the corresponding engine wiring diagram.

Insert a test lead into the remote power take-off (PTO) switch return pin of the OEM harness connector and connect it to the multimeter probe. Insert the other test lead into the remote PTO switch signal pin of the connector and connect it to the other probe.

Make sure the switch is connected to the circuit. Move the remote PTO switch to the ON position. Measure the resistance with the multimeter. The multimeter **must** show a closed circuit (10 ohms or less). If the circuit is **not** closed, inspect the switch return wire and the remote PTO switch signal wire for an open circuit. Repair or replace the OEM harness, provided the switch has been previously checked. Refer to the OEM troubleshooting and repair manual for the procedures.

If the resistance is correct, the remote PTO switch return wire and the remote PTO switch signal wire **must** be checked for a short circuit to ground, a short circuit from pin to pin, and a short circuit to an external voltage source.

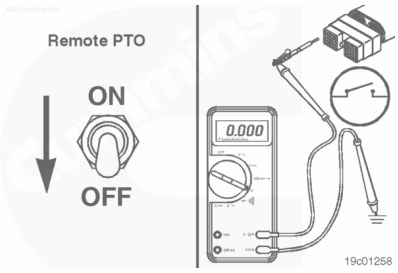
Connect all components after the repair is complete.



Check for Short Circuit to Ground

⚠ CAUTION ⚠

Proper leads and/or a Cummins® approved circuit testing tool must be used when working with electrical connectors to prevent pin expansion and damage to the connector.



Disconnect the original equipment manufacturer (OEM) harness engine interface connector. To determine the location of the connector, see the corresponding engine wiring diagram.

Insert the test lead into the remote PTO switch signal pin in the OEM harness connector and connect it to the multimeter probe. Touch the other probe to engine block ground.

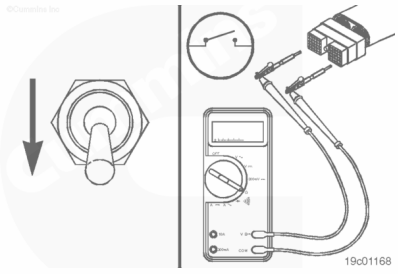
With the remote PTO switch in the OFF position, read the resistance.

The multimeter **must** show an open circuit (100k ohms or more).

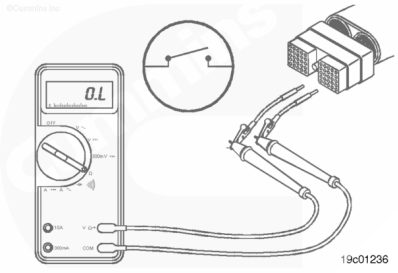
If the resistance values are **not** correct, make sure the remote PTO switch signal wire and the ground wire are properly installed on the switch. If both wires are correctly installed, inspect the wires for a short to ground circuit, provided the remote PTO switch has been previously checked.

Check for Short Circuit from Pin to Pin

Check for a short circuit from pin to pin. Set the remote PTO switch to the OFF position. Insert the test lead into the remote PTO switch return pin of the OEM harness connector and connect it to the multimeter probe. With a test lead connected to the other multimeter probe, check all the other pins in the connector. Measure the resistance. The multimeter **must** show an open circuit (100k ohms or more).



Remove the lead from the remote PTO switch return pin and insert it into the remote PTO switch signal pin of the harness connector. With the other test lead, check all other pins in the connector. Measure the resistance. The multimeter **must** show an open circuit (100k ohms or more).



If the circuit is **not** open, there is a short circuit between the switch circuit and any pin that did **not** measure an open circuit, provided the switch has previously been checked. Repair or replace the wires in the OEM harness according to the vehicle manufacturer's procedures.

Connect all components after completing the repair.

Last Modified: 29-Jun-2015

ANADOLU ISUZU AFTER SALES

General Information

A remote PTO switch is available for applications where PTO operation control is desired away from the operator controls.

The remote PTO switch circuit consists of the remote PTO switch signal wire and a switch common return.

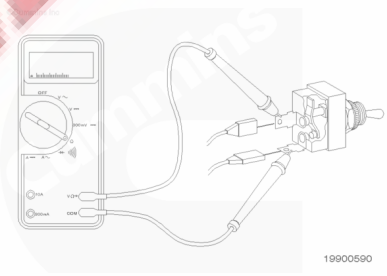


Resistance Check

Locate the desired ON/OFF toggle switch.

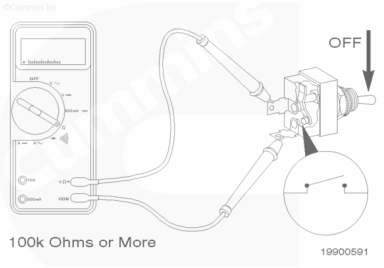
Remove and tag the two connectors from the terminals on the switch.

Touch the multimeter probes to the terminals on the switch.



Move the switch to the OFF position and measure the resistance. The multimeter **must** show 100k ohms or more (open circuit). If the circuit is **not** open, the switch has failed.

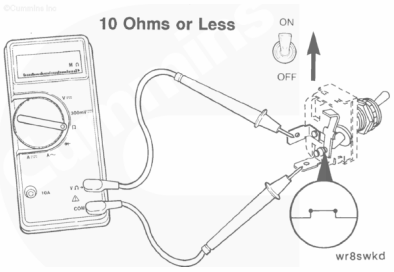
Replace the switch. Refer to the OEM troubleshooting and repair manual for the replacement procedures.



Move the switch to the ON position and measure the resistance. The multimeter **must** show 10 ohms or less (closed circuit). If the circuit is **not** closed, the switch has failed.

Replace the switch. Refer to the OEM troubleshooting and repair manual for the replacement procedures.

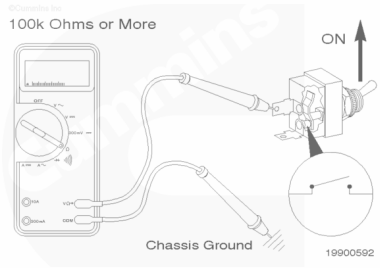
If the resistance value is correct, the switch **must** still be checked for a short circuit to ground.



ANADOLU ISUZU PARTS SALES

Check for Short Circuit to Ground

Touch one of the multimeter probes to one of the switch terminals. Touch the other probe to chassis ground. Move the switch to the ON position and measure the resistance. The multimeter **must** show 100k ohms or more (open circuit). If the circuit is **not** open, the switch has failed. Replace the switch. Refer to the OEM troubleshooting and repair manual for replacement procedures. If the switch passes all of the previous checks, the circuit **must** be checked for an open circuit, a short circuit to ground, a short circuit from pin to pin, and a short circuit to an external voltage source.



ANADOLU ISUZU
AFTER SALES

Last Modified: 08-Apr-2003

Select Service Tools

Recommended Cummins® Service Tools

- Engine control module (ECM) connector break-out header, Part Number 2892510
- Test lead, Part Number 3164113

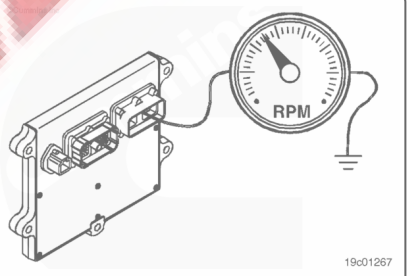
Additional Service Items

- Multimeter

General Information

The ECM can supply an output signal to operate the vehicle tachometer.

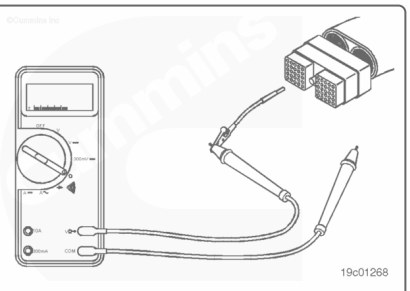
The circuit is the tachometer SIGNAL wire and a RETURN wire in the original equipment manufacturer (OEM) harness.



Resistance Check

⚠ CAUTION ⚠

Do NOT insert test leads into the ECM connector terminals. Doing so may cause terminals to spread and cause intermittent electrical connections. To perform pin-out diagnostic checks, use ECM connector break-out header, Part Number 2892510, and test lead, Part Number 3164113.



Disconnect the OEM harness from the ECM connector.

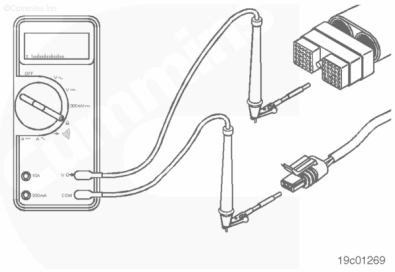
Disconnect the tachometer from the OEM harness.

Insert the test lead into the tachometer SIGNAL pin of the OEM harness connector. Connect it to the multimeter probe.

ANADOLU ISUZU AFTER SALES

Locate the tachometer connector of the OEM harness.

Connect the other lead to the multimeter probe. Connect it to the tachometer SIGNAL pin of the tachometer connector coming from the engine ECM. See equipment manufacturer service information for wiring schematics.



Adjust the multimeter to the resistance setting.

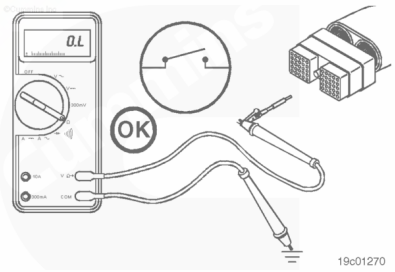
Measure the resistance.

The multimeter **must** show a closed circuit (10 ohms or less). If the circuit is **not** closed, there is an open circuit or the wires in the tachometer connector are reversed. Repair or replace the wire connected to the tachometer SIGNAL pin in the OEM harness according to the vehicle manufacturer's procedures.

Check for Short Circuit to Ground

Disconnect the tachometer from the OEM harness.

Insert the test lead into the tachometer SIGNAL pin of the OEM harness connector. Connect it to the multimeter probe. Touch the other multimeter probe to the engine block ground.



Measure the resistance.

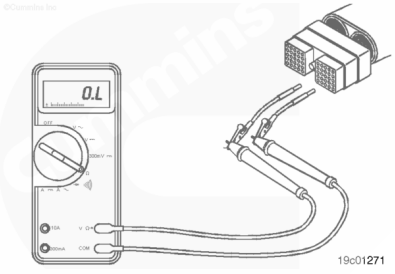
The multimeter **must** show an open circuit (100k ohms or more).

If the circuit is **not** open in either of the prior checks, repair the wires which have incorrect readings. See equipment manufacturer service information for the repair procedures.

Check for Short Circuit from Pin to Pin

Disconnect the tachometer from the OEM harness.

Insert the test lead into the tachometer SIGNAL pin of the OEM harness connector. Connect it to the multimeter probe. Insert the other lead into any pin, except the tachometer switch return, of the OEM harness connector. Connect it to the other multimeter probe.

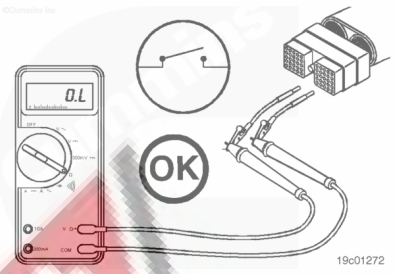


Measure the resistance.

The multimeter **must** show an open circuit (100k ohms or more).

Measure the resistance from the tachometer signal pin to all other pins in the OEM connector. The multimeter **must** show an open circuit.

Remove the test lead from the last tested pin, insert it into the tachometer switch RETURN pin. Measure the resistance from the tachometer switch RETURN pin to the tachometer SIGNAL pin in the OEM harness connector.



The multimeter **must** show an open circuit (100k ohms or more) at all pins.

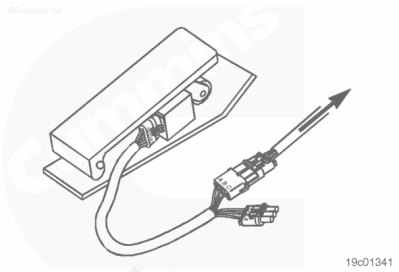
If any pin-to-pin check measures as **not** open, there is a short circuit between the tachometer SIGNAL pin and any other pin that measured a **not** open circuit. Repair or replace the OEM harness. Refer to Procedure 019-071 in Section 19. (/qs3/pubsys2/xml/en/procedures/99/99-019-071.html)

ANADOLU ISUZU AFTER SALES

Last Modified: 10-Aug-2016

General Information

The accelerator pedal or lever position sensor will vary with OEM. Refer to the vehicle manufacturer's manual for the specific troubleshooting and repair procedures. This section contains troubleshooting and repair procedures for one typical accelerator pedal or lever position sensor.



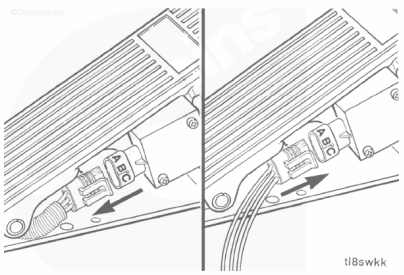
The accelerator pedal or lever position sensor sends a signal to the ECM when the operator pushes on the accelerator pedal or lever. The accelerator position circuit consists of the accelerator pedal or lever position sensor, the ECM, accelerator pedal/lever position +5 volt, accelerator pedal/lever position signal, and accelerator pedal/lever position return wires.

Resistance Check

If an electronic service tool is available, monitor the accelerator position sensor for proper operation. If **not**, follow the troubleshooting procedures in this section.

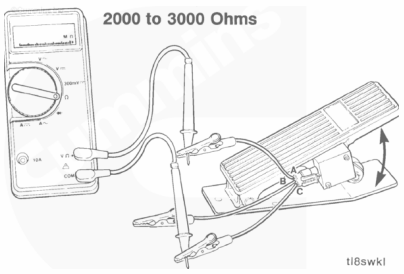
Disconnect the 3-pin connector from the accelerator position sensor.

Connect the test connector.



Connect the multimeter positive (+) test lead to the accelerator pedal/lever position +5 volt supply test connector wire. Connect the negative (-) multimeter test probe to the accelerator pedal/lever position return test connector wire.

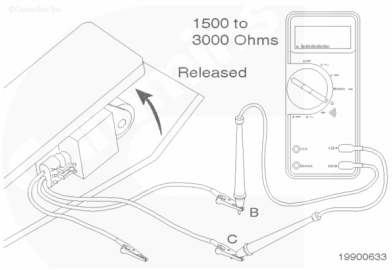
Measure the resistance. The multimeter **must** show between 2000 and 3000 ohms when the accelerator pedal is released (idle position) or depressed (full-fuel position).



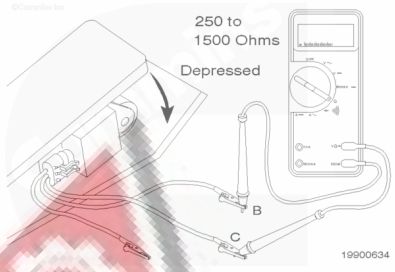
If the resistance is **not** within the specification, the accelerator position sensor has failed. Replace the accelerator position sensor. Refer to the OEM troubleshooting and repair manual for the procedures.

Remove the multimeter probe from the accelerator pedal/lever position +5 volt supply test connector wire and connect it to the accelerator pedal/lever position signal test connector wire.

When the accelerator pedal is in the released (idle) position, measure the resistance. The multimeter **must** show between 1500 and 3000 ohms.



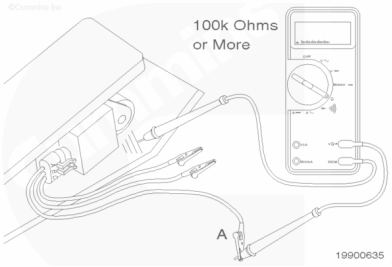
Depress the accelerator pedal assembly (full-fuel position) and measure the resistance. The multimeter **must** show between 250 and 1500 ohms. This resistance value **must** be at least 1000 ohms lower than the resistance value of 1500 to 3000 ohms measured in the above check. If the resistance values in the two previous steps are **not** within the specification, the accelerator position sensor has failed. Replace the accelerator position sensor according to the vehicle manufacturer's procedures. If the resistance values are within the specifications, the accelerator position sensor **must** still be checked for a short circuit to ground.



Check for Short Circuit to Ground

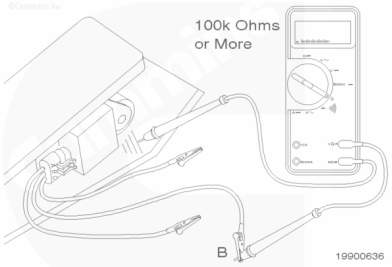
Connect the multimeter positive (+) probe to the accelerator pedal/lever position return test connector wire. Touch the negative (-) multimeter probe to the chassis ground and measure the resistance.

The multimeter **must** show an open circuit (100k ohms or more).



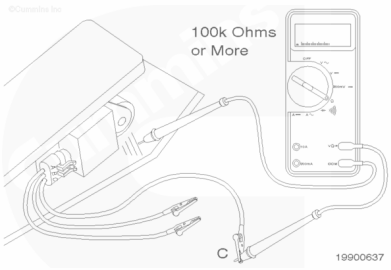
Remove the multimeter positive (+) probe from accelerator pedal/lever position return test connector wire and connect it to the accelerator pedal/lever position signal test connector wire. Measure the resistance.

The multimeter **must** show an open circuit (100k ohms or more).



Remove the multimeter positive (+) probe from the accelerator pedal/lever position signal test connector wire and connect it to the accelerator pedal/lever position +5 volt

supply test connector wire. Measure the resistance. The multimeter **must** show an open circuit (100k ohms or more).



If the resistance values are **not** within the specifications in the previous check, the accelerator position sensor has failed. Replace the accelerator position sensor according to the vehicle manufacturer's procedures.

If the accelerator position sensor has passed all the previous checks, connect the sensor to the wiring harness. The accelerator position sensor circuit **must** still be checked.

Last Modified: 29-Jun-2015

ANADOLU ISUZU
AFTER SALES

Select Service Tools

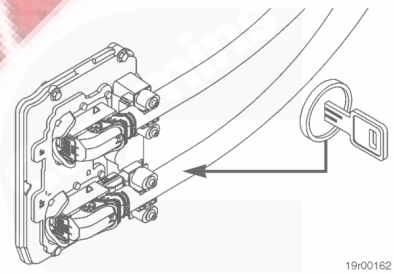
Recommended Cummins® Service Tools

- Engine control module (ECM) connector break-out header, Part Number 2892510
- Test lead, Part Number 3164113

Additional Service Items

- Multimeter

General Information



The ECM receives constant voltage from the batteries through the ECM battery SUPPLY positive (+) wire connected directly to the positive (+) battery post. There is one in-line 30 amperes fuse in the ECM SUPPLY wire to protect the ECM. The ECM receives switched battery input through the keyswitch input signal when the vehicle keyswitch is turned ON. The ECM battery SUPPLY negative (-) wire is connected directly to the negative (-) battery post.

The ECM battery SUPPLY positive (+) and the ECM battery SUPPLY negative (-) wires are in the original equipment manufacturer (OEM) wiring harness.

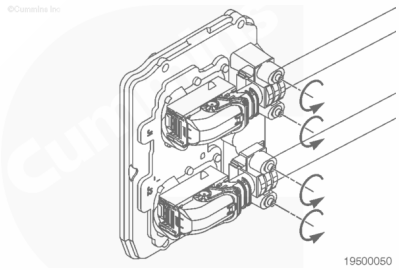
Always check the ECM battery supply fuse when troubleshooting the ECM and power supply circuit.

Check the battery voltage. Refer to Procedure 019-008 in Section 19. (/qs3/pubsys2/xml/en/procedures/99/99-019-008.html)

Remove

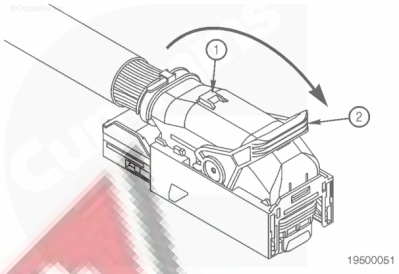
Note : Do NOT remove the wire ties attaching the hold-down clamps to the wire harness.

Remove the wire harness hold-down clamps from the ECM.



⚠ CAUTION ⚠

Do NOT close the lever after the connector has been removed from the ECM. Attempting to do so will cause damage to the connector.

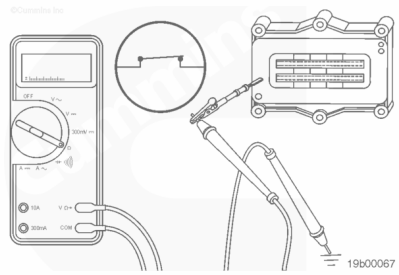


Remove the OEM connector from the ECM by pressing down on the locking tab (1) and pulling up on the lever (2). This connector includes the battery SUPPLY wires.

Resistance Check

⚠ CAUTION ⚠

Do not insert test leads into the ECM connector terminals. Doing so can cause terminals to spread and cause intermittent electrical connections. To perform pin-out diagnostic checks, use ECM connector break-out header, Part Number 2892510, and test lead, Part Number 3164113.



Adjust the multimeter to measure resistance.

Use an ECM connector break-out header to connect a test lead into the ECM battery supply negative (-) pin of the OEM wiring harness connector. See the appropriate wiring diagram for pin locations. Attach it to the multimeter probe. Touch the other multimeter probe to the engine block ground and measure the resistance

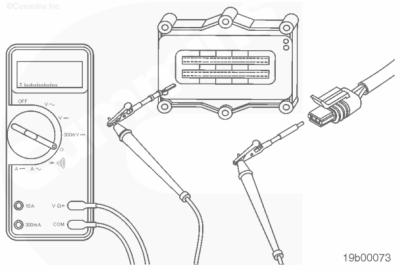
The multimeter **must** show 10 ohms or less.

Repeat the measurement for all other ECM battery SUPPLY negative (-) pins populated in the OEM wiring harness connector.

If the resistance value is **not** correct, check the OEM wiring harness.

Repair or replace the OEM wiring harness.

When the checks have been completed, connect the OEM wiring harness connector.



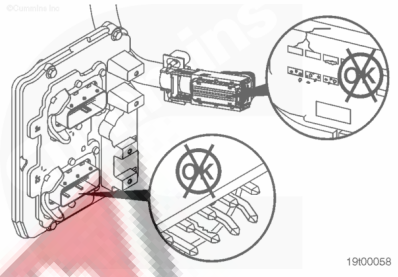
Note : Some OEM applications have the ECM power harness with all four pins in the connector populated.

Check the battery RETURN wire in the ECM power harness for proper grounding.

Disconnect the harness from the ECM connector.

Check for damaged pins in the ECM and the harness.

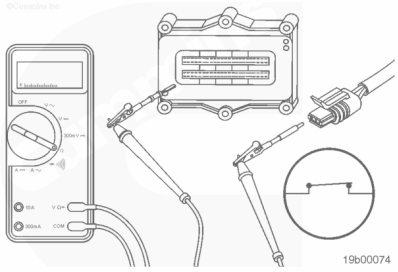
Repair or replace any damaged pins. Refer to Procedure 019-505 in Section 19. (/qs3/pubsys2/xml/en/procedures/00/00-019-505.html)



Voltage Check

⚠ CAUTION ⚠

Do NOT insert test leads into the ECM connector terminals. Doing so can cause terminals to spread and cause intermittent electrical connections. To perform pin-out diagnostic checks, use ECM connector break-out header, Part Number 2892510, and test lead, Part Number 3164113.



Check the battery voltage SUPPLY at the ECM battery SUPPLY positive (+) pins of the OEM wiring harness connector.

Turn the keyswitch to the OFF position.

Set the multimeter to measure VDC.

Use an ECM connector break-out header to connect a test lead into the ECM battery supply positive (+) pin of the OEM wiring harness connector. See the appropriate wiring diagram for pin locations. Attach it to the multimeter probe. Touch the other multimeter probe to the engine block ground stud, located below the ECM. Measure the voltage.

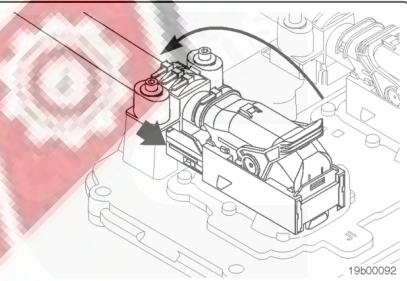
The voltage **must** read within 1 VDC of battery voltage at this pin.

Repeat the measurement for all other ECM battery SUPPLY positive (+) pins populated in the OEM wiring harness connector.

If the voltage is **not** correct, repair or replace the OEM wiring harness.

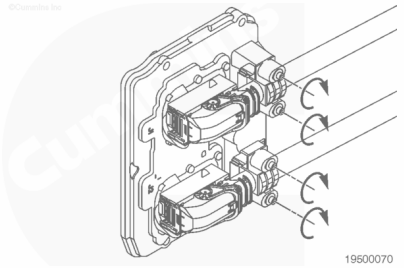
Install

Connect the harness to the ECM by placing the harness connector into the ECM header. Pull back on the locking lever until the connector is fully seated and the lever locking tab is engaged.



⚠ CAUTION ⚠

Do not overtighten the harness hold down clamp mounting screws or damage to the ECM will occur.



Install the wire harness hold down clamps. Refer to Procedure 019-043 in Section 19. (/qs3/pubsys2/xml/en/procedures/425/425-019-043.html)

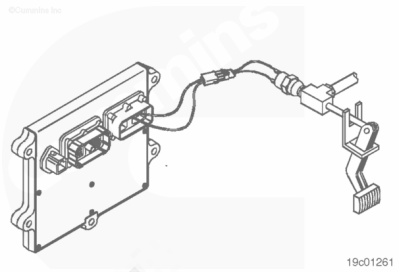
ANADOLU ISUZU

Last Modified: 10-Aug-2016

General Information

⚠ CAUTION ⚠

When troubleshooting the brake line switch circuit, make sure the brake pressure switch is identified. The vehicle brake light pressure switch, which is not a part of the Signature system, is commonly mistaken for the brake line switch used in the Signature system.

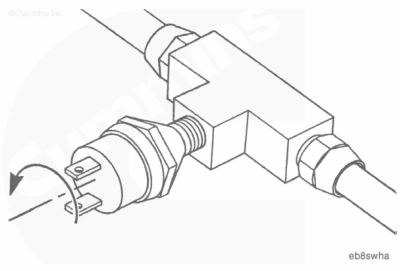


The brake pedal position switch detects the position of the service brake pedal. Certain features such as cruise control and PTO respond to the state of the brake pedal position switch and disengage when the brakes are applied. The circuit has a normally-closed switch, switch return wire, and brake pedal position switch signal wire of the OEM harness. The brake pedal position switch is mounted in the low pressure side of the vehicle pneumatic brake system. When the vehicle brakes are applied, the normally-closed switch opens and disables the cruise control operation.

Remove

⚠ WARNING ⚠

To avoid personal injury or death, do not apply the vehicle brakes when the switch is removed from the brake line fitting.



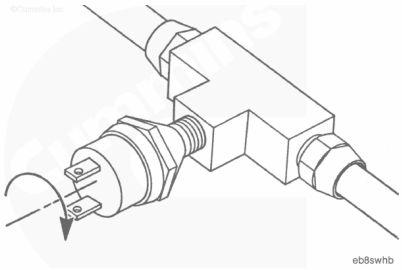
Disconnect the OEM harness from the brake pedal position switch.

Remove the brake pedal position switch from the fitting.

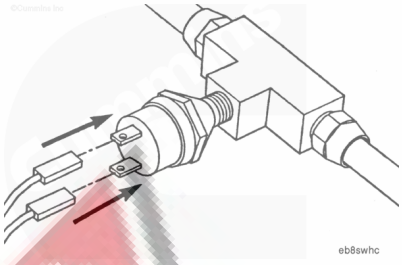
Install

ANADOLU ISUZU PARTS CENTER SALES

Install the new brake pedal position switch into the fitting according to the vehicle manufacturer's procedures.



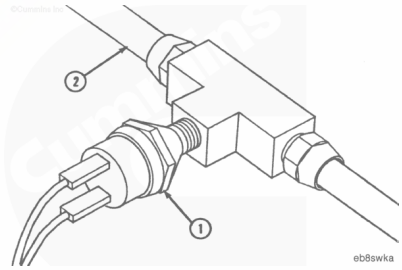
Connect the two wire connectors to the brake pedal position switch.



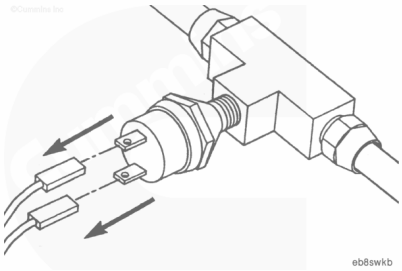
Resistance Check

If an electronic service tool is available, monitor the brake pedal position switch for proper operation. If **not**, follow the troubleshooting procedures in this section.

The brake pedal position switch (1) will be located in the vehicle brake line (2). The location will depend on the OEM installation procedures.



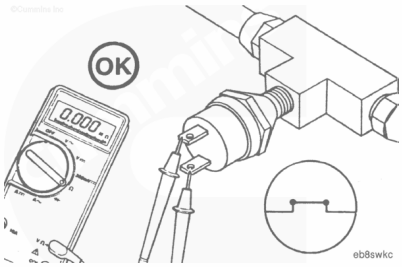
Disconnect the two wire connectors from the brake pedal position switch.



Connect the probes of the multimeter to the brake pedal position switch terminals.

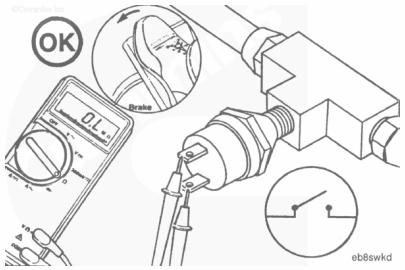
Measure the resistance.

The multimeter **must** show a closed circuit (10 ohms or less) when the brakes are **not** applied. If the circuit is **not** closed, replace the brake pedal position switch.



⚠ CAUTION ⚠

The vehicle must have enough air pressure to activate the brakes.

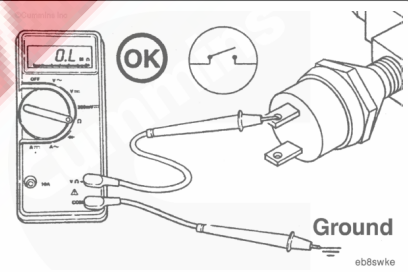


Depress the vehicle brake pedal. The multimeter **must** show an open circuit (100k ohms or more) when the brakes are applied. If the circuit is **not** open, replace the brake pedal position switch.

If the resistance value is correct, the switch **must** still be checked for a short circuit to ground.

Check for Short Circuit to Ground

Touch one multimeter probe to one of the brake pedal position switch terminals. Touch the other multimeter probe to chassis ground. Measure the resistance. The multimeter **must** show an open circuit (100k ohms or more) when the brake pedal is released. If the circuit is **not** open, replace the brake pedal position switch.



If the brake pedal position switch passed all the previous checks, connect the switch to the wiring harness. The brake pedal position switch circuit **must** still be checked.

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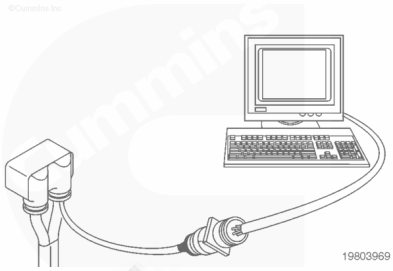
Resistance Check

⚠ CAUTION ⚠

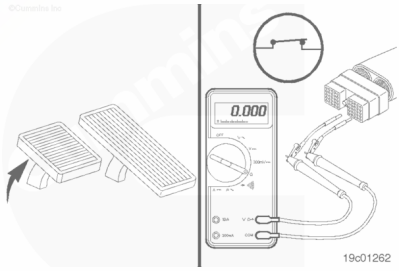
Proper leads and/or a Cummins® approved circuit testing tool must be used when working with electrical connectors to prevent pin expansion and damage to the connector.



If electronic service tool is available, monitor the brake pedal position switch for proper operation. If **not**, follow the troubleshooting procedures in this section.

Disconnect the original equipment manufacturer (OEM) harness engine interface connector. To determine the location of the connector, see the corresponding engine wiring diagram.

Make sure the brake pedal position switch is connected to the circuit.

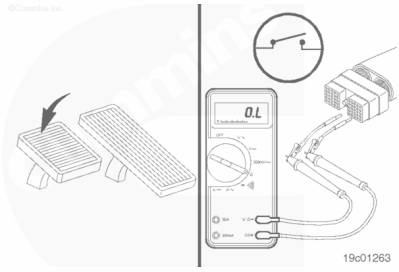


Insert a test lead into the brake pedal position switch signal pin of the OEM harness connector. Attach the lead to a multimeter probe. Insert the other test lead into the switch return pin of the connector and attach it to the other probe.

Adjust the multimeter to the resistance setting and measure the resistance. The multimeter **must** show a closed circuit (10 ohms or less) when the brakes are **not** engaged (brake pedal released). If the circuit is **not** closed, there is a problem with the OEM harness, provided the brake pedal position switch has been previously checked.

⚠ CAUTION ⚠

The vehicle must have enough air pressure to activate the brakes.

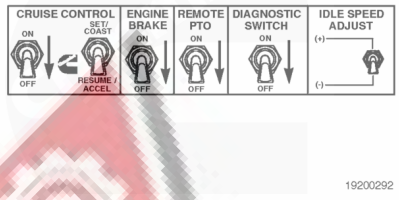


Depress the vehicle brake pedal and repeat the resistance check. The multimeter **must** show an open circuit (100k ohms or more). If the circuit is **not** open, there is a problem with the OEM harness, provided the brake pedal position switch has been previously checked.

If the values are correct, the circuit **must** still be checked for a short circuit to ground, a short circuit from pin to pin, and a short circuit to an external voltage source.

Check for Short Circuit to Ground

To isolate the brake pedal position switch circuit when checking for a short circuit, turn all cab panel switches to the OFF or neutral position.



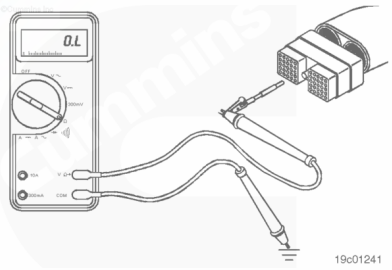
19200292

Disconnect the OEM harness connector from the ECM and the OEM harness from the brake pedal position switch.

Set the service brake using the trailer brake hand valve.

Disconnect the clutch pedal position switch, accelerator position switch and the idle validation on/off switch.

Insert a test lead into the brake pedal position switch signal pin of the OEM harness connector. Connect the lead to the multimeter probe. Remove the alligator clip from the other multimeter probe and touch the probe to the engine block.



19c01241

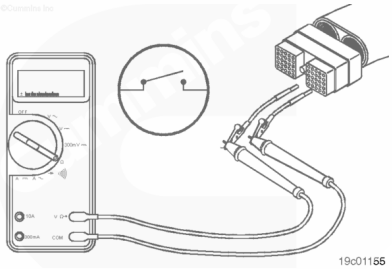
The multimeter **must** show an open circuit (100k ohms or more). If the circuit is **not** open, there is a short circuit to ground in the brake pedal position switch signal wire, provided that the switch has been previously checked.

Repair or replace the wire connected to the brake pedal position switch signal pin in the OEM harness according to the vehicle manufacturer's procedures.

Measure the resistance.

Check for Short Circuit from Pin to Pin

Isolate the brake pedal position switch circuit by disconnecting the brake pedal position switch connector and the OEM harness connector at the ECM. Insert a test lead into the brake pedal position switch signal pin of the OEM harness connector. Insert the other test lead into the switch return pin of the OEM harness connector. Connect the


19c01155

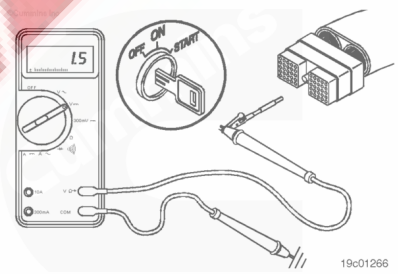
alligator clips to the multimeter probes. Measure the resistance. The multimeter **must** show an open circuit (100k ohms or more).

Remove the lead from the switch return pin and test all other pins in the connector. The multimeter **must** show an open circuit (100k ohms or more) at all pins. If the circuit is **not** open, there is a short circuit between the wire connected to the service brake switch signal pin and any pin that did **not** show an open circuit.

Repair or replace the wires in the OEM harness according to the vehicle manufacturer's procedures.

Check for Short Circuit to External Voltage Source

Disconnect the brake pedal position switch from the OEM harness and disconnect the OEM harness from the ECM. Turn the vehicle keyswitch to the ON position. Adjust the multimeter to measure VDC. Insert a test lead into the brake pedal position switch signal pin and connect it to the positive multimeter probe. Remove the lead from the negative multimeter probe and touch the probe to the engine block ground. Measure the voltage. The voltage **must** be 1.5 VDC or less.



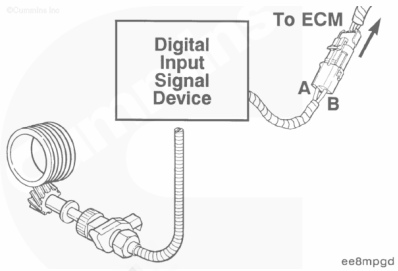
Note : An external voltage source is any wire in the OEM wiring that carries voltage.

If the voltage is more than 1.5 VDC, there is a short circuit between the wire connected to the brake pedal position switch signal pin and a wire carrying power in the OEM harness. Repair the OEM harness according to the vehicle manufacturer's procedures.

Connect all components after completing the repair.

General Information

The digital input signal device is an OEM optional part. It changes the signal pulses from AC to DC. This part is near the transmission or in the vehicle cab. The DC voltage pulses are then sent to the ECM and computed into miles per hour.



The digital vehicle speed sensor circuit consists of the speed sensor, the digital vehicle speed sensor +5 volt supply wire, the digital vehicle speed sensor signal wire, and the digital vehicle speed sensor return wire.

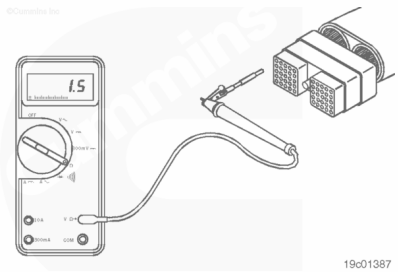
⚠ CAUTION ⚠

When the OEM-supplied signal conditioner is internally grounded, do not connect the vehicle speed sensor signal negative (-) wire to the ECM. This will create a ground loop in the system that will inject unwanted electrical noise into the system. Only the digital vehicle speed sensor +5 volt supply wire is required in this case.

Resistance Check

⚠ CAUTION ⚠

Proper leads and/or a Cummins® approved circuit testing tool must be used when working with electrical connectors to prevent pin expansion and damage to the connector.

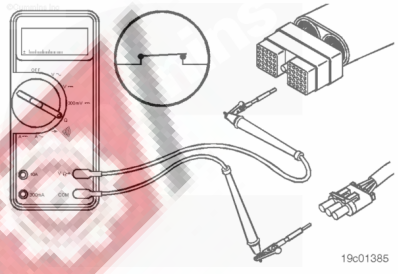


Disconnect the original equipment manufacturer (OEM) harness engine interface connector. To determine the location of the connector, see the corresponding engine wiring diagram.

Disconnect the digital vehicle speed sensor from the OEM harness.

Insert a test lead into the digital vehicle speed sensor +5 volt supply pin in the OEM harness connector, and connect it to the multimeter probe.

Insert the other test lead to the digital vehicle speed sensor +5 volt supply in the vehicle speed sensor connector and connect the alligator clip to the other multimeter probe. Adjust the multimeter to the resistance setting and measure the resistance.



The multimeter **must** show a closed circuit (10 ohms or less).

If the circuit is **not** closed, there is an open circuit. Repair or replace the wire connected to the digital vehicle speed sensor +5 volt supply pin in the OEM harness according to the vehicle manufacturer's procedures.

Remove the lead from the digital vehicle speed sensor +5 volt supply pin and insert it into the digital vehicle speed sensor signal pin of the OEM harness connector. Remove the multimeter lead from the digital vehicle speed sensor +5 volt supply at the speed sensor connector and connect it to the digital vehicle speed sensor signal pin in the vehicle speed sensor connector. Measure the resistance.

The multimeter **must** show a closed circuit (10 ohms or less).

If the circuit is **not** closed, there is an open circuit. Repair or replace the wire connected to the vehicle speed sensor signal pin in the OEM harness according to the vehicle manufacturer's procedures.

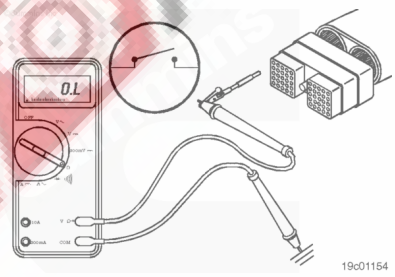
Remove the lead from the digital vehicle speed sensor signal pin and insert it into the digital vehicle speed sensor return pin of the OEM harness connector. Remove the multimeter lead from the digital vehicle speed sensor signal pin at the speed sensor connector and connect it to the digital vehicle speed sensor return pin in the vehicle speed sensor connector. Measure the resistance.

The multimeter **must** show a closed circuit (10 ohms or less).

If the circuit is **not** closed, there is an open circuit. Repair or replace the wire connected to the vehicle speed sensor return pin in the OEM harness according to the vehicle manufacturer's procedures.

If the values are correct, the circuit **must** still be checked for a short circuit to ground and a short circuit from pin-to-pin.

Check for Short Circuit to Ground



Disconnect the vehicle speed sensor from the OEM harness. Disconnect the original equipment manufacturer (OEM) harness engine interface connector. To determine the location of the connector, see the corresponding engine wiring diagram.

Insert a test lead into the digital vehicle speed sensor signal return pin of the OEM harness connector, and connect it to the multimeter probe. Touch the other multimeter probe to the engine block ground. Measure the resistance.

The multimeter **must** show an open circuit (100k ohms or more).

Remove the test lead from the digital vehicle speed sensor signal return pin and insert it into the digital vehicle speed sensor +5 volt supply pin of the OEM harness connector. Touch the other multimeter probe to the engine block ground. Measure the resistance.

The multimeter **must** show an open circuit (100k ohms or more).

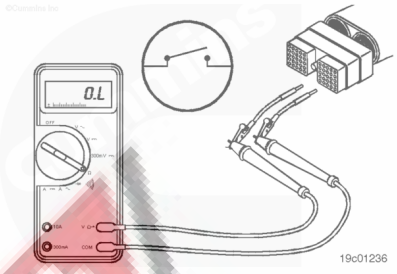
Remove the test lead from the digital vehicle speed sensor signal +5 volt supply pin and insert it into the digital vehicle speed sensor signal pin of the OEM harness connector. Touch the other multimeter probe to the engine block ground. Measure the resistance.

The multimeter **must** show an open circuit (100k ohms or more).

If the circuit is **not** open in either of these checks, there is a short circuit to ground in the digital vehicle speed sensor circuit in the OEM harness.

Repair the wires which have a short circuit according to the vehicle manufacturer's procedures.

Check for Short Circuit from Pin to Pin



Disconnect the vehicle speed sensor from the OEM harness.

Disconnect the original equipment manufacturer (OEM) harness engine interface connector. To determine the location of the connector, see the corresponding engine wiring diagram.

Insert one test lead into the digital vehicle speed sensor +5 volt supply pin of the OEM harness connector, and connect it to the multimeter probe. Connect the other test lead to the other multimeter probe and check all pins in the OEM harness connector.Measure the resistance.

The multimeter **must** show an open circuit at all pins (100k ohms or more).

Remove the test lead from the digital vehicle speed sensor +5 volt supply pin, and insert it into the digital vehicle speed sensor signal return pin.

Use the other test lead to check all pins in the connector. Measure the resistance.

The multimeter **must** show an open circuit (100k ohms or more).

Remove the test lead from the digital vehicle speed sensor return pin, and insert it into the digital vehicle speed sensor signal signal pin.

Use the other test lead to check all pins in the connector. Measure the resistance.

The multimeter **must** show an open circuit (100k ohms or more).

If the circuit is **not** open in any of the checks, repair the wires that have the short circuit according to the vehicle manufacturer's procedures.

Note : If the values are correct for all of the circuit checks in Procedure 019-090, the vehicle speed sensor circuit is good.

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The problem is in the vehicle speed sensor. Repair or replace the vehicle speed sensor according to the vehicle manufacturer's procedures.

Last Modified: 29-Jun-2015

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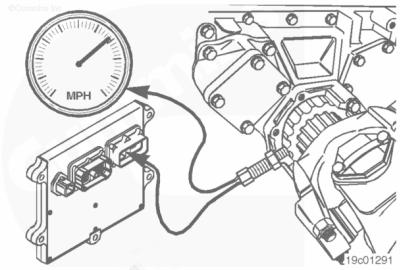
General Information

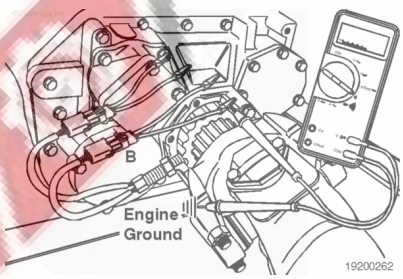
The vehicle speed sensor (VSS) senses the speed of the output shaft of the transmission. The vehicle's road speed is computed from this data by the electronic control module (ECM). The ECM uses programmed gearing and tire size data to compute the road speed.



The vehicle speed sensor is located in the rear of the transmission housing.

The vehicle speed sensor has two coils. One coil is connected to the ECM and the other coil is connected to the vehicle speedometer, or some other vehicle device.

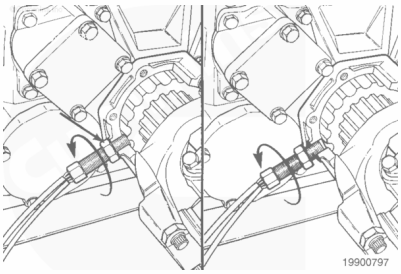
Note : Vehicle speed sensor design varies with the application. Refer to the original equipment manufacturer (OEM) troubleshooting and repair manual to understand which type of vehicle speed sensor is being used in a given location.



Remove

Disconnect the engine harness from the vehicle speed sensor.

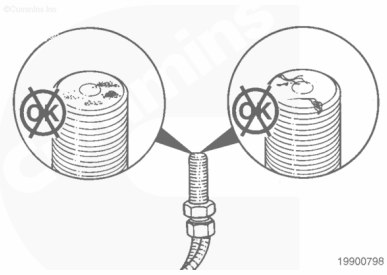
Loosen the locknut. Turn the vehicle speed sensor out of the transmission housing.



Inspect for Reuse

Inspect the tip of the vehicle speed sensor for dirt, debris, or physical damage (cracked potting, and so forth).

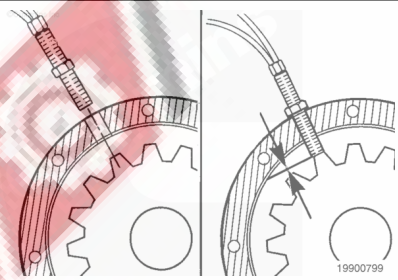
Clean the tip if dirty, or replace the vehicle speed sensor if damaged.



Install

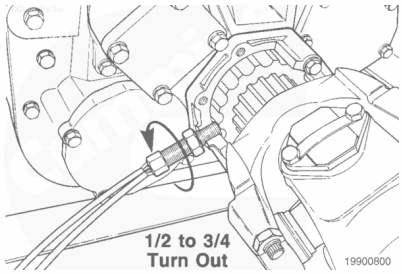
⚠ CAUTION ⚠

Make sure a gear tooth is aligned with the hole in the housing. Install the vehicle speed sensor into the hole until it touches the gear tooth.



Note : If the vehicle speed sensor does **not** turn in with finger pressure, check the transmission hole threads and the sensor threads for dirt or damage.

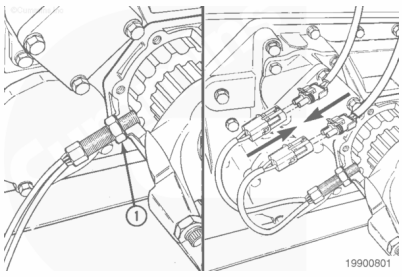
Turn the vehicle speed sensor out 1/2 to 3/4 of a turn.



Tighten the locknut against the transmission housing.

Torque the sensor according to the OEM or transmission specifications. Refer to the OEM troubleshooting and repair manual for detailed procedures.

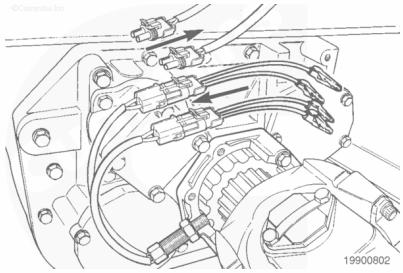
Install both of the connectors together until connectors "snap" into position. The connectors can be interchanged with each other without changing the performance of the system.



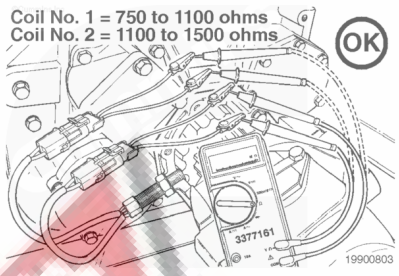
Resistance Check

Lift the tab on the connectors and pull them apart.

Note : When measuring the resistance value of the vehicle speed sensor coils, use two female test leads. This will allow the electrical leads of the sensor to be softly flexed to check for damaged or partially broken wire strands under the insulation.

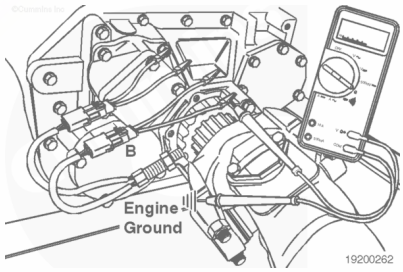


Use a multimeter to measure the resistance between the two pins of each connector on the vehicle speed sensor. Refer to the OEM troubleshooting and repair manual for detailed procedures. If the resistance is **not** correct, replace the vehicle speed sensor. If the resistance value is correct, the vehicle speed sensor **must** still be checked for a short circuit to ground and a short circuit between coils.

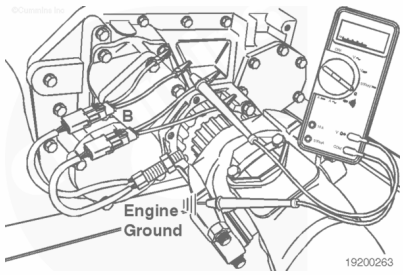


Check for Short Circuit to Ground

Measure the resistance between the magnetic vehicle speed sensor signal negative (-) pin of one of the connectors and the engine block. Refer to the OEM troubleshooting and repair manual for detailed procedures.

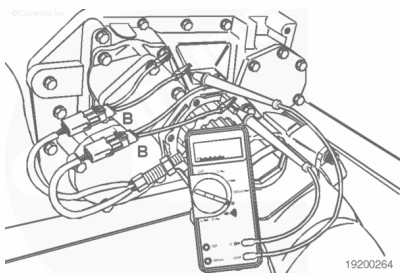


Measure the resistance between the magnetic vehicle speed sensor signal negative (-) pin of the other connector and the engine block. Refer to the OEM troubleshooting and repair manual for detailed procedures.



Check for a short circuit between coils

Use a multimeter to measure the resistance between the magnetic vehicle speed sensor signal negative (-) pin of one of the connectors and the magnetic vehicle speed sensor signal (-) pin of the other connector. Refer to the OEM troubleshooting and repair manual for detailed procedures.



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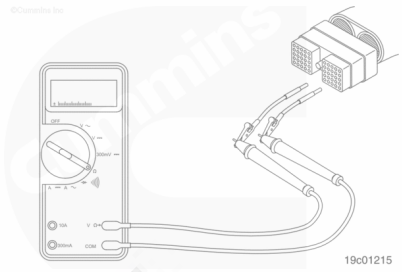
Resistance Check

⚠ CAUTION ⚠

Proper leads and/or a Cummins® approved circuit testing tool must be used when working with electrical connectors to prevent pin expansion and damage to the connector.



Disconnect the original equipment manufacturer (OEM) harness engine interface connector. To determine the location of the connector, see the corresponding engine wiring diagram. Make sure the vehicle speed sensor is connected to the OEM harness.

Insert a test lead into the magnetic vehicle speed sensor signal positive (+) pin in the OEM harness connector. Insert the other lead into the magnetic vehicle speed sensor signal negative (-) pin of the connector.

Connect the two alligator clips to the two probes of the multimeter. Adjust the multimeter to the resistance setting and measure resistance. When measuring the resistance with the sensor connected, refer to the OEM troubleshooting and repair manual for the correct resistance value. If the value is **not** correct, there is a problem with the OEM harness, provided that the vehicle speed sensor component has been previously checked.

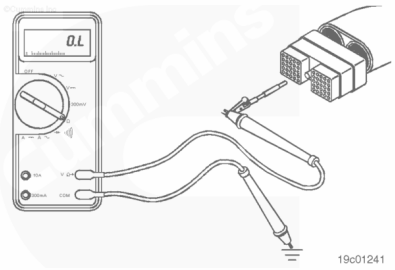
Note : Repair or replace the OEM harness. Refer to Procedure 019-071 (/qs3/pubsys2/xml/en/procedures/99/99-019-071.html), or to the OEM troubleshooting and repair manual for OEM harness replacement.

If the value is correct, the circuit **must** still be checked for a short circuit to ground and a short circuit from pin-to-pin.

Check for Short Circuit to Ground

Check for a short circuit to ground. Insert the multimeter probe with attached test lead into the magnetic vehicle speed sensor signal positive (+) pin of the OEM harness

connector. Touch the other multimeter probe to the engine block. Measure the resistance. The multimeter **must** show an open circuit (100k ohms or more).

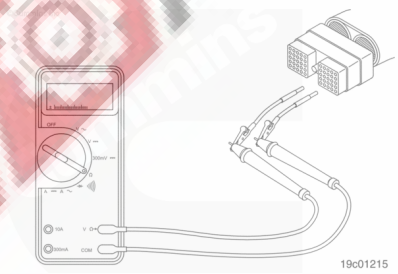


If the circuit is **not** open, there is a short circuit to ground in the vehicle speed sensor circuit in the engine harness or OEM harness.

Repair the wires which are shorted in the circuit according to the vehicle manufacturer's procedures.

Check for Short Circuit from Pin to Pin

Check for a short circuit from pin-to-pin. Insert the multimeter probe with attached test lead into the magnetic vehicle speed sensor signal positive (+) pin of the OEM harness connector. Insert the other test lead into all the other pins, one at a time, to check for a short to another pin.



Measure the resistance. The multimeter **must** show an open circuit (more than 100k ohms).

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Last Modified: 29-Jun-2015

Select Service Tools

Recommended Cummins® Service Tools

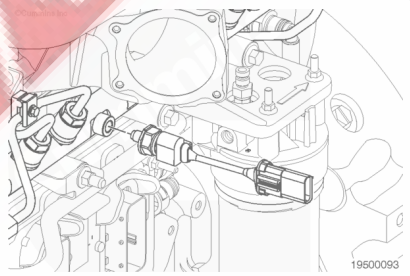
- No Cummins® Service Tools required.

Additional Service Items

- No additional service items required.

General Information

The fuel pressure sensor is located on the fuel rail. Use the following procedure for the fuel pressure sensor location. Refer to Procedure 100-002 in Section E. (/qs3/pubsys2/xml/en/procedures/425/425-100-002.html)



Preparatory Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

⚠ WARNING ⚠

Normal engine operation creates highly pressurized fuel in the fuel line which will remain in the fuel line after engine shutdown. Never open the fuel system when the engine is operating. Before servicing the fuel system, always loosen the pump-to-rail fuel line at the rail to vent the pressure. Keep hands clear of the line when loosening. High-pressure fuel spray can penetrate the skin, resulting in serious personal injury or death.

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Note : A machined slot in this fitting directs the fuel spray towards the engine block.

- Disconnect the batteries. See equipment manufacturer service information.
- Before servicing the fuel system, loosen the pump to rail line at the rail to vent the pressure.
- Keep hands clear of the line when loosening.
- Tighten the fuel rail nut.

Torque Valve: 65 n.m [48 ft-lb]

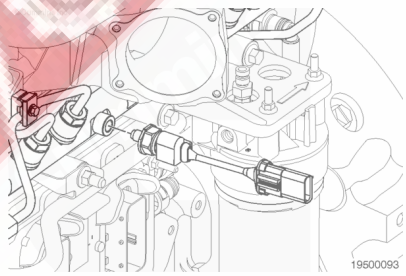
- Use the following procedure for additional fuel line information. Refer to Procedure 006-051 in Section 6. (/qs3/pubsys2/xml/en/procedures/425/425-006-051.html)

Remove

Clean the area around the fuel pressure sensor.

Disconnect the pressure sensor connector from the engine harness.

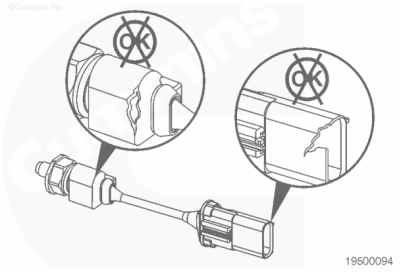
Remove the fuel pressure sensor.



Inspect for Reuse

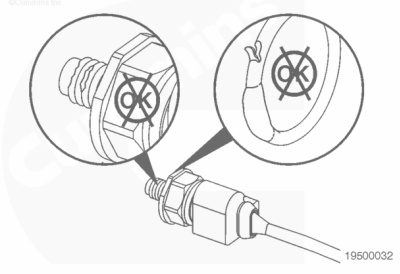
Inspect the engine harness connector and fuel pressure sensor connector for the following:

- Cracked or broken connector shell
- Missing or damaged connector seals
- Dirt, debris, or moisture in or on the connector pins
- Corroded, bent, broken, pushed back, or expanded pins.



Inspect the fuel pressure sensor for the following:

- Damaged seal surface in the rail
- Damaged seal surface on the sensor
- Thread damage.



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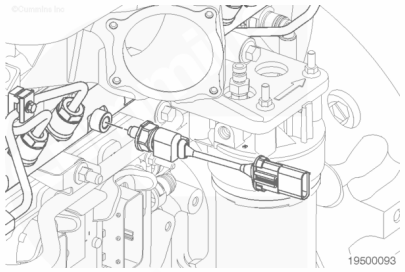
Install

Install a rail fuel pressure sensor.



Torque Value: 47 n•m [35 ft-lb]

Note : The fuel rail pressure sensor can **only** be installed a total of three times. After numerous removals and installations, the sensor **must** be replaced because the sealing capability of the sensor has been compromised and could result in a fuel leak.

Connect the engine harness to the fuel pressure sensor.

Finishing Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

- Connect the batteries. See equipment manufacturer service information.
- Start the engine. Check for leaks.

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Last Modified: 10-Aug-2016

Select Service Tools

Recommended Cummins® Service Tools

- No Cummins® Service Tools required.

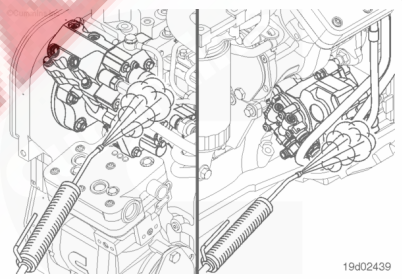
Additional Service Items

- No additional service items required.

Preparatory Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.



⚠ WARNING ⚠

When using a steam cleaner, wear safety glasses or a face shield, as well as protective clothing. Hot steam can cause serious personal injury.

⚠ WARNING ⚠

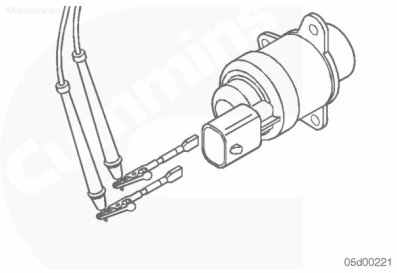
Wear appropriate eye and face protection when using compressed air. Flying debris and dirt can cause personal injury.

- Disconnect the batteries. See equipment manufacturer service information.
- Steam clean the fuel pump and the area around the fuel pump.
- Dry with compressed air.
- Disconnect the fuel pump actuator harness connector.

Initial Check

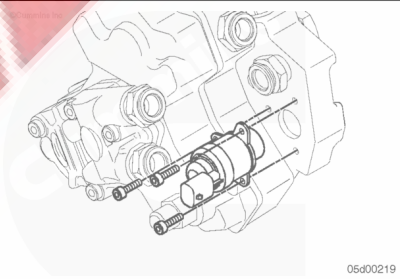
Measure the fuel pump actuator resistance.

- Minimum Resistance: 0.1 ohms
- Maximum Resistance: 5 ohms.



Remove

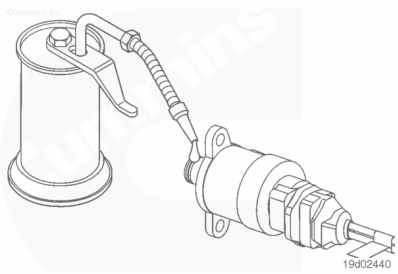
Remove the capscrews and fuel pump actuator.



Install

⚠ CAUTION ⚠

Do not pause more than 2 minutes between torque steps 1 and 2. This can cause the capscrews not to maintain their torque value. Leakage or engine damage can result.



Lubricate the o-ring with clean oil before installation.

Fully press the fuel pump actuator into the fuel pump housing, use a slight twisting motion. Do this before starting the capscrews.

Note : Fully installing the fuel pump actuator prior to starting the capscrews reduces the risk of side loading the plunger and reduced component life.

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Note : Make sure the fuel pump actuator flange is flush with the mounting surface on the fuel pump before tightening the capscrews.

Install and tighten the capscrews.

Torque Value: 3 n•m [27 in-lb]

Torque Value: 6.5 n•m [58 in-lb]

Finishing Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

- Connect the batteries. See equipment manufacturer service information.
- Connect the fuel pump actuator harness connector.
- Operate the engine. Check for leaks.

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Last Modified: 10-Aug-2016

Select Service Tools

Recommended Cummins® Service Tools

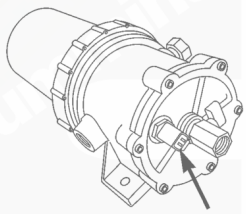
- Engine control module (ECM) connector break-out header, Part Number 2892510
- Test lead, Part Number 3164113

Additional Service Items

- Multimeter

General Information

Note : The water in fuel sensor is an original equipment manufacturer (OEM) supplied component and can be incorporated into the suction-side fuel filter. See equipment manufacturer service information for additional information.



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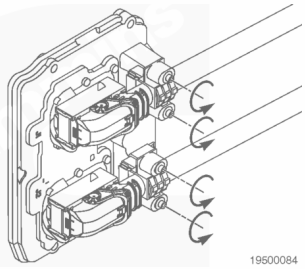
The water in fuel sensor separator is located at the base of the suction-side fuel filter. The water in fuel sensor sends a signal to the ECM when a set volume of water has accumulated in the fuel filter. The water in fuel circuit contains two wires, the water in fuel RETURN wire and the water in fuel SIGNAL wire.

Remove

Note : Do **not** remove the wire-ties attaching the hold down clamps to the wire harness.

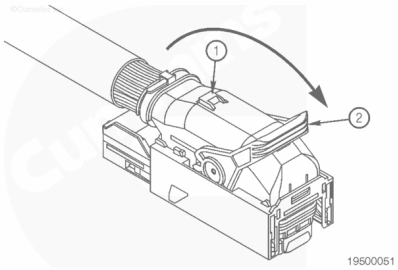


19500084

Remove the OEM wire harness hold down clamps from the ECM.

⚠ CAUTION ⚠

Do not close the lever after the connector has been removed from the ECM. Attempting to do so will cause damage to the connector.

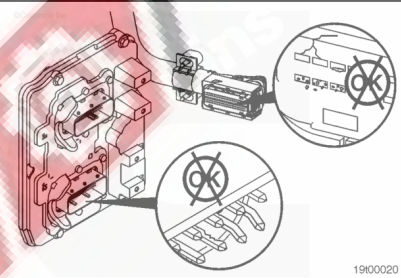


Remove the OEM connector from the ECM by pressing down on the locking tab (1) and pulling up on the lever (2). This connector includes the battery SUPPLY wires.

Resistance Check

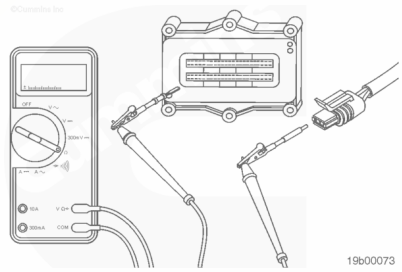
Check for damaged pins.

Disconnect the water in fuel sensor from the OEM harness.



⚠ CAUTION ⚠

Do not insert test leads into the ECM connector terminals. Doing so can cause terminals to spread and cause intermittent electrical connections. To perform pin-out diagnostic checks, use ECM connector break-out header, Part Number 2892510, and test lead, Part Number 3164113.



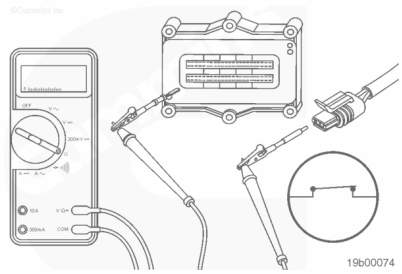
Return Wire Resistance - Checking

Use an ECM connector break-out header to connect the test lead into the sensor RETURN pin (common return) of the engine harness connector. Connect the alligator clip to the multimeter probe. Touch the other multimeter probe to water in fuel RETURN pin of the water in fuel sensor, harness-side.

Measure the resistance.

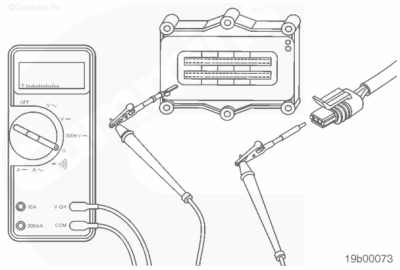
The multimeter **must** show a closed circuit 10 ohms or less.

If more than 10 ohms are measured, there is an open circuit in the RETURN wire. Repair the wire, or replace the engine harness.



⚠ CAUTION ⚠

Do NOT insert test leads into the ECM connector terminals. Doing so can cause terminals to spread and cause intermittent electrical connections. To perform pin-out diagnostic checks, use ECM connector break-out header, Part Number 2892510, and test lead Part Number, 3164113.



SIGNAL Wire Resistance - Checking

Use an ECM connector break-out header to connect the test lead into the water in fuel SIGNAL pin of the engine harness connector. Connect the alligator clip to the multimeter probe. Touch the other multimeter probe to the SIGNAL wire pin of the water in fuel sensor, harness-side.

Measure the resistance.

The multimeter **must** show a closed circuit 10 ohms or less.

If more than 10 ohms are measured, there is an open circuit in the SIGNAL SUPPLY wire. Repair the wire, or replace the OEM harness.

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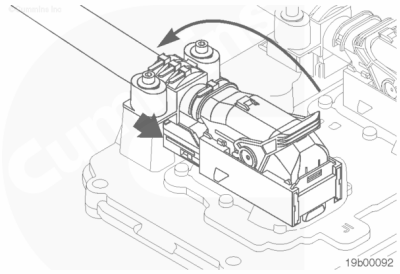
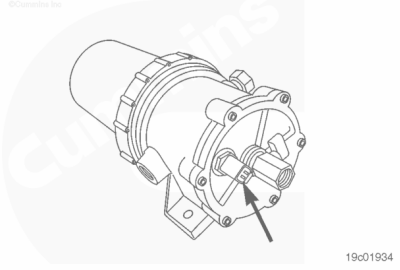
Install

Connect the harness to the ECM by placing the harness connector into the ECM header. Pull back on the locking lever until the connector is fully seated and the lever locking tab is engaged.



⚠ CAUTION ⚠

Do not overtighten the harness hold-down clamp mounting screws or damage to the ECM will occur.



Install the wire harness hold-down clamps. Use the following procedure for torque specifications. Refer to Procedure 019-043 in Section 19. (/qs3/pubsys2/xml/en/procedures/425/425-019-043.html)

Connect the water in fuel sensor to the OEM harness.

Last Modified: 10-Aug-2016

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Select Service Tools

Recommended Cummins® Service Tools

- No Cummins® Service Tools required.

Additional Service Items

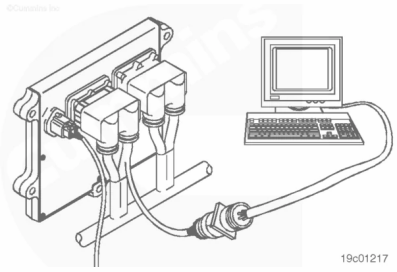
- No additional service items required.

General Information

The intake manifold temperature and intake manifold pressure sensors are combined into a single sensor. The sensor is located in the intake manifold. Use the following procedure for a detailed component location view. Refer to Procedure 100-002 in Section E. (/qs3/pubsys2/xml/en/procedures/425/425-100-002.html)

Initial Check

Use an electronic service tool to monitor the value of the intake manifold pressure/temperature sensor with the keyswitch ON and the engine **not** running.



The value of the intake manifold temperature sensor should be checked when the engine is cold, and should read within 5.5°C or 10°F of the local ambient air temperature.

The value of the intake manifold pressure should read 0 kPa ±24 kPa [0 in-hg ±7 in-hg].

If either value is out of specification, first verify the correct intake manifold pressure/temperature sensor is installed on the engine.

Compare the part number of the intake manifold pressure/temperature sensor to the part number listed in the parts catalog in QuickServe™ Online for the engine serial number (ESN).

If the correct part is installed, and either value is still out of specification, replace the intake manifold pressure/temperature sensor.

Preparatory Steps

⚠ WARNING ⚠

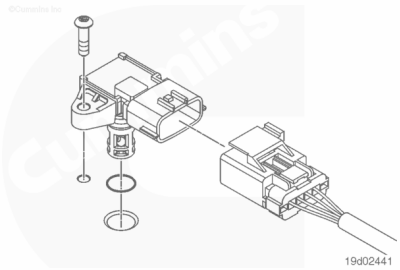
Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

- Disconnect the batteries. See equipment manufacturer service information.
- Clean the area around the intake manifold pressure/temperature sensor.

Remove

⚠ CAUTION ⚠

Be careful not to damage the o-ring seal when removing the sensor. Do not pry the sensor, as damage to the plastic cage can occur.



Disconnect the sensor connector from the engine harness.

Remove the mounting capscrew.

Remove the sensor from the engine by pulling straight up on the sensor.

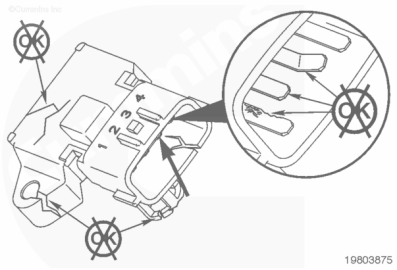
Clean and Inspect for Reuse

Inspect the engine harness connector and intake manifold pressure/temperature sensor for the following:

- Cracked or broken shell
- Missing or damaged connector seals

- Dirt, debris, or moisture in or on the connector pins
- Corroded, bent, broken, pushed back, or expanded pins
- Chipped, cracked, extruded, or damaged sensor.

Repair or replace parts as necessary.



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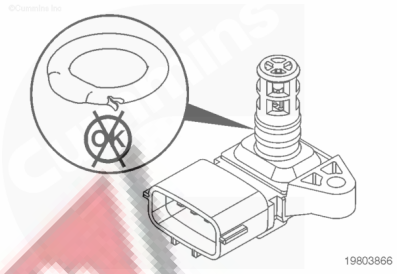
Inspect the intake manifold pressure/temperature sensor for the following:

- Swollen o-ring
- Nicks or cuts in or on the o-ring.

Replace the o-ring if **any** damage is found.



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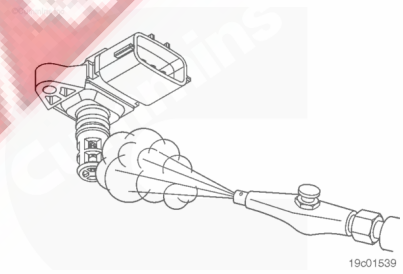
⚠ WARNING ⚠

Wear appropriate eye and face protection when using compressed air. Flying debris and dirt can cause personal injury.


19c01539

Inspect the tip of the sensor for soot and carbon buildup.

Use compressed air to remove the soot from the sensor, if necessary.

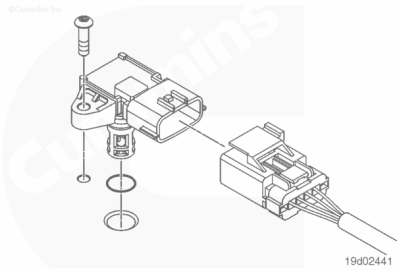
Do **not** replace the sensor for soot in the sensor.

Install

Lubricate the o-ring with clean engine oil before installation.

Install the intake manifold pressure/temperature sensor by pressing firmly on the top of the sensor until the o-ring is fully seated.

Install and tighten the capscrew.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Torque Value: 7 n•m [62 in-lb]

Connect the engine harness to the intake manifold pressure/temperature sensor.

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GENUINE PARTS

Finishing Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

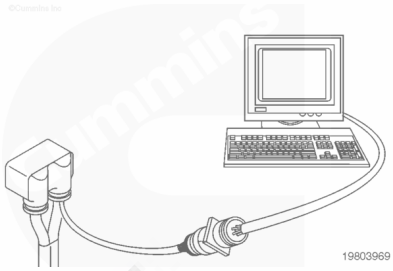
- Connect the batteries. See equipment manufacturer service information.
- Operate the engine. Check for leaks.

ANADOLU ISUZU AFTER SALES

Last Modified: 10-Aug-2016

General Information

The OEM J1939 datalink circuit is located in the OEM wiring harness.



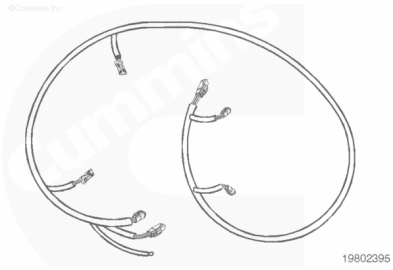
The purpose of this datalink is to allow communication with vehicle control-operated systems such as transmission controllers, traction control system, etc.

The traditional OEM J1939 datalink circuit is described as a shielded twisted pair and includes the wires connected to the J1939 datalink positive (+) pin, the J1939 datalink negative (-) pin, and the J1939 (shield) pin in the OEM harness.

On newer vehicles and equipment, OEM's can utilize an OEM J1939 datalink circuit that is described as an unshielded twisted pair (UTP). The unshielded twisted pair (UTP) J1939 datalink does **not** include the J1939 (shield) pin and **only** includes the J1939 datalink positive (+) pin and the J1939 datalink negative (-) pin in the OEM harness.

With the keyswitch in the ON position, public datalink messages will be broadcast on the OEM J1939 datalink. The broadcast will stop when the keyswitch is turned to the OFF position.

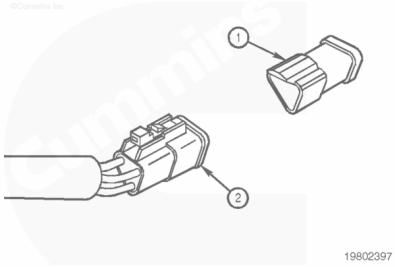
The Society of Automotive Engineers (SAE) J1939 has strict guidelines that **must** be followed for successful communication. Understanding some fundamentals about SAE J1939 will help make sure these guidelines are followed.



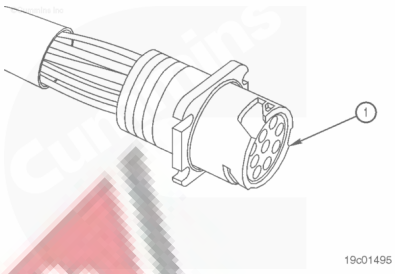
The main component of an SAE J1939 system is a backbone harness. The harness can be up to 40 meters [131 feet] in length. The backbone harness is terminated at each end with a 120 ohm resistor.

A maximum of thirty different devices can be attached to the SAE J1939 backbone at once. Each device, such as the datalink adapter, is connected to the backbone through a stub, which can be up to 1 meter [3.3 ft] in length. The stub connector is a 3-pin plug.

The terminating resistor caps (1) **must** be in place on the OEM backbone harness plugs (2) to maintain proper communication. Each resistor is 120 ohms and can be located in a removable cap.



Some OEMs will choose to provide a complete SAE J1939 backbone harness. If this is supplied, connection to the electronic service tool is accomplished by a 9-pin datalink connector (1), Part Number 3162848.



Note : Some OEM's place a 9-pin connector in the cab, but do **not** connect all of the pins to support J1939 protocol.

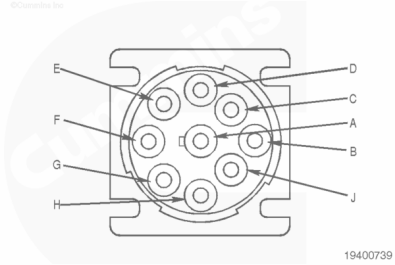
To check for the OEM J1939 backbone, turn the keyswitch to the OFF position. Measure the resistance from the SAE J1939 datalink positive (+) pin to the SAE J1939 datalink negative (-) pin of the 9-pin Deutsch™ connector.

The multimeter **must** read between 50 and 65 ohms for the electronic service tool to be able to establish communication.

If the OEM does **not** supply the J1939 backbone harness to the 9-pin connector, the **only** way to establish J1939 communication is through either the bench communication setup or for the Engine Control Module through the engine communication setup. Refer to Procedure 022-999 (/qs3/pubsys2/xml/en/procedures/00/00-022-999.html).

Note : The typical SAE J1939 connector will be a 9-pin connector.

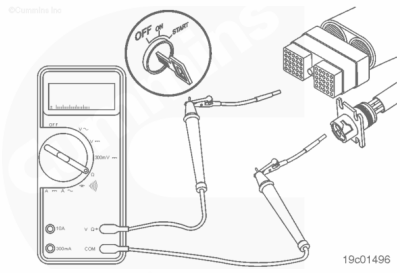
Pin	Signal
A	Ground
B	Unswitched Battery
C	J1939 datalink (+)
D	J1939 datalink (-)
E	J1939 datalink (shield) (if available)
F	J1708 datalink (+)
G	J1708 datalink (-)
H	Open
J	Open



Resistance Check

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.



⚠ CAUTION ⚠

Proper leads and/or a Cummins® approved circuit testing tool must be used when working with electrical connectors to prevent pin expansion and damage to the connector.

Turn the keyswitch to the OFF position.

Disconnect the batteries.

Disconnect the OEM harness connector from the ECU.

Insert a test lead into the SAE J1939 datalink positive (+) pin of the OEM harness connector, and connect it to the multimeter probe. Insert the other test lead into the SAE J1939 datalink positive (+) pin of the 9-pin Deutsch™ connector, and connect it to the multimeter.

Measure the resistance. The multimeter **must** show a closed circuit (10 ohms or less).

If the circuit is **not** closed, repair or replace the OEM harness. Refer to the OEM troubleshooting and repair manual for the procedures.

Insert the multimeter lead into the SAE J1939 datalink negative (-) of the OEM harness connector. Touch the other lead to the SAE J1939 datalink negative (-) pin of the 9-pin Deutsch™ connector. Measure the resistance. The multimeter **must** show a closed circuit (10 ohms or less)

If the circuit is **not** closed, repair or replace the OEM harness. Refer to the OEM troubleshooting and repair manual for the procedures.

If the values are correct, the circuit **must** still be checked for a short circuit to ground and a short circuit from pin to pin.

Remove the lead from the SAE J1939 datalink negative (-) pin of the OEM harness connector and insert it into the SAE J1939 datalink (shield) pin, if the shield pin is available.

If the J1939 datalink circuit is an unshielded twisted pair (UTP), the shield pin will **not** be provided.

If the shield pin is provided, measure the resistance from the SAE J1939 datalink (shield) pin of the OEM harness connector to the SAE J1939 datalink (shield) pin of the 9-pin Deutsch™ connector.

The multimeter **must** show a closed circuit (10 ohms or less). If the circuit is **not** closed, repair or replace the OEM harness. Refer to the OEM troubleshooting and repair manual for the procedures.

If the (shield) pin is provided, measure the resistance from the SAE J1939 datalink (shield) pin of the 9-pin Deutsch™ connector to the engine block or chassis ground. The SAE J1939 datalink shield **must** be grounded to the vehicle battery ground. The multimeter **must** show a closed circuit (10 ohms or less). If the circuit is **not** closed, refer to the OEM troubleshooting and repair manual for repair instruction.

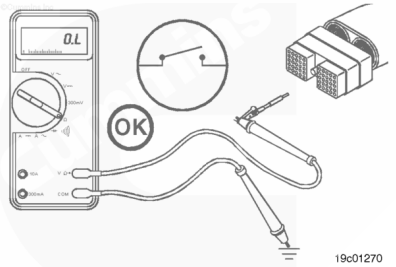
If more than 10 ohms are measured in any of these steps, there can be an open circuit in the SAE J1939 datalink positive (+) pin, the SAE J1939 datalink negative (-) pin, or the SAE J1939 (shield) pin, or the polarity is **not** correct. There can also be an open circuit from the datalink (shield) pin to vehicle battery ground.

If the values are correct, the SAE J1939 datalink positive (+) pin and the datalink negative (-) pin **must** still be checked for a short circuit to ground. The SAE J1939 datalink positive (+) pin, the datalink negative (-) pin, and the datalink (shield) pin **must** still be checked for a short circuit from pin to pin.

Check for Short Circuit to Ground

⚠ CAUTION ⚠

Proper leads and/or a Cummins® approved circuit testing tool must be used when working with electrical connectors to prevent pin expansion and damage to the connector.



Disconnect the original equipment manufacturer (OEM) harness engine interface connector. To determine the location of the connector, see the corresponding engine wiring diagram.Insert a test lead into the SAE J1939 datalink positive (+) pin of the OEM harness connector and connect it to a multimeter probe. Touch the other multimeter probe to the engine block or chassis ground.

Measure the resistance. The multimeter **must** show an open circuit (100k ohms or more).

If the circuit is **not** open, repair or replace the OEM harness. Refer to the OEM troubleshooting and repair manual.

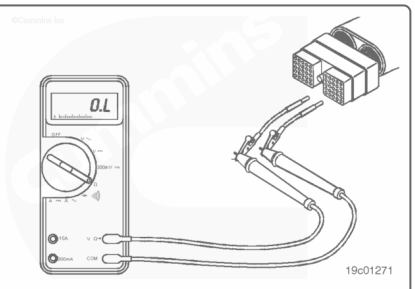
Remove the test lead from the SAE J1939 datalink positive (+) pin and insert it into the SAE J1939 datalink negative (-) pin. Measure the resistance from the SAE J1939 datalink negative (-) pin of the OEM harness connector to the engine block or chassis ground. The multimeter **must** show an open circuit (100k ohms or more).

If the circuit is **not** open, repair or replace the OEM harness. Refer to the OEM troubleshooting and repair manual.

Check for Short Circuit from Pin to Pin

⚠ CAUTION ⚠

Proper leads and/or a Cummins® approved circuit testing tool must be used when working with electrical connectors to prevent pin expansion and damage to the connector.



Disconnect the original equipment manufacturer (OEM) harness engine interface connector. To determine the location of the connector, see the corresponding engine wiring diagram.

Insert a test lead into the SAE J1939 datalink positive (+) pin of the OEM harness connector and connect it to the multimeter probe. Insert the other test lead into another pin in the connector of the OEM harness and connect it to the other multimeter probe.

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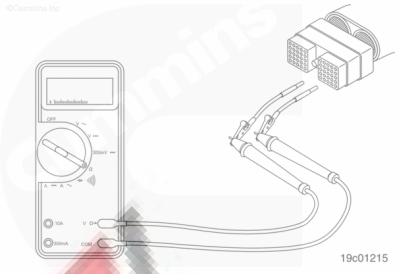
Measure the resistance from the SAE J1939 datalink positive (+) pin to the first pin in the connector. The multimeter **must** show an open circuit (100k ohms or more).

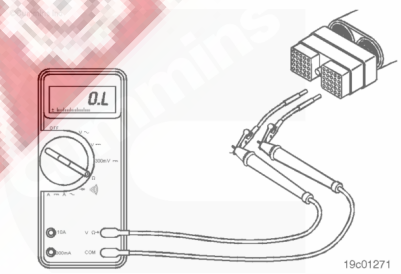
If the circuit is **not** open, repair or replace the OEM harness. Refer to the OEM troubleshooting and repair manual.

Measure the resistance from the SAE J1939 datalink positive (+) pin of the OEM harness connector to all other pins in the connector, one at a time. The multimeter **must** show an open circuit (100k ohms or more) at all pins, except the J1939 datalink negative (-).



If the circuit is **not** open, repair or replace the OEM harness. Refer to the OEM troubleshooting and repair manual.

Remove the test lead from the J1939 datalink positive (+) pin and insert it into the J1939 datalink (shield) pin of the OEM harness connector, if the shield pin is available



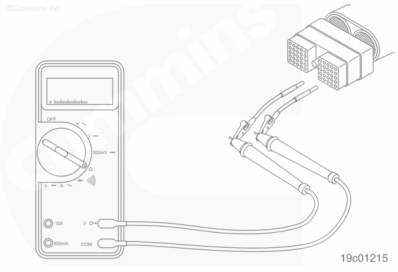
Note : If the J1939 datalink circuit is an unshielded twisted pair (UTP), the (shield) pin will **not** be provided. If the shield pin is **not** provided, the datalink negative (-) pin **must** still be checked for a short circuit to the other pins.

Insert the other test lead into another pin in the connector. Measure the resistance.

The multimeter **must** show an open circuit (100k ohms or more).

If the circuit is **not** open, repair or replace the OEM harness. Refer to the OEM troubleshooting and repair manual.

Measure the resistance from the SAE J1939 datalink (shield) pin, if available, to all other pins in the connector, one at a time. The multimeter **must** show an open circuit (100k ohms or more).

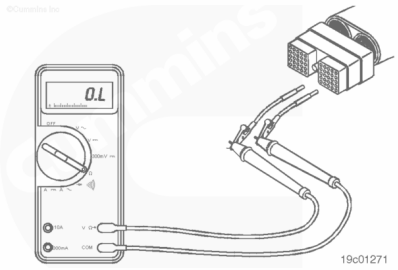


If the circuit is **not** open, repair or replace the OEM harness. Refer to the OEM troubleshooting and repair manual.

Remove the test lead from the SAE J1939 datalink (shield) pin and insert it into the SAE J1939 datalink negative (-) pin of the OEM harness connector. Insert the other test lead into another pin in the connector. Measure the resistance.

The multimeter **must** show an open circuit (100k ohms or more).

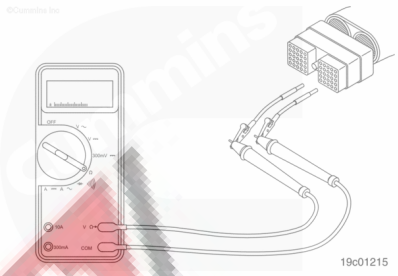
If the circuit is **not** open, repair or replace the OEM harness. Refer to the OEM troubleshooting and repair manual.



Measure the resistance from the SAE J1939 datalink negative (-) pin of the OEM harness connector to all other pins in the connector. The multimeter **must** show an open circuit (100k ohms or more) at all pins, except the J1939 datalink positive (+) pin.

If the circuit is **not** open, repair or replace the OEM harness. Refer to the OEM troubleshooting and repair manual.

Connect all the components after the repair is complete.



Last Modified: 25-Jun-2015

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General Information

The exhaust brake on/off switch circuit signals the system that the operator is requesting the exhaust brake system to be activated.



19900525

After the ECM receives the signal from the exhaust brake on/off switch, the ECM will supply 12 VDC to the exhaust brake signal pin in the engine harness, provided the engine speed is **not** below 1000 rpm and the driver is **not** in cruise control or depressing the accelerator or clutch pedals.

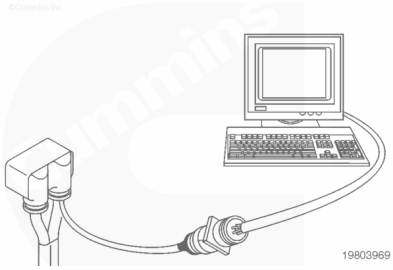


19900525

Resistance Check

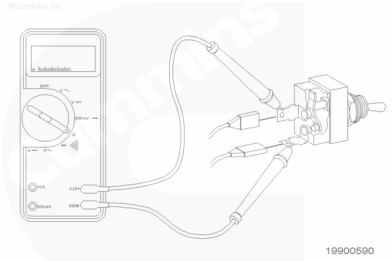
If an electronic service tool is available, monitor the exhaust brake select switch for proper operation. If **not**, follow the troubleshooting procedures in this section.

Label the wires with the location on the switch or the wire number. Remove the electrical connectors from the switch.


19803969

Set the multimeter to measure resistance.

Touch one multimeter probe to the center terminal of the switch. Touch the other multimeter probe to the bottom terminal of the switch.


19900590

Set the switch to the OFF position.

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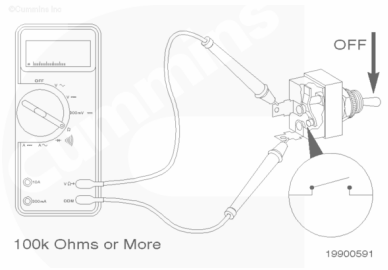
The multimeter **must** show an open circuit (100k ohms or more).

If the circuit is **not** open, the switch has failed. Replace the switch.

Refer to the OEM repair manual for replacement instructions.

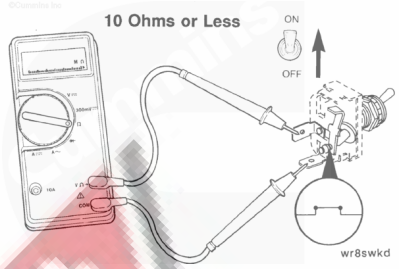


Set the switch to the ON position.

The multimeter **must** show a closed circuit (10 ohms or less).

If the circuit is **not** closed, the switch has failed. Replace the switch.

Refer to the OEM troubleshooting and repair manual for replacement instructions.



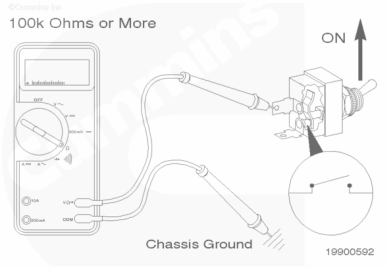
Check for Short Circuit to Ground

Touch one of the multimeter probes to one of the switch terminals. Touch the other probe to chassis ground. Move the switch to the ON position, and measure the resistance.

The multimeter **must** show an open circuit (100k ohms or more).

If the circuit is **not** open, the switch has failed. Replace the switch. Refer to the OEM troubleshooting and repair manual for replacement instructions.

If the switch passes all of the previous checks, the circuit **must** be checked for open circuits, short circuits to ground, short circuits from pin to pin, and short circuits to an external voltage source.



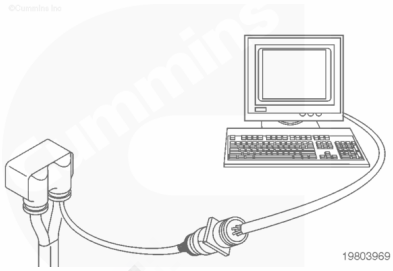
ANDOU ISUZU TECHNICIANS

Last Modified: 29-Jun-2015

Resistance Check

⚠ CAUTION ⚠

Proper leads and/or a Cummins® approved circuit testing tool must be used when working with electrical connectors to prevent pin expansion and damage to the connector.



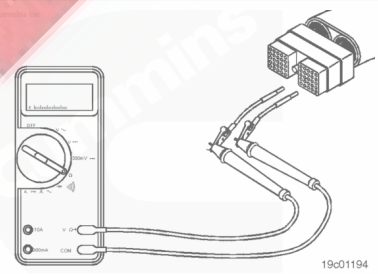
If electronic service tool is available, monitor the exhaust brake switch circuit for proper operation.

If **not**, follow the troubleshooting procedures in this section.

Disconnect the original equipment manufacturer (OEM) harness engine interface connector. To determine the location of the connector, see the corresponding engine wiring diagram.

Insert the appropriate test lead into exhaust brake ON/OFF switch input pin of the OEM harness connector.

Insert the other appropriate test lead into switch return pin of the connector.

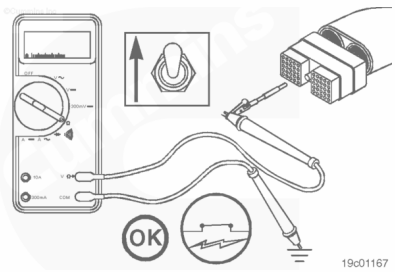


Set the exhaust brake switch to the ON position.

The multimeter **must** show a closed circuit (10 ohms or less).

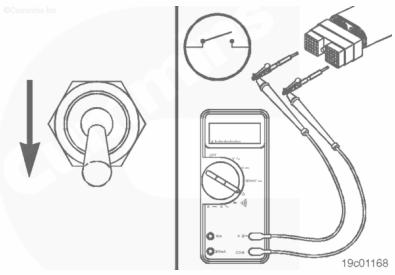
Set the exhaust brake switch to the OFF position.

The multimeter **must** show an open circuit (100k ohms or more).



If the resistance values are **not** correct, make sure exhaust brake ON/OFF switch input pin and the battery positive (+) bus to switch return pin are properly installed on the switch.

If both wires are correctly installed, inspect exhaust brake ON/OFF switch input pin and the battery positive (+) bus to switch return pin for open circuits to ground and short circuits to other pins, provided the switch has been previously checked.

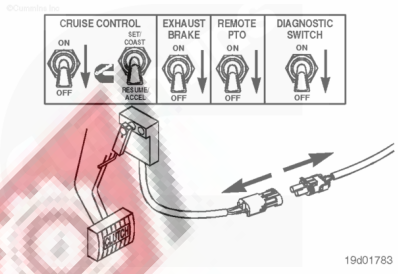


ANADOLU ISUZU PARTS

If the resistance values are correct in the previous checks, exhaust brake ON/OFF switch input pin and switch return pin **must** still be checked for short circuits to ground and short circuits from pin-to-pin.

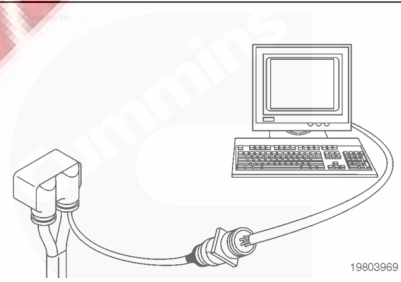
Check for Short Circuit to Ground

To isolate the exhaust brake circuit when checking for an electrical short, turn all cab switches to the OFF or NEUTRAL position.

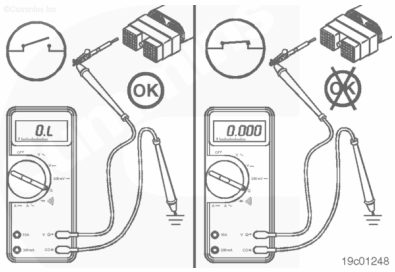


If electronic service tool is available, monitor the engine brake ON/OFF switch circuit for proper operation.

If **not**, follow the troubleshooting procedures in this section.



Disconnect the original equipment manufacturer (OEM) harness engine interface connector. To determine the location of the connector, see the corresponding engine wiring diagram.



Insert the appropriate test lead into exhaust brake ON/OFF switch input pin of the OEM harness connector. Touch the other multimeter probe to engine block ground. Measure the resistance.

The multimeter **must** show an open circuit (100k ohms or more).

If the resistance value is **not** correct, there is a short circuit to ground in the harness.

Repair or replace the OEM harness. Refer to Procedure 019-071 (/qs3/pubsys2/xml/en/procedures/99/99-019-071.html).

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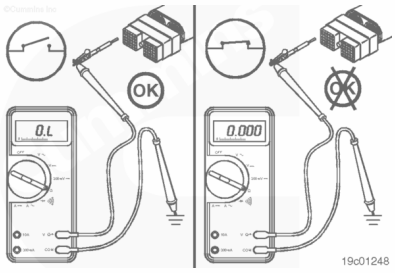
Touch one multimeter probe to the engine block. Insert the other multimeter probe with attached appropriate test lead into switch return pin of the OEM harness connector. Measure the resistance.



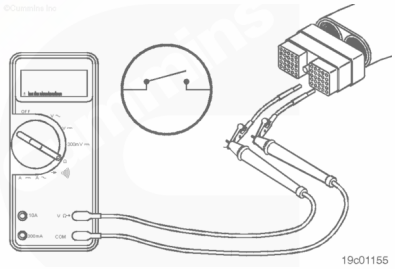
The multimeter **must** show an open circuit (100k ohms or more).

If the resistance value is **not** correct, there is a short circuit to ground in the harness. Repair or replace the OEM harness. Refer to Procedure 019-071 (/qs3/pubsys2/xml/en/procedures/99/99-019-071.html).

If the resistance value is correct in the previous checks, the exhaust brake ON/OFF switch input pin **must** still be checked for short circuits from pin-to-pin.

Check for Short Circuit from Pin to Pin

Isolate the switch circuit as in the previous section.

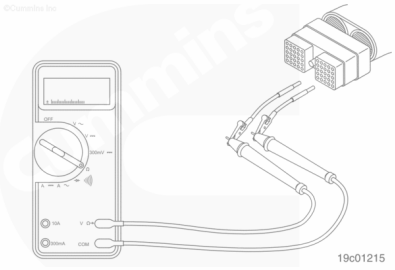


Insert the appropriate test lead into exhaust brake ON/OFF switch input pin of the OEM harness connector.

Insert the other appropriate test lead into pin 1 of the connector. Connect the alligator clips to the multimeter probes. Measure the resistance.

The multimeter **must** show an open circuit (100k ohms or more).

Remove the lead and check all other pins.



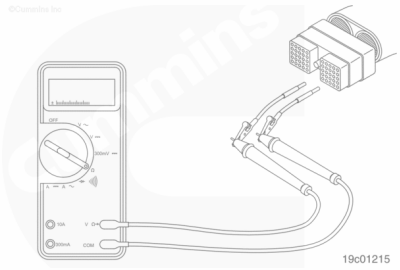
The multimeter **must** show an open circuit (100k ohms or more).

If the circuit is **not** open, there is a short circuit between the wire connected to exhaust brake ON/OFF switch input pin and any pin that measured less than 100k ohms.

Repair or replace the OEM harness. Refer to (Procedure Refer to Procedure 019-071 (/qs3/pubsys2/xml/en/procedures/99/99-019-071.html)).

Insert the test lead into switch return pin of the OEM harness connector. Check all pins of the harness connector. Measure the resistance.

The multimeter **must** show an open circuit (100k ohms or more) at all pins.



If the circuit is **not** open, there is a short circuit to ground in the positive switch supply bus, provided the switch has been previously checked.

Repair or replace the wiring connected to switch return pin in the OEM harness. Refer to Procedure 019-071 (/qs3/pubsys2/xml/en/procedures/99/99-019-071.html).

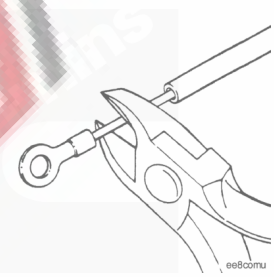
Last Modified: 25-Jun-2015

ANADOLU ISUZU AFTER SALES

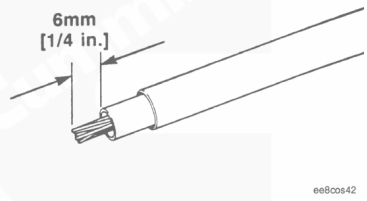
Connector Replacement

Terminals are used for various connections including grounds and fuel shutoff valve supply.

Use wire crimp tool, Part Number 3822930, to cut and remove the ring terminal connector as shown.

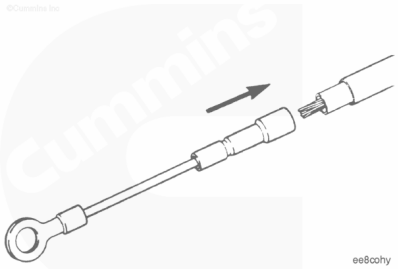


Use wire crimp tool, Part Number 3822930, to remove 6 mm [1/4 in] of insulation from the harness wire.



Install the proper-size ring terminal on the bare wire. The ring terminals that are included in the wiring repair kit, Part Number 3164572, are as follows:

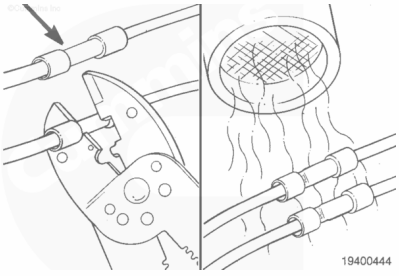
Ring Terminal Size	Part No.
No. 10	3823760
1/2 inch	3823761



⚠ CAUTION ⚠

Only use wire crimping pliers, Part Number 3822930, when repairing electrical terminals.

Crimp the repair wire on the bare wire.



ANADOLU ISUZU
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Use a heat gun, Part Number 3822860, or open flame to heat the shrink tubing. The tubing will shrink and make the connection waterproof.

Last Modified: 21-Mar-2012

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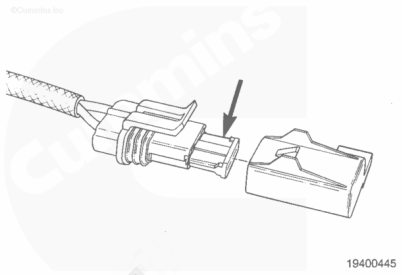
Inspect

Remove the fuse protective covers from the fuse(s) that are being checked. Check to make sure the fuse is installed in the fuse holder correctly.

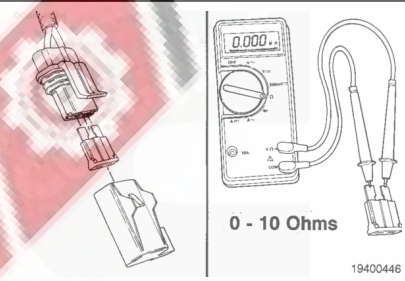


If the fuse is installed correctly, check for a blown fuse.

Remove the fuse(s) to be checked.

Touch each one of the multimeter leads to each fuse terminal. Measure the resistance.

The multimeter **must** show less than 10 ohms, which is a closed circuit. If the circuit is closed then put the fuse back into the holder and connect the fuse cover.



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AFTER SALES

Last Modified: 21-Mar-2012

Select Service Tools

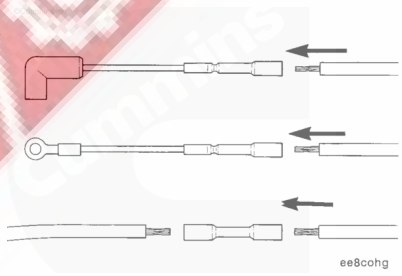
The following Cummins Service Tools or equivalent are required to complete this procedure:

1. Wire Stripping Tool, Part Number 3400045, or equivalent.
2. Wire Crimping Tool, Part Number 3163109, or equivalent.
3. Heat shrink tube installer (butane), Part Number 5298996, or equivalent.

General Information

Butt splice connectors are used when repairing wiring harnesses or damaged wires.

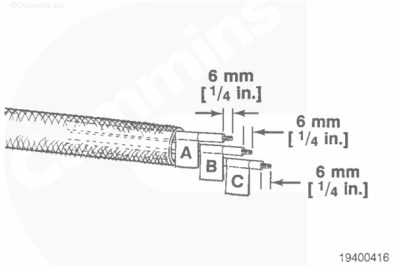
This procedure **only** covers butt splice connectors provided by Cummins Inc. Installation procedures for other butt splice connectors may be different.



Repair

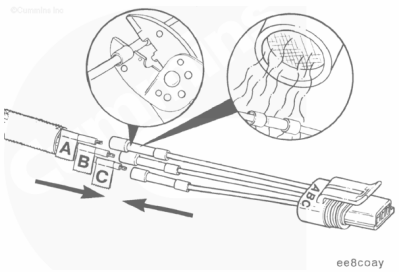
Crimp Splice

Strip 6 mm [¼ in] of insulation from the end of the wires. Use Cummins® service tool, Part Number 3400045, wire stripping tool or equivalent.



⚠ WARNING ⚠

To reduce the possibility of personal injury, wear goggles and protective clothing.



⚠ CAUTION ⚠

ANADOLU ISUZU
AFTER SALES

Connect the repair connector wires to the correct harness wires or electrical problems will occur.

Install the wire end(s) into the end(s) of the crimp butt splice connector.

Crimp the butt splice connector. Use Cummins® service tool, Part Number 3163109, wire crimping tool or equivalent.

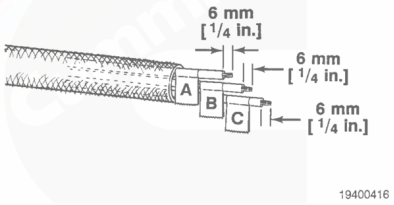
Heat the butt splice connector. Use Cummins® service tool, Part Number 5298996, heat shrink tube installer (butane) or equivalent.

Apply heat evenly over the entire butt splice connector.

Apply heat until the shrink tube portion of the butt splice connector has sealed the joint.

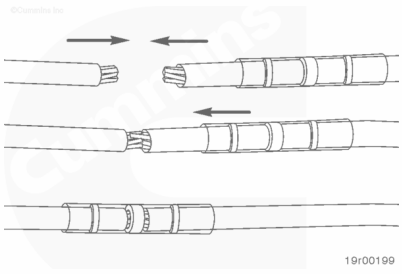
Solder Splice

Strip 6 mm [¼ in] of insulation from the end of the wires. Use Cummins® service tool, Part Number 3400045, wire stripping tool or equivalent.



⚠ CAUTION ⚠

Connect the repair connector wires to the correct harness wires or electrical problems will occur.



Slide the solder butt splice connector on the repair wire.

Engage the stripped end of the wires to be connected.

Slide the solder butt splice connector over the bare wires until the solder is centered over the bare wires.

Rotating the solder butt splice connector will assist with installation.

⚠ WARNING ⚠

To reduce the possibility of personal injury, wear goggles and protective clothing.

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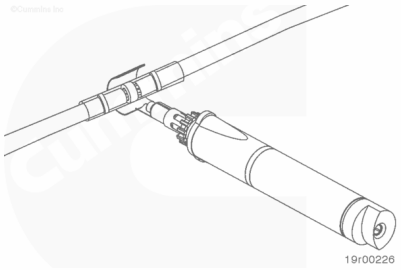
Heat the solder of the butt splice connector. Use Cummins® service tool, Part Number 5298996, heat shrink tube installer (butane) or equivalent.

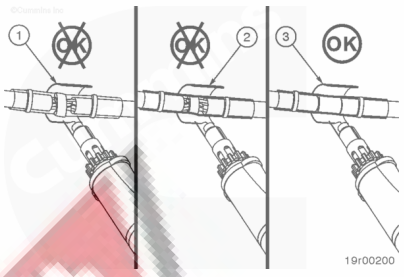
Apply heat evenly over the entire butt splice connector.

Apply heat until the solder of the butt splice connector has flowed into the wire strands.



Verify the solder butt splice connector has been installed correctly.

1. Incorrect.
    - Insufficient heat.
    - Shrink tube not sealed.
    - Solder not melted.
2. Incorrect.
    - Insufficient heat on solder.
    - Uneven solder distribution.
3. Correct.
    - Shrink tube sealed.
    - Colored seal bands sealed and flattened.
    - Even solder distribution.



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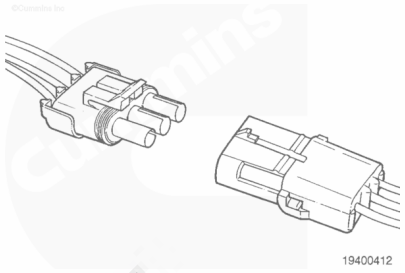
AFTER SALES

Last Modified: 08-Oct-2014

Pin Replacement

This connector is used to connect many different components to the engine, or other devices. The connector can have many different pin configurations. All types of connectors are repaired in the same manner. The two-way connector is displayed in this procedure.

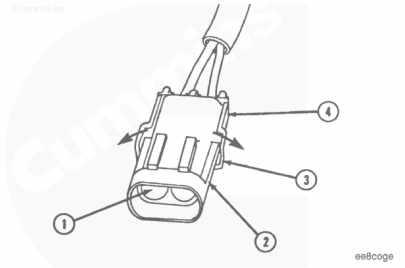


Before installing the new repair wire, perform a test fit to make sure the wire is the correct size.

Refer to the appropriate wiring repair kit in the service tools table in the front of Section 19 for the correct repair wire. Replace one contact wire at a time. If more than one wire needs replaced, attach a lettered tag to each wire removed.

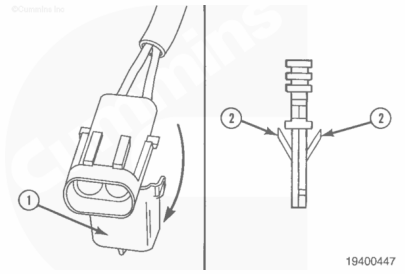
Refer to the wiring diagram in Section E for pin locations.

To replace the Weather-Pack terminal (1), pull the locking tabs (3) apart on the wire lock (4).



Note : The wire is held in the connector body by the wire lock (1) and two locking lances (2) on the terminal.

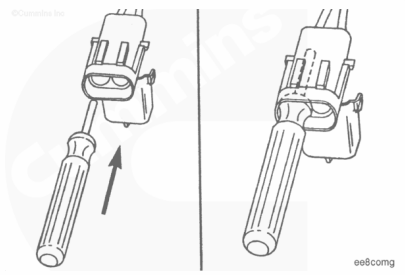
Open the wire lock.



⚠ CAUTION ⚠

This tool can be easily broken. Care must be taken when using this tool. Do not force the tool into place.

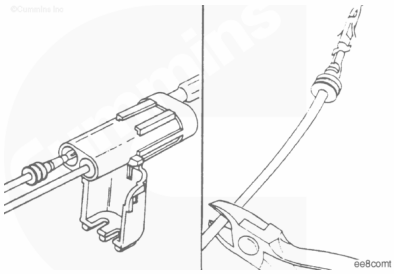
Insert the Weather-Pack extraction tool, Part Number 3822608, over the terminal. Use a twisting motion to push the tool to the bottom of the cavity.



ANADOLU ISUZU AFTER SALES

⚠ CAUTION ⚠

If more than one wire is being repaired, tag each wire and install it in the original location. Electrical problems can occur if wires are switched.

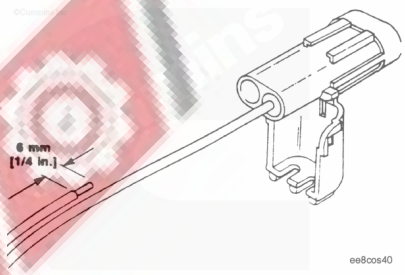


Pull the wire and the terminal out of the connector body.

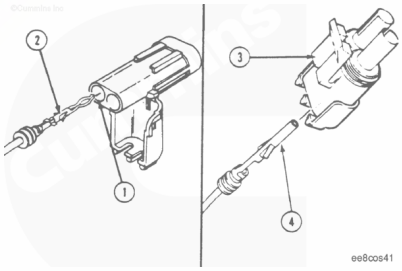
Note : The repair wire and the terminal is 127 mm [5 in] long.

Use crimping tool, Part Number 3822930, to cut 127 mm [5 in] of the terminal wire.

Use wire crimping tool, Part Number 3822930, to remove approximately 6 mm [¼ in] of insulation from the wire.



Note : The shroud connector bodies (1) use pin terminals (2). The tower connector bodies (3) use socket terminals (4).



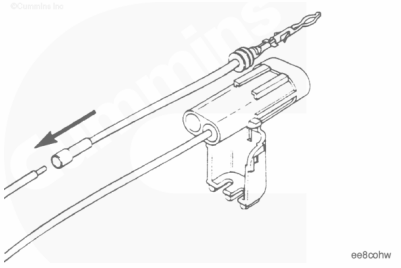
Before installing the new repair wire, perform a test fit to make sure the wire is the correct size.

Refer to the appropriate wiring repair kit in the service tools table in the front of Section 19 for the correct repair wire. Replace one contact wire at a time. If more than one wire needs to be replaced, attach a lettered tag to each wire removed.

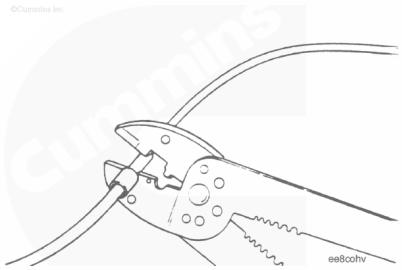
Refer to the wiring diagram in Section E for pin locations.

Install the correct repair wire on the bare wire.

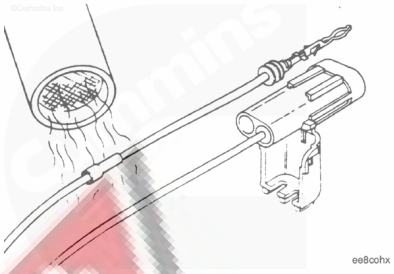
Make sure that the bare wire extends into the insulated butt splice connector.



Use wire crimping tool, Part Number 3822930, to crimp the repair wire on the bare wire.

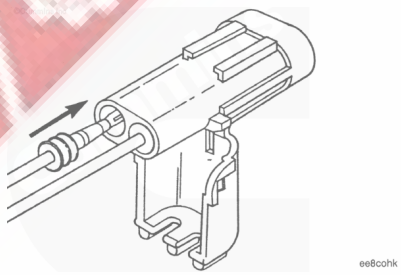


Use heat gun, Part Number 3822860, to heat the shrink tubing. The tubing will shrink and make the connection waterproof.



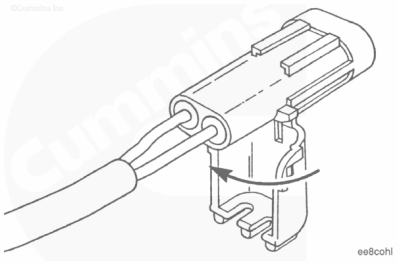
⚠ CAUTION ⚠

If more than one wire is repaired or if the connector body is replaced, make sure to insert the wires into the same locations as they were in. Electrical problems can occur if wires are switched.

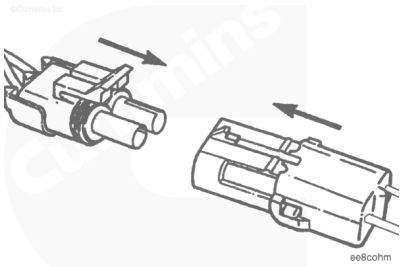


Insert the terminal into the connector body. The terminal locking lances **must** click and hold the terminal in the body.

Close and latch the wire on the connector body.



Insert the two connector halves together.



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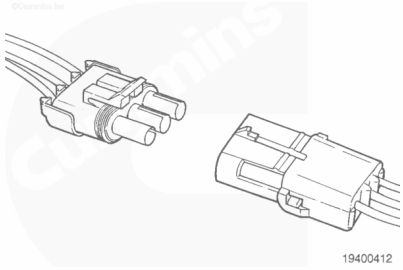
Connector Replacement

The connector is used to connect many different components to the engine, or other devices. The connector can have many different pin configurations. All types of connectors are repaired in the same manner. The two-way connector is displayed in this procedure.



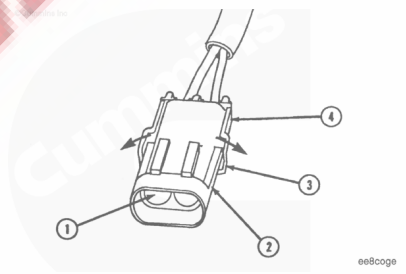
Before installing the new connector, perform a test fit to make sure the connector is keyed correctly.

Refer to the appropriate wiring repair kit in the service tools table in the front of Section 19 for the correct repair connector.

Refer to the wiring diagram in Section E for pin locations.

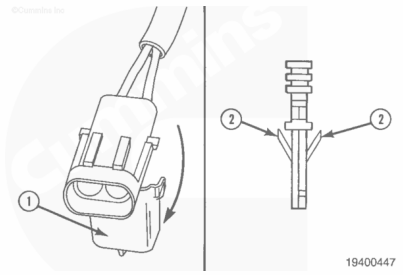
Replace one contact wire at a time. If more than one wire needs to be replaced, attach a lettered tag to each wire removed.

To replace the Weather-Pack connector body (2), pull the locking tabs (3) apart on the wire lock (4).



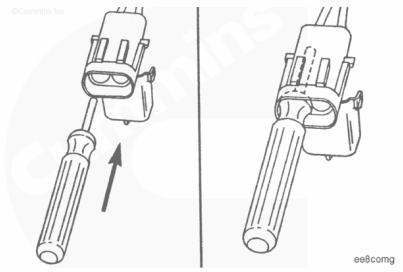
The wire is head in the connector body by the wire lock (1) and two locking lances (2) on the terminal.

Open the wire lock.



⚠ CAUTION ⚠

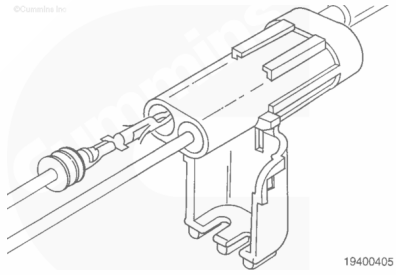
This tool can be easily broken. Care must be taken when using this tool. Do not force the tool into place.



Insert Weather-Pack extraction tool, Part Number 3822608, over the terminal. Use a twisting motion to push the tool to the bottom of the cavity.

Pull the wire and the terminal out of the connector body.

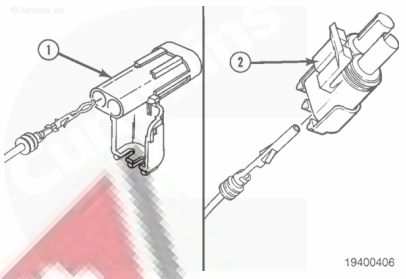
ANADOLU ISUZU AFTER SALES



Before installing the new connector, perform a test fit to make sure the connector is keyed correctly.

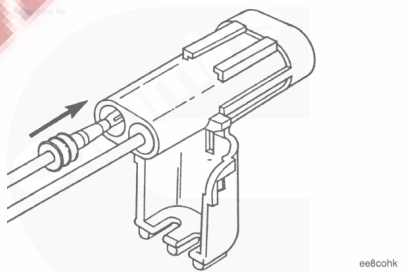
Refer to the appropriate wiring repair kit in the service tools table in the front of Section 19 for the correct repair connector.

Replace one contact wire at a time. If more than one wire needs replaced, attached a lettered tag to each wire removed.



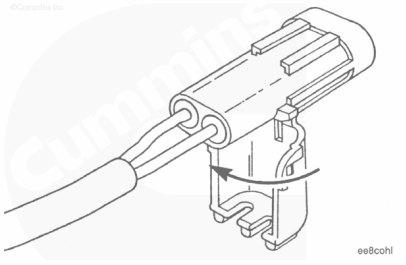
⚠ CAUTION ⚠

If more that one wire is repaired or if the connector body is replaced, make sure to insert the wires into the same locations as they were in. Electrical problems can occur if wires are switched.

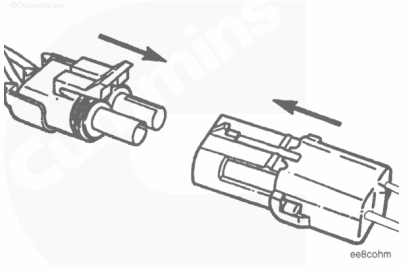


Insert the terminal into the connector body. The terminal locking lances **must** click and hold the terminal in the body.

Close and latch the wire lock on the connector body.



Insert the two connector halves together.



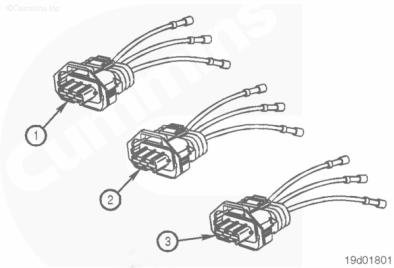
ANADOLU ISUZU AFTER SALES

Last Modified: 11-May-2014



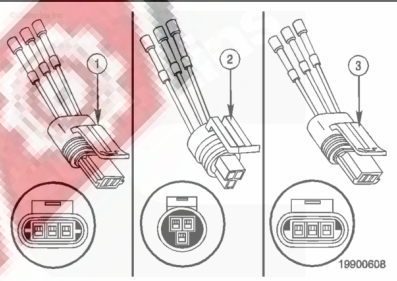
Pin Replacement

The connector can have multiple pin configurations. All types of connectors are repaired in the same manner.



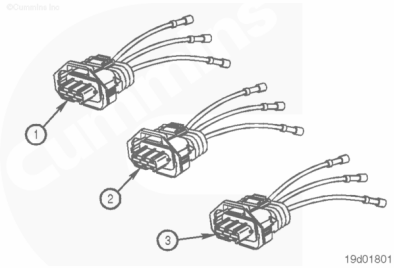
The connector pins can **not** be repaired or replaced. The connector **must** be replaced as a unit.

Refer to the connector replacement procedure for replacement instructions.



Connector Replacement

The connector can have multiple pin configurations. All types of connectors are repaired in the same manner.

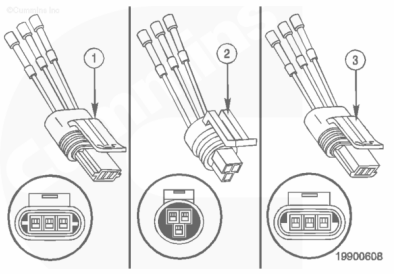


The connectors have different keying and can **not** be interchanged with each other.

Before installing the new connector, perform a test fit to make sure the connector is keyed correctly.

Refer to the appropriate wiring repair kit in the service tools table in the front of Section 19 for the correct repair connector.

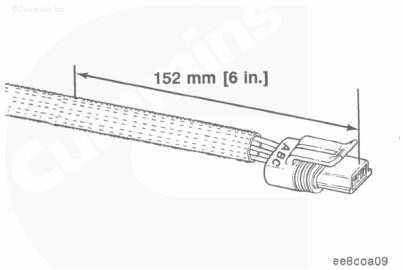
Refer to the wiring diagram in Section E for pin locations.



ANADOLU ISUZU AFTER SALES

Replace one contact wire at a time. If more than one wire needs replaced, attach a lettered tag to each wire removed.

Measure 152 mm [6 in] back from the face of the connector, and remove the wiring harness protective cover.

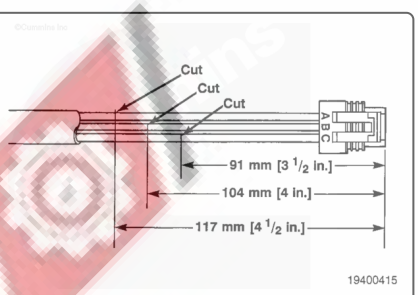


Before cutting the wires, measure and tag the wires.

Use wire cutters to cut wire A 117 mm [4-½ in] from the face of the connector.

Use wire cutters to cut wire B 104 mm [4 in] from the face of the connector.

Use wire cutters to cut wire C 91 mm [3-½ in] from the face of the connector.



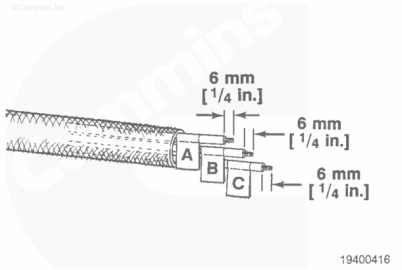
Use crimping tool, Part Number 3822930, to remove 6 mm [¼ in] of insulation from all electrical wires.

Before installing the new connector, perform a test fit to make sure the connector is keyed correctly.

Refer to the appropriate wiring repair kit in the service tools table in the front of Section 19 for the correct repair connector.

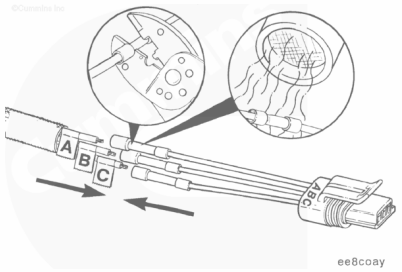
Refer to Section E for pin locations.

Replace one contact at a time. If more than one wire needs replaced, attach a lettered tag to each wire removed.

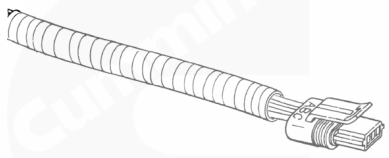


Install the terminal repair wires on the bare wires and use wire crimping tool, Part Number 3822930, to crimp the terminals.

Use heat gun, Part Number 3822860, to heat the shrink tubing. The tubing will shrink and make the connection waterproof.



Wrap the wires with tape, for added protection to complete the repair.



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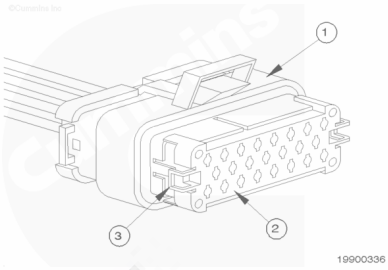
Last Modified: 03-Apr-2003

ANADOLU ISUZU AFTER SALES

Pin Replacement

⚠ CAUTION ⚠

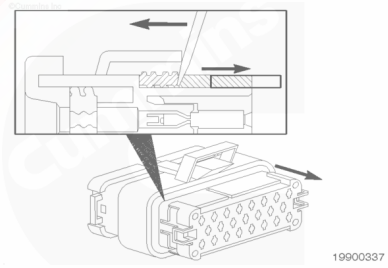
Use care in handling the AMP connectors. They are very fragile and easily damaged. Follow the steps outlined in this procedure to avoid damage.



Check to be sure the connector wedge lock is in the open position.

Note : The connector assembly is shipped in one piece, with the wedge lock in the open position. It is possible that during adverse shipping conditions that some wedge locks can get bumped into the closed position.

If the wedge lock is closed, perform the following:



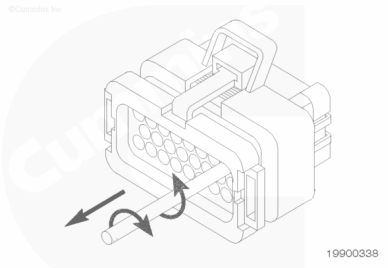
Insert screwdriver blade (flat) between the matting seal and one of the red wedge lock tabs.

Depress the lock tabs (Item 3 in the figure in the previous step).

Pry open the wedge lock to the open position.

Note : The wedge lock **must not** be removed from the housing for insertion or removal of the contacts.

Remove the damaged contacts, rotate the contact wire back and forth over a half turn (¼ turn in each direction). Gently pull the wire until the contact is removed.



Refer to the appropriate wiring repair kit in the service tools table in the front of Section 19 for the correct repair wire.

Note : Replace one contact wire at a time. If more than one wire needs replaced, attach a lettered tag to each wire removed.

Refer to the wiring diagram in Section E for pin locations.

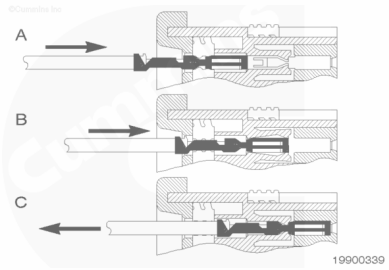
Before installing the new repair wire, perform a test fit to make sure the wire is the correct size.

Install a new wire and contact.

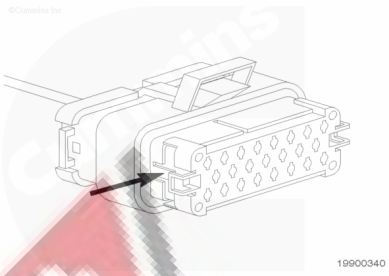
Insert wire straight into the appropriate circuit cavity.

Insert the wire until the pin bottoms out.

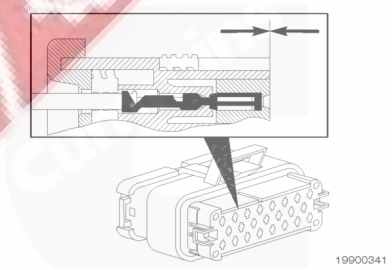
Pull back gently to be sure the retention fingers are holding the contact.



After all of the required contacts have been replaced, the wedge lock **must** be closed to its LOCKED position. Release the locking latches by squeezing them inward.



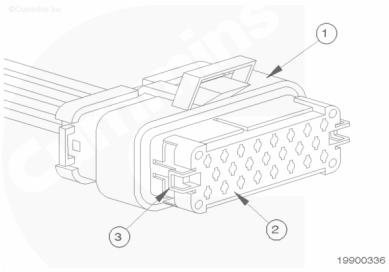
Slide the wedge lock into the housing until it is flush with the housing.



Connector Replacement

⚠ CAUTION ⚠

Use care in handling the AMP connectors. They are very fragile and easily damaged. Follow the steps outlined in this procedure to avoid damage.



Note : The connector assembly is shipped in one piece, with the wedge lock in the open position. It is possible that during adverse shipping conditions that some wedge locks can get bumped into the closed position.

Check to be sure the connector wedge lock is in the open position.

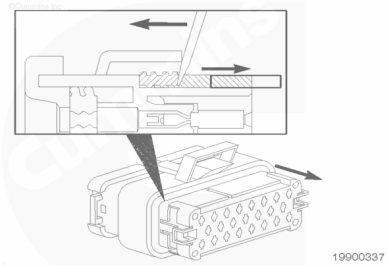
Note : The wedge lock **must not** be removed from the housing for insertion or removal of the contacts.

If the wedge lock is closed, perform the following:

Insert screwdriver blade (flat) between the matting seal and one of the red wedge lock tabs.

Depress the lock tabs (Item 3 in the figure in the previous step).

Pry open the wedge lock to the open position.



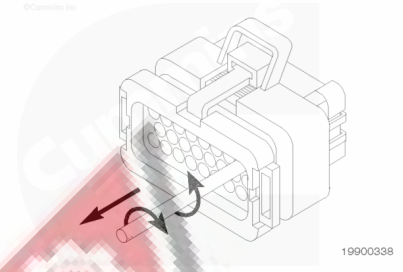
Replace one contact wire at a time. Attach a lettered tag to each wire removed.

Before installing the new connector, perform a test fit to make sure the connector is keyed correctly.

Remove all of the contacts. Rotate the contact wires back and forth over a half turn (¼ turn in each direction). Gently pull the wire until the contact is removed.

Refer to the appropriate wiring repair kit in the service tools table in the front of Section 19 for the correct repair connector.

Refer to the wiring diagram in Section E for pin locations.

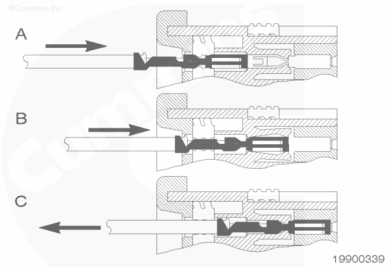


Install a new wire and contact by:

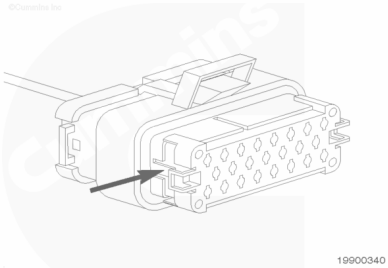
Insert wire straight into the appropriate circuit cavity.

Insert the wire until the pin bottoms out.

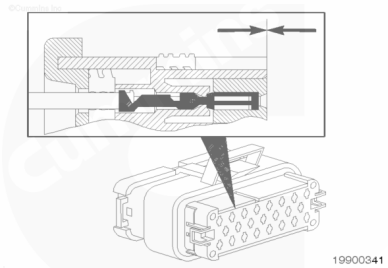
Pull back gently to be sure the retention fingers are holding the contact.



After all of the required contacts have been replaced, the wedge lock **must** be closed to its LOCKED position. Release the locking latches by squeezing them inward.



Slide the wedge lock into the housing until it is flush with the housing.



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Pin Replacement

Replace one contact wire at a time. If more than one wire needs to be replaced, attach a lettered tag to each wire removed.

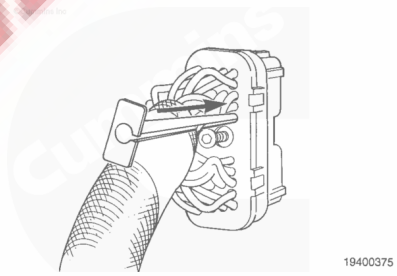
Refer to the wiring diagram for pin locations.

Use the Deutsch extraction tool, listed in the table below, to remove a pin from the connector.

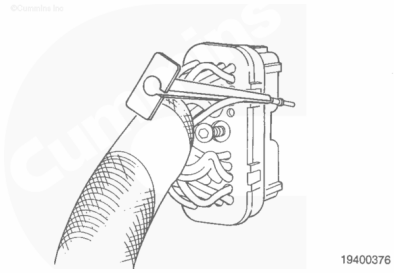


Tool Part Number	Wire Size
3824815	20 gauge
3822760	16 gauge
3824816	12 gauge

Push the tool into the connector approximately 25 mm [1 in] until it bottoms on the terminal flange.



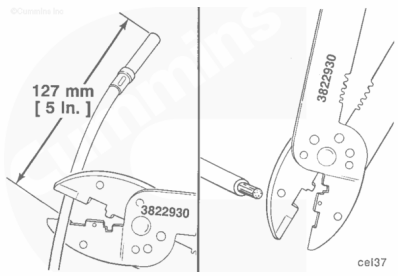
Hold the tool on the terminal flange and pull the wire and connecting pin out of the connector. Note and record the hole from which the pin is removed.



Note : The repair wire is 127 mm [5 in] long.

Use wire crimping tool, Part Number 3822930, to cut 127 mm [5 in] off the wire and pin.

Use the crimping tool to remove 6 mm [¼ in] of insulation from the wire.



Refer to the appropriate wiring repair kit in the service tools table in the front of Section 19 for the correct repair wire.

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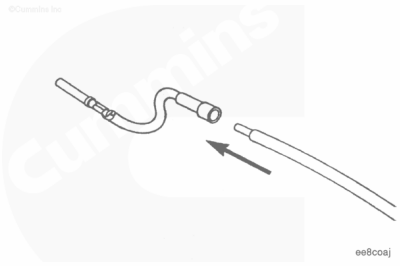
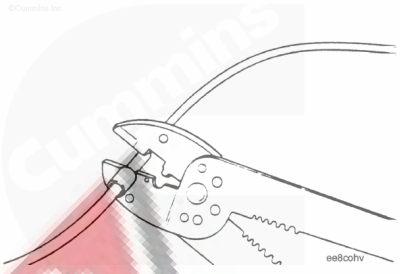
AFTER SALES

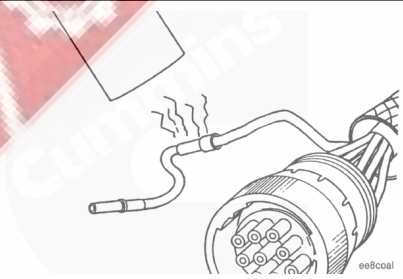
Install the correct repair wire on the bare wire, make sure that the bare wire extends into the splice connector.



Use the wire crimping tool to crimp the repair wire onto the bare wire.



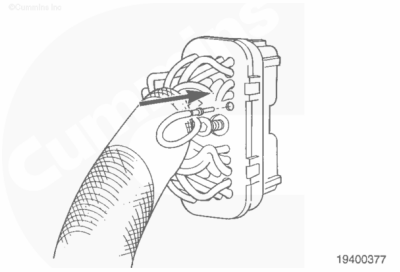
Use heat gun, Part Number 3822860, or an open flame to heat the shrink tubing around the wire. The tubing will shrink and make the connector waterproof.



Insert the pin into the correct hole of the connector.

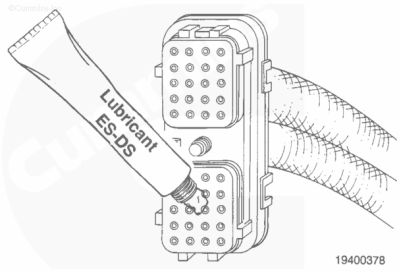
The pin **must** click into place and hold the wire in the connector.

Pull the wire gently to make sure it is seated in the connector.



⚠ CAUTION ⚠

Use only Cummins recommended lubricant DS-ES, Part Number 3822934. Other lubricants, such as lubricating oil or grease, in the connectors can cause Electronic Control Unit damage, poor performance, or premature connector pin wear.



Apply a small amount of lubricant to the connector terminals. Do **not** fill the entire connector cavity with the lubricant.

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Connector Replacement

Use the Deutsch extraction tool, listed in the table below, to remove a pin from the connector.

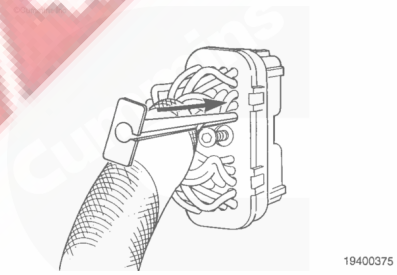


Tool Part Number	Wire Size
3824815	20 gauge
3822760	16 gauge
3824816	12 gauge

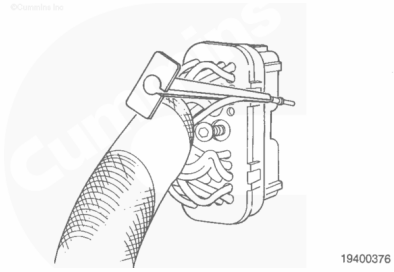
Replace one wire at a time. Attach a lettered tag to each wire removed.

Refer to the wiring diagram for pin locations.

Push the tool into the connector approximately 25 mm [1 in] until it bottoms on the terminal flange.



Hold the tool on the terminal flange and pull the wire and the connecting pin out of the connector. Note and record the hole from which the pin is removed.



Before installing the new connector, perform a test fit to make sure the connector is keyed correctly.

Refer to the appropriate wiring repair kit in the service tools table in the front of Section 19 for the correct repair connector.

Refer to the wiring diagram for pin locations.

Insert the pins into the correct holes of the replacement connector.

Each pin **must** click into place and hold the wires in the connector.

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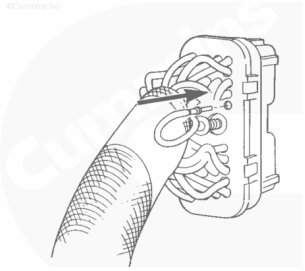
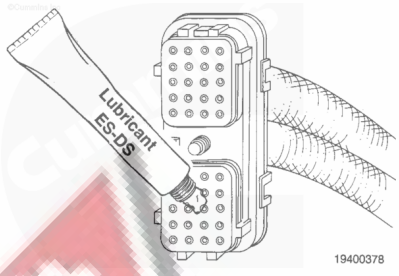
Pull each wire gently to make sure it is seated in the connector.



⚠ CAUTION ⚠

Use only Cummins lubricant DS-ES, Part Number 3822934. Other lubricants such as lubricating oil or grease, in the connectors can cause Electronic Control Unit damage, poor performance or premature connector pin wear.



Apply a small amount of lubricant to the connector terminals. Do **not** fill the entire connector cavity with lubricant.

Last Modified: 04-Feb-2016

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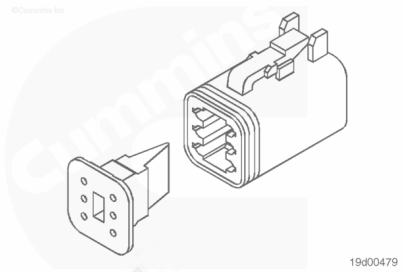
Pin Replacement

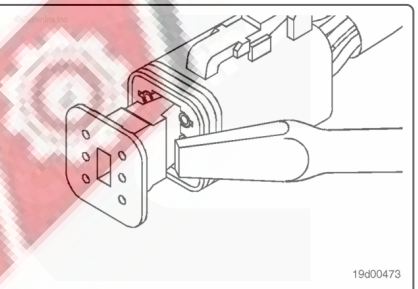
The connector can have multiple pin configurations. All type of connectors are repaired in the same manner.

Replace one contact wire at a time. If more than one wire needs replaced, attach a lettered tag to each wire removed.

Refer to the wiring diagram in Section E for pin locations.

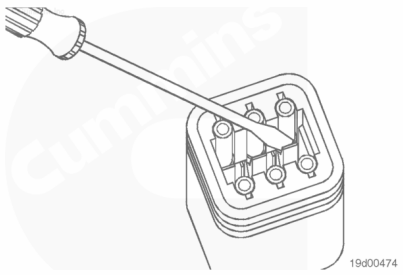


To replace the pin in the receptacle connector, remove the orange wedge using needle nose pliers or a hook-shaped wire to pull the wedge straight out.



⚠ CAUTION ⚠

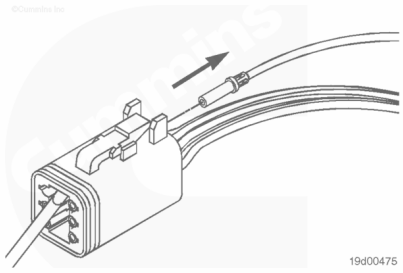
Locking finger can be easily broken. Care must be taken when using this tool. Do not force the tool into place.



To remove the contact out of the connector body, gently pull wire backward, while at the same time releasing the locking finger by moving it away from the contact with a screwdriver.

⚠ CAUTION ⚠

If more than one wire is being repaired, tag each wire and install it in the original location. Electrical damage can occur if wire is installed in the incorrect location.



Pull the wire and the terminal out of the connector body.

Refer to the appropriate wiring repair kit in the service tools table in the front of Section 19 for the correct repair wire.

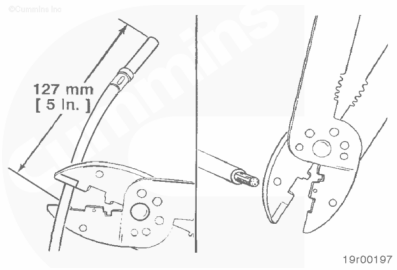
Replace one contact wire at a time. If more than one wire needs replaced, attach a lettered tag to each wire removed.

Refer to the wiring diagram in Section E for pin locations.

Before installing the new repair wire, perform a test fit to make sure the wire is the correct size.

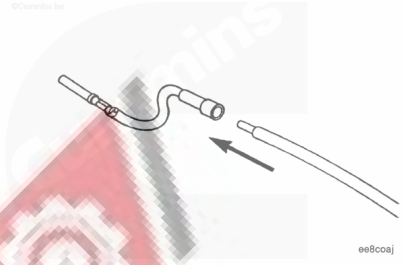
Use wire crimping tool, Part Number 3163109 or equivalent, to cut 127 mm [5 in] off the wire and pin.

Use wire crimping tool, Part Number 3163109 or equivalent, to remove 6 mm [¼ in] of insulation from the wire.

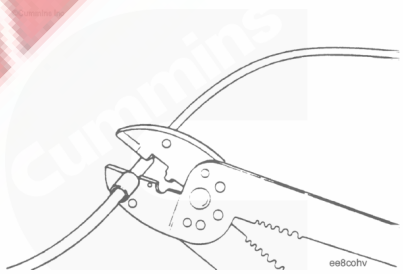


Install the correct repair wire on the bare wire.

Make sure the bare wire extends into the splice connector.

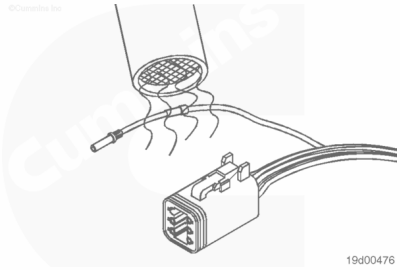


Use wire crimping tool, Part Number 3822930, to crimp the repair wire onto the bare wire.



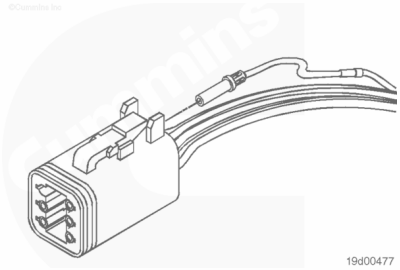
Use heat gun, Part Number 3822860, to heat shrink the tubing around the wire.

The tubing will shrink and make the connection waterproof.



⚠ CAUTION ⚠

If more than one wire is repaired or if the connector body is replaced, make sure to insert wires into the same locations as they are in the original connector. If wires are not in the original location electrical damage can occur.



Replace the connector and install the wire and terminal into the connector body. Push the wire and terminal into the seal at the back of the connector. Push the wires straight in until a

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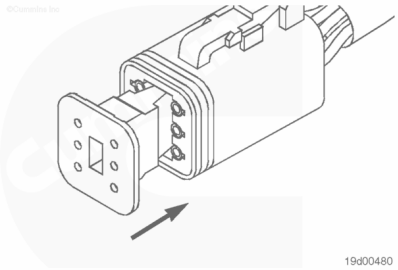
click is felt. A slight tug will confirm that it is properly locked in place.

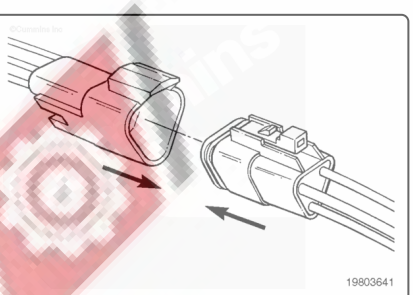
Once the wires are in place, insert the orange wedge with arrow pointing toward the exterior locking mechanism.

Push the orange wedge in until it snaps in place.

Make sure both seals are in place and the back of the connector plug and receptacle. Be sure the rubber seal has been installed on the connector plug.



Push the connector plug into the connector receptacle until the external locking clip snaps into place.



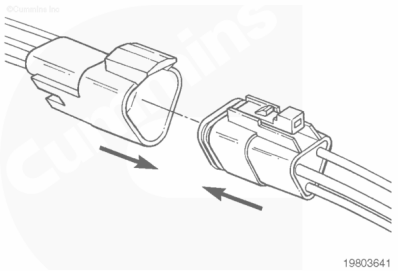
Connector Replacement

The connector can have multiple pin configurations. All types of connectors are repaired in the same manner.

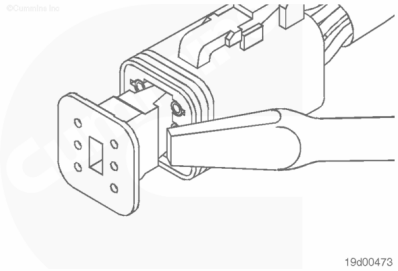
Before installing the new connector perform a test fit to make sure the connector is keyed correctly.

Refer to the appropriate wiring repair kit in the service tools table in the front of Section 19 for the correct repair connector.

Refer to the wiring diagram in Section E for pin locations.

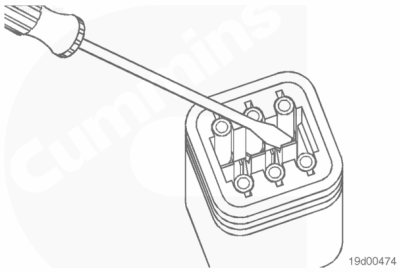


To replace the pin in the plug connector, grasp the orange wedge and pull the wedge straight out.



⚠ CAUTION ⚠

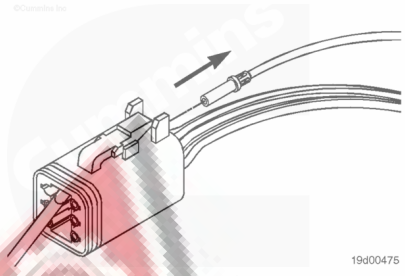
Locking finger can be easily broken. Care must be taken when using this tool. Do not force the tool into place.



To remove the contact out of the connector body, gently pull wire backward, while at the same time releasing the locking finger by moving it away from the contact with a screwdriver.

⚠ CAUTION ⚠

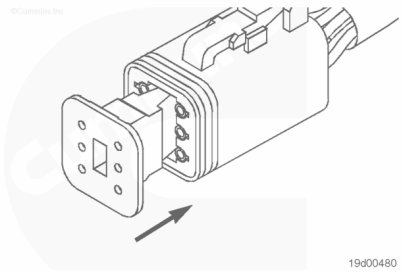
If more than one wire is repaired or if the connector body is replaced, be sure to insert the wires into the same location as they were in the original connector. If wires are not in the original location electrical damage can occur.



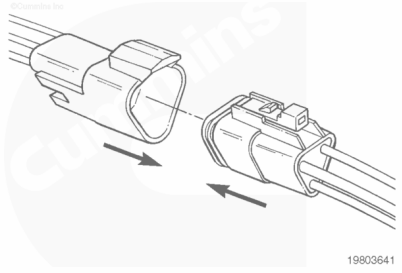
Replace the connector and install the wire and terminal into the seal at the back of the connector. Push the wires straight in until a click is felt. A slight tug will confirm that it is properly locked in place.

Once the wires are in place, insert the orange wedge with arrow pointing toward the exterior locking mechanism. Push the orange wedge in until it snaps in place.

Make sure both seals are in place at the back of the connector plug and receptacle. Make sure the rubber seal has been installed on the connector plug.



Push the connector plug into the connector receptacle until the external locking clip snaps into place.



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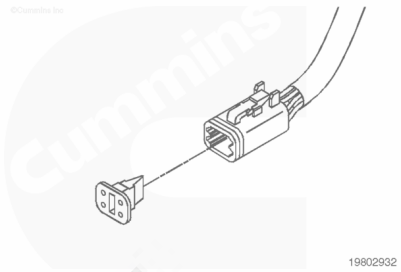
Pin Replacement

The connector can have multiple pin configurations.

The connector pins can **not** be repaired or replaced. The connector **must** be replaced as a unit.

Refer to the connector replacement procedure for replacement procedures.



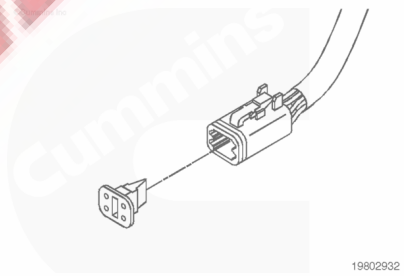
Connector Replacement

Before installing the new connector, perform a test fit to make sure the connector is keyed correctly.

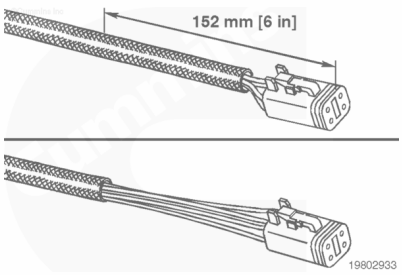
Refer to the appropriate wiring repair kit in the service tool table in the front of Section 19 for the correct repair connector.

Refer to the wiring diagram in Section E for pin locations.

The replacement connector shown in the following procedure is a 4-pin Deutsch series. All sizes of DTM connectors are replaced in the same manner.



Measure 152 mm [6 in] back from the face of the connector and remove the wiring harness protective cover.

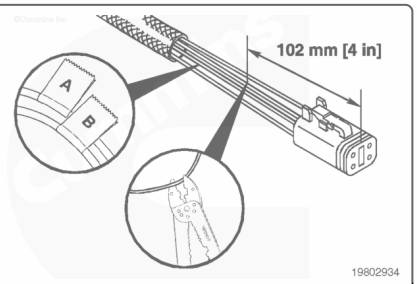


Before cutting the wires, measure and tag all wires.

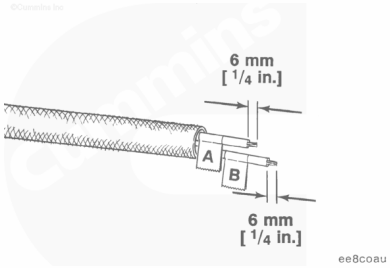
Use wire crimping tool, Part Number 3822930.

Cut wire A 102 mm [4 in] from the face of the connector.

Cut wire B 102 mm [4 in] from the face of the connector.

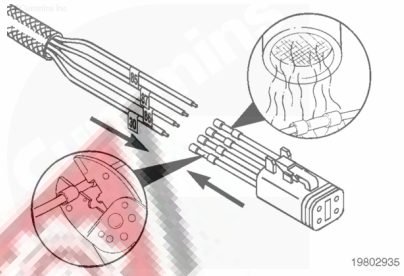


Use wire crimping tool, Part Number 3822930, to remove 6 mm [¼ in] of insulation from both electrical wires.

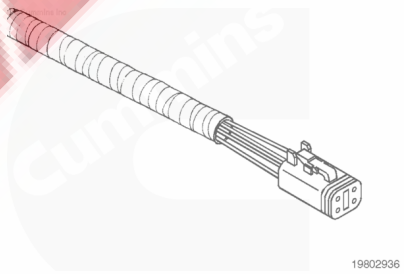


Install the connector repair wires and use wire crimping tool, Part Number 3822930, to crimp the terminals.

Use heat gun, Part Number 3822860, to heat the shrink tubing. The tubing will shrink and make the connection waterproof.



Wrap the wires with tape, for added protection, to complete the repair.



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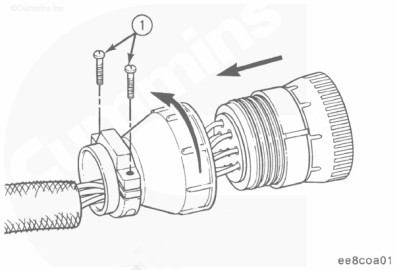
Last Modified: 06-Sep-2012

Pin Replacement

These connectors are available with multiple pin configurations.



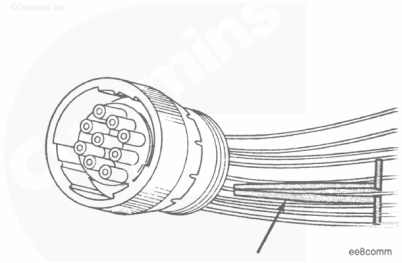
Refer to the appropriate wiring repair kit in the service tools table in the front of Section 19 for the correct repair wire. Replace one contact at a time. If more than one wire needs replaced, attach a lettered tag to each wire removed.

Refer to the wiring diagram in Section E for pin locations.

Unlock the connector. Rotate the locking tab **counterclockwise** by hand. Do **not** use pliers; they can damage the connector.

Remove the two clamp capscrews (1) from the rear of the connector. Turn the rear support of the connector **counterclockwise** until the two pieces are separated.

These connectors are available with multiple pin configurations.



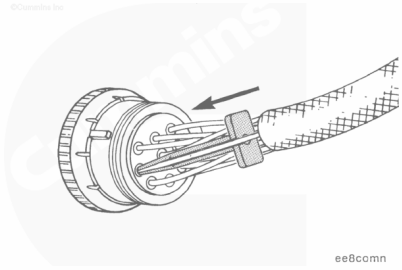
Use the Deutsch extraction tool, listed in the table below, to remove a pin from the connector.

Tool Part Number	Wire Size
3824815	20 gauge
3822760	16 gauge
3824816	12 gauge

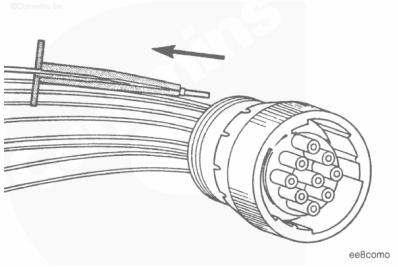
Replace one contact wire at a time. If more than one wire needs replaced, attach a lettered tag to each wire removed.

Refer to the wiring diagram in Section E for pin locations.

Push the tool into the connector approximately 25 mm [1 in] until it bottoms on the terminal flange.



Hold the tool on the terminal flange and pull the wire and the connecting pin out of the connector. Note and record the hole from which the pin is removed.



Note : The repair wire is 127 mm [5 in] long.

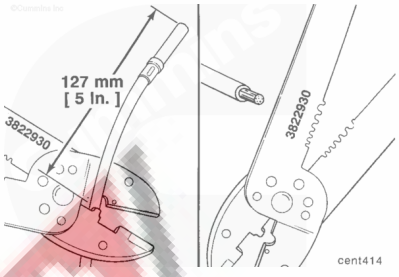
Remove about 6 mm [¼ in] of insulation from the wire.

Before installing the new repair wire, perform a test fit to make sure the wire is the correct size.

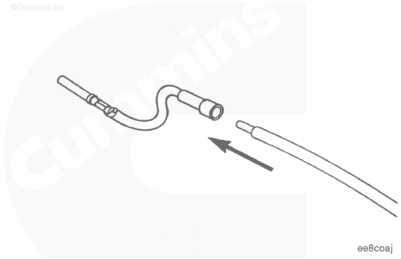
Refer to the appropriate wiring repair kit in the service tools table in the front of Section 19 for the correct repair wire.

Replace one contact wire at a time. If more than one wire needs replaced, attach a lettered tag to each wire removed.

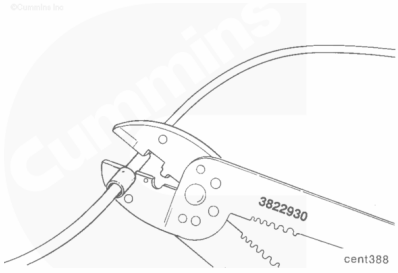
Refer to the wiring diagram in Section E for pin locations.



Install a repair wire on the bare wire. Make sure the bare wire extends into the splice.



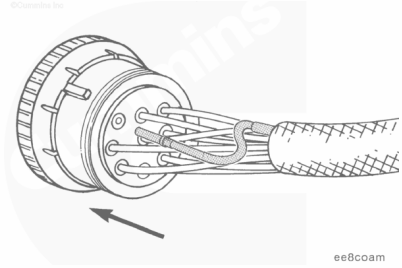
Use wire crimping tool, Part Number 3822930, to crimp the repair wire onto the bare wire.



Insert the pin into the correct hole of the connector.

The pin **must** lock into place and hold the wire in the connector.

Pull the wire gently to make sure it is seated in the connector.



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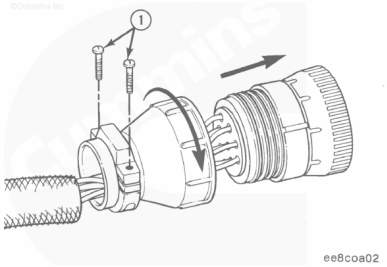
Install the rear connector support.

Tighten the two wire clamp capscrews.

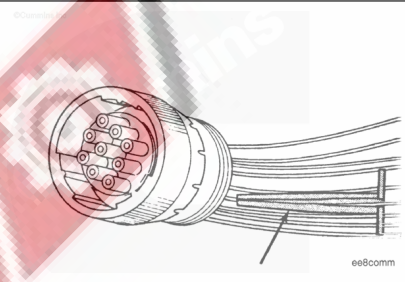
Torque Value: 1 n•m [9 in-lb]



Connector Replacement

These connectors are available with multiple pin configurations.

Use the Deutsch extraction tool, listed in the table below, to remove a pin from the connector.

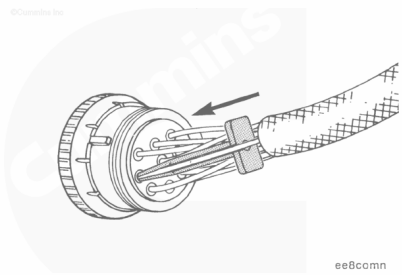


Tool Part Number	Wire Size
3824815	20 gauge
3822760	16 gauge
3824816	12 gauge

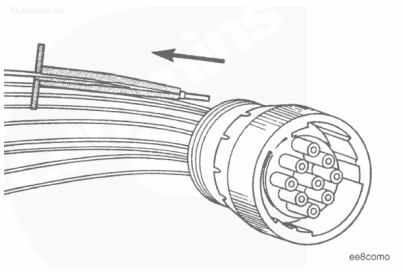
Replace one contact wire at a time. If more than one wire needs replaced, attach a lettered tag to each wire removed.

Refer to the wiring diagram in Section E for pin locations.

Push the tool into the connector approximately 25 mm [1 in] until it bottoms on the terminal flange.



Hold the tool on the terminal flange and pull the wire and the connecting pin out of the connector. Note and record the hole from which the pin is removed.



Before installing the new connector, perform a test fit to make sure the connector is keyed correctly.

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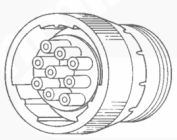
Refer to the appropriate wiring repair kit in the service tools table in the front of Section 19 for the correct repair connector.

Refer to the wiring diagram in Section E for pin locations.



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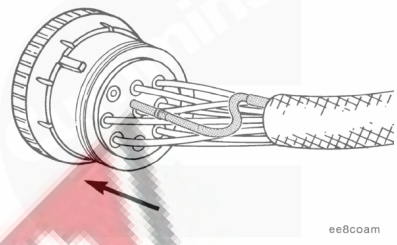
Insert the pins into the correct holes of the replacement connector.

The pin **must** click into place and hold the wire in the connector.

Pull the wire gently to make sure it is seated in the connector.



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Last Modified: 09-Oct-2003

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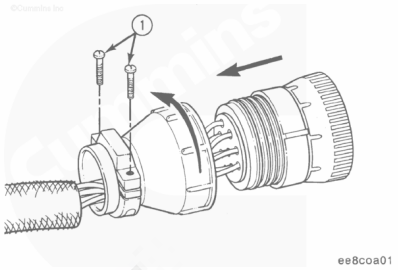
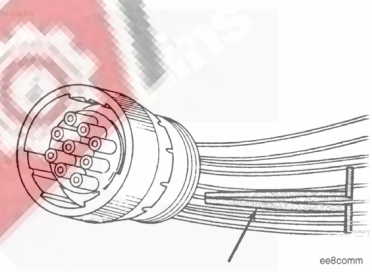
Pin Replacement

Remove the two clamp capscrews (1) from the rear of the connector.

Turn the retainer of the connector **counterclockwise** until the two pieces are separated.



Use the Deutsch extraction tool, listed in the table below, to remove a pin from the connector.



Tool Part Number	Wire Size
3824815	20 gauge
3822760	16 gauge
3824816	12 gauge

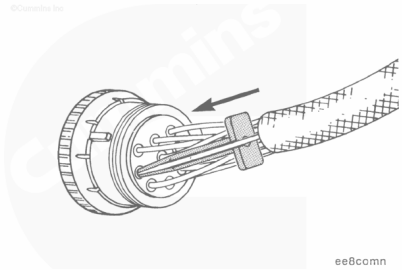
Before installing the new repair wire, perform a test fit to make sure the wire is the correct size.

Refer to the appropriate wiring repair kit in the service tools table in the front of Section 19 for the correct repair wire.

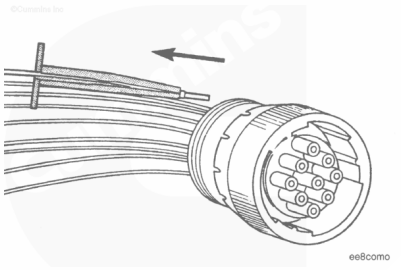
Replace one contact wire at a time. If more than one wire needs replaced, attach a lettered tag to each wire removed.

Refer to the wiring diagram in Section E for pin locations.

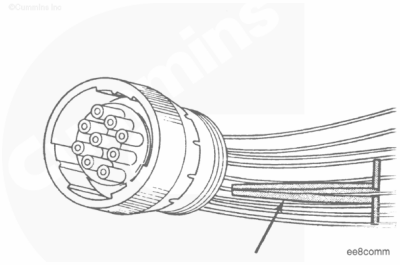
Push the tool into the connector about 25 mm [1 in] until it bottoms on the terminal flange.



Hold the tool on the terminal flange and pull the wire and the connecting pin out of the connector. Note and record the hole from which the pin is removed.



Note : The repair wire is 127 mm [5 in] long.



Before installing the new repair wire, perform a test fit to make sure the wire is the correct size.

Refer to the appropriate wiring repair kit tools table in the front of Section 19 for the correct repair wire.

Replace one contact wire at a time. If more than one wire needs replaced, attach a lettered tag to each wire removed.

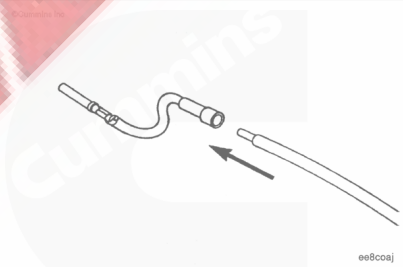
Refer to the wiring diagram in Section E for pin locations.

Use wire crimping tool, Part Number 3822930, to cut 127 mm [5 in] off the wire and pin.

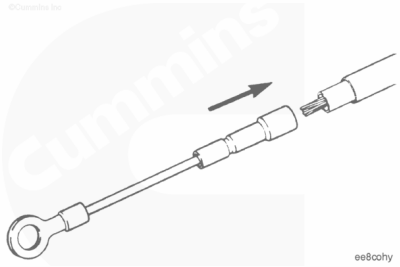
Use the wire crimping tool to remove 6 mm [¼ in] of insulation from the wire.

Install the correct repair wire on the bare wire.

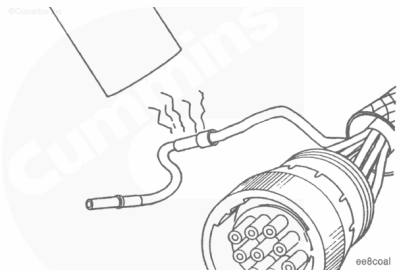
Make sure the bare wire extends into the splice connector.



Use the wire crimping tool to crimp the repair wire onto the bare wire.



Use heat gun, Part Number 3822860, or an open flame to heat shrink the tubing around the wire. The tubing will shrink and make the connector waterproof.



Insert the pin into the correct hole of the connector.

The pin **must** click into place and hold the wire in the connector.

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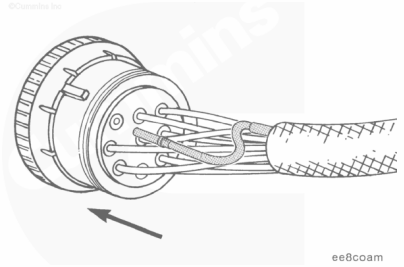
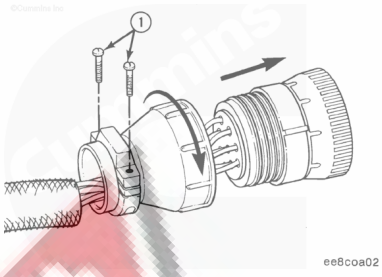
Pull the wire gently to make sure it is seated in the connector.



Install the retainer. Tighten the two clamp capscrews.

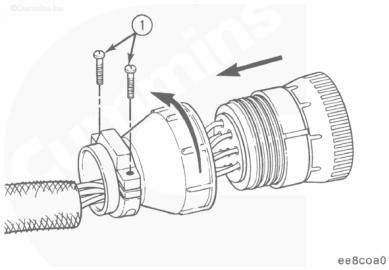
Torque Value: 1 n•m [9 in-lb]



Connector Replacement

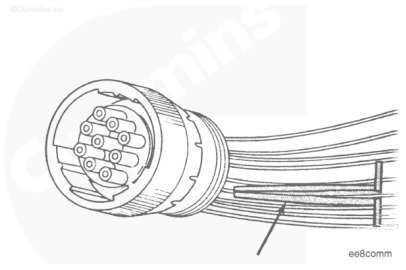
Remove the two clamp capscrews (1) from the rear of the connector.

Turn the retainer of the connector **counterclockwise** until the two pieces are separated.



Use the Deutsch extraction tool, listed in the table below, to remove a pin from the connector.

Tool Part Number	Wire Size
3824815	20 gauge
3822760	16 gauge
3824816	12 gauge



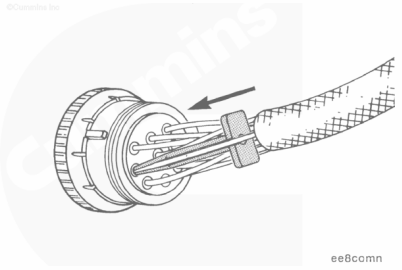
Before installing the new repair wire, perform a test fit to make sure the wire is the correct size.

Refer to the appropriate wiring repair kit in the service tools table in the front of Section 19 for the correct repair wire.

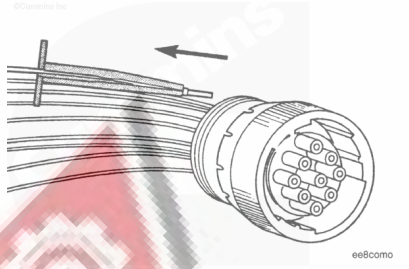
Refer to the wiring diagram in Section E for pin locations.

Replace one contact wire at a time. If more than one wire needs replaced, attach a lettered tag to each wire removed.

Push the tool into the connector about 25 mm [1 in] until it bottoms on the terminal flange.



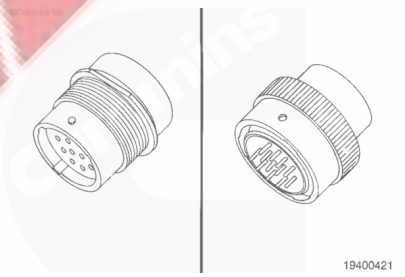
Hold the tool on the terminal flange and pull the wire and connecting pin out of the connector. Note and record the hole from which the pin is removed.



Before installing the new connector, perform a test fit to make sure the connector is keyed correctly.

Refer to the appropriate wiring repair kit in the service tools table in the front of Section 19 for the correct repair connector.

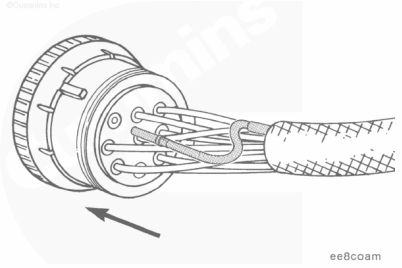
Refer to the wiring diagram in Section E for pin locations.



Insert the pins into the correct holes of the connector.

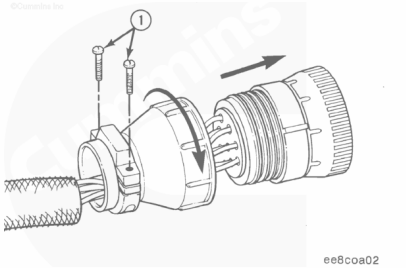
The pin **must** click into place and hold the wire in the connector.

Pull the wire gently to make sure it is seated in the connector.



Install the retainer. Tighten the two clamp capscrews

Torque Value: 1 n•m [9 in-lb]



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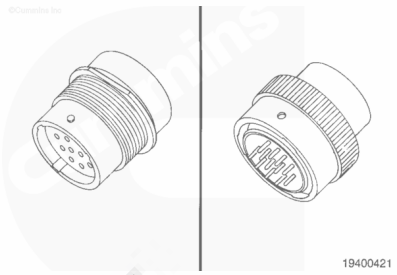
AFTER SALES

Pin Replacement

The connector pins can **not** be repaired or replaced. The connector **must** be replaced as a unit.

Refer to the Connector Replacement procedure for replacement instructions.



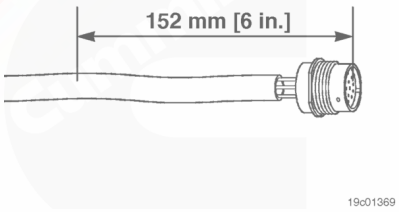
Connector Replacement

Measure 152 mm [6 in] back from the face of the connector and remove the wiring harness protective cover.

Before installing the new connector, perform a test fit to make sure the connector is keyed correctly.

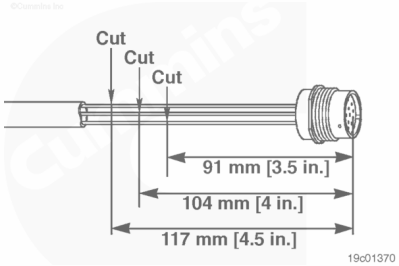
Refer to the appropriate wiring repair kit in the service tools table in the front of Section 19 for the correct repair connector.

Replace one contact wire at a time. If more than one wire needs replaced, attach a lettered tag to each wire removed.

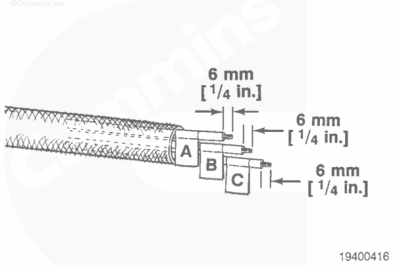


Use wire crimping tool, Part Number 3822930, to cut the wires. Cut the first wire 91 mm [3-½ in] from the face of the connector.

Cut the remaining seven wires in increments of 12 mm [½ in] back from the previous cut.

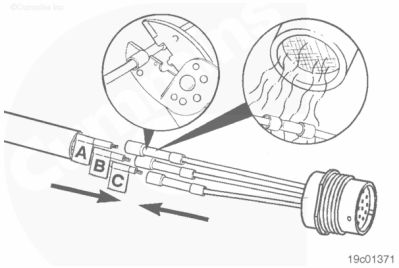


Use the wire crimping tool to remove 6 mm [¼ in] of insulation from all eight electrical wires.

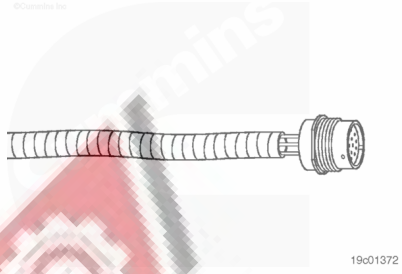


Install the terminal repair wires on the bare wires and use the wire crimping tool to crimp the terminal.

Use heat gun, Part Number 3822860, or an open flame to heat the shrink tubing. The tubing will shrink and make the connection waterproof.



For added protection, wrap the wire with tape to complete the repair.



Last Modified: 03-Apr-2003

ANADOLU ISUZU AFTER SALES

Pin Replacement

The connector pins can **not** be replaced. The connector **must** be replaced as a unit.

Refer to the Connector Replacement procedure for replacement instructions.

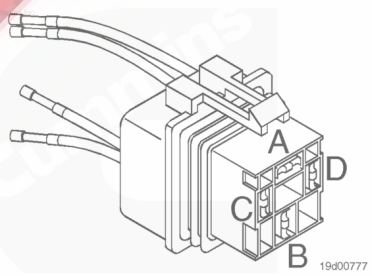
Connector Replacement

Before installing the new connector, perform a test fit to make sure the connector is keyed properly.

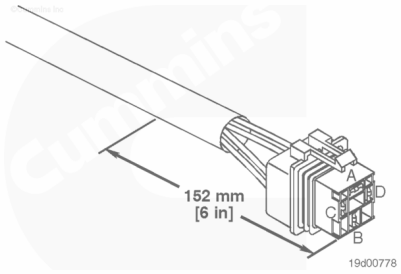
Refer to the appropriate wiring repair kit in the service tools table in the front of Section 19 for the correct repair connector.

Refer to the wiring diagram for pin locations.

Replace one contact wire at a time. If more than one wire needs replaced, attach a lettered tag to each wire removed.



Measure 152 mm [6 in] from the face of the connector, and remove the wiring harness protective cover.



Before cutting the wires measure and tag them.

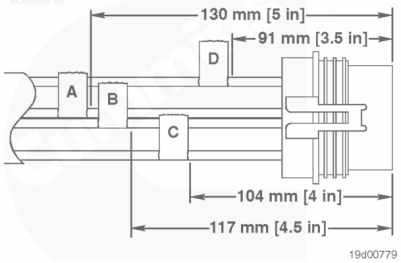
Use wire crimping tool, Part Number 3822930.

Cut wire A 130 mm [5 in] from the face of the connector.

Cut wire B 117 mm [4-½ in] from the face of the connector.

Cut wire C 104 mm [4 in] from the face of the connector.

Cut wire D 91 mm [3-½ in] from the face of the connector.



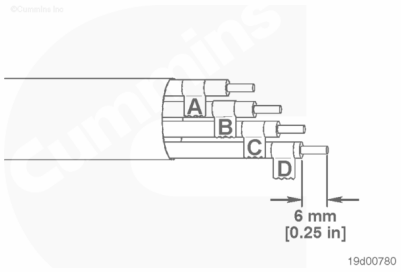
Use crimping tool, Part Number 3822930, to remove 6 mm [¼ inch] of insulation from the electrical wires.

Before installing the new connector, perform a test fit to make sure the connector is keyed correctly.

Refer to the appropriate wiring repair kit in the service tools table in the front of Section 19 for the correct repair connector.

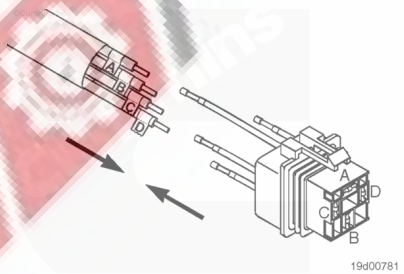
Refer to the wiring diagram for pin locations.

Replace one contact wire at a time. If more than one wire needs replaced, attach a lettered tag to each wire removed.

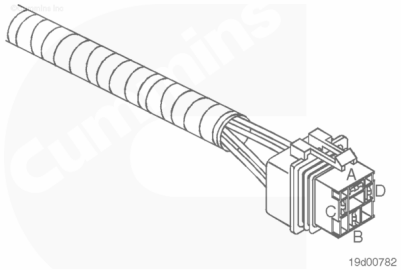


Install the terminal repair wires on the bare wires. Use wire crimping tool, Part Number 3822930, to crimp the terminals.

Use heat gun, Part Number 3822860, or an open flame to heat the shrink tubing. The tubing will shrink and make the connection waterproof.

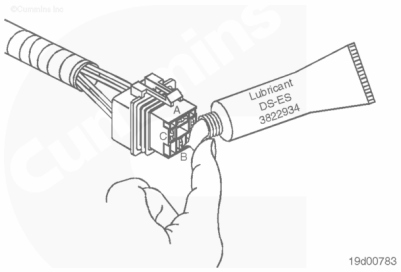


Wrap the wires with tape, for added protection, to complete the repair.



⚠ CAUTION ⚠

Use only Cummins-recommended lubricant DS-ES, Part Number 3822934, other lubricants, such as lubricating oil or grease, in the connectors can cause electronic control unit damage, poor performance, or premature connector pin wear.



Apply a small amount of lubricant to the connector terminals. Before installing, fill the entire connector cavity with lubricant.

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AFTER SALES


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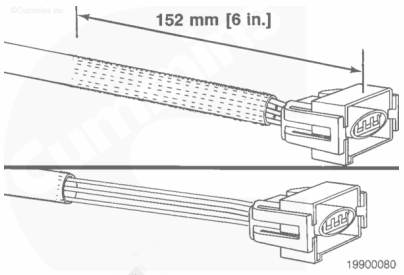
AFTER SALES

Connector Replacement

Measure 152 mm [6 in] back from the face of the connector, and using the braid removal tool, Part Number 3822932, remove the wiring harness protective cover.

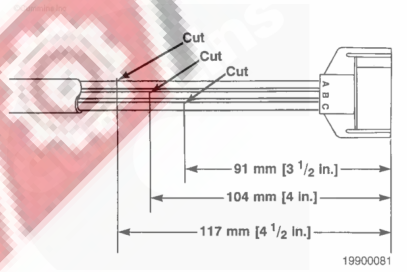


Before cutting the wires, measure and tag the three wires.

Cut wire A 117 mm [4-½ in] from the face of the connector.

Cut wire B 104 mm [4 in] from the face of the connector.

Cut wire C 91 mm [3-½ in] from the face of the connector.



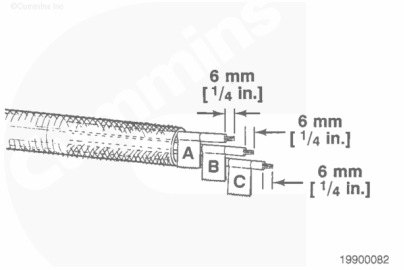
Remove 6 mm [¼ in] of insulation from all three wires using wire crimp tool, Part Number 3822930.

Before installing the new connector, perform a test fit to make sure the connector is keyed correctly.

Refer to the appropriate wiring repair kit in the service tools table in the front of Section 19 for the correct repair connector.

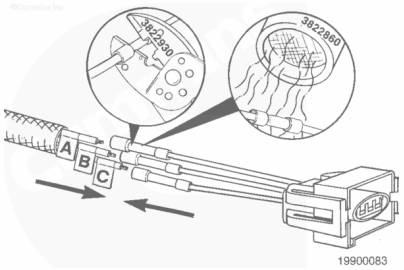
Refer to the wiring diagram in Section E for pin locations.

Replace one contact wire at a time. If more than one wire needs replaced, attach a lettered tag to each wire removed.

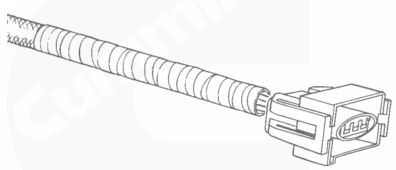


Install the terminal repair wires onto the bare wires and use wire crimping tool, Part Number 3822930, to crimp them together.

Use heat gun, Part Number 3823860, or an open flame to heat the shrink tubing. The tubing will shrink and make the connection waterproof.



Wrap the wires with tape, for added protection, to complete the repair.



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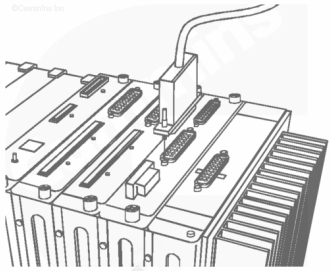
Last Modified: 09-Oct-2003

ANADOLU ISUZU AFTER SALES

Pin Replacement

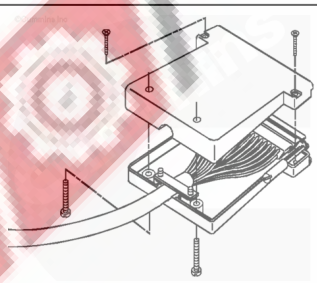
The D-sub miniature connector is used to attach the appropriate harnesses to the ECM.

Remove the connector.

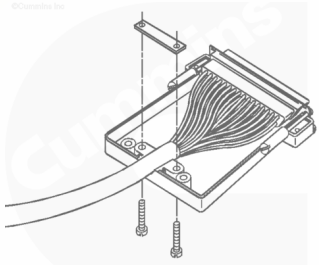


Remove the backshell from the connector.

Locate the damaged pin or wire.



Remove the strain relief to be able to work with the damaged pin.



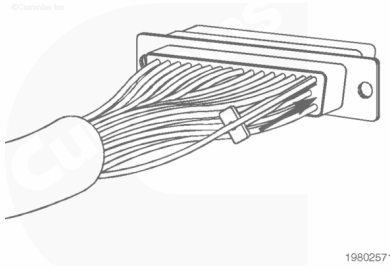
Use the D-sub miniature extraction tool, Part Number 3163971, place over the wire to remove a pin from the connector.

Before installing the new repair wire, perform a test fit to make sure the wire is the correct size.

Refer to the appropriate wiring repair kit in the service tools table in the front of Section 19 for the correct repair wire.

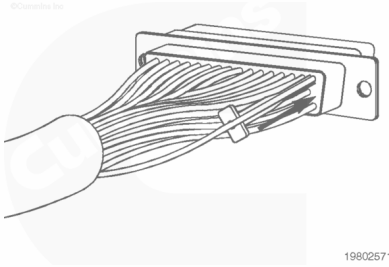
Replace one contact wire at a time. If more than one wire needs replaced, attach a lettered tag to each wire removed.

Refer to the wiring diagram in Section E for pin locations.

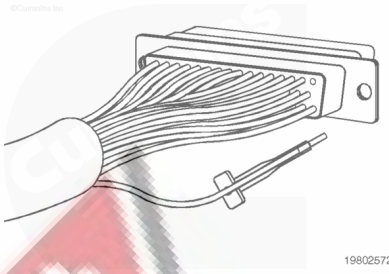


ANADOLU ISUZU AFTER SALES

With a twisting motion, push the pin extraction tool into the connector approximately 25 mm [1 in] until it bottoms on the terminal flange. A click will be heard when the extraction tool is in place.



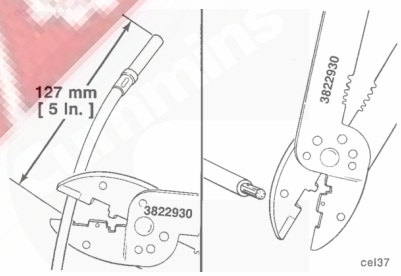
Hold the tool on the terminal flange and pull the wire and connecting pin out of the connector. Note and record the hole from which the pin is removed.



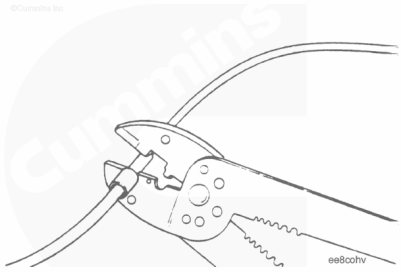
Note : The repair wire is 127 mm [5 in] long.

Use wire crimping tool, Part Number 3822930, to cut 127 mm [5 in] off the wire and pin.

Use the crimping tool to remove 6 mm [¼ in] of insulation from the wire.



Use the wire crimping tool to crimp the repair wire onto the bare wire.



Use heat gun, Part Number 3822860, to heat shrink the tubing around the wire. The tubing will shrink and make the connection waterproof.

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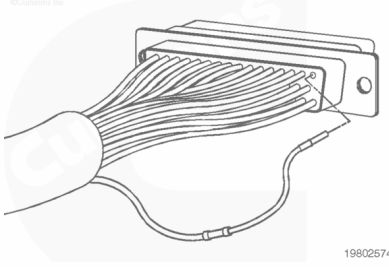
Insert the pin into the correct hole of the connector.

The pin **must** click into place and hold the wire in the connector.

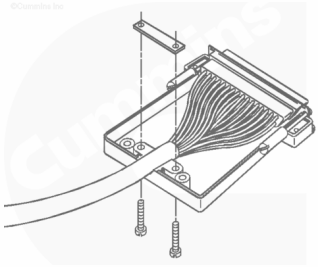
Pull the wire gently to make sure it is seated in the connector.



ANADOLU ISUZU AFTER SALES

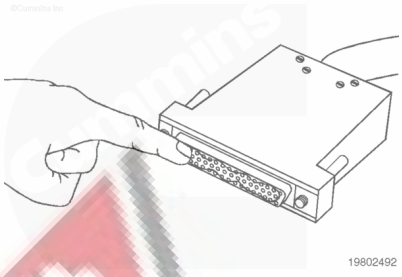
Tighten the strain relief.

Complete the assembly of the backshell by placing the two halves together and tightening the screws.



⚠ CAUTION ⚠

Use only Cummins-recommended lubricant DS-ES, Part Number 3822934. Other lubricants, such as lubricating oil or grease, in the connectors can cause ECM damage, poor engine performance, or premature connector pin wear.



Apply a small amount of lubricant to the connector terminals. Do **not** fill the entire connector cavity with lubricant.

Connector Replacement

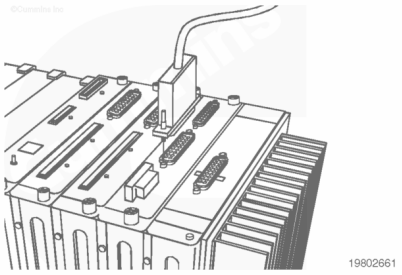
The 50-pin D-sub miniature connector is used to attach the appropriate harnesses to the ECM.

Before installing the new connector, perform a test fit to make sure the connector is keyed correctly.

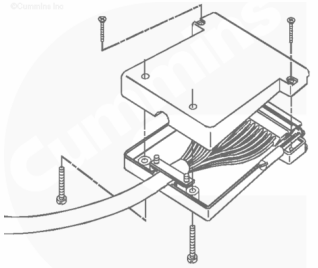
Refer to the appropriate wiring repair kit in the service tools table in the front of Section 19 for the correct repair connector.

Refer to the wiring diagram in Section E for pin locations.

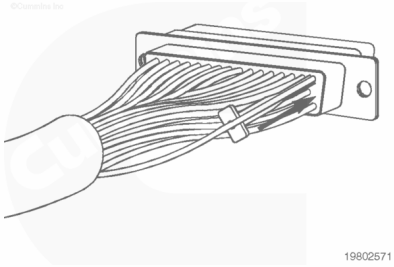
Replace one contact wire at a time. If more than one wire needs replaced, attach a lettered tag to each wire removed.



Remove the backshell from the connector. Remove the stain relief.



To replace the connector use the D-sub miniature extraction tool, Part Number 3163971, place over each wire to remove all pins from the connector.



Before installing the new connector, perform a fit test to make sure the connector is keyed correctly.

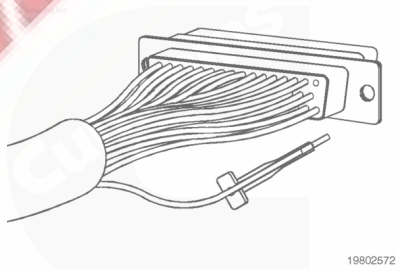
Refer to the appropriate wiring repair kit in the service tools table in the front of Section 19 for the correct repair connector.

Refer to the wiring diagram in Section E for pin locations.

Replace one contact wire at a time. If more than one wire needs replaced, attach a lettered tag to each wire removed.

With a twisting motion, push the pin extraction tool into the connector approximately 25 mm [1 in] until it bottoms on the terminal flange. A click will be heard when the extraction tool is in place.

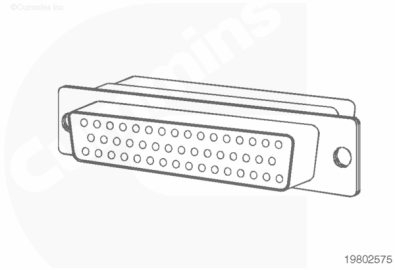
Hold the tool on the terminal flange and pull the wire and connecting pin out of the connector. Note and record the hole from which the pin was removed.



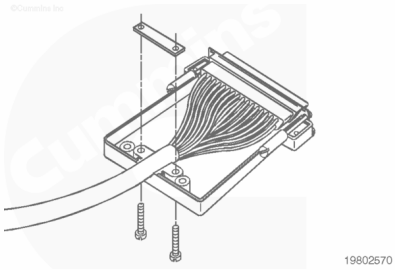
Insert the pins into the correct holes of the replacement connector.

Each pin **must** click into place and hold the wires in the connector.

Pull each wire gently to make sure it is seated in the connector.

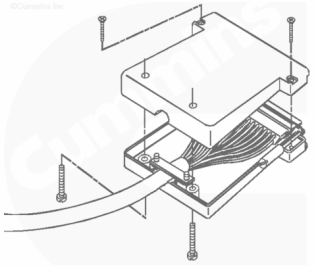


Place the connector pin block onto the lower half of the backshell. Place all wires within the strain relief and tighten the strain relief.



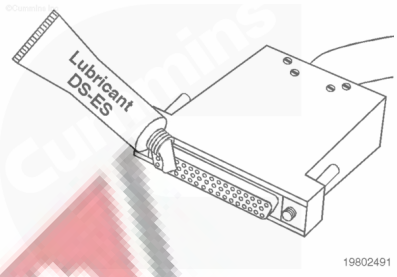
Complete the assembly of the connector by placing the upper half of the backshell onto the lower half and tightening the screws.

ANADOLU ISUZU AFTER SALES



⚠ CAUTION ⚠

Use only Cummins-recommended lubricant DS-ES, Part Number 3822934. Other lubricants, such as lubricating oil or grease, in the connectors can cause ECM damage, poor engine performance, or premature connector pin wear.



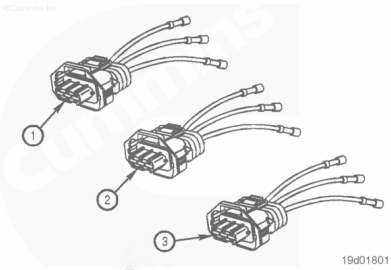
Apply a small amount of lubricant to the connector terminals. Do **not** fill the entire connector cavity with lubricant.

Last Modified: 09-Oct-2003

ANADOLU ISUZU
AFTER SALES

Pin Replacement

The connector is **not** repairable. If any part of the connector becomes damaged, replace the connector with the appropriate repair connector.



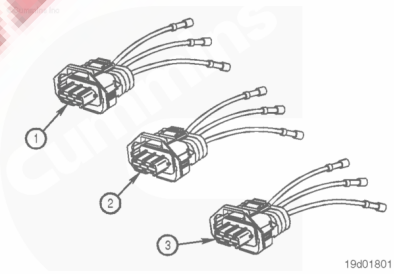
Connector Replacement

Before installing the new connector, perform a test fit to make sure the connector is keyed correctly.

Refer to the appropriate wiring repair kit in the service tools table in the front of Section 19 for the correct repair connector.

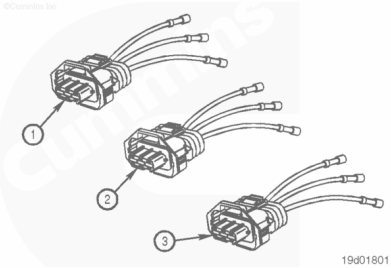
Refer to the wiring diagram in Section E for pin locations.

The connector is **not** repairable. If any part of the connector becomes damaged, replace the connector with the appropriate repair connector.

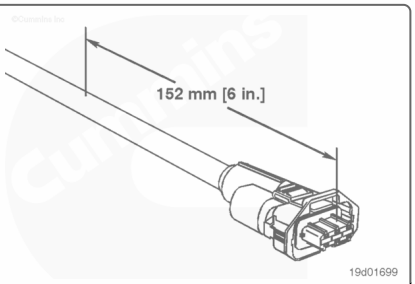


The connectors have different keying and can **not** be interchanged with each other.

Make sure the correct wires are connected to pin 1, pin 2, and pin 3, when replacement is necessary.



Measure 152 mm [6 in] back from the face of the connector, and remove the wiring harness protective cover.

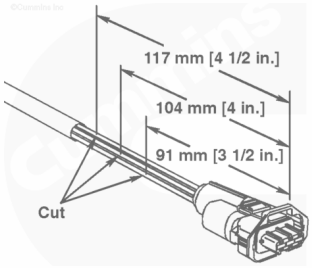


Before cutting the wires, measure and tag the three wires.

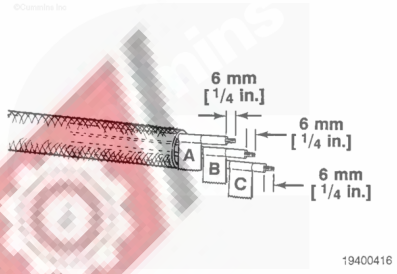
Use wire cutters to cut wire 1 117 mm [4-½ in] from the face of the connector.

Use wire cutters to cut wire 2 104 mm [4 in] from the face of the connector.

Use wire cutters to cut wire 3 91 mm [3-½ in] from the face of the connector.

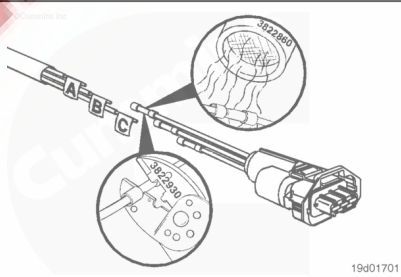


Use wire crimping tool, Part Number 3822930, to remove 6 mm [¼ in] of insulation from all electrical wires.

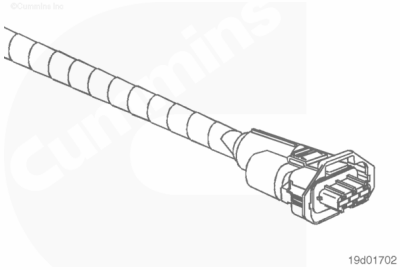


Install the pin repair wires and connector onto the bare wires of the harness and use the wire crimping tool to crimp each repair wire onto the harness.

Use heat gun, Part Number 3822860, to shrink the tubing. The tubing will shrink and make the connection waterproof.



Wrap the wires with tape, for added protection, to complete the repair.



ANADOLU ISUZU AFTER SALES

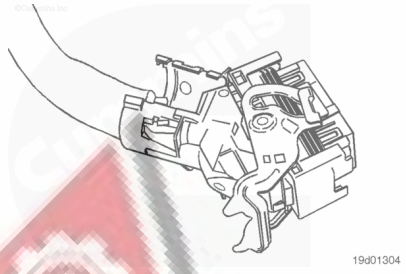
Last Modified: 19-Mar-2009

Pin Replacement

This connector is used to attach the appropriate harness to the ECM.

Remove the connector shell by slightly bending the connector shell (black) away from the two tangs that hold the shell to the ECM connector (red).

Before pins can be removed, they **must** be unlocked. Slide the purple tabs on the edges of the connector sideways at the same time. When unlocked, the purple tab will align with a slot, making the entire length of the purple tab visible.



Use Bosch® extraction tool, Part Number 3164091, place over the wire to remove a pin from the connector.

Replace one contact wire at a time. If more than one wire needs replaced, attach a lettered tag to each wire removed.

Refer to the wiring diagram in Section E for pin locations.

Insert the pin extraction tool into the unlocking holes in the connector.

Do **not** push the tool all the way into the connector.

Push the corresponding wire toward the pin extraction tool.

Press the pin extraction tool all the way into the connector.

⚠ CAUTION ⚠

If the wire is difficult to remove, do not pull hard on wire; the locking tang of the wire terminal will stick or the terminal will pull off the wire and remain in the connector.

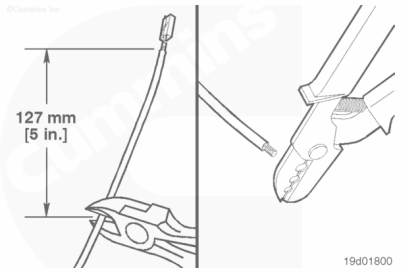
Carefully pull the wire out of the connector. If it is difficult to remove, repeat the entire procedure.

Note : The repair wire is 127 mm [5 in] long.

Use wire cutters to cut 127 mm [5 in] off the wire and pin.

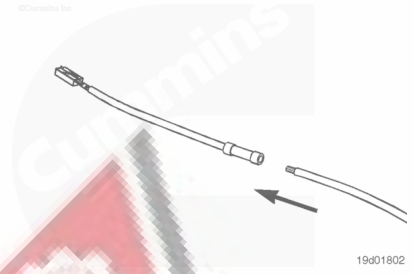
Refer to the appropriate wiring repair kit in the service tools table in the front of Section 19 for the correct repair wire.

Before installing the new repair wire, perform a test fit to make sure the wire is the correct size.

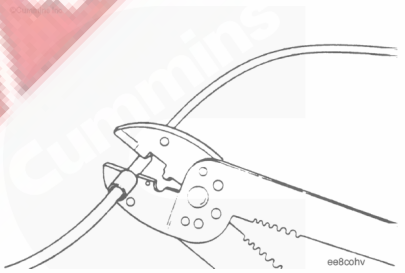


Install the repair wire on the bare wire.

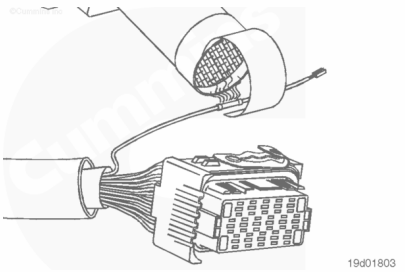
Make sure the bare wire extends into the splice connector.



Use the wire crimping tool, Part Number 3822930, to crimp the repair wire onto the bare wire.



Use heat gun, Part Number, 3822860, to heat the shrink tubing around the wire. The tubing will shrink and make the connection waterproof.



The wire terminal has locating pins that **only** allow it to be inserted in a certain orientation.

Insert the wire from the backside of the connector.

Pull the wire into the connector.

Pull the wire gently to make sure it is locked into the connector.

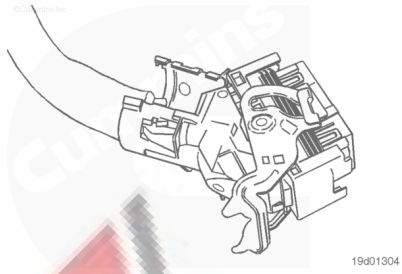
Note : If the wire's locking tang did **not** latch, then remove the wire and pry the tang away from the terminal and repeat this step.

ANADOLU ISUZU AFTERSALES

Connector Replacement

This connector is used to attach the harness to the ECM.

Remove the connector shell by slightly bending the connector shell (black) away from the two tangs that hold the shell to the ECM connector (red).



Before pins can be removed, they **must** be unlocked. Slide the purple tabs on the edges of the connector sideways at the same time. When unlocked, the purple tab will align with a slot, making the entire length of the purple tab visible.

Replace one contact wire at a time. If more than one wire needs replaced, attach a lettered tag to each wire removed.

Refer to the wiring diagram in Section E for pin locations.

Refer to the appropriate wiring repair kit in the service tools table in the front of Section 19 for the correct repair connector.

To replace the connector, use Bosch® extraction tool, Part Number 3164091, over each wire to remove all pins from the connector.

Insert the pin extraction tool into the unlocking holes in the connector.

Do **not** push the tool all the way into the connector.

Push the corresponding wire toward the pin extraction tool.

Press the pin extraction tool all the way into the connector.

⚠ CAUTION ⚠

If the wire is difficult to remove, do not pull hard on the wire; otherwise, the locking tang of the wire terminal will stick or the terminal will pull off the wire and remain in the connector.

ANADOLU ISUZU AFTER SALES

Carefully pull the wire out of the connector and record the hole from which the pin is removed. If it is difficult to remove, repeat the procedure.

Before installing the new connector, perform a test fit to make sure the connector is keyed correctly.

Refer to the appropriate wiring repair kit in the service tools table in the front of Section 19 for the correct repair connector.

Refer to the wiring diagram in Section E for pin locations.

The wire terminal has locating pins that allow it to be inserted in **only** a certain orientation.

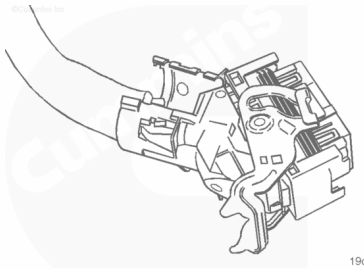
Insert the pins into the correct holes of the replacement connector.

Each pin **must** click into place and hold the wires in the connector.

Pull each wire gently to make sure it is seated in the connector.

Replace the connector shell by inserting the hinge of the connector shell (black) into the hinge of the connector (red).

Close the connector shell onto the connector and wiring harness by pressing it onto the tang of the connector until a click is heard.



ANADOLU ISUZU
AFTERSALES

Last Modified: 19-Mar-2009

Pin Replacement

The connector is used to attach the appropriate harness to the ECM.



Remove the connector shell by slightly bending the connector shell (black) away from the two tangs that hold the shell to the ECM connector (red).

Before pins can be removed, they **must** be unlocked. Slide the purple tabs on the edges of the connector sideways at the same time. When unlocked, the purple tab will align with a slot, making the entire length of the purple tab visible.

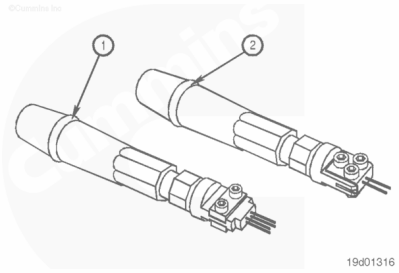


Use Bosch® extraction tool (2), Part Number 3164093, (small terminals), or use Bosch® extraction tool (1), Part Number 3164091 (large terminals), over the wire to remove a pin from the connector.

Replace one contact wire at a time. If more than one wire needs replaced, attach a lettered tag to each wire removed.

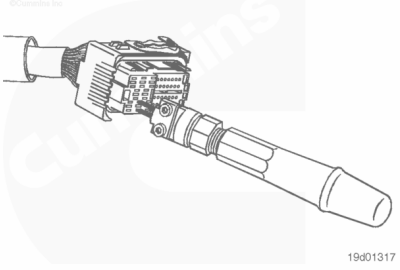
Refer to the wiring diagram in Section E for pin locations.

Refer to the appropriate wiring repair kit in the service tools table in the front of Section 19 for the correct repair wire.

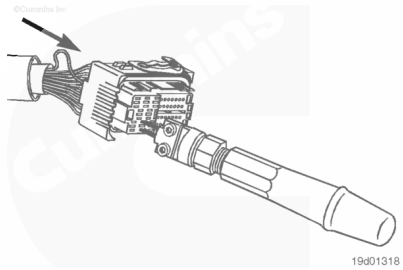


Insert the pin extractor tool into the unlocking holes in the connector.

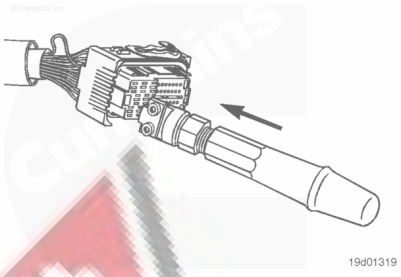
Do **not** push the tool all the way into the connector.



Push the corresponding wire toward the pin extraction tool.

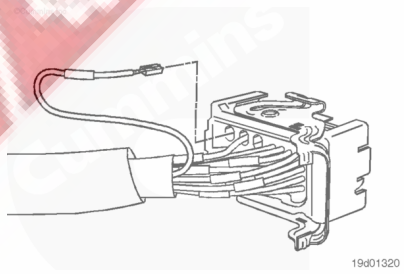


Press the pin extraction tool all the way into the connector.



⚠ CAUTION ⚠

If the wire is difficult to remove, do not pull hard on the wire; otherwise, the locking tang of the wire terminal will stick or the terminal will pull off the wire and remain in the connector.



Carefully pull the wire out of the connector. If it is difficult to remove, repeat the entire procedure.

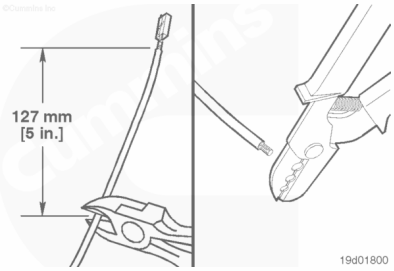
Note : The repair wire is 127 mm [5 in] long.

Use wire cutters to cut 127 mm [5 in] of the wire and pin.

Use wire crimping tool, Part Number 3822930, to remove 6 mm [¼ in] of insulation from the wire.

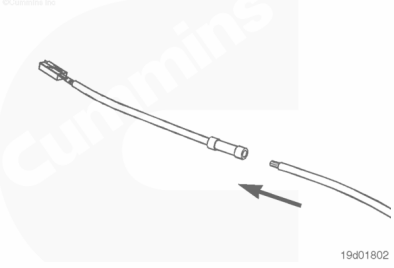
Refer to the appropriate wiring repair kit in the service tools table in the front of Section 19 for the correct repair wire.

Before installing the new repair wire, perform a test fit to make sure the wire is the correct size.

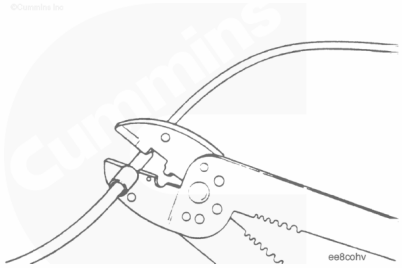


Install the repair wire on the bare wire.

Make sure the bare wire extends into the splice connector.

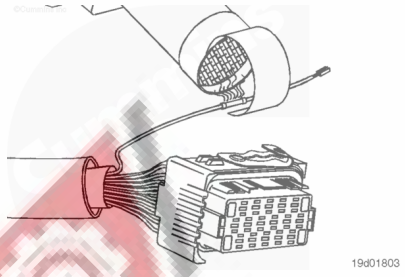


Use wiring crimping tool, Part Number 3822930, to crimp the repair wire onto the bare wire.



Use heat gun, Part Number 3822860, to heat the shrink tubing around the wire.

The tubing will shrink and make the connection waterproof.



The wire terminal has locating pins that **only** allow it to be installed in a certain orientation.

GRAPHIC NOT FOUND

Insert the wire from the backside of the connector.

Push the wire into the connector.

Pull the wire gently to make sure it is locked into the connector.

Note : If the wire's locking tang has **not** latched, then remove the wire, pry the tang away from the terminal, and repeat this step.

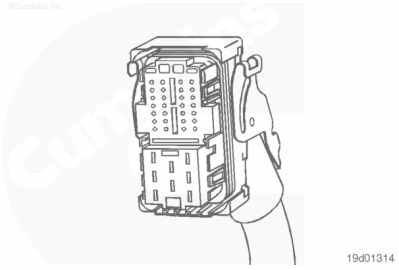
Connector Replacement

This connector is used to attach the engine harness to the ECM.



Remove the connector shell by slightly bending the connector shell (black) away from the two tangs that hold the shell to the ECM connector (red).

Before pins can be removed, they **must** be unlocked. Slide the purple tabs on the edges of the connector sideways at the same time. When unlocked, the purple tab will align with a slot, making the entire length of the purple tab visible.

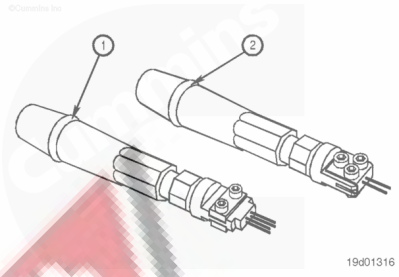


Use Bosch® extraction tool (2), Part Number 3164093, (small terminals), or use Bosch® extraction tool (1), Part Number 3164091 (large terminals), over the wire to remove a pin from the connector.

Remove one contact wire at a time. If more than one wire needs replaced, attach a lettered tag to each wire removed.

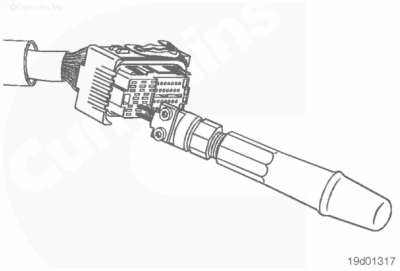
Refer to the wiring diagram in Section E for pin locations.

Refer to the appropriate wiring repair kit in the service tools table in the front of Section 19 for the correct repair wire.

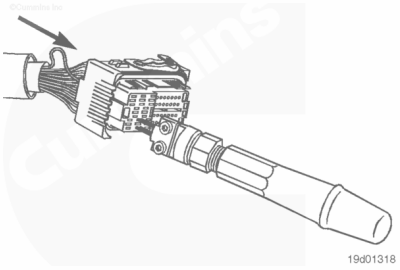


Insert the pin extraction tool into the unlocking holes in the connector.

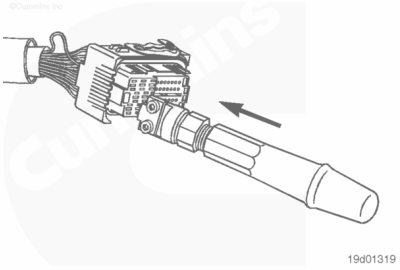
Do **not** push the tool all the way into the connector.



Push the corresponding wire toward the pin extraction tool.



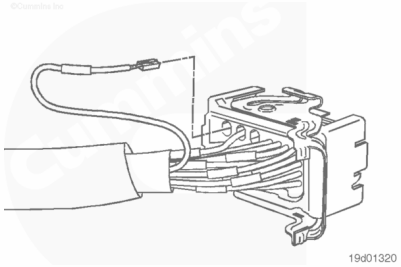
Press the pin extraction tool all the way into the connector.



⚠ CAUTION ⚠

ANADOLU ISUZU AFTER SALES

If the wire is difficult to remove, do not pull hard on the wire; otherwise, the locking tang of the wire terminal will stick or the terminal will pull off the wire and remain in the connector.

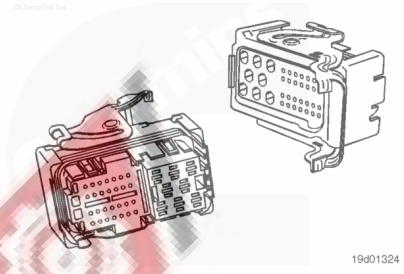


Carefully pull the wire out of the connector and record the hole from which the pin is removed. If it is difficult to remove, repeat the entire procedure.

Before installing the new connector, perform a test fit to make sure the connector is keyed correctly.

Refer to the appropriate wiring repair kit in the service tools table in the front of Section 19 for the correct repair connector.

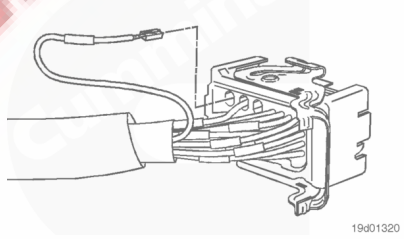
Refer to the wiring diagram in Section E for pin locations.



Insert the pins into the correct hole of the replacement connector.

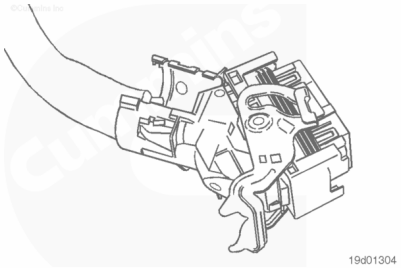
Each pin **must** click into place and hold the wires in the connector.

Pull each wire gently to make sure it is seated in the connector.



Replace the connector shell by inserting the hinge of the connector shell (black) into the hinge of the connector (red).

Close the connector shell onto the connector and wiring harness by pressing it on the tang of the connector until a click is heard.



ANADOLU ISUZU
GENUINE PARTS

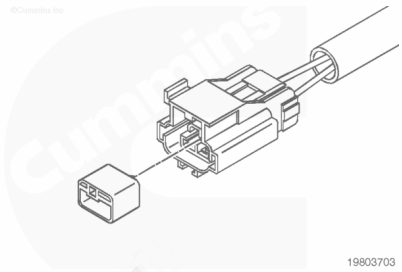
Last Modified: 23-Apr-2009

Pin Replacement

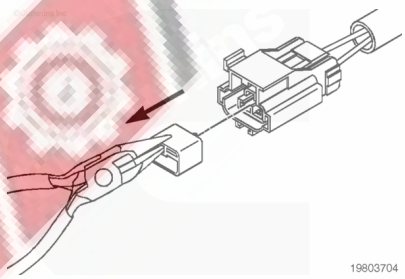
The connector can have multiple pin configurations. All type of connectors are repaired in the same manner.

Replace one contact wire at a time. If more than one wire needs replaced, attach a lettered tag to each wire removed.

Refer to the wiring diagram in Section E for pin locations.

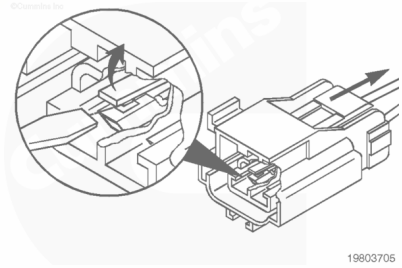


To replace the pin in the receptacle connector, remove the blue inter connector lock using needle nose pliers.



⚠ CAUTION ⚠

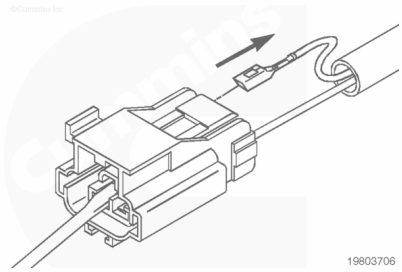
The locking finger can be easily broken. Care must be taken when using this tool. Do not force the tool into place.



To remove the contact out of the connector body, gently pull wire backward, while at the same time releasing the locking finger by moving it away from the contact with a screwdriver.

⚠ CAUTION ⚠

If more than one wire is being repaired, tag each wire and install it in the original location. Electrical damage can occur if a wire is installed in the incorrect location.



Pull the wire and the terminal out of the connector body.

Refer to the appropriate wiring repair kit in the service tools table in the front of this section for the correct repair wire.

Replace one contact wire at a time. If more than one wire needs replaced, attach a lettered tag to each wire removed.

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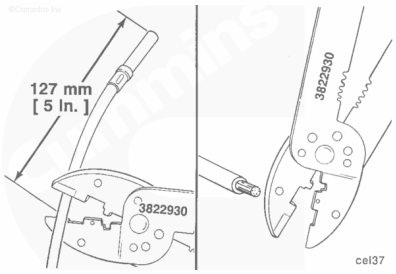
Refer to the wiring diagram in Section E for pin locations.

Before installing the new repair wire, perform a test fit to make sure the wire is the correct size.

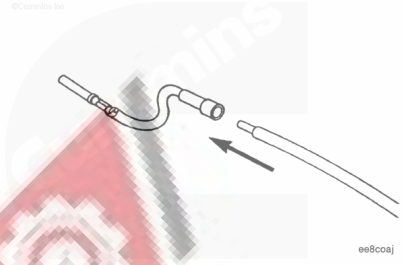
Use wire crimping tool, Part Number 3822930, to cut 127 mm [5 in] off the wire and pin.

Use wire crimping tool, Part Number 3822930, to remove 6 mm [¼ in] of insulation from the wire.

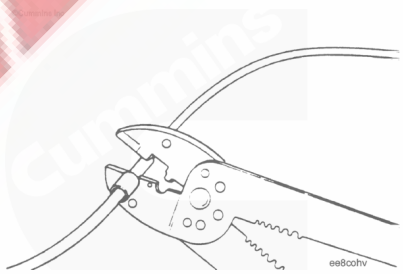


Install the correct repair wire on the bare wire.

Make sure the bare wire extends into the splice connector.

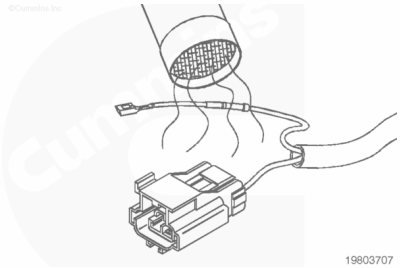


Use wire crimping tool, Part Number 3822930, to crimp the repair wire onto the bare wire.



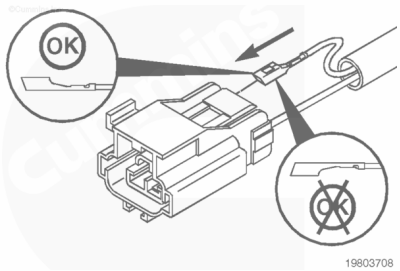
Use heat gun, Part Number 3822860, to heat shrink the tubing around the wire.

The tubing will shrink and make the connection waterproof.



⚠ CAUTION ⚠

If more than one wire is repaired or if the connector body is replaced, make sure to insert wires into the same locations as they are in the original connector. If wires are not in the original location, electrical damage can occur.



Install the wire and terminal into the connector body. Push the wire and terminal into the seal at the back of the connector. Install the replacement terminal and wire so that

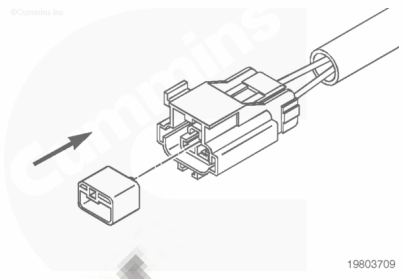
ANADOLU ISUZU
AFTERSALES

the longest point of the terminal is closest to the connector locking tab.

Push the wires straight in until a click is felt. A slight tug will confirm that it is properly locked in place.

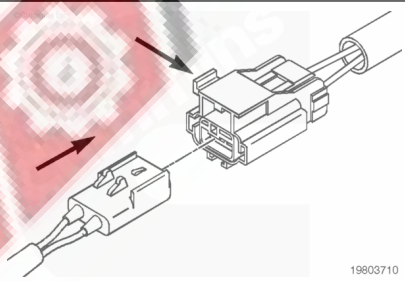
Once the wires are in place, insert the blue inter connector lock with the locking tab positioned towards the connector locking tab.

Push the blue inter connector lock in until it snaps in place.



Push the connector plug into the connector receptacle until the external locking clip snaps into place.

Slide the connector locking tab to the locked position.



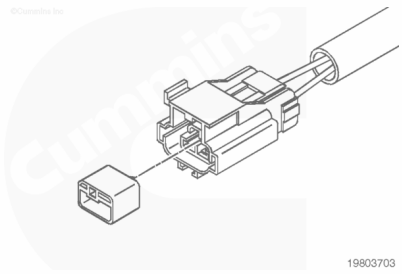
Connector Replacement

The connector can have multiple pin configurations. All types of connectors are repaired in the same manner.

Before installing the new connector perform a test fit to make sure the connector is keyed correctly.

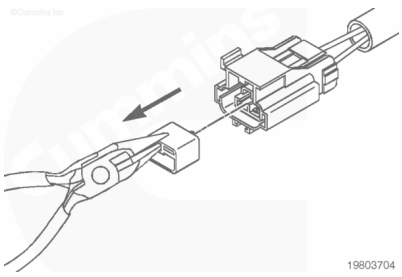
Refer to the appropriate wiring repair kit in the service tools table in the front of this section for the correct repair connector.

Refer to the wiring diagram in Section E for pin locations.



⚠ CAUTION ⚠

If more than one wire is repaired or if the connector body is replaced, be sure to insert the wires into the same location as they were in the original connector. If the wires are not in the original location, electrical damage can occur.



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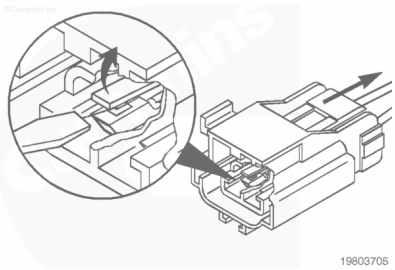
To replace the connector, grasp the blue inter connector and pull it straight out.

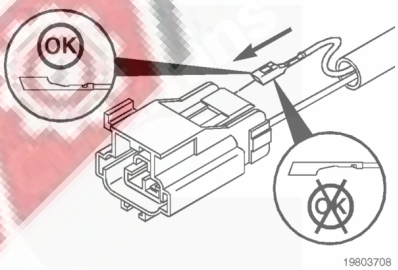
⚠ CAUTION ⚠

The locking finger can be easily broken. Care must be taken when using this tool. Do not force the tool into place.



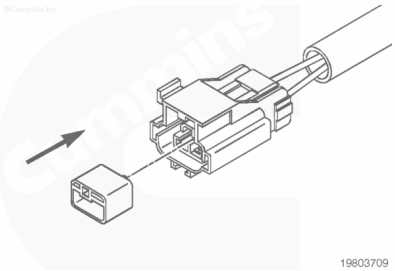
To remove the contact out of the connector body, gently pull wire backward, while at the same time releasing the locking finger by moving it away from the contact with a screwdriver.

Replace the connector and install the wires and terminals into the seal at the back of the connector. Push the wires straight in until a click is felt. A slight tug will confirm that it is properly locked in place.



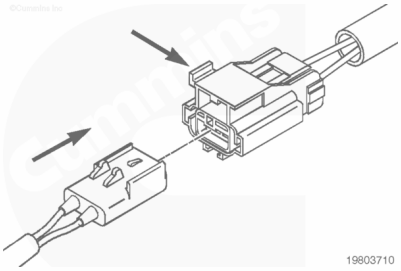
Once the wires are in place, insert the blue inter connector lock with the locking tab positioned towards the connector locking tab.

Push the blue inter connector lock in until it snaps in place.



Push the connector plug into the connector receptacle until the external locking clip snaps into place.

Slide the connector locking tab to the locked position.



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Last Modified: 09-Oct-2003


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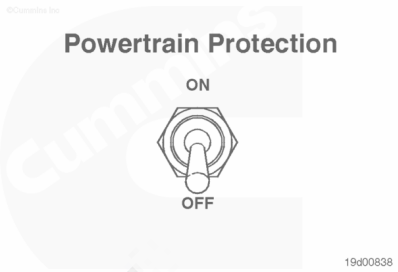
AFTER SALES

General Information

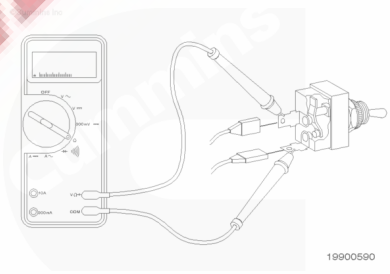
The powertrain protection switch circuit signals the system to protect the drivetrain when lower gears are engaged. The powertrain protection feature can limit engine output torque depending upon transmission gear ratio. Engine torque limits based on transmission gear ratio can be adjusted using the recommended Cummins® electronic service tool or equivalent.



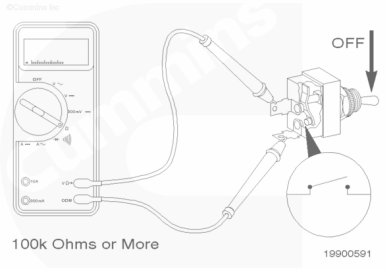
Resistance Check

If an electronic service tool is available, monitor the powertrain protection switch for proper operation. If **not**, follow the troubleshooting procedures in this section.

Locate the powertrain protection switch. Remove and tag the two connectors from the terminals on the switch. Touch the multimeter probes to the terminals on the switch.

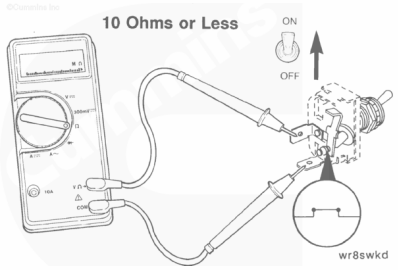


Move the switch to the OFF position, and measure the resistance. The multimeter **must** show an open circuit (100k ohms or more). If the circuit is **not** open, the switch has failed. Refer to the original equipment manufacturer (OEM) troubleshooting and repair manual for the replacement instructions.



Move the switch to the ON position, and measure the resistance. The multimeter **must** show a closed circuit (10 ohms or less). If the circuit is **not** closed, the switch has failed. Refer to the OEM troubleshooting and repair manual for the replacement instructions.

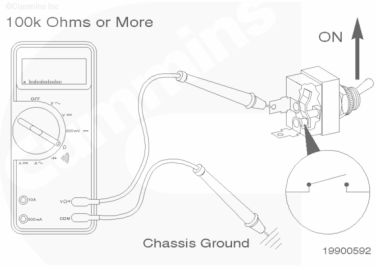
If the resistance value is correct, the switch **must** still be checked for a short circuit to ground.



Check for Short Circuit to Ground

Touch one of the multimeter probes to one of the switch terminals. Touch the other probe to chassis ground. Move the switch to the ON position, and measure the resistance. The multimeter **must** show an open circuit (100k ohms or more).

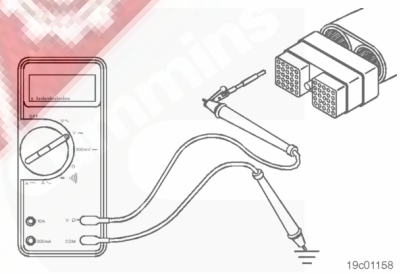
If the circuit is **not** open, the switch has failed. Refer to the OEM troubleshooting and repair manual for replacement procedures.



Check for Short Circuit to External Voltage Source

⚠ CAUTION ⚠

The leads must fit tightly in the connector without expanding the pins in the connector otherwise the connector will be damaged.



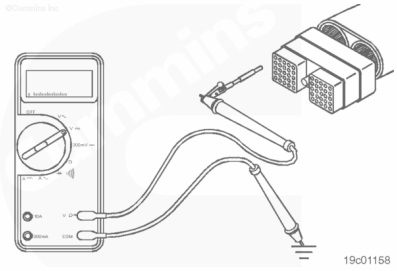
Isolate the powertrain protection switch circuit. Turn the vehicle keyswitch to the ON position. Adjust the multimeter to measure VDC.

Insert the test lead connected to the positive (+) multimeter probe into the powertrain protection switch signal pin of the OEM harness.

Disconnect the negative (-) multimeter probe from the test lead, touch it to the engine block ground, and measure the voltage. The voltage **must** be 1.5 VDC or less.

Note : An external voltage source is any wire in the OEM harness wiring that carries the voltage.

If the voltage value is more than 1.5 VDC, there is a short circuit between the wire connected to the powertrain protection switch signal pin and a wire carrying power in the OEM harness. Repair the OEM harness according to the vehicle manufacturer's procedures.



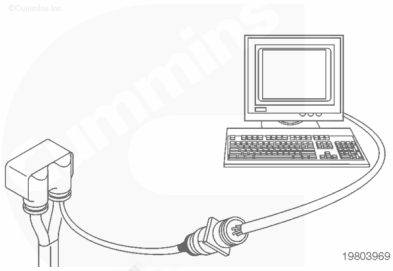
Last Modified: 27-Jan-2020



Resistance Check

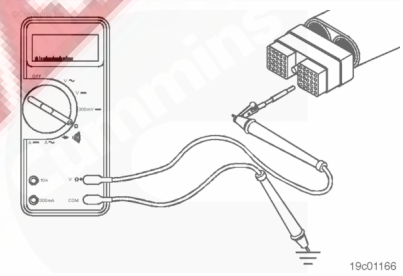
⚠ CAUTION ⚠

Proper leads and/or a Cummins® approved circuit testing tool must be used when working with electrical connectors to prevent pin expansion and damage to the connector.

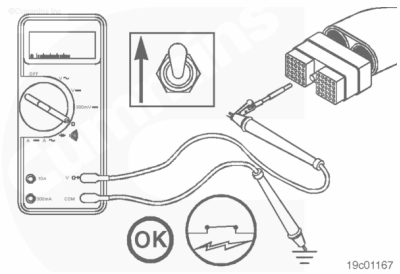


If electronic service tool is available, monitor the powertrain protection switch circuit for proper operation. If **not**, follow the troubleshooting procedures in this section.

Disconnect the original equipment manufacturer (OEM) harness engine interface connector. To determine the location of the connector, see the corresponding engine wiring diagram. Insert the multimeter probe into powertrain protection switch signal pin in the OEM harness. Touch the other probe to the engine block ground.



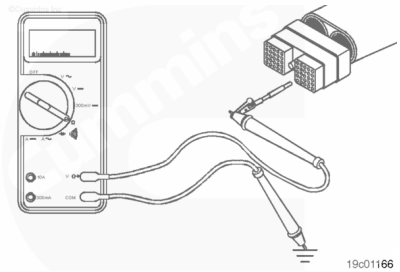
Move the powertrain protection switch to the ON position. The multimeter **must** show a closed circuit (10 ohms or less). If the circuit is **not** closed, inspect the signal wire for an open circuit. Refer to the OEM troubleshooting and repair manual. If the resistance is within specification, the signal pin **must** be checked for a short circuit to ground, a short circuit from terminal to terminal, and a short circuit to an external voltage source.



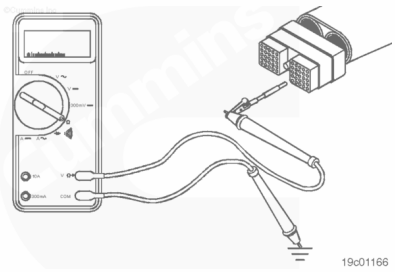
Check for Short Circuit to Ground

Isolate the powertrain protection switch circuit.

Touch multimeter probe to the engine block. With the other electrical lead inserted into powertrain protection switch signal pin, measure the resistance.



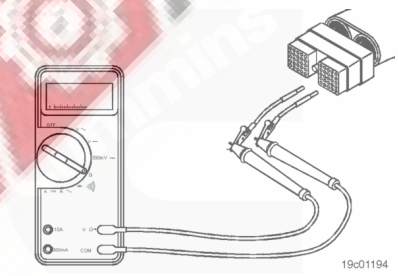
The multimeter **must** show an open circuit (100k ohms or more). If the circuit is **not** open, there is a short circuit to ground in the powertrain protection switch circuit, provided that the switch has been previously checked. Repair or replace the wire connected to powertrain protection switch signal pin according to the vehicle manufacturer's instructions.



Check for Short Circuit from Pin to Pin

Isolate the powertrain protection switch circuit. Place one of the leads into power train protection switch signal pin. Insert the pin of the other lead into pin 1. Connect the alligator clips to the multimeter probes. Measure the resistance.

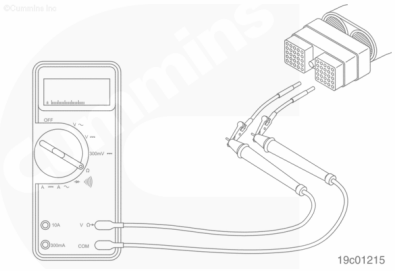
The multimeter **must** show an open circuit (100k ohms or more).



Remove the lead from pin 1, and check all other pins. The multimeter **must** show an open circuit (100k ohms or more).

If the circuit is **not** open, there is a short circuit from the wire connected to powertrain protection switch signal pin and any pin that measured less than 100k ohms.

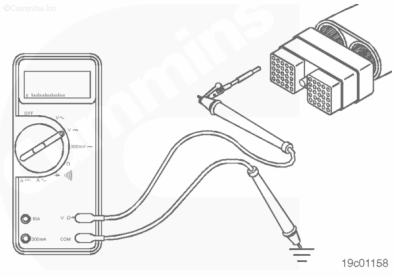
Repair or replace the wires in the OEM harness according to the vehicle manufacturer's instructions.



Check for Short Circuit to External Voltage Source

Isolate the powertrain protection switch circuit. Turn the vehicle keyswitch to the ON position. Set the multimeter to measure VDC.

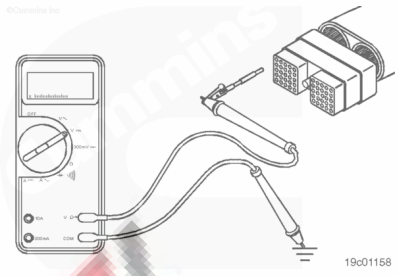
Insert the test lead connected to the positive (+) multimeter probe into powertrain protection switch signal pin of the OEM harness.



Disconnect the negative (-) multimeter probe from the test lead, touch it to the engine block ground, and measure the voltage. The voltage **must** be 1.5 VDC or less.

Note : An external voltage source is any wire in the OEM harness wiring that carries the voltage.

If the voltage value is more than 1.5 VDC, there is a short circuit between the wire connected to powertrain protection switch signal pin and a wire carrying power in the OEM harness. Repair the OEM harness according to the vehicle manufacturer's procedures.

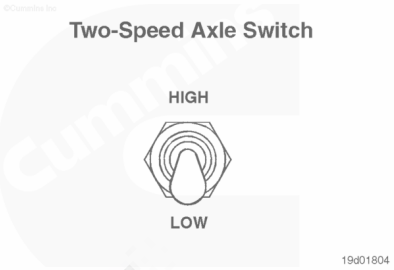


Last Modified: 25-Jun-2015

ANADOLU ISUZU AFTER SALES

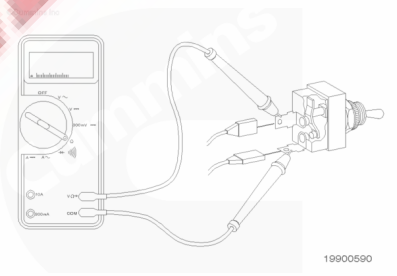
General Information

The 2-speed axle switch allows the operator the capability of switching from one axle to another. The ECM can then calculate the vehicle speed correctly.



Resistance Check

If a recommended Cummins® electronic service tool or equivalent is available, monitor the 2-speed axle switch for proper operation. If **not**, follow the troubleshooting procedures in this section.



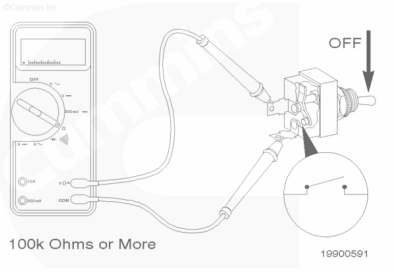
Locate the 2-speed axle switch.

Remove and tag the two connectors from the terminals on the switch.

Touch the multimeter probes to the terminals on the switch.

Move the switch to the OFF position, and measure the resistance.

The multimeter **must** show an open circuit (100k ohms or more).

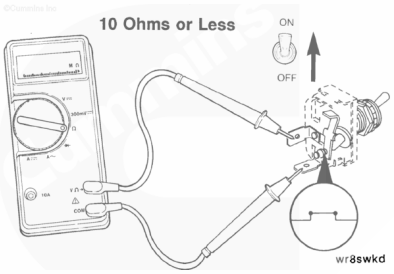


If the circuit is **not** open, the switch is damaged and **must** be replaced.

Refer to the OEM troubleshooting and repair manual for the replacement instructions.

Move the switch to the ON position, and measure the resistance.

The multimeter **must** show a closed circuit (10 ohms or less).



ANADOLU ISUZU AFTER SALES

If the circuit is **not** closed, the switch is damaged and **must** be replaced.

Refer to the OEM troubleshooting and repair manual for the replacement instructions.

If the resistance value is correct, the switch **must** still be checked for a short circuit to ground.

Check for Short Circuit to Ground

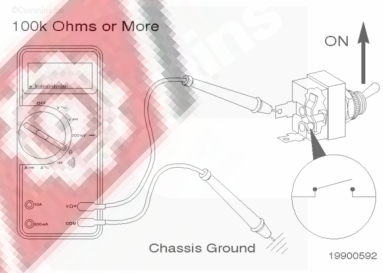
Touch one of the multimeter probes to one of the switch terminals. Touch the other probe to chassis ground.

Move the switch to the ON position, and measure the resistance.

The multimeter **must** show an open circuit (100k ohms or more).

If the circuit is **not** open, the switch is damaged and **must** be replaced.

Refer to the OEM repair manual for replacement procedures.



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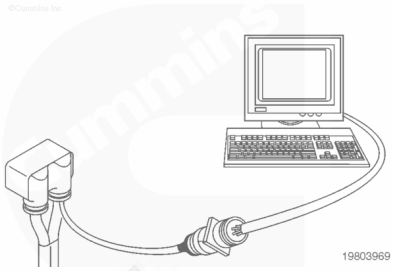
AFTER SALES

Last Modified: 27-Jan-2020

Resistance Check

⚠ CAUTION ⚠

Proper leads and/or a Cummins® approved circuit testing tool must be used when working with electrical connectors to prevent pin expansion and damage to the connector.



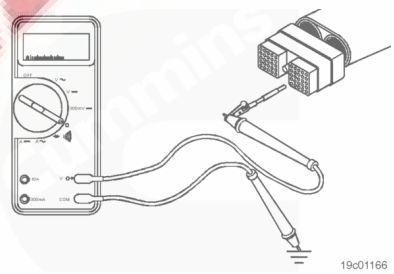
If a recommended Cummins® electronic service tool or equivalent is available, monitor the 2-speed axle switch circuit for proper operation.

If **not**, follow the troubleshooting procedures in this section.

Disconnect the OEM harness from the ECM connector.

Insert a test lead into the 2-speed axle switch signal pin of the OEM harness connector, and attach it to a multimeter probe.

Touch the other multimeter probe to the engine block ground.

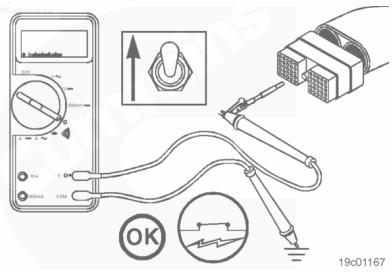


Move the 2-speed axle switch to the ON position.

The multimeter **must** show a closed circuit (10 ohms or less).

If the circuit is **not** closed, inspect the 2-speed-axle-switch signal wire for an open circuit. Refer to the OEM troubleshooting and repair manual.

If the resistance is within specification, the 2-speed axle switch signal pin **must** be checked for a short circuit to ground, a short circuit from pin-to-pin, and a short circuit to an external voltage source.

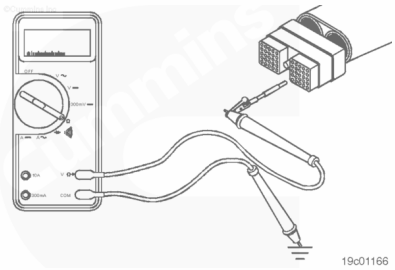


Check for Short Circuit to Ground

Isolate the 2-speed axle switch circuit.

Insert the test lead attached to the multimeter probe into the 2-speed axle switch signal pin of the OEM harness connector.

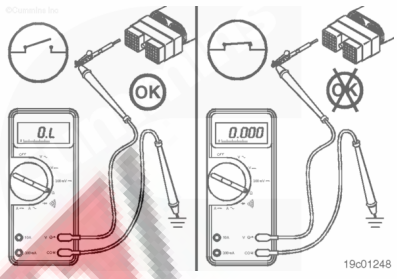
Touch the other multimeter probe to the engine block, and measure the resistance.



The multimeter **must** show an open circuit (100k ohms or more).

If the circuit is **not** open, there is a short circuit to ground in the 2-speed axle switch circuit, provided that the switch has been previously checked.

Repair or replace the wire connected to the 2-speed axle switch signal pin according to the vehicle manufacturer's instructions.



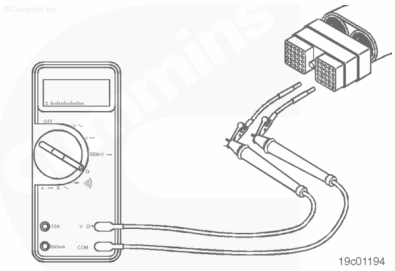
Check for Short Circuit from Pin-to-Pin

Isolate the 2-speed axle switch circuit.

Insert the appropriate test lead into the 2-speed axle switch signal pin of the OEM harness connector.

Insert the other appropriate test lead into one of the other pins of the connector. Connect the alligator clips to the multimeter probes. Measure the resistance.

The multimeter **must** show an open circuit (100k ohms or more).

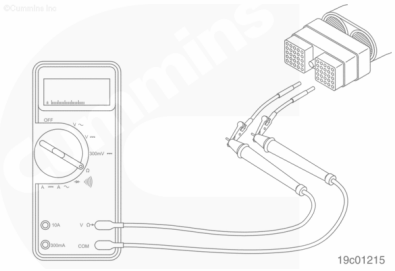


Remove the lead and check all other pins.

The multimeter **must** show an open circuit (100k ohms or more).

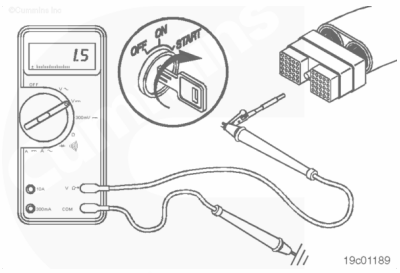
If the circuit is **not** open, there is a short circuit from the wire connected to the 2-speed axle switch signal pin to any pin that measured less than 100k ohms.

Repair or replace the wires in the OEM harness according to the vehicle manufacturer's instructions.



Check for Short Circuit to External Voltage Source

Isolate the 2-speed axle switch circuit. Turn the keyswitch to the ON position. Set the multimeter to measure VDC.



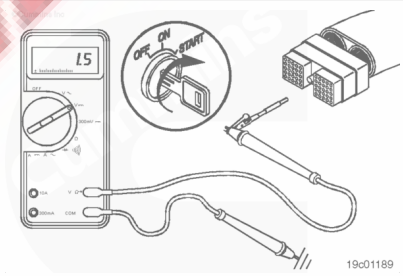
Insert the test lead connected to the positive (+) multimeter probe into the 2-speed axle switch signal pin of the OEM harness connector.

Disconnect the negative (-) multimeter probe from the test lead, touch it to the engine block ground, and measure the voltage.

The voltage **must** be 1.5-VDC or less.

Note : An external voltage source is any wire in the OEM harness wiring that carries the voltage.

If the voltage value is more than 1.5-VDC, there is a short circuit between the wire connected to the 2-speed axle switch signal pin and a wire that is carrying power in the OEM harness.



Repair or replace the OEM harness. Refer to Procedure 019-071 (/qs3/pubsys2/xml/en/procedures/99/99-019-071.html).

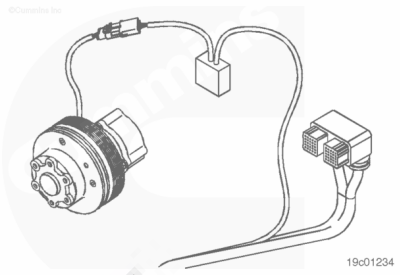
Connect all components after completing the repairs.

ANADOLU ISUZU AFTER SALES

Last Modified: 27-Jan-2020

General Information

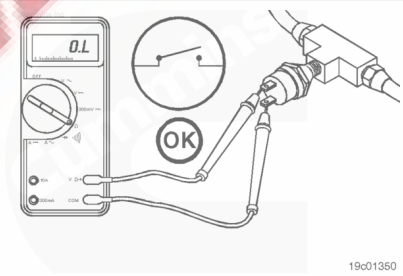
The air conditioning pressure switch circuit signals the system that the air conditioner head pressure is high and the engine fan **must** be engaged. The air conditioning pressure circuit consists of the air conditioning pressure switch signal pin and switch return pin. This circuit is considered “fail safe”, meaning when the circuit is open, the engine fan will be engaged by the electronic control module (ECM).



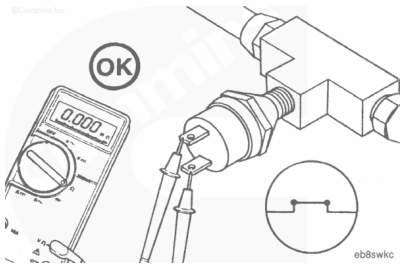
Resistance Check

Locate the air conditioning pressure switch. Remove the electrical connection from the switch. Adjust the multimeter to measure resistance. Touch one multimeter probe to one of the terminals on the switch. Touch the other multimeter probe to the other terminal of the switch.

When the system head pressure is high, the multimeter **must** show an open circuit (100k ohms or more). If the circuit is **not** open, the switch has failed. Refer to the original equipment manufacturer (OEM) troubleshooting and repair manual for replacement procedures.



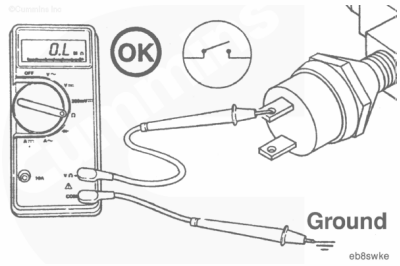
When the system head pressure is low, the multimeter **must** show a closed circuit (10 ohms or less). If the circuit is **not** closed, the switch has failed. Refer to the OEM troubleshooting and repair manual for replacement procedures. If the resistance value is correct, the switch **must** still be checked for a short circuit to ground.



Check for Short Circuit to Ground

When the system head pressure is low, touch one of the multimeter probes to one of the switch terminals. Touch the other probe to chassis ground. The multimeter **must** show

an open circuit (100k ohms or more). If the circuit is **not** open, the switch has failed. Refer to the OEM troubleshooting and repair manual for replacement procedures. If the switch passes all of the previous checks, the circuit **must** be checked for an open circuit, a short circuit to ground, a short circuit from pin to pin, and a short circuit to an external voltage source.



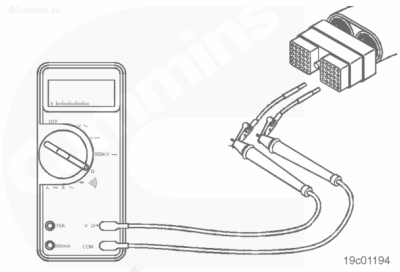
Last Modified: 30-May-2008

ANADOLU ISUZU
AFTER SALES

Resistance Check

⚠ CAUTION ⚠

Proper leads and/or a Cummins® approved circuit testing tool must be used when working with electrical connectors to prevent pin expansion and damage to the connector.

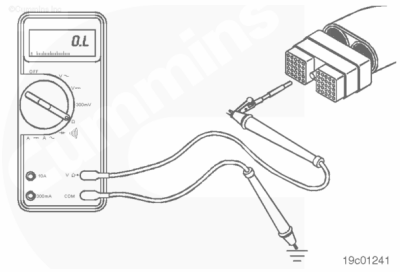


Disconnect the original equipment manufacturer (OEM) harness engine interface connector. To determine the location of the connector, see the corresponding engine wiring diagram. Insert one of the test leads into the switch return of the OEM harness connector and connect the alligator clip to the multimeter probe. Insert the other lead into the air conditioning pressure switch signal pin of the harness connector and connect the alligator clip to the other multimeter probe.

When the system head pressure is low, the multimeter **must** show a closed circuit (10 ohms or less). If the circuit is **not** closed, inspect the switch return and the air conditioning pressure switch signal wire for an open circuit, provided that the switch has been previously checked. Refer to the OEM troubleshooting and repair manual for repair procedures. If the resistance is within the specification, the switch return and the air conditioning pressure switch wire **must** be checked for a short circuit to ground, a short circuit from pin-to-pin, and a short circuit to an external voltage source.

Check for Short Circuit to Ground

To isolate the air conditioning switch circuit when checking for an electrical short, disconnect the OEM harness engine interface connector.



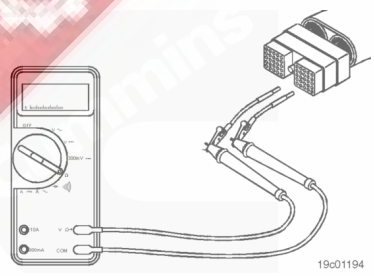
Adjust the multimeter to measure resistance. When the system head pressure is low, insert a test lead into the air conditioning pressure switch signal pin of the OEM harness

connector and connect it to a multimeter probe. Touch the other multimeter probe to the engine block ground. Measure the resistance.

The multimeter **must** show an open circuit (100k ohms or more). If the circuit is **not** open, there is a short circuit to ground in the air conditioning switch circuit, provided that the switch has been previously checked. Repair or replace the wire connected to the air conditioning pressure switch signal pin in the OEM harness. Refer to Procedure 019-071 (/qs3/pubsys2/xml/en/procedures/99/99-019-071.html).

Check for Short Circuit from Pin to Pin

Check for a short circuit from pin-to-pin. Isolate the air conditioning circuit by removing the OEM harness from the ECM. Insert the lead into the air conditioning pressure switch signal pin. Connect the alligator clip to the multimeter. With the other lead inserted into the switch return pin, measure the resistance. The multimeter **must** show an open circuit (100k ohms or more).

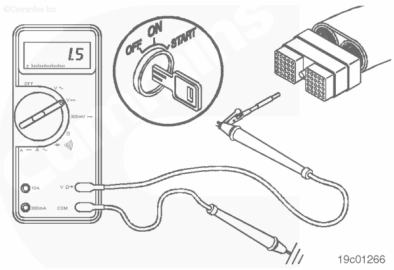


Allow the head pressure to drop and remove the lead from the air conditioning pressure switch signal pin and check all other pins. When the system head pressure is low, measure the resistance. The multimeter **must** show an open circuit (100k ohms or more). If the circuit is **not** open, there is a short circuit between the air conditioning pressure circuit and any pin that shows a closed circuit. Repair or replace the wires in the engine harness. Refer to Procedure 019-043 (/qs3/pubsys2/xml/en/procedures/16/16-019-043.html). Repair or replace the wires in the OEM harness. Refer to Procedure 019-071 (/qs3/pubsys2/xml/en/procedures/99/99-019-071.html).

Check for Short Circuit to External Voltage Source

Turn the keyswitch to the ON position. When the system head pressure is low, adjust the multimeter to measure VDC. Insert a test lead into the air conditioning pressure switch signal pin of the OEM connector and attach it to a multimeter

probe. Touch the other multimeter probe to the engine block ground. Measure the voltage. The voltage **must** be 1.5 VDC or less. If the voltage is **not** correct, there is an external voltage source connected to the circuit, or there is a short circuit between the air conditioning pressure switch circuit and a wire carrying power in the engine or OEM harness. Remove the voltage source, or repair or replace the wiring in the OEM harness. Refer to Procedure 019-071 (/qs3/pubsys2/xml/en/procedures/99/99-019-071.html). Remove the voltage source or repair or replace the wires in the engine harness. Connect all components after completing the repair.



Note : If the air conditioning pressure switch circuit was approved in all of the previous tests, it is functioning properly.

Last Modified: 29-Jun-2015

ANADOLU ISUZU
AFTER SALES

General Information

The accelerator interlock switch inhibits the operation of the cab accelerator and the remote accelerator. For example, busses inhibit the accelerator as passengers embark and disembark, to ensure the bus remains stationary. The accelerator interlock feature, available **only** on special transit and vocational calibrations, uses this switch. Installation varies; busses commonly use a door-actuated switch.

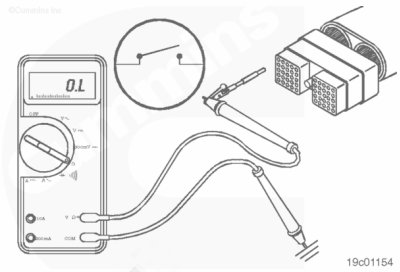
Last Modified: 22-Jan-2003

ANADOLU ISUZU AFTER SALES

Resistance Check

⚠ CAUTION ⚠

Proper leads and/or a Cummins® approved circuit testing tool must be used when working with electrical connectors to prevent pin expansion and damage to the connector.



The accelerator interlock switch is programmable. Check the setting with a recommended Cummins® electronic service tool or equivalent before continuing with the troubleshooting steps.

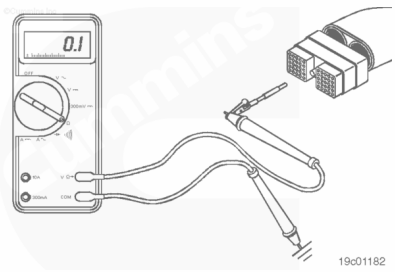
If electronic service tool is available, monitor the accelerator interlock switch for proper operation. If **not**, follow the procedure below.

Note : The accelerator interlock signal input can also be used as the engine torque limit switch signal as well.

Disconnect the original equipment manufacturer (OEM) harness connector from the electronic control module (ECM). Insert a test lead into the accelerator interlock switch signal pin. Touch the other multimeter probe to engine block ground. With the switch in the inhibit position, the multimeter **must** read an open circuit (100k ohms or more).

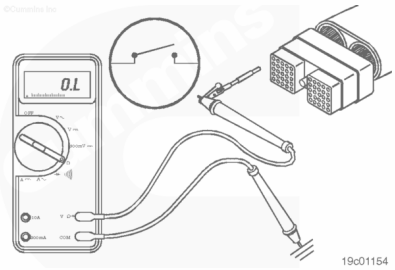
With the switch in the normal position, the multimeter **must** read a closed circuit (10 ohms or less).

If the circuit is **not** closed, inspect the accelerator interlock switch signal line for an open circuit.



Check for Short Circuit to Ground

Connect one of the multimeter probes to the accelerator interlock switch signal wire. Touch the other probe to chassis ground. Move the switch to the inhibit position and measure the resistance.

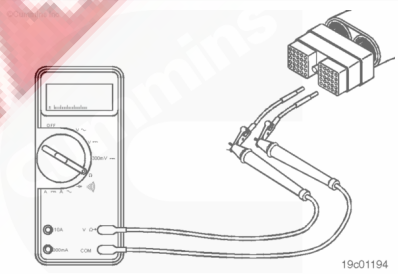


The multimeter **must** show an open circuit (100k ohms or more). If the circuit does **not** show an open circuit then there is a short to ground in the circuit somewhere.

Repair or replace the OEM harness. Refer to Procedure 019-071 (/qs3/pubsys2/xml/en/procedures/99/99-019-071.html).

Check for Short Circuit from Pin-to-Pin

Check for a short circuit from pin-to-pin. Insert a test lead into the accelerator interlock switch signal pin. Insert the other test lead into the switch return pin. Measure the resistance. The multimeter **must** show an open circuit (100k ohms or more).

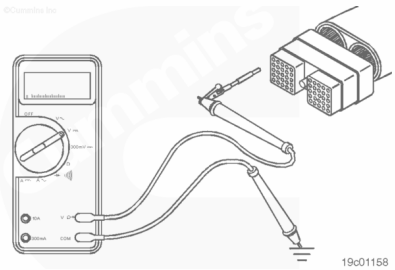


Remove the test lead from the switch return pin and test all other pins in the connector. The multimeter **must** show an open circuit on all pins.

Repair any pin circuits that show a closed circuit with the accelerator governor switch signal pin.

Check for Short Circuit to External Voltage Source

Set the switch to normal position and set the multimeter to read VDC. Insert one test lead into the accelerator interlock switch signal pin and connect a multimeter lead to it. Touch the other multimeter lead to engine block ground. Measure the voltage.



The voltage **must** read 1.5 VDC or less.

If the voltage is **not** correct, there is an external voltage source connected to the circuit. Repair or replace the OEM wiring. Refer to Procedure 019-071 (/qs3/pubsys2/xml/en/procedures/99/99-019-071.html).

ANADOLU ISUZU AFTER SALES

Last Modified: 27-Jan-2020



General Information

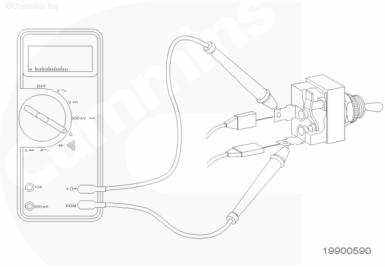
The cab switchable governor switch selects between variable speed (VS) and automotive accelerator governors. Governor selection often occurs while changing operation modes: for example, between cab accelerator and remote accelerator. When the OEM enables the switchable accelerator type of feature, the automotive or VS governing feature uses the accelerator governor switch.



The accelerator governor switch has two positions: ALTERNATE and PROGRAMMABLE. The PROGRAMMABLE position allows the accelerator-type parameter, VS or automotive, to choose the governor. The ALTERNATE position chooses the opposite governor from that selected by the accelerator-type parameter.

Resistance Check

If a recommended Cummins® electronic service tool or equivalent is available, monitor the switch for proper operation. If **not**, follow the following procedure.



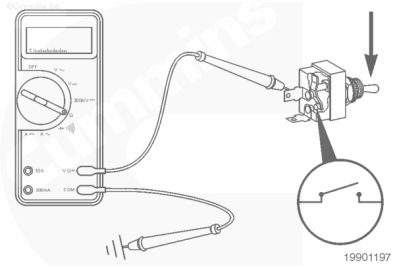
Locate the switch. Disconnect the connectors and label the wires. Touch a multimeter probe to each switch terminal and measure the resistance with the switch set to both positions.

The multimeter **must** show a value of 100k ohms or more (open circuit) while the switch is in one position and a value of 10 ohms or less (closed circuit) in the other position.

If the switch does **not** transition from an open to a closed circuit when flipped from one position to the other, the switch is defective. Replace the switch. Refer to the original equipment manufacturer (OEM) troubleshooting and repair manual.

Check for Short Circuit to Ground

Locate the switch. Disconnect the connectors and label the wires. Touch one of the multimeter probes to one of the switch terminals and touch the other multimeter to engine block ground. Move the switch from one position to the other.



The multimeter **must** show a value of 100k ohms or more (open circuit) with the switch in both positions. If the switch does not show an open circuit, the switch is defective. Replace the switch. Refer to the original equipment manufacturer (OEM) troubleshooting and repair manual.

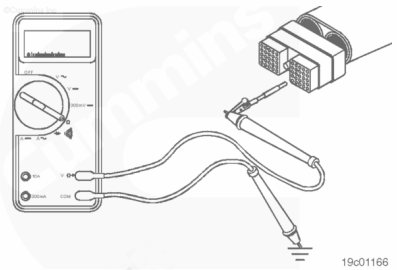
Last Modified: 27-Jan-2020

ANADOLU ISUZU AFTER SALES

Resistance Check

⚠ CAUTION ⚠

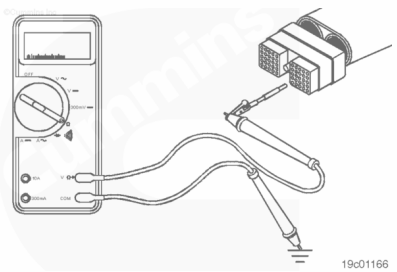
Proper leads and/or a Cummins® approved circuit testing tool must be used when working with electrical connectors to prevent pin expansion and damage to the connector.



If a recommended Cummins® electronic service tool or equivalent is available, monitor the switch for proper operation. If **not**, follow the following procedure.

Disconnect the original equipment manufacturer (OEM) harness connector from the electronic control module (ECM). Set the multimeter to measure resistance. Insert a test lead into the accelerator governor switch input pin of the OEM harness connector, and attach the alligator clip to a multimeter probe. Touch the other multimeter probe to engine block ground.

Transition the switch from one position to the other and measure the resistance at both positions. The multimeter **must** show a value of 100k ohms or more (open circuit) while the switch is in one position, and a value of 10 ohms or less (closed circuit) in the other position.



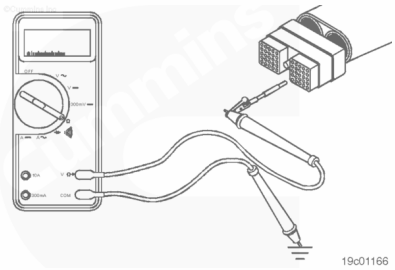
If the switch does **not** transition from an open to a closed circuit when flipped from one position to the other, there is an open circuit in the input wire. If the specification is correct, the circuit **must** still be checked for a short circuit to ground, a short circuit from pin-to-pin, and a short circuit to an external voltage source.

Check for Short Circuit to Ground

⚠ CAUTION ⚠

Proper leads and/or a Cummins® approved circuit testing tool must be used when working with electrical connectors to prevent pin expansion and damage to the

connector.

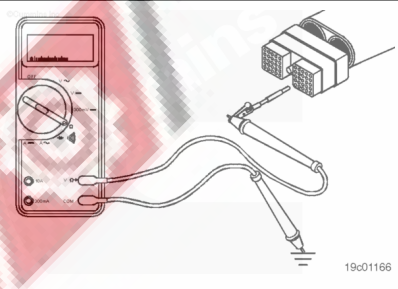


Disconnect the OEM harness connector from the ECM. Set the multimeter to measure resistance.

Insert a test lead into the accelerator governor switch input pin of the OEM harness connector, and attach the alligator clip to a multimeter probe.

Touch the other multimeter probe to engine block ground. Move the switch from its present position to the other position, and measure the resistance.

The multimeter **must** show a value of 100k ohms or more (open circuit).



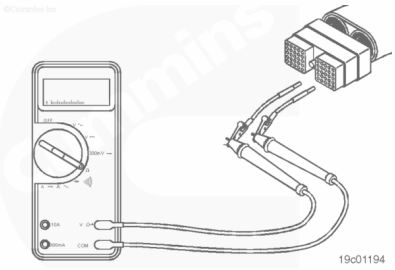
If the multimeter does **not** show an open circuit, there is a short circuit to ground in the circuit.

Repair or replace the OEM harness. Refer to Procedure 019-071 (/qs3/pubsys2/xml/en/procedures/99/99-019-071.html).

Check for Short Circuit from Pin-to-Pin

⚠ CAUTION ⚠

Proper leads and/or a Cummins® approved circuit testing tool must be used when working with electrical connectors to prevent pin expansion and damage to the connector.



Disconnect the OEM harness connector from the ECM. Set the multimeter to measure resistance.

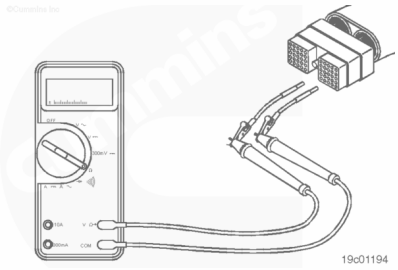
Insert a test lead into the accelerator governor switch input pin of the OEM harness connector, and attach the alligator clip to a multimeter probe.

Touch the other multimeter probe with attached test lead to all other pins in the connector. Measure the resistance.

The multimeter **must** show a value of 100k ohms or more (open circuit) at all pins.

If any circuit is **not** open, there is a short circuit between the input pin and the applicable pin.

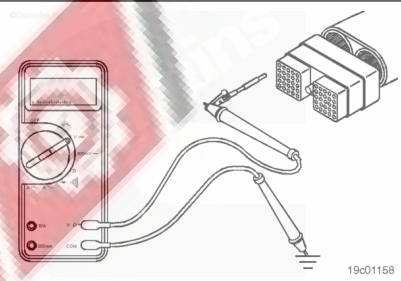
Repair or replace the OEM harness. Refer to Procedure 019-071 (/qs3/pubsys2/xml/en/procedures/99/99-019-071.html).



Check for Short Circuit to External Voltage Source

⚠ CAUTION ⚠

Proper leads and/or a Cummins® approved circuit testing tool must be used when working with electrical connectors to prevent pin expansion and damage to the connector.



Disconnect the OEM harness connector from the ECM. Set the multimeter to measure VDC. Turn the keyswitch to the ON position.

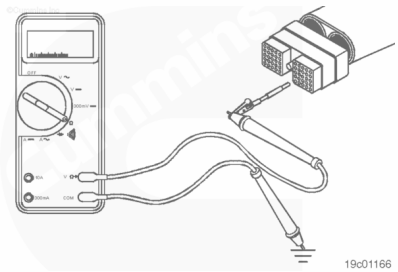
Insert a test lead into the accelerator governor switch input pin of the OEM harness connector, and attach the alligator clip to a multimeter probe.

Touch the other multimeter probe to engine block ground and measure the voltage.

The multimeter **must** show a value of 1.5 VDC or less.

If the voltage is more than 1.5 VDC, there is a short circuit to an external voltage source.

Remove the external voltage source.



ANADOLU ISUZU

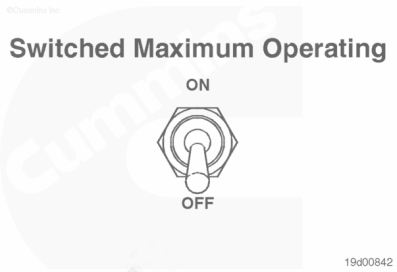
Last Modified: 27-Jan-2020


ANADOLU ISUZU
AFTER SALES

General Information

The maximum engine speed switch is an original equipment manufacturer (OEM) installed switch that allows a driver to select a lower, programmable maximum engine speed.

Certain applications, such as one that uses a hydraulic system, can possibly need to be protected from an overspeed condition. The operator can toggle this switch and limit the maximum engine rpm to a lower value in which the hydraulic system can safely operate.



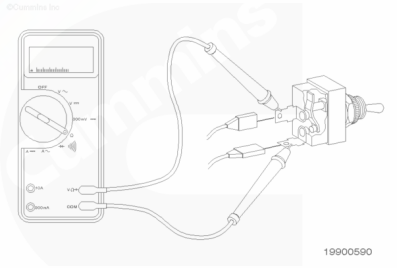
Resistance Check

If an electronic service tool is available, monitor the switched maximum operating switch for proper operation. If **not**, follow the troubleshooting procedures in this section.

Locate the maximum engine speed switch. Label the wires with the location on the switch or the wire number.

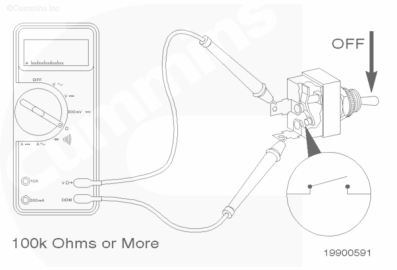
Remove the electrical connectors from the switch.

Set the multimeter to measure resistance. Touch the other multimeter probe to the other terminal of the switch.



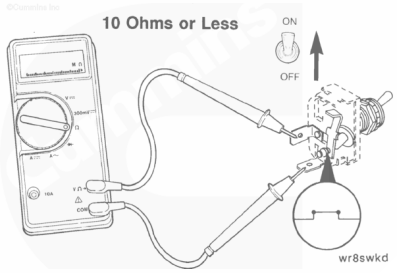
Place the switch in the OFF position and measure the resistance. The multimeter **must** show an open circuit (100k ohms or more).

If the circuit is **not** open, the switch is defective. Refer to the OEM troubleshooting and repair manual for replacement procedures.



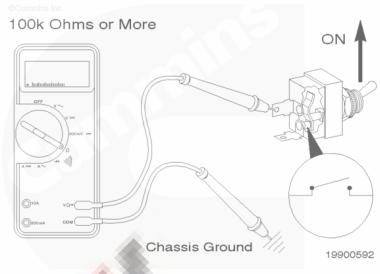
Place the switch in the ON and measure the resistance. The multimeter **must** show a closed circuit (10 ohms or less). If the circuit is **not** closed, the switch is defective. Refer to the OEM troubleshooting and repair manual for the replacement procedures.

If the resistance value is correct, the switch **must** still be checked for a short circuit to ground.



Check for Short Circuit to Ground

Touch one of the multimeter probes to one of the switch terminals. Touch the other probe to chassis ground. Move the switch to the normal position and measure the resistance. The multimeter **must** show an open circuit (100k ohms or more).



If the circuit is **not** open, the switch has failed. Refer to the OEM troubleshooting and repair manual for replacement procedures.

If the switch passes all of the previous checks, the circuit **must** be checked for an open circuit, a short circuit to ground, a short circuit from pin-to-pin, and a short circuit to an external voltage source.

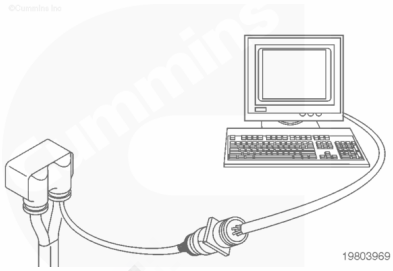
ANADOLU ISUZU AFTER SALES

Last Modified: 29-Jun-2015

Resistance Check

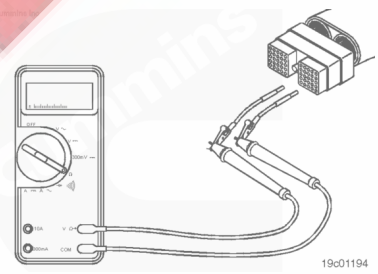
⚠ CAUTION ⚠

Proper leads and/or a Cummins approved circuit testing tool must be used when working with electrical connectors to prevent pin expansion and damage to the connector.



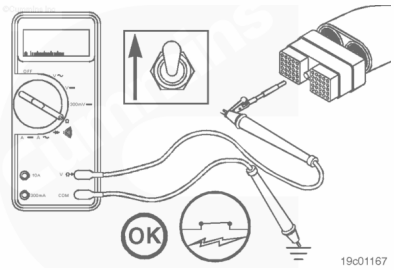
If electronic service tool is available, monitor the switched maximum operating speed switch circuit for proper operation. If **not**, follow the troubleshooting procedures in this section.

Disconnect the original equipment manufacturer (OEM) harness engine interface connector. To determine the location of the connector, see the corresponding engine wiring diagram. Set the multimeter to measure resistance.



Insert a test lead into the switched maximum operating speed switch return (-) pin of the OEM harness connector, and connect the alligator clip to the multimeter probe. Touch the other lead to the switched maximum operating speed switch input pin of the connector, and connect the alligator clip to the other multimeter probe.

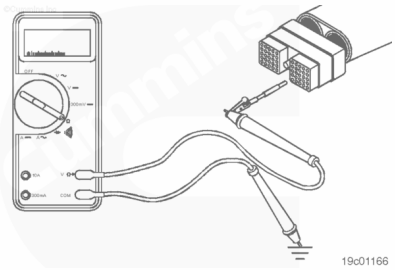
Move the switched maximum operating speed switch to the ON position. The multimeter **must** show 10 ohms or less (closed circuit). If the circuit is **not** closed, inspect both the return (-) wire and the input wire for an open circuit, provided that the switch has been previously checked.



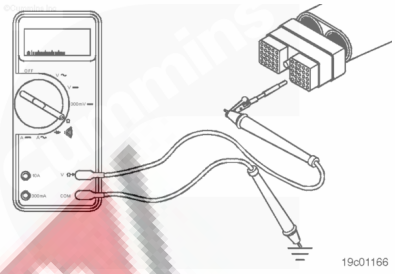
Refer to the OEM troubleshooting and repair manual. If the resistance is within specification, both the return (-) wire and the input wire **must** be checked for a short circuit to ground, a short circuit from pin-to-pin, and a short circuit to an external voltage source.

Check for Short Circuit to Ground

Isolate the switched maximum operating speed switch circuit.



Insert one of the test leads into the switched maximum operating speed switch return (-) pin of the OEM harness connector, and connect the alligator clip to the multimeter probe. Touch the other multimeter probe to the engine block, and measure the resistance.

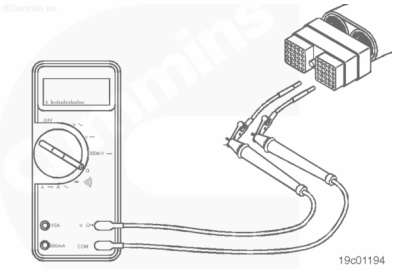


The multimeter **must** show 100k ohms or more (open circuit). If the circuit is **not** open, there is a short circuit to ground in the switched maximum operating speed switch circuit, provided that the switch has been previously checked.

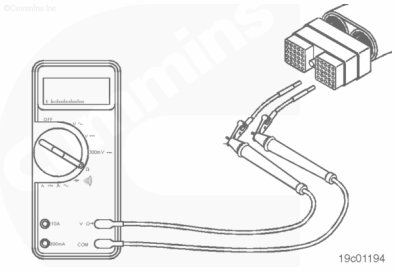
Repair or replace the wire connected to the return (-) pin according to the vehicle manufacturer's instructions.

Check for Short Circuit from Pin to Pin

Isolate the switched maximum operating speed switch circuit. Disconnect the OEM harness connector from the ECM. Set the multimeter to measure resistance.



Insert a test lead into the maximum operating speed switch input pin of the OEM harness connector. Insert the other test lead into the switch return pin of the connector. Connect the alligator clips to the multimeter probes.

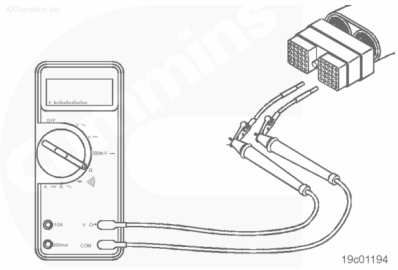


Measure the resistance.

The multimeter **must** show 100k ohms or more (open circuit).

ANADOLU ISUZU
OEM SALES

Remove the lead from the maximum operating speed switch return pin, and check all other pins.

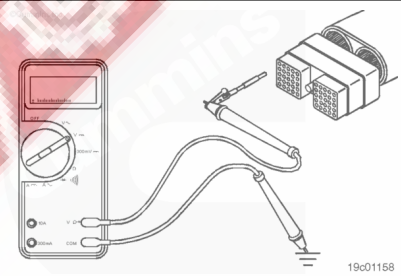


The multimeter **must** show 100k ohms or more (open circuit) at all pins. If the circuit is **not** open, there is a short circuit from the wire between the applicable pins that measured less than 100k ohms.

Repair or replace the wires in the OEM harness. Refer to Procedure 019-071 (/qs3/pubsys2/xml/en/procedures/99/99-019-071.html).

Check for Short Circuit to External Voltage Source

Note : An external voltage source is any wire in the OEM harness wiring that carries the voltage.

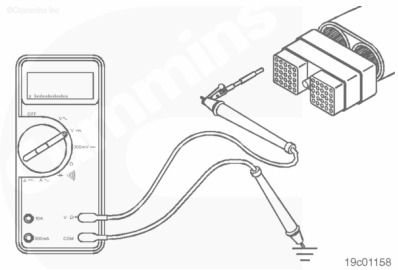


Set the switched maximum operating speed switch to normal. Disconnect the OEM harness connector from the ECM. Turn the vehicle keyswitch to the ON position. Set the multimeter to measure VDC.

Insert a test lead into the switched maximum operating speed switch input pin of the OEM harness connector. Connect the lead to the positive (+) multimeter probe.

Touch the negative (-) multimeter probe to the engine block ground, and measure the voltage. The voltage **must** be 1.5 VDC or less.

If the voltage value is more than 1.5 VDC, there is a short circuit between the wire connected to the switched maximum operating speed switch input pin and a wire carrying power in the OEM harness. Repair the OEM harness. Refer to Procedure 019-071 (/qs3/pubsys2/xml/en/procedures/99/99-019-071.html).



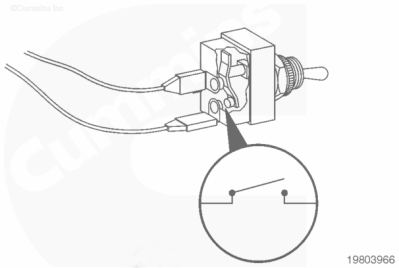
Connect all components after completing the repairs.

ANADOLU ISUZU PARTS


ANADOLU ISUZU
AFTER SALES

General Information

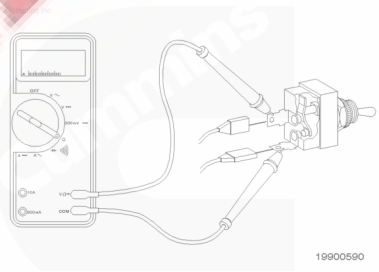
The Multiple Unit Synchronization feature allows two or more engines to be controlled by a single throttle input. One engine is configured as the primary engine, all other engines **must** be configured as secondary.



Resistance Check

If a recommended Cummins® electronic service tool or equivalent is available, monitor the switch for proper operation. If **not**, follow the troubleshooting procedures in this section.

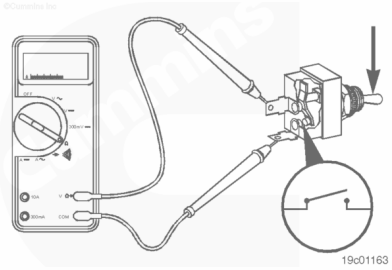
Locate the desired ON/OFF toggle switch. Remove and tag the two connectors from the terminals on the switch. Touch the multimeter probes to the terminals on the switch.



Move the switch to the OFF position and measure the resistance.

The multimeter **must** show an open circuit (100K ohms or more).

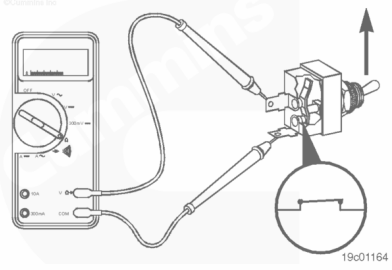
If the circuit is **not** open, the switch is damaged and **must** be replaced. Refer to the OEM troubleshooting and repair manual for the replacement procedures.



Move the switch to the ON position and measure the resistance.

The multimeter **must** show a closed circuit (10 ohms or less).

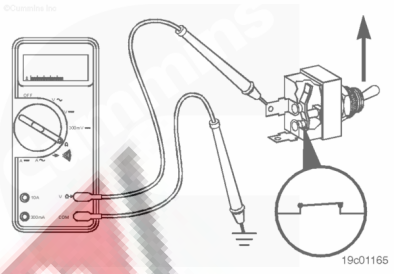
If the circuit is **not** closed, the switch is damaged and **must** be replaced. Refer to the OEM troubleshooting and repair manual for the replacement procedures.



If the resistance value is correct, the switch **must** still be checked for a short circuit to ground.

Check for Short Circuit to Ground

Touch one of the multimeter probes to one of the switch terminals. Touch the other probe to chassis ground. Move the switch to the ON position and measure the resistance.



The multimeter **must** show an open circuit (100K ohms or more).

If the circuit is **not** open, the switch is damaged and **must** be replaced. Refer to the OEM troubleshooting and repair manual for replacement procedures.

If the switch passes all of the previous checks, the circuit **must** be checked for an open circuit, a short circuit to ground, a short circuit from pin-to-pin, and a short circuit to an external voltage source.

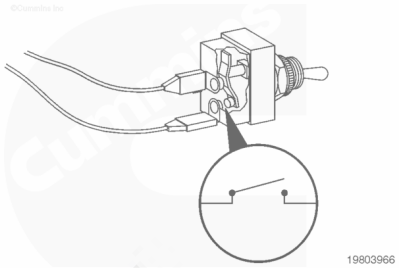
ANADOLU ISUZU AFTER SALES

Last Modified: 27-Jan-2020

General Information

This switch is used to enable the alternate torque curve feature and switch up to and between two derated torque curves.

Note : This switch can be a simple ON/OFF switch or an optional 3-position switch. Use the correct section for the particular switch on your application.

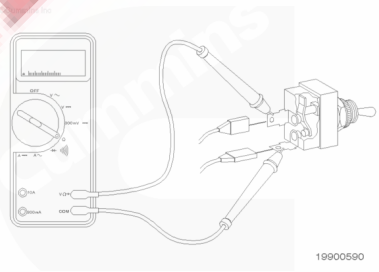


Resistance Check

ON/OFF Type of Switch

If a recommended Cummins® electronic service tool or equivalent is available, monitor the switch for proper operation. If **not**, follow the troubleshooting procedures in this section.

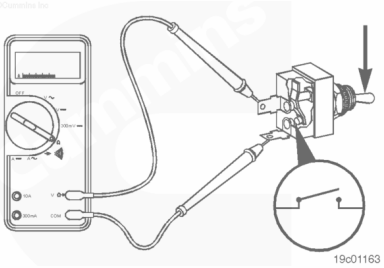
Locate the desired ON/OFF toggle switch. Remove and tag the two connectors from the terminals on the switch. Touch the multimeter probes to the terminals on the switch.



Move the switch to the OFF position and measure the resistance.

The multimeter **must** show an open circuit (100K ohms or more).

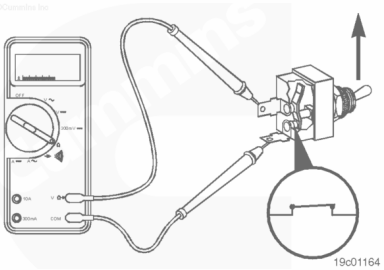
If the circuit is **not** open, the switch is damaged and **must** be replaced. Refer to the OEM troubleshooting and repair manual for the replacement procedures.



Move the switch to the ON position and measure the resistance.

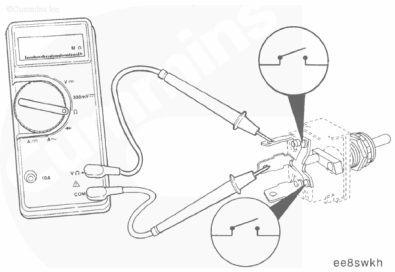
The multimeter **must** show a closed circuit (10 ohms or less).

If the circuit is **not** closed, the switch is damaged and **must** be replaced. Refer to the OEM troubleshooting and repair manual for the replacement procedures.



If the resistance value is correct, the switch **must** still be checked for a short circuit to ground.

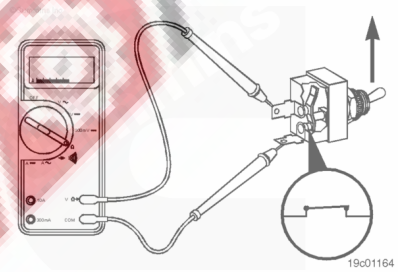
3-Position Type of Switch



Move the switch to the OFF position, and measure the resistance.

The multimeter **must** show an open circuit (100K ohms or more).

If the circuit is **not** open, the switch is damaged and **must** be replaced. Refer to the OEM troubleshooting and repair manual for the replacement instructions.

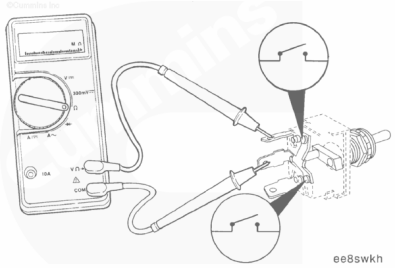


Move the switch to the ON position, and measure the resistance.

The multimeter **must** show a closed circuit (10 ohms or less).

If the circuit is **not** closed, the switch is damaged and **must** be replaced. Refer to the OEM troubleshooting and repair manual for the replacement instructions.

If the resistance value is correct, the switch **must** still be checked for a short circuit to ground.



Move the switch to the center position, and measure the resistance.

The multimeter **must** show 1000 to 2000 ohms.

If **not**, the switch is damaged and **must** be replaced. Refer to the OEM troubleshooting and repair manual for the replacement instructions.

If the resistance value is correct, the switch **must** still be checked for a short circuit to ground.

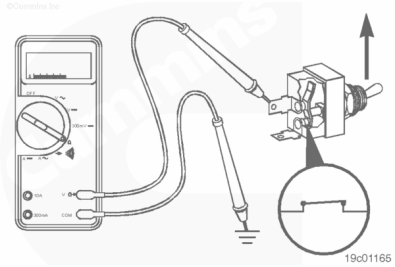
Preparatory Steps

Touch one of the multimeter probes to one of the switch terminals. Touch the other probe to chassis ground. Move the switch to the ON position and measure the resistance.

The multimeter **must** show an open circuit (100K ohms or more).

If the circuit is **not** open, the switch is damaged and **must** be replaced. Refer to the OEM troubleshooting and repair manual for replacement procedures.

If the switch passes all of the previous checks, the circuit **must** be checked for an open circuit, a short circuit to ground, a short circuit from pin-to-pin, and a short circuit to an external voltage source.



Last Modified: 27-Jan-2020

ANADOLU ISUZU AFTER SALES

Select Service Tools

Recommended Cummins® Service Tools

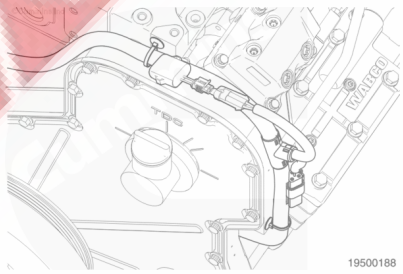
- Electrical contact cleaner, Part Number 3824510

Additional Service Items

- No additional service items required.

General Information

The real-time clock battery is connected to the engine harness main branch on top of the front gear cover.

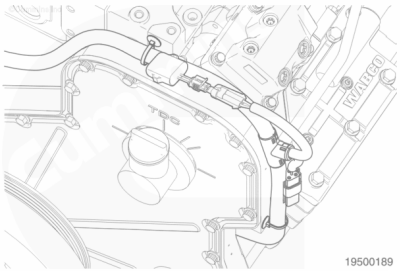


The engine control module (ECM) uses the real-time clock feature to time stamp faults and other data with the time and date. The battery is used to power the real-time clock circuitry in the ECM when vehicle battery power is removed from the ECM. If a battery is installed, the ECM clock will maintain the correct time and date with power removed from the ECM, provided the engine harness connector remains plugged into the ECM.

If a real-time clock battery is **not** installed on the engine, it will be necessary to set the time and date with INSITE™ electronic service tool whenever the real-time clock feature is enabled in the ECM and vehicle battery power is removed from the ECM.

Remove

Locate the real-time clock battery on the main engine harness. Cut the wire-tie securing the module case to the harness.

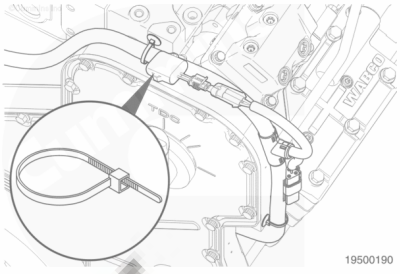


Clean the area around the battery harness connector.

Disconnect the battery from the engine harness.

Install

Use quick-dry electrical contact cleaner, Part Number 3824510, to clean all dirt and moisture from the battery and harness connector.



Do **not** apply grease or oil to either the harness connector or battery.

Connect the battery to the engine harness.

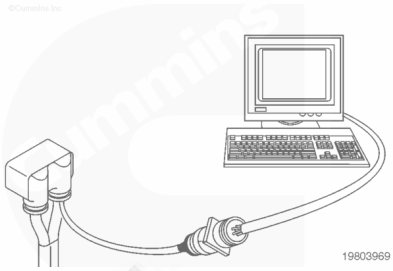
Secure the battery to the main engine harness using wire ties.

Last Modified: 10-Aug-2016

ANADOLU ISUZU AFTER SALES

General Information

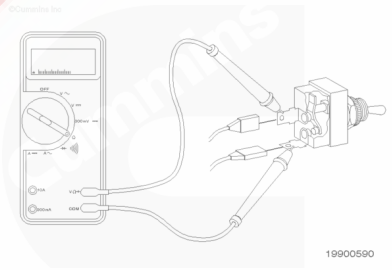
The engine protection override switch is an original equipment manufacturer (OEM) installed switch that allows a driver to abort a pending engine protection shutdown. The switch is **only** active when it is properly wired by the OEM and the engine protection shutdown override feature is enabled in the calibration. If the switch is **not** preventing a shutdown from occurring, check the feature with the electronic service tool to see if it is enabled in the calibration.



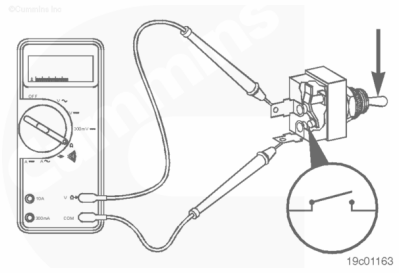
Resistance Check

If a recommended Cummins® electronic service tool or equivalent is available, monitor the engine protection override switch for proper operation. If **not**, follow the troubleshooting procedures in this section.

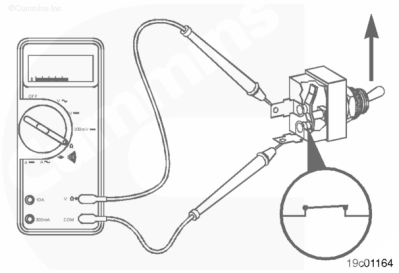
Locate the engine protection override switch. Label the wires with the location on the switch or the wire number. Remove the electrical connectors from the switch. Adjust the multimeter to measure resistance. Touch one multimeter probe to one of the terminals on the switch. Touch the other multimeter probe to the other terminal of the switch.



Place the switch in the non-override (released) position and measure the resistance. The multimeter **must** show an open circuit (100k ohms or more). If the circuit is **not** open, the switch is defective. Refer to the original equipment manufacturer (OEM) troubleshooting and repair manual for replacement procedures.



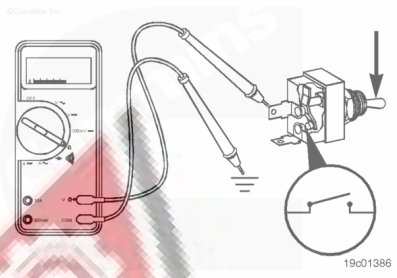
Place the switch in the override (pressed) position and measure the resistance. The multimeter **must** show a closed circuit (10 ohms or less). If the circuit is **not** closed, the switch is defective. Refer to the OEM troubleshooting and



repair manual for replacement procedures. If the resistance value is correct, the switch **must** still be checked for a short circuit to ground.

Check for Short Circuit to Ground

Touch one of the multimeter probes to one of the switch terminals. Touch the other probe to chassis ground. Move the switch to the non-override (released) position and measure the resistance. The multimeter **must** show an open circuit (100k ohms or more).



If the circuit is **not** open, the switch has failed. Refer to the OEM troubleshooting and repair manual for replacement procedures.

If the switch passes all of the previous checks, the circuit **must** be checked for an open circuit, a short circuit to ground, a short circuit from pin-to-pin, and a short circuit to an external voltage source.

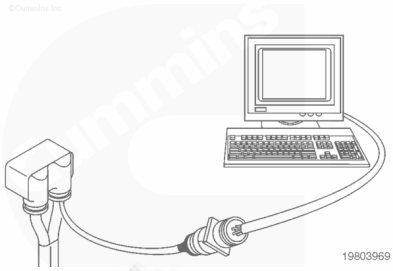
ANADOLU ISUZU AFTER SALES

Last Modified: 27-Jan-2020

Resistance Check

⚠ CAUTION ⚠

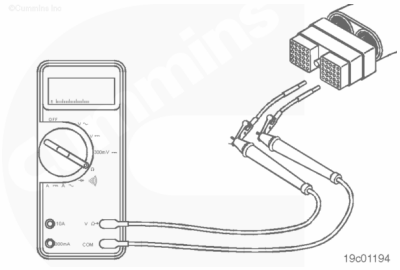
Proper leads and/or a Cummins® approved circuit testing tool must be used when working with electrical connectors to prevent pin expansion and damage to the connector.



If a recommended Cummins® electronic service tool or equivalent is available, monitor the engine protection override switch circuit for proper operation. If **not**, follow the troubleshooting procedures in this section.

Disconnect the original equipment manufacturer (OEM) harness connector from the electronic control module (ECM). Insert one of the test leads into the switch return negative (-) pin of the OEM harness connector and connect the alligator clip to the multimeter probe. Insert the other lead into the engine protection override switch signal pin of the OEM harness connector and connect the alligator clip to the other multimeter probe.

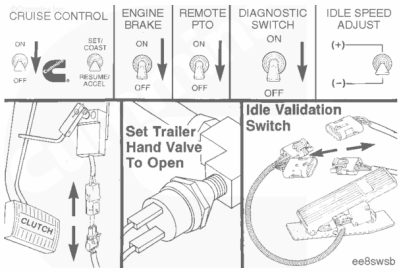
Move the engine protection override switch to the override (pressed) position. The multimeter **must** show a closed circuit (10 ohms or less). If the circuit is **not** closed, inspect the switch return negative (-) wire and the engine protection override switch wire for an open circuit, provided that the switch has been previously checked. Refer to the OEM troubleshooting and repair manual for repair procedures.



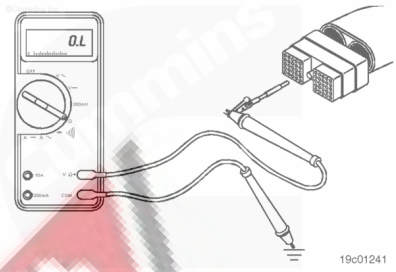
If the resistance is within the specification, the cab switch return negative (-) wire and the engine protection override switch wire **must** be checked for a short circuit to ground, a short circuit from pin-to-pin, and a short circuit to an external voltage source.

Check for Short Circuit to Ground

To isolate the engine protection override switch circuit when checking for an electrical short, disconnect the OEM harness from the ECM connector and the OEM harness from the engine protection override switch. Disconnect the idle validation switch. Set all cab panel switches to the OFF or neutral position. Set the service brake using the trailer brake hand valve.



Adjust the multimeter to measure resistance. Insert a test lead into the engine protection override switch pin of the OEM harness connector and connect it to a multimeter probe. Touch the other multimeter probe to the engine block ground. Measure the resistance.

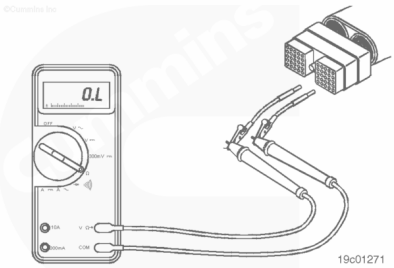


The multimeter **must** show an open circuit (100k ohms or more). If the circuit is **not** open, there is a short circuit to ground in the engine protection override switch circuit, provided that the switch has been previously checked.

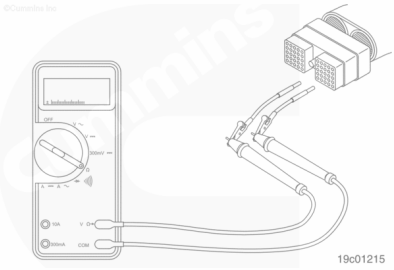
Repair or replace the wire connected to cruise control input wire in the OEM harness according to the vehicle manufacturer's procedure.

Check for Short Circuit from Pin-to-Pin

Check for a short circuit from pin-to-pin. Isolate the engine protection override circuit by setting the switches as in the previous section. Set the engine protection override switch to the override position. Insert the lead into the engine protection override switch pin. Connect the alligator clip to the multimeter. With the other lead inserted into the cab switch return negative (-) pin, measure the resistance. The multimeter **must** show an open circuit (100k ohms or more).

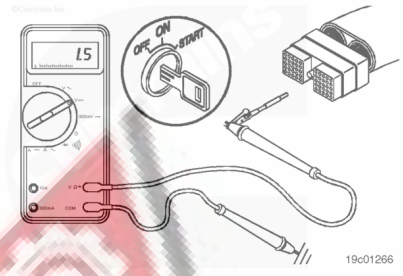


Remove the lead from the engine protection override switch pin and check all other pins. Measure the resistance. The multimeter **must** show an open circuit (100k ohms or more). If the circuit is **not** open, there is a short circuit between the engine protection override switch circuit and any pin that shows a closed circuit, provided the switch has previously been checked.



Repair or replace the wires in the OEM harness. Refer to Procedure 019-071 (/qs3/pubsys2/xml/en/procedures/99/99-019-071.html).

Check for Short Circuit to External Voltage Source



Turn the keyswitch to the ON position. Set the engine protection override switch to the override position. Adjust the multimeter to measure VDC. Insert a test lead into the engine protection override switch pin and attach it to a multimeter probe. Touch the other multimeter probe to the engine block ground. Measure the voltage. The voltage **must** be 1.5 VDC or less.

If the voltage is **not** correct, there is an external voltage source connected to the circuit, or there is a short circuit between the engine protection override switch circuit and a wire carrying power in the OEM harness. Remove the voltage source or repair the wiring in the OEM harness. Refer to Procedure 019-071 (/qs3/pubsys2/xml/en/procedures/99/99-019-071.html). Connect all components after completing the repair.

Note : If the engine protection override switch circuit was approved in all of the previous tests, it is functioning properly.

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Last Modified: 27-Jan-2020

General Information

The fan clutch switch allows the driver to control the operation of the engine's fan.

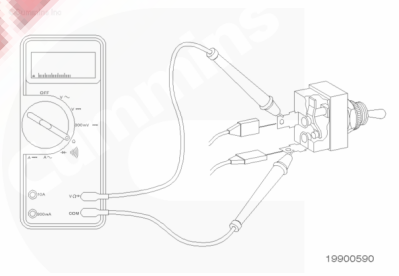


Resistance Check

If a recommended Cummins® electronic service tool or equivalent is available, monitor the fan clutch switch for proper operation. If **not**, follow the troubleshooting procedures in this section.

Locate the fan clutch switch. Remove and tag the two connectors from the terminals on the switch.

Touch the multimeter probes to the terminals on the switch.

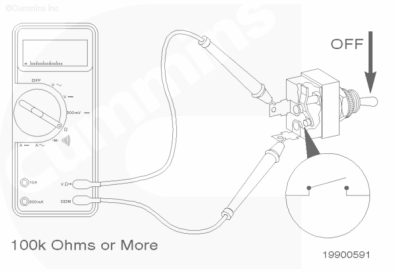


Move the switch to the OFF position, and measure the resistance.

The multimeter **must** show 100k ohms or more (open circuit).

If the circuit is **not** open, the switch has failed.

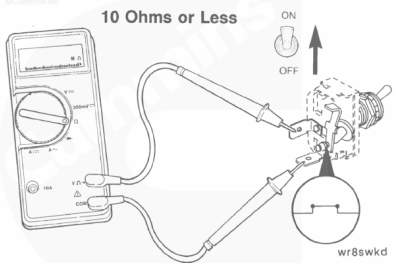
Replace the switch. Refer to the OEM troubleshooting and repair manual for the replacement instructions.



Move the switch to the ON position, and measure the resistance.

The multimeter **must** show 10 ohms or less (closed circuit).

If the circuit is **not** closed, the switch is damaged and **must** be replaced. Refer to the OEM repair manual for the replacement instructions.



If the resistance value is correct, the switch **must** still be checked for a short circuit to ground.

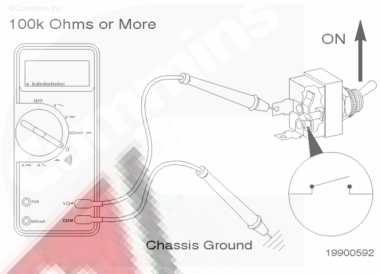
Check for Short Circuit to Ground

Touch one of the multimeter probes to one of the switch terminals. Touch the other probe to chassis ground.

Move the switch to the ON position, and measure the resistance.

The multimeter **must** show 100k ohms or more (open circuit).

If the circuit is **not** open, the switch is damaged and **must** be replaced. Refer to the OEM repair manual for replacement procedures.



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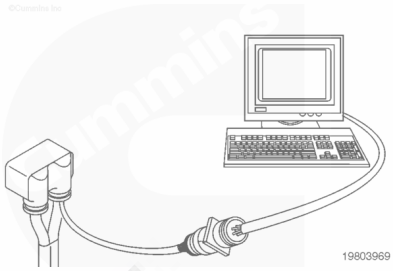
AFTER SALES

Last Modified: 27-Jan-2020

Resistance Check

⚠ CAUTION ⚠

Proper leads and/or a Cummins® approved circuit testing tool must be used when working with electrical connectors to prevent pin expansion and damage to the connector.



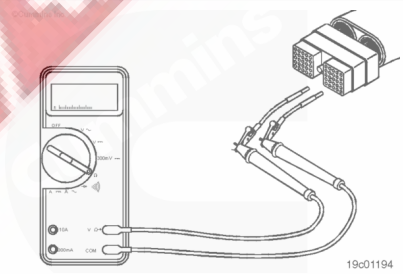
If a recommended Cummins® electronic service tool or equivalent is available, monitor the switch for proper operation. If **not**, follow the following procedure.

Disconnect the OEM harness connector from the ECM connector. Set the multimeter to measure resistance.

Insert a test lead into the manual fan clutch switch input pin of the OEM harness connector, and attach the alligator clip to a multimeter probe.

Insert the other lead attached to the multimeter probe to the switch return (-) pin of the OEM harness connector.

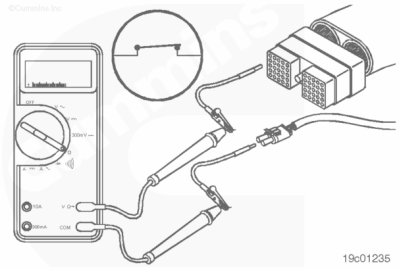
Set the manual fan clutch switch to the OFF position and measure the resistance.



The multimeter **must** show a value of 10 ohms or less (closed circuit).

If the specification is **not** correct, there is an open circuit in the return (-) wire or input wire, provided the switch has previously been checked.

If the resistance is within specification, the return (-) wire and switch wire **must** still be checked for a short circuit to ground, a short circuit from pin-to-pin, and a short circuit to an external voltage source.



Check for Short Circuit to Ground

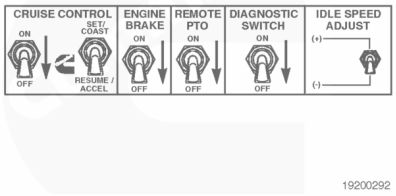
Disconnect the OEM harness connector from the ECM connector.

Disconnect the manual fan clutch switch from the OEM harness.

Disconnect the clutch switch and the idle validation switch.

Set all cab switches to the OFF or neutral position.

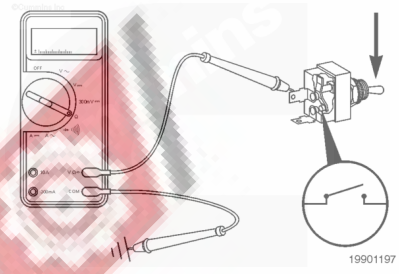
Set the service brake using the trailer brake hand valve. Set the multimeter to measure resistance.



19200292

Insert a test lead into the manual fan clutch switch input pin of the OEM harness connector, and attach the alligator clip to a multimeter probe.

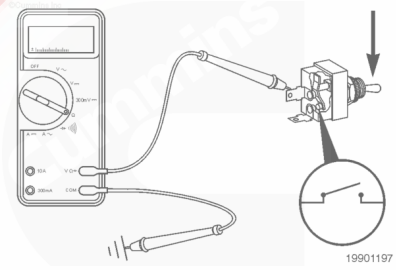
Touch the other multimeter probe to engine block ground and measure the resistance.


19901197

The multimeter **must** show a value of 100k ohms or more (open circuit).

If the circuit is **not** open, there is a short circuit to ground in the manual fan clutch circuit, provided the switch has been previously checked and is good.

Repair or replace the OEM harness. Refer to the OEM troubleshooting and repair manual.


19901197

Check for Short Circuit from Pin-to-Pin

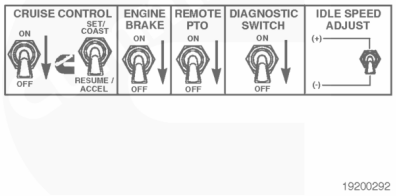
Disconnect the OEM harness connector from the ECM connector.

Disconnect the manual fan clutch switch from the OEM harness.

Disconnect the clutch switch and the idle validation switch.

Set all cab switches to the OFF or neutral position.

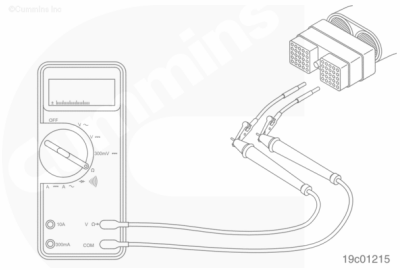
Set the service brake using the trailer brake hand valve. Set the multimeter to measure resistance.



19200292

Insert a test lead into the manual fan clutch switch input pin of the OEM harness connector, and attach the alligator clip to a multimeter probe.

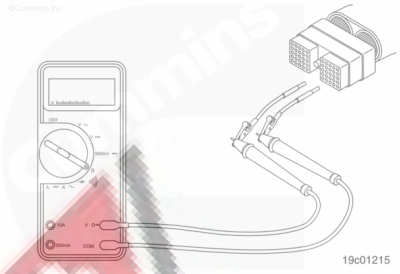
Touch the other multimeter probe with attached test lead to all other pins in the connector. Measure the resistance.



The multimeter **must** show a value of 100k ohms or more (open circuit) at all pins.

If any circuit is **not** open, there is a short circuit between the input pin and the applicable pin, provided the switch has been checked and is good.

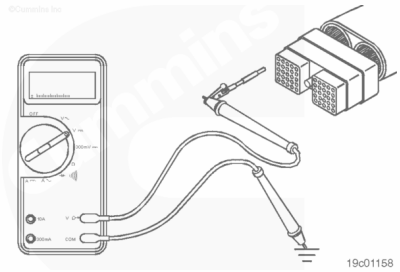
Repair or replace the OEM harness. Refer to the OEM troubleshooting and repair manual.



Check for Short Circuit to External Voltage Source

⚠ CAUTION ⚠

Proper leads and/or a Cummins® approved circuit testing tool must be used when working with electrical connectors to prevent pin expansion and damage to the connector.



Disconnect the OEM harness connector from the ECM connector. Set the multimeter to measure VDC. Turn the keyswitch to the ON position.

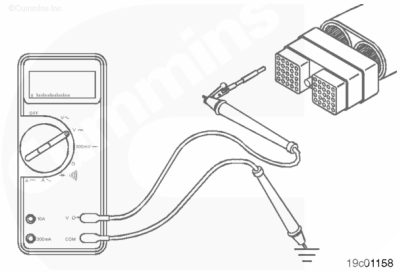
Insert a test lead into the manual fan clutch switch input pin of the OEM harness connector, and attach the alligator clip to a multimeter probe.

Touch the other multimeter probe to engine block ground and measure the voltage.

The multimeter **must** show a value of 1.5-VDC or less.

If the voltage is more than 1.5-VDC, there is a short circuit to an external voltage source.

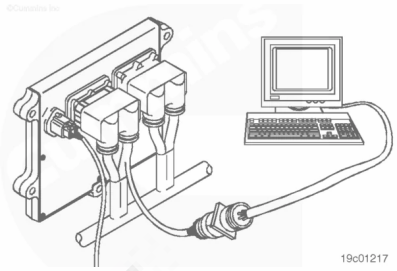
Remove the external voltage source.



Last Modified: 27-Jan-2020

General Information

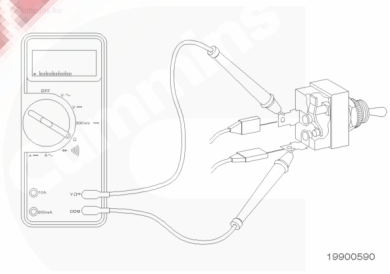
The remote accelerator switch enables and disables the remote accelerator feature. When enabled, the remote accelerator feature allows an operator to control the fueling of the engine from a remote location. Often, the remote accelerator switch is located on a remote panel very close to the remote accelerator sensor.



Resistance Check

If an electronic service tool is available, monitor the switch for proper operation. If an electronic service tool is **not** available, follow the troubleshooting procedures in this section.

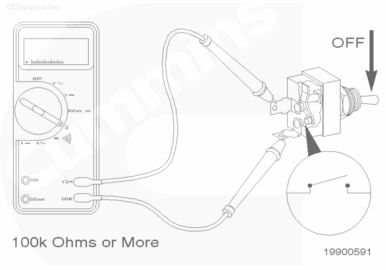
Locate the remote accelerator switch. Remove and tag the two connectors from the terminals on the switch.



Touch the multimeter probes to the terminals on the switch.

Move the switch to the OFF position and measure the resistance. The multimeter **must** show an open circuit (100K ohms or more).

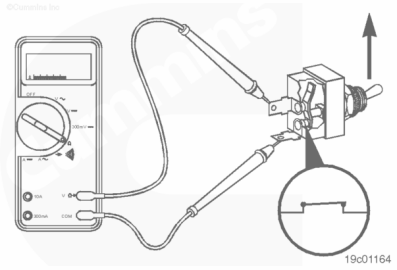
If the circuit is **not** open, the switch has failed. Refer to the OEM troubleshooting and repair manual for the replacement procedures.



Move the switch to the ON position and measure the resistance. The multimeter **must** show a closed circuit (10 ohms or less).

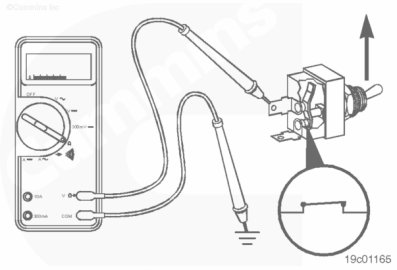
If the circuit is **not** closed, the switch has failed. Refer to the OEM troubleshooting and repair manual for replacement procedures.

If the resistance value is correct, the switch **must** still be checked for a short circuit to ground.



Check for Short Circuit to Ground

Touch one of the multimeter probes to one of the switch terminals. Touch the other probe to chassis ground. Move the switch to the ON position and measure the resistance. The multimeter **must** show an open circuit (100K ohms or more). If the circuit is **not** open, the switch has failed. Refer to the OEM troubleshooting and repair manual for replacement procedures.



If the switch passes all of the previous checks, the circuit **must** be checked for an open circuit, a short circuit to ground, a short circuit from pin to pin and a short circuit to an external voltage source.

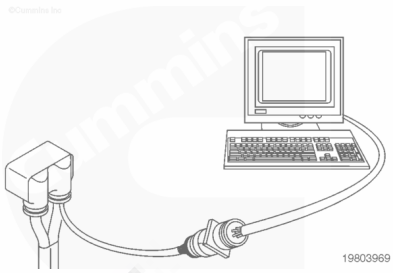
ANADOLU ISUZU
AFTER SALES

Last Modified: 29-Jun-2015

Resistance Check

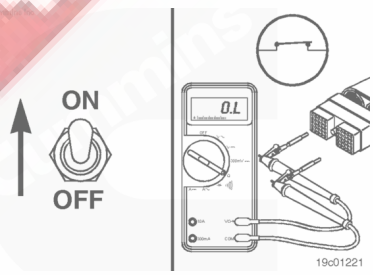
⚠ CAUTION ⚠

Proper leads and/or a Cummins® approved circuit testing tool must be used when working with electrical connectors to prevent pin expansion and damage to the connector.



If electronic service tool is available, monitor the switch circuit for proper operation. If **not**, follow the troubleshooting procedures in this section.

Disconnect the original equipment manufacturer (OEM) harness engine interface connector. To determine the location of the connector, see the corresponding engine wiring diagram.



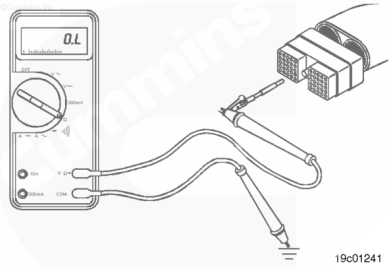
Insert a test lead into the remote accelerator switch signal of the OEM harness connector and attach it to the multimeter probe. Touch the other probe to engine block ground. Move the remote accelerator switch to the ON position. The multimeter **must** show a closed circuit (10 ohms or less).

If the circuit is **not** closed, inspect the remote accelerator switch signal line wire for an open circuit. Refer to the OEM troubleshooting and repair manual.

If the resistance is within specification, the remote accelerator switch signal wire **must** be checked for short circuit to ground, short circuit from pin-to-pin, and a short circuit to an external voltage source.

Check for Short Circuit to Ground

To isolate the remote accelerator switch circuit when checking for a short circuit, disconnect the OEM harness connector from the ECM and the OEM harness from the remote accelerator switch.



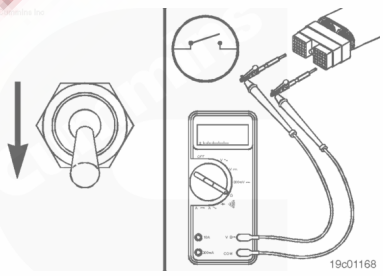
Adjust the multimeter to measure resistance. Insert a test lead into the remote accelerator switch signal wire of the OEM harness connector and attach it to a multimeter probe. Touch the other multimeter probe to engine block ground. Measure the resistance.

The multimeter **must** show an open circuit (100K ohms or more). If the circuit is **not** open, there is a short circuit to ground in the remote accelerator switch circuit, provided the switch has already been checked.

Repair or replace the wire connected to the remote accelerator switch signal. Refer to the OEM troubleshooting and repair manual.

Check for Short Circuit from Pin to Pin

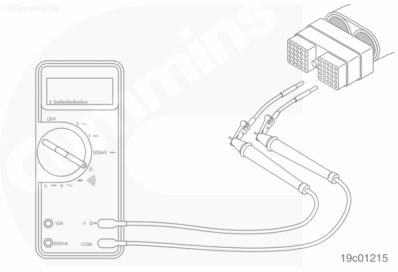
Turn the remote accelerator switch to the OFF position. Insert a test lead into the remote accelerator switch signal wire at the OEM harness connector.



Connect the multimeter probe to the test lead. Insert the other multimeter probe with a test lead attached into the switch return wires within the OEM harness connector. Measure the resistance.

The multimeter **must** show an open circuit (100K ohms or more).

Remove the test lead from the remote accelerator switch signal wire and check all other pins. The multimeter **must** show an open circuit (100K ohms or more).

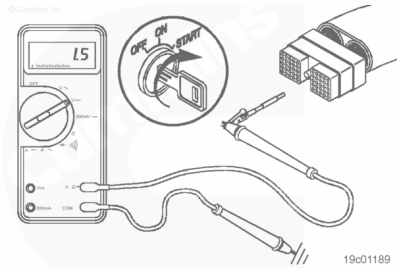


If the circuit is **not** open, there is a short circuit between the remote accelerator switch signal pin and any other pin that shows a closed circuit, provided the switch has previously been checked.

Repair or replace the wires in the OEM harness. Refer to Procedure 019-071 (/qs3/pubsys2/xml/en/procedures/99/99-019-071.html).

Check for Short Circuit to External Voltage Source

Turn the vehicle keyswitch to the ON position. Set the remote accelerator switch to the ON position. Set the multimeter to measure VDC. Insert a test lead into the remote accelerator switch signal wire and attach it to a multimeter probe. Touch the other multimeter probe to engine block ground. Measure the voltage, the voltage **must** be 1.5 volts or less.



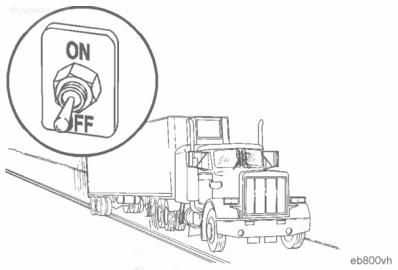
If the voltage is **not** correct, there is an external voltage source connected to the circuit, or there is a short circuit between the remote accelerator switch circuit and a wire carrying power in the OEM harness. Repair or replace the OEM harness. Refer to Procedure 019-071 (/qs3/pubsys2/xml/en/procedures/99/99-019-071.html).

ANADOLU ISUZU
AFTER SALES

Last Modified: 25-Jun-2015

General Information

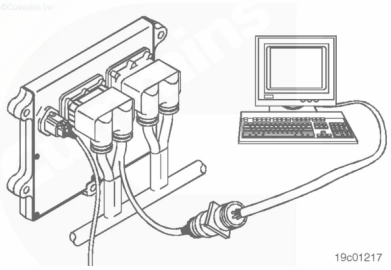
The engine torque limit switch allows the operator to switch to a different torque output limit by the engine. This is desirable in applications where auxiliary equipment can **not** handle full engine torque.



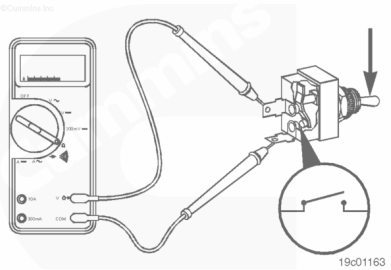
Activating this switch protects the equipment by limiting the maximum output torque of the engine. This maximum torque value can be entered through the electronic service tool under the powertrain protection feature.

Resistance Check

If a recommended Cummins® electronic service tool or equivalent is available, monitor the engine torque limit switch for proper operation. If **not**, follow the troubleshooting procedures in this section.



Locate the engine torque limit switch. Label the wires with the location of the switch or the wire number. Remove the electrical connectors from the switch. Adjust the multimeter to measure resistance. Touch one multimeter probe to one of the terminals on the switch. Touch the other multimeter probe to the other terminal of the switch.

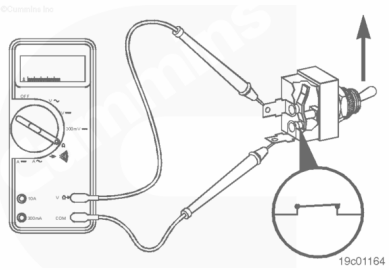


Note : The torque limit switch is programmable by the OEM. The open or closed position of the switch can represent “Normal” or “Torque Limit” depending on how the OEM programs the switch. Before continuing troubleshooting refer to the OEM literature to determine how the switch is programmed and apply the “switch failed” criteria accordingly when performing the troubleshooting.

Place the switch in the torque limit position and measure the resistance. The multimeter **must** show an open circuit (100K ohms or more). If the circuit is **not** open, the switch has

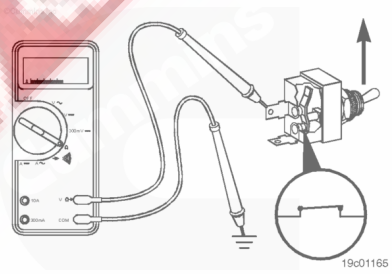
failed. Refer to the OEM troubleshooting and repair manual for replacement procedures.

Place the switch in the normal position and measure the resistance. The multimeter **must** show a closed circuit (10 ohms or less). If the circuit is **not** closed, the switch has failed. Refer to the OEM troubleshooting and repair manual for replacement procedures. If the resistance value is correct, the switch **must** still be checked for a short circuit to ground.



Check for Short Circuit to Ground

Touch one of the multimeter probes to one of the switch terminals. Touch the other probe to chassis ground. Move the switch to the normal position and measure the resistance. The multimeter **must** show an open circuit (100K ohms or more). If the circuit is **not** open, the switch has failed. Refer to the OEM troubleshooting and repair manual for replacement procedures. If the switch passes all of the previous checks, the circuit **must** be checked for an open circuit, a short circuit to ground, a short circuit from pin to pin, and a short circuit to an external voltage source.



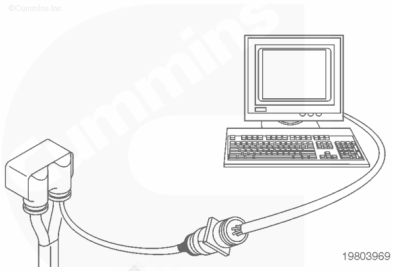
ANADOLU ISUZU PARTS

Last Modified: 27-Jan-2020

Resistance Check

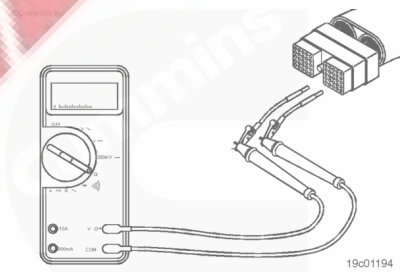
⚠ CAUTION ⚠

Proper leads and/or a Cummins® approved circuit testing tool must be used when working with electrical connectors to prevent pin expansion and damage to the connector.



If a recommended Cummins® electronic service tool or equivalent is available, monitor the engine torque limit switch circuit for proper operation. If **not**, follow the troubleshooting procedures in this section.

Disconnect the original equipment manufacturer (OEM) harness connector from the electronic control module (ECM). Insert one of the test leads into the switch return pin of the OEM harness connector and connect the alligator clip to the multimeter probe. Insert the other lead into the engine torque limit signal pin of the OEM harness connector and connect the alligator clip to the other multimeter probe.

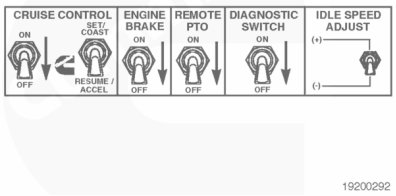


Note : The torque limit switch is programmable by the OEM. The open or closed position of the switch can represent “Normal” or “Torque Limit” depending on how the OEM programs the switch. Before continuing to troubleshoot refer to the OEM troubleshooting and repair manual to determine how the switch is programmed and apply the defective switch criteria accordingly when performing the troubleshooting.

Move the torque limit switch to the normal position. The multimeter **must** show a closed circuit (10 ohms or less). If the circuit is **not** closed, inspect the switch return wire and the engine torque limit signal wire for an open circuit, provided that the switch has been previously checked. Refer to the OEM troubleshooting and repair manual for repair procedures. If the resistance is within the specification, the switch return wire and the engine torque limit signal wire **must** be checked for a short circuit to ground, a short circuit from pin-to-pin, and a short circuit to an external voltage source.

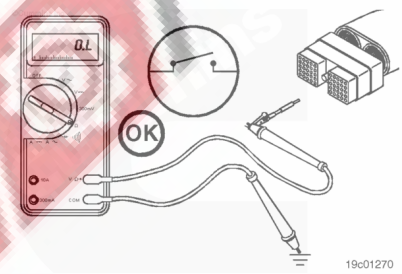
Check for Short Circuit to Ground

To isolate the engine torque limit switch circuit when checking for an electrical short, disconnect the OEM harness from the ECM and the OEM harness from the engine torque limit switch. Disconnect the clutch pedal position switch/engine protection override switch and the accelerator pedal assembly. Set all cab panel switches to the OFF or neutral position. Set the service brake using the trailer brake hand valve.



19200292

Adjust the multimeter to measure resistance. Insert a test lead into the engine torque limit switch pin of the OEM harness connector and connect it to a multimeter probe. Touch the other multimeter probe to the engine block ground.



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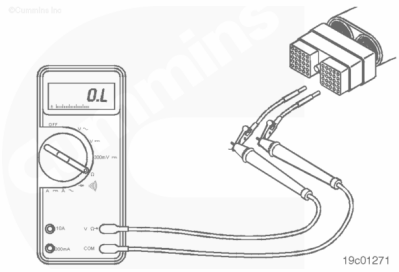
Measure the resistance. The multimeter **must** show an open circuit (100K ohms or more). If the circuit is **not** open, there is a short circuit to ground in the engine torque limit switch circuit, provided that the switch has been previously checked.

Repair or replace the wire connected to the engine torque limit control switch signal wire in the OEM harness. Refer to the OEM troubleshooting and repair manual.

Check for Short Circuit from Pin-to-Pin

Isolate the engine torque limit switch circuit by setting the switches as in the previous section. Set the engine torque limit switch to the normal position. Insert the lead into the engine torque limit switch signal pin. Connect the alligator clip to the multimeter. With the other lead inserted into the switch return pin, measure the resistance. The multimeter **must** show an open circuit (100K ohms or more).


19c01271

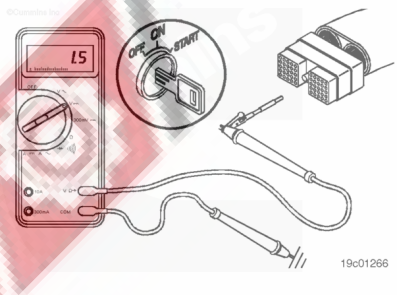
Remove the lead from the engine torque limit switch pin and check all other pins. Measure the resistance. The multimeter **must** show an open circuit (100K ohms or more). If the circuit is **not** open, there is a short circuit between the

engine torque limit switch circuit and any pin that shows a closed circuit, provided the switch has previously been checked.

Repair or replace the wires in the OEM harness. Refer to Procedure 019-071 (/qs3/pubsys2/xml/en/procedures/99/99-019-071.html).

Check for Short Circuit to External Voltage Source

Turn the keyswitch to the ON position. Set the engine torque limit switch to the normal position. Adjust the multimeter to measure VDC. Insert a test lead into the engine torque limit switch signal pin and attach it to a multimeter probe. Touch the other multimeter probe to the engine block ground. Measure the voltage. The voltage **must** be 1.5 VDC or less.



If the voltage is **not** correct, there is an external voltage source connected to the circuit, or there is a short circuit between the engine torque limit switch circuit and a wire carrying power in the OEM harness. Remove the voltage source or repair the wiring in the OEM harness according to the vehicle manufacturer's procedures.

Connect all components after completing the repair.

Note : If the engine torque limit switch circuit was approved in all of the previous tests, it is functioning correctly.

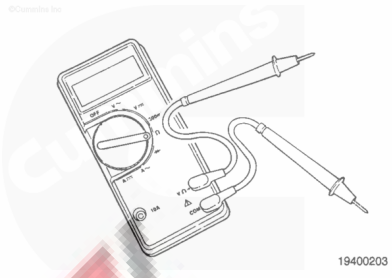
ANADOLU ISUZU

Last Modified: 27-Jan-2020

General Information

How to Use a Multimeter

On most meters, the negative (-), (black) meter probe **must** be plugged into the COM position and the positive (+), (red) meter probe **must** be plugged into one of the positions marked for amperage, resistance, or voltage. Refer to the manufacturer's procedures for more detail.



Note : When measuring to a block or chassis ground, use a clean, unpainted metal surface to make sure a good measurement exists.

Use of Special Test Leads

⚠ CAUTION ⚠

To reduce the possibility of pin and harness damage, use the appropriate test lead for the connector. Refer to the Service Tools listing or the appropriate wiring repair kit for this control system.

Refer to the appropriate wiring repair kit for specific test leads used on this application.

How to Measure Amperage

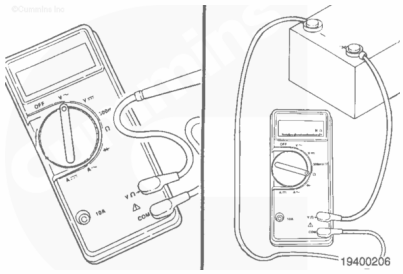
Make an open circuit at the place where the current is to be measured.

Select the AC current (A ˜) or DC current (A-) function on the meter.

Turn on the power in the circuit being measured.

Put the probes of the meter across the open circuit to measure the amperage.

Read the displayed measurement.



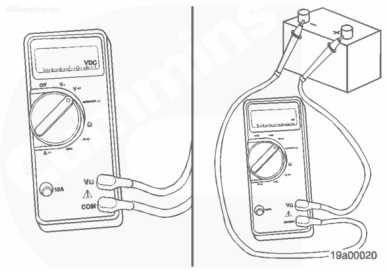
How to Measure Voltage

Select the AC voltage (V ˜) or DC voltage (V-) function on the meter.

Turn on the power in the circuit being measured.

Touch the positive (+) probe of the multimeter to the terminal or pin that is being measured for voltage. Touch the other probe to a clean, unpainted metal surface that is connected to battery ground or to the negative (-) post of the battery.

Read the displayed measurement.



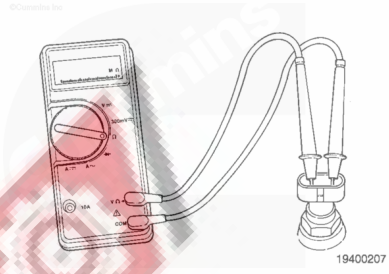
How to Measure Resistance

Select the resistance function on the meter.

Verify that there is no power to the components being tested.

Disconnect both ends of the circuit or component to be measured. Touch one probe to one end of the circuit or component terminal. Touch the other probe to the other end of the circuit or the other component terminal.

Read the displayed measurement.



How to Find the Internal Resistance of the Meter

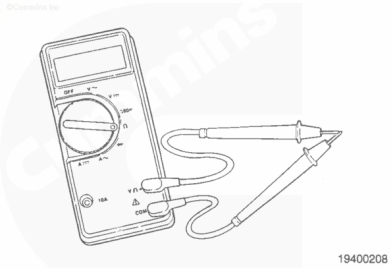
It is important to know the internal resistance of the meter when measuring small resistances. To measure small resistances accurately, the internal resistance of the meter **must** be subtracted from the measured resistance.

Turn the meter ON.

Set the meter to the lowest ohm scale.

Measure the resistance of the meter by touching the test probes together and reading the resistance value (including special test leads, if they are being used).

ZERO the meter or subtract this value when taking measurements.

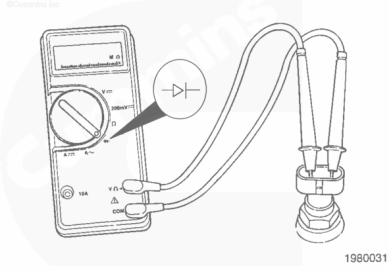


How to Test for Continuity

Select the continuity function on the meter (usually marked with a diode symbol).

Make sure there is no power to the component being measured.

Disconnect both ends of the circuit or component to be measured. Touch one probe to one end of the circuit or component terminal. Touch the other probe to the other end of the circuit or the other component terminal.



Read the displayed measurement.

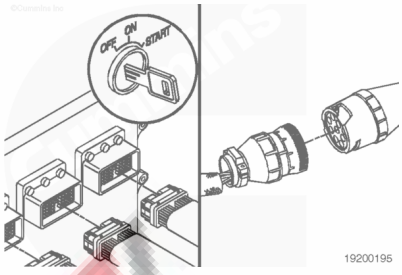
The meter will beep if the resistance is less than about 150 ohms. If there is an open circuit, the meter does **not** beep.

Short Circuit to Ground - Check

Short circuit to ground is a condition where a connection from a circuit to ground exists when it is **not** intended.

The procedure for checking for a short circuit to ground is as follows:

- Turn keyswitch OFF.
- Disconnect the connectors that are to be tested.



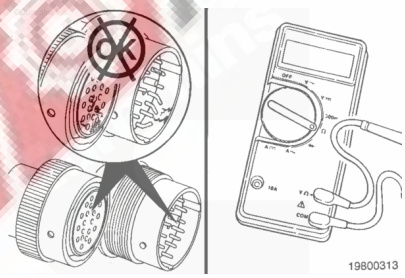
When testing a sensor, **only** the sensor connection is required to be disconnected.

When testing a harness, the harness connector at the electronic control unit and the connector at the sensor or multiple sensors should be disconnected.

Identify the pins that need to be tested.

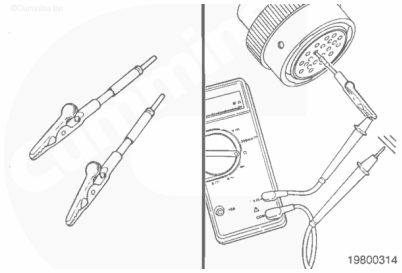
Inspect the connector pins. 019-361.

Adjust the multimeter to measure resistance.



⚠ CAUTION ⚠

To reduce the possibility of pin and harness damage, use the appropriate test lead for the connector. Refer to the Service Tools listing or the appropriate wiring repair kit for this control system.



Touch one of the multimeter probes to the correct pin to be tested.

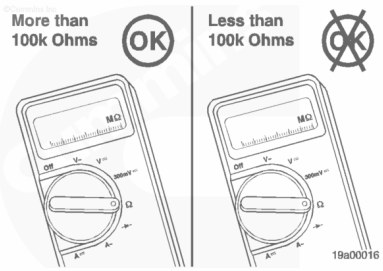
Touch the other probe of the multimeter to a clean, unpainted surface on the engine block or chassis ground.

Read the value on the multimeter display.

The multimeter **must** read greater than 100k ohms, which is an open circuit.

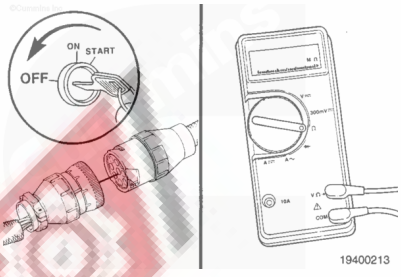
If the circuit is **not** open, the wire being checked has a short circuit to ground, engine block or chassis ground.

Repair or replace the component or wire.



Short Circuit from Pin to Pin - Check

Short circuit from pin to pin is a condition in which an electrical path exists between two pins where it is **not** intended to exist.

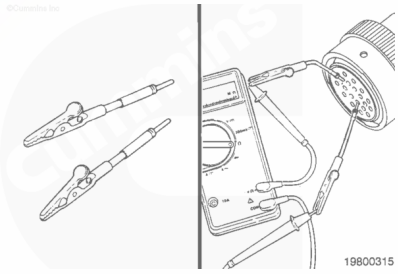


The procedure for checking short circuit from pin to pin is as follows:

1. Turn keyswitch OFF.
2. Disconnect the connector that is to be tested.
3. Identify the pins that are to be tested.
4. Adjust the multimeter to measure resistance.

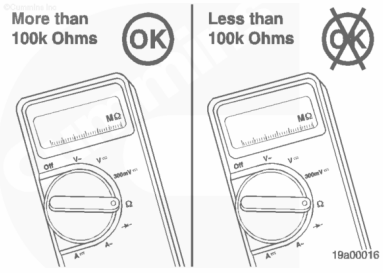
⚠ CAUTION ⚠

To reduce the possibility of pin and harness damage, use the appropriate test lead for the connector. Refer to the Service Tools listing or the appropriate wiring repair kit for this control system.



1. Touch one of the multimeter probes to the correct pin to be tested on the harness side of the connector.
2. Touch the other probe of the multimeter to all other pins on the harness side of the connector.

1. Read the value on the multimeter display.
2. The multimeter **must** read greater than 100k ohms, which is an open circuit.
3. If the circuit is **not** open, the pins being checked are electrically connected.

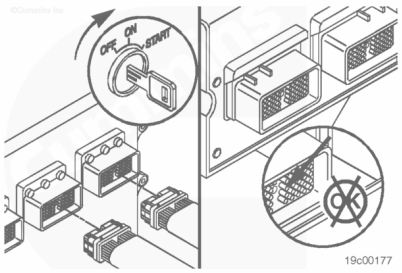


Note : Refer to the wiring diagram to verify that the wires in question are **not** supposed to be connected.

1. Inspect the harness connectors for moisture that can be the cause of an inappropriate electrical connection.
2. Repair or replace the harness.

Voltage Checking

Voltage check is a procedure to measure the difference in voltage potential between two points.

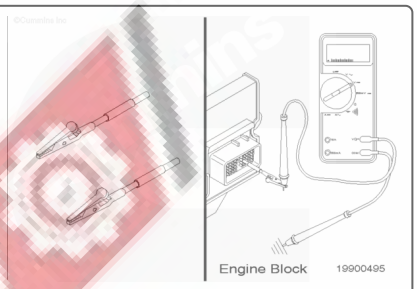


The procedure for checking voltage is as follows:

1. Disconnect the connectors that are to be tested.
2. Turn keyswitch ON.
3. Identify the pins that are to be tested.
4. Adjust the multimeter to AC voltage (V ˜) or DC voltage (V-).

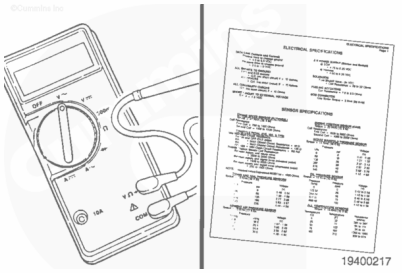
⚠ CAUTION ⚠

To reduce the possibility of pin and harness damage, use the appropriate test lead for the connector. Refer to the Service Tools listing or the appropriate wiring repair kit for this control system.



1. Touch one of the multimeter test probes to the correct lead to be tested.
2. Touch the other multimeter probe to a clean, unpainted surface on the engine block, chassis ground or to the appropriate return pin.

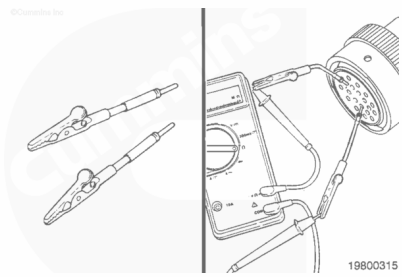
1. Read the value on the multimeter display. Compare the measured value to the range of voltage given in the specifications.
2. If the measured value falls outside of the specified range, check the repair procedure for the electrical system that is being checked for the appropriate action.



Circuit Load Test

⚠ CAUTION ⚠

To reduce the possibility of pin and wiring harness damage, always use the appropriate test lead for the connector. Reference Service Tools listing or the appropriate wiring harness repair kit.



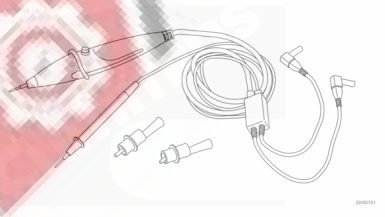
⚠ CAUTION ⚠

Never insert test leads into ECM connector terminals. Connector terminals can spread and cause intermittent electrical connections.

Circuit load testing is a procedure to measure the amount of voltage loss that occurs in a circuit caused by high circuit resistance. Perform this test with Cummins® service tool, Part Number **5394709**, circuit load test leads or equivalent, or with a 12 VDC H6024 or H6054 headlight or equivalent.

Use electrical circuit tester, to help identify terminal number locations. See corresponding wiring diagram for circuit terminal locations.

Circuit load test with Cummins® service tool, Part Number 5394709, or equivalent.



Initial Set-up

Remove multimeter test leads and install Cummins® service tool, Part Number **5394709**, circuit load test leads or equivalent. Connect connector test leads to connector pins and connect alligator clips to multimeter probe.

Never use circuit load test lead positive red (+) probe in RETURN pin of circuit as this can energize a component switched in ground.

Measurement

The procedure for performing circuit load testing is as follows:

1. Disconnect load component (sensor or actuator) from wiring harness connector.
2. Disconnect ECM power harness connector from ECM.
3. Using appropriate test leads, connect external 12/24 VDC battery positive to one end of the wire to be tested.
4. Connect battery negative to a clean, unpainted surface on engine cylinder block or chassis ground.
5. Connect circuit load tester positive red (+) probe at other end of wire to be tested.
6. Connect negative circuit load tester lead to a clean, unpainted surface on engine cylinder block or chassis ground.
7. Adjust multimeter to DC voltage (V-).
8. If voltage is within + 1 volt of battery voltage, proceed to step 10.
9. If voltage is **not** within + 1 volt of battery, perform open circuit checks.

10. Depress circuit load tester probe button for maximum of 5 to 8 seconds. Record voltage drop.
11. Repeat steps 3, 4, 5, 6, 7, 8 and 9 for all pins at sensor, or actuator connector.
12. If voltage drops, there is high resistance in wiring circuit.

Specification

Maximum allowable voltage drop	Less than 0.8 VDC per wire

If high resistance is found in circuit. See corresponding Service Manual. Reference 019-360 in Section 19.

Circuit load test with a 12 VDC H6024 or H6054 or equivalent headlight

Initial Set-up

The procedure for performing circuit load testing is as follows:

1. Disconnect load component (sensor or actuator) from engine harness connector.
2. Disconnect ECM power harness connector from ECM.
3. Using appropriate test leads, connect external 12 VDC battery positive to one end of the wire to be tested.
4. Connect battery negative to a clean, unpainted surface on the engine block or chassis ground.
5. Connect headlight at the opposite end of the wire being tested, with the appropriate pin/socket connector test lead.
6. Connect RETURN pins of the headlight to a clean, unpainted surface on the engine block or chassis ground. Reference specification.
7. Repeat steps 3, 4, 5 and 6 for all pins at sensor, or actuator connector.
8. Connect multimeter test leads across the headlight terminals and measure voltage drop.

Specification

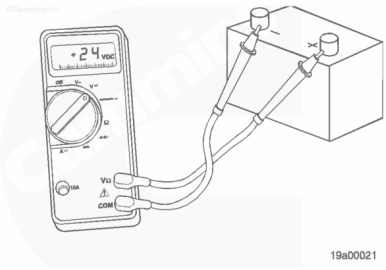
Voltage drop across headlight terminal	Within + 1 VDC of battery voltage

If the headlight light does **not** light when tested, then a malfunctioning wiring harness has been detected.

Polarity Check

A battery will be used as an example to check polarity of a circuit.

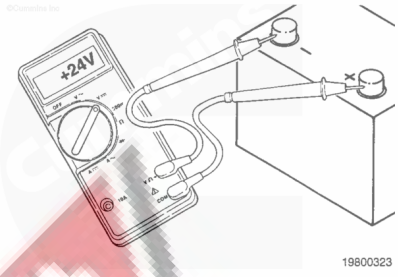
The terminals of a battery are marked for polarity. The multimeter displays the voltage difference of the positive (+) probe (red) to the negative (-) probe (black).



The polarity is correct when the positive (red) probe of the multimeter is on the positive (+) terminal of the battery and the negative (black) probe of the multimeter is on the negative (-) terminal of the battery.

The multimeter will display positive voltage if the polarity is correct.

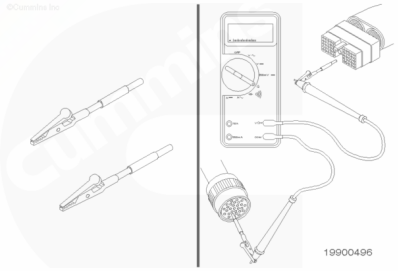
If the multimeter probes are reversed, the multimeter displays a negative voltage.



Continuity Check

⚠ CAUTION ⚠

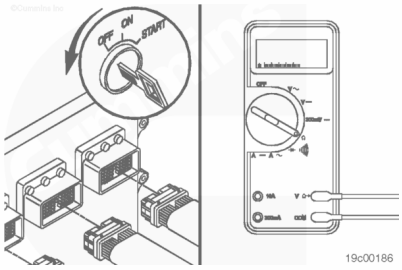
To reduce the possibility of pin and harness damage, use the appropriate test lead for the connector. Refer to the Service Tools listing or the appropriate wiring repair kit for this control system.



Continuity is an electrical connection between two pins that is less than a certain resistance value. For harness wires, the specification is less than 10 ohms.

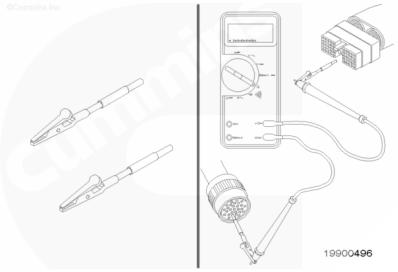
The procedure for checking continuity is as follows:

1. Turn keyswitch OFF.
2. Disconnect the harness connectors that are to be tested.
3. Adjust the multimeter to measure resistance.



⚠ CAUTION ⚠

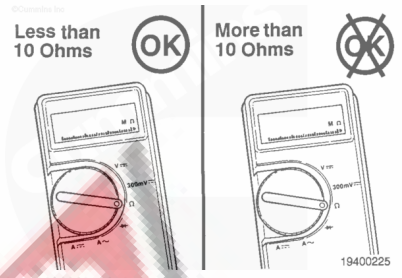
To reduce the possibility of pin and harness damage, use the appropriate test lead for the connector. Refer to the Service Tools listing or the appropriate wiring repair kit for this control system.



1. Insert test lead to the pin of the wire being tested and connect the alligator clip to the multimeter probe.
2. Insert the other test lead to the pin at the other end of the wire being tested and connect the alligator clip to the other multimeter probe.
3. Read the value on the multimeter display.

The multimeter **must** display less than 10 ohms for wire continuity.

If the multimeter displays greater than 10 ohms, the wire **must** be repaired or the harness replaced.

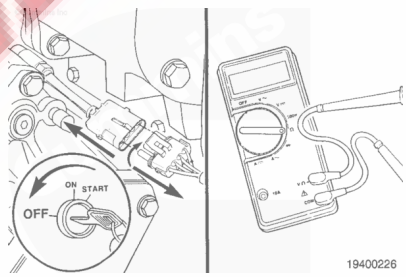


Resistance Check - Coil

Turn keyswitch OFF.

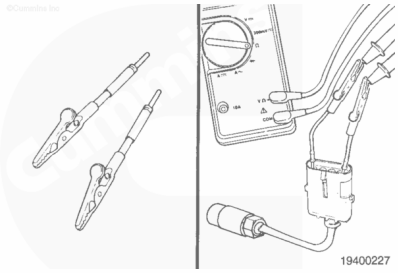
Disconnect the harness from the coil.

Adjust the multimeter to measure resistance.



⚠ CAUTION ⚠

To reduce the possibility of pin and harness damage, use the appropriate test lead for the connector. Refer to the Service Tools listing or the appropriate wiring repair kit for this control system.



Insert test lead to the coil connector pin, and connect the alligator clip to the multimeter probe.

Insert the other test lead to the other coil connector pin, and connect the alligator clip to the other multimeter probe.

Note : For internally grounded coils, touch one multimeter lead to the coil terminal and the other multimeter lead to a clean, unpainted surface on the engine block.

Read the measured resistance on the multimeter display.

Check the measured resistance against the resistance specification for the coil.

Note : The internal resistance of the multimeter is significant in some coil resistance checks.

Last Modified: 22-Feb-2018

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General Information

Use this procedure **only** if the harness or connector can be repaired.

After performing any of the checks below, and it is necessary to repair or replace a harness or connector, refer to the table of contents in section 19 for the appropriate repair or replacement procedure.

Fault code troubleshooting trees will refer to this procedure when it is necessary to measure resistance on a harness, connector, or component that the fault code applies to. Each fault code troubleshooting tree will troubleshoot a particular component and the associated circuitry such as a pressure sensor, wiring harness and connectors that connect the sensor to the electronic control unit.

When troubleshooting to determine if a short or open exists in a particular circuit, all of the associated connectors, pins, circuit names and connections that apply to this component can be viewed on the applicable wiring diagram.

Use the following procedures to determine how to make the necessary resistance checks on components, connectors and circuits that apply to the fault code that referred you to this procedure.

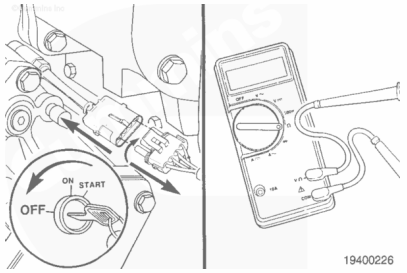
Resistance Check

Turn the key switch off.

Disconnect the appropriate connector from the component.

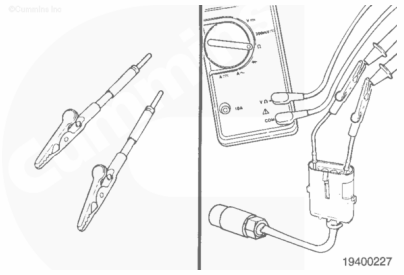
Adjust the multimeter to measure resistance.

Use the wiring diagram to determine the pins that apply to the component you are measuring.



⚠ CAUTION ⚠

To reduce the possibility of pin and harness damage, use the appropriate test lead for the connector. Refer to the Service Tools listing or the appropriate wiring repair kit.

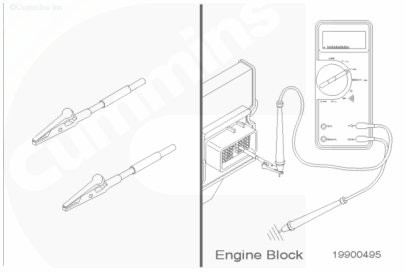


Connect the appropriate connector test leads to the connector pins and connect the alligator clips to the multimeter probe. Measure the resistance.

Compare this value to the applicable fault code specification or applicable Electrical or Sensor Specification on the wiring diagram. If the value is not correct, the component is malfunctioning. Refer to the applicable fault code procedure for instructions.

Continuity Check

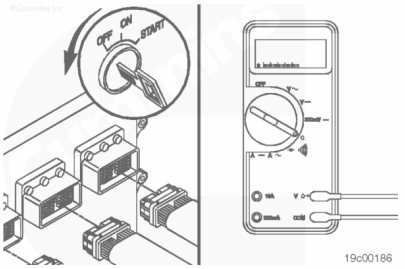
Continuity is an electrical connection between two pins that is less than a certain value. For harness wires, the specification is less than 10 ohms.



Turn the key switch to the OFF position.

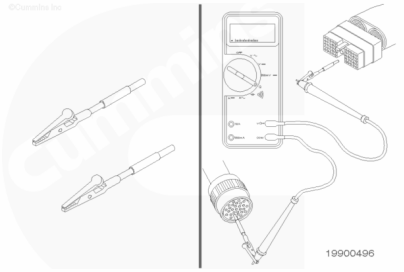
Disconnect the harness connectors that are to be tested.

Adjust the multimeter to measure resistance.



⚠ CAUTION ⚠

To reduce the possibility of pin and harness damage, use the appropriate test lead for the connector. Refer to the Service Tools listing or the appropriate wiring repair kit.



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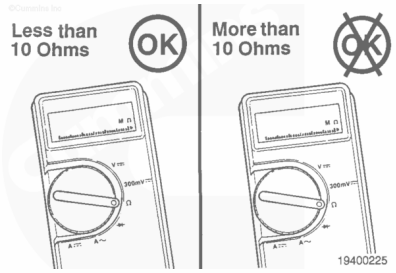
Connect the appropriate connector test leads to the connector pins and connect the alligator clips to the multimeter probe. Measure the resistance.

The multimeter **must** display less than 10 ohms for wire continuity. If the multimeter displays greater than 10 ohms, the wire **must** be repaired or the harness replaced.

Refer to the applicable fault code procedure for instructions.



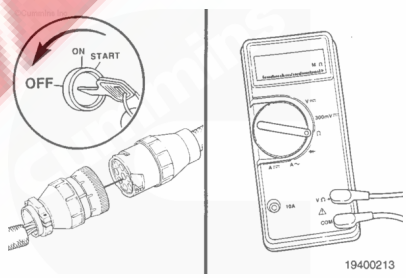
Check for Short Circuit from Pin to Pin

Short circuit from pin to pin check is a condition in which an electrical connection exists between two pins where it is **not** intended to exist.

Turn the key switch to the OFF position.

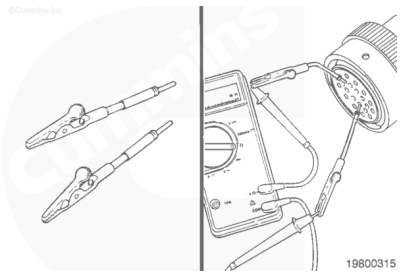
Disconnect the harness connectors that are to be tested.

Adjust the multimeter to measure resistance.



⚠ CAUTION ⚠

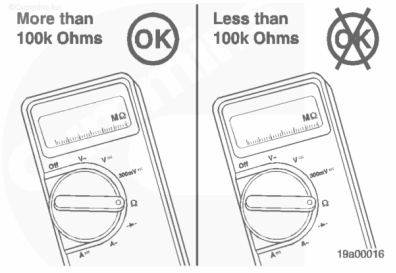
To reduce the possibility of pin and harness damage, use the appropriate test lead for the connector. Refer to the Service Tools listing or the appropriate wiring repair kit.



Connect the appropriate connector test leads to the connector pins and connect the alligator clips to the multimeter probes. Measure the resistance.

The multimeter **must** read greater than 100k ohms, which is an open circuit. If the circuit is **not** open, the pins being checked are electrically connected. Refer to the wiring diagram to verify that the wires are intended to be connected.

Inspect the harness connectors for moisture that can cause an inappropriate electrical connection.Refer to Procedure procedure 019-361 (/qs3/pubsys2/xml/en/procedures/99/99-



019-361.html).

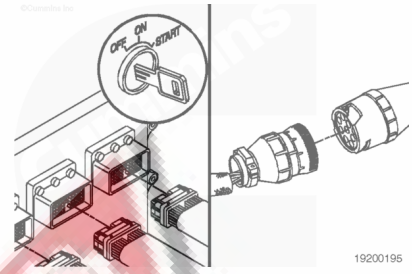
Refer to the applicable fault code procedure for instructions.

Check for Short Circuit to Ground

Short circuit to ground is a condition where a connection from a circuit to ground exists when it is not intended.

Turn the key switch to the OFF position.

Disconnect the harness connectors that are to be tested.

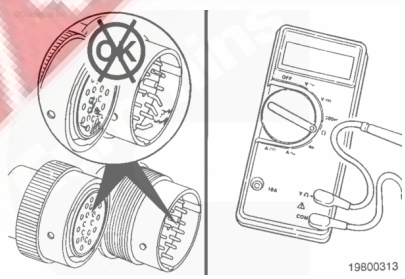


When testing a sensor, **only** the sensor connection is required to be disconnected.

When testing a harness, the harness connector at the electronic control unit and the connector at the sensor or multiple sensors **must** be disconnected.

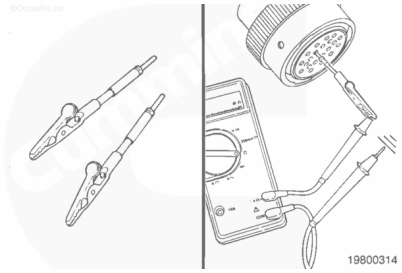
Identify the pins that need to be tested.

Inspect the connector pins.Refer to Procedure procedure 019-361 (/qs3/pubsys2/xml/en/procedures/99/99-019-361.html).



⚠ CAUTION ⚠

To reduce the possibility of pin and harness damage, use the appropriate test lead for the connector. Refer to the Service Tools listing or the appropriate wiring repair kit.



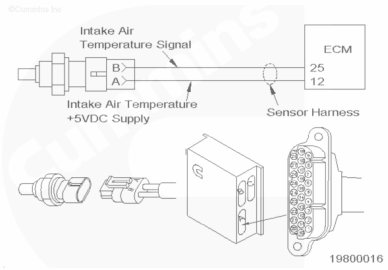
Connect the appropriate connector test lead to a connector pin and connect the alligator clip to the multimeter probe.

Touch the other multimeter probe to a clean, unpainted surface on the engine block or chassis ground. Measure the resistance.

The multimeter **must** read greater than 100k ohms, which indicates an open circuit. If the circuit is **not** open, the wire being checked has a short circuit to ground, the engine block

or chassis ground.

Refer to the applicable fault code procedure for instructions.



Last Modified: 26-Mar-2012

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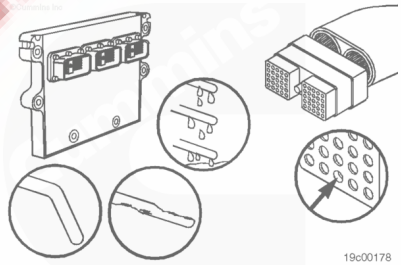
General Information

The following inspection procedures should be used for any component, connector, or harness connector to ensure there is no pin damage.

To troubleshoot electrical circuit faults that are intermittent and are currently inactive. Refer to Procedure 019-362 in Section 19. (/qs3/pubsys2/xml/en/procedures/99/99-019-362.html)

Inspect for Reuse

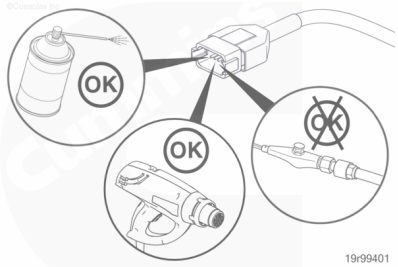
When disconnecting connectors during troubleshooting, **always** check for loose connectors (gently pull the wires at the back of the connector) and inspect the pins to make sure they are **not** the cause of a bad connection. The things to look for are bent, corroded, and pushed back pins.



Moisture in Connector

Moisture in a connector can also cause system performance issues. Many times it is difficult to see moisture in a connector. If moisture is suspected, the connector **must** be dried by applying contact cleaner, Part Number 3824510, to the connector. A heat gun can also be used on a low heat setting so that it will **not** damage the connector or wires.

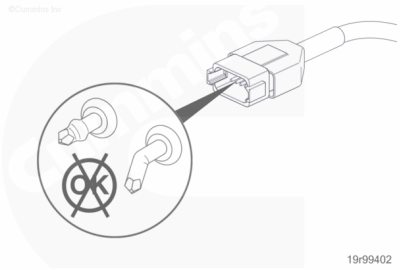
Note : Do **not** blow compressed air in the electronic control unit ports or connector. Compressed air can contain moisture due to condensation.



Bent or Expanded Pins

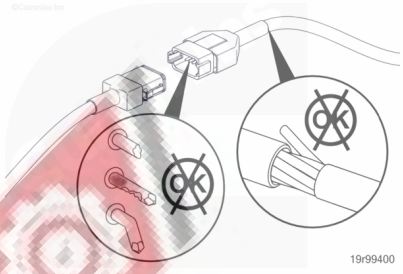
Inspect the male terminals of the connector. If any of the terminals are bent, so that they will **not** easily mate with the other side of the connector, or if the male terminals are expanded, that is, bulged out or squashed so as to make

them too large to mate with the other side of the connector, then the pin **must** be replaced. See the repair section for the specific connector in question.



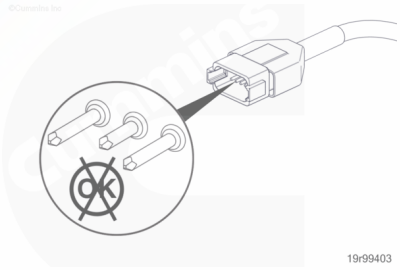
Corroded Pins

Inspect both the male and female terminals for corrosion, which can cause a poor electrical connection within the connector. If any corrosion is evident on the pins, then the corroded pins **must** be replaced. See the repair section for the specific connector in question.



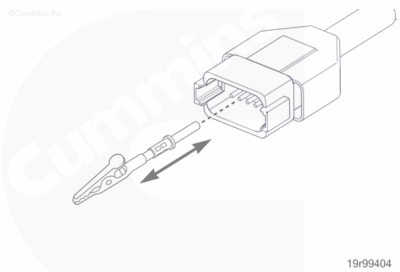
Pushed Back Pins

Inspect both the male and female terminals for pins that can **not** be making contact because they are pushed back in the connector. To repair, push the pin into the connector body from the back of the connector. Make sure the terminal locks into place. If the terminal will **not** lock into place, then replace it. See the repair section for the specific connector in question.



Drag Test

Use the correct mating terminal from the test lead kit, Part Number 5299367, manually insert the new lead into each terminal in the connector. As you slide the terminal in and out, it should fit securely and you should feel a significant amount of drag. If **not**, the terminal **must** be replaced. See the repair section for the specific connector in question.



Last Modified: 12-Jun-2019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AFTER SALES

General Information

This procedure is designed to troubleshoot electrical circuit faults that are intermittent and are currently inactive. This procedure can also be used to troubleshoot high inactive counts of circuit related fault codes.

If multiple fault codes are present, use a wiring diagram to check for common sensor supplies and ground circuits that may be shared between sensors, actuators, and switches. Pressure sensors may share a common 5 volt supply and ground circuit. Temperature sensors and actuators may share a common ground circuit. If either a sensor supply or a ground circuit has an intermittent connection, fault codes related to all the sensors may be active or have high counts of inactive fault codes.

If the conditions for a fault code to trigger exist and then the conditions are no longer present, an inactive fault code is created. When conditions are intermittent, there may be multiple inactive counts for a given fault code. If there are more than 10 inactive counts, the fault code should be troubleshot as an active fault code. Troubleshooting priority should be given to fault codes that are associated engine performance.

Initial Check

Interview the operator and determine the engine operating conditions when the fault occurs and what symptoms occur when the fault is active.



Determine if there have been any recent service repairs or maintenance performed that may be related to the intermittent condition.

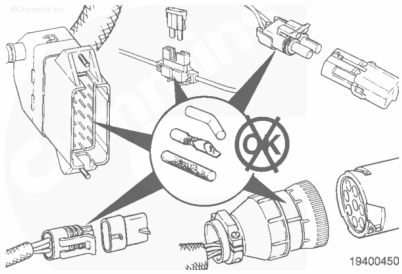
Review the “Shop Talk” section of the fault code troubleshooting tree. Shop Talk will give additional troubleshooting information and will list possible causes for the fault code.

Verify the electronic control module (ECM) calibration is correct. Check the calibration revision history found on QuickServe® Online for applicable fixes for the ECM calibration. If necessary, recalibrate the ECM. See procedure 019-032 Engine Control Module Calibration Code.

Disconnect the sensor or actuator related to the intermittent condition.

ANADOLU ISUZU AFTER SALES

Inspect the wiring harness and connector for the following:

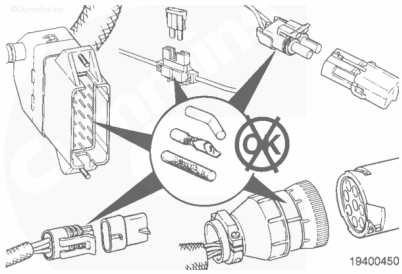


- Loose connector (gently pull the wires at the back of the connectors)
- Corroded pins
- Bent or broken pins
- Pushed back or expanded pins
- Moisture in or on the connectors
- Dirt or debris in, or on, the connector pins
- Missing or damaged connector seals
- Wire insulation damage
- Connector shell broken
- Damaged locking tab connector
- Pin wear (close visual inspection)
- Rusty, painted, corroded, or loose grounds.

Thoroughly inspect the wiring harness between the suspected component and ECM connection. Check for the proper strain relief on the wiring harness.

A dark powder found inside the connector may be a sign of pin fretting. Clean the pin contacts and reconnect the connector.

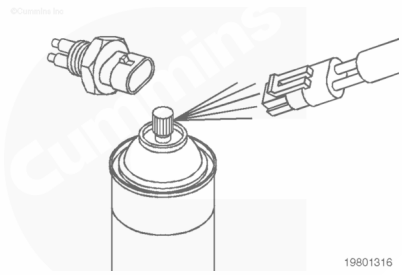
Disconnect the wiring harness connector from the ECM. Inspect the ECM connector for the following:



- Loose connector (gently pull the wires at the back of the connectors)
- Corroded pins
- Bent or broken pins
- Pushed back or expanded pins
- Moisture in or on the connectors
- Dirt or debris in, or on, the connector pins
- Missing or damaged connector seals
- Wire insulation damage
- Connector shell broken
- Damaged locking tab connector
- Pin wear (close visual inspection)
- Rusty, painted, corroded, or loose grounds.

Clean connector(s) of any components related to the fault code. Use Cummins® service tool, Part Number 3823290, QD® contact cleaner or equivalent.

Clear all fault codes.



ANADOLU ISUZU PARTS CATALOG

Harness Shake Test

Connect a recommended Cummins® electronic service tool or equivalent and open the Data Monitor/Logger feature.

Monitor the sensor signal voltage for the appropriate sensor or component.

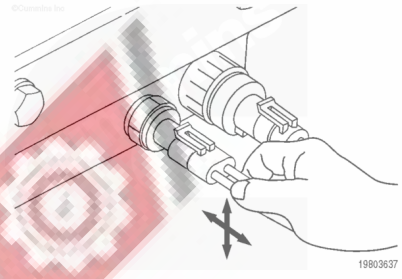
Monitor the actual value of the sensor or component.



Beginning at the component in question and working back through the harness to the ECM, gently twist, bend and pull at each connection and in between connections in the harness.

While performing the Harness Shake Test, the sensor signal voltage that the electronic service tool displays should remain steady. A typical reading should be between 0.5 and 5.12 volts.

Note : This procedure can also be used to check for loose or damaged wires for switches. Switch status can be monitored with an electronic service tool. Look for switch changes when performing the Harness Shake Test.



If the fault code goes active, inactive counts increase, the sensor signal voltage fluctuates, or the switch status changes, there is a loose connection or damaged wire at that specific location. Inspect the pins at the corresponding connectors. Refer to Procedure 019-361 (/qs3/pubsys2/xml/en/procedures/99/99-019-361.html).

Note : The ECM will **not** change the status of switches and faults instantaneously. Approximately 10 to 15 seconds should be used to gently twist the harness and see a reading change from the ECM. Monitoring too many parameters at one time with an electronic service tool will slow down the update rate on the screen. Keep the number of parameters monitored with the electronic service tool to minimum to increase the update rate.



Start the engine.

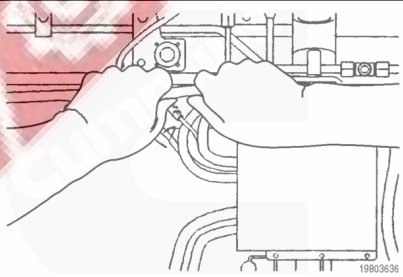
Monitor the sensor signal voltage for the appropriate sensor. Also monitor the actual value of the sensor or component.

While performing the Harness Shake Test, the sensor signal voltage that the electronic service tool displays should remain steady. A typical reading should be between 0.5 and 5.12 volts.

Now gently bend, twist, and pull the connections and in between connections in the harness while monitoring the sensor signal voltage.

If the sensor signal voltage fluctuates during the test, then there is a loose connection or damaged wire at that specific location. Inspect the pins at the connectors in question. Repair or replace as necessary. Refer to Procedure 019-361 (/qs3/pubsys2/xml/en/procedures/99/99-019-361.html).

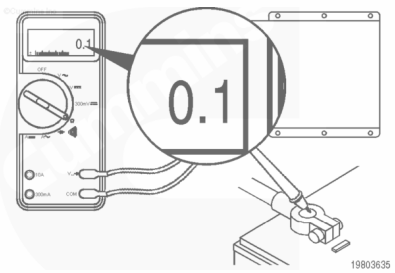
Ground Circuit Check



Check for poor battery and chassis grounds. Firmly pull on ground wires or cables checking for loose connections. Check the following grounds making sure they are secure, clean, and on a non-painted surface:

- Engine block grounds.
- Chassis grounds
- ECM grounds.
- Alternator negative (-) post.
- Starter negative (-) post.

While performing this step, check to see if the fault code goes active, or if inactive counts increase. If this happens, there is a loose connection or damaged wire at that location. Disconnect, clean grounding cables and grounding surfaces, then reconnect. Repair or replace grounding cables or wires if necessary.



Use a multimeter to measure resistance. Refer to Procedure 019-359 (/qs3/pubsys2/xml/en/procedures/99/99-019-359.html).

Measure resistance from the battery negative (-) post to:

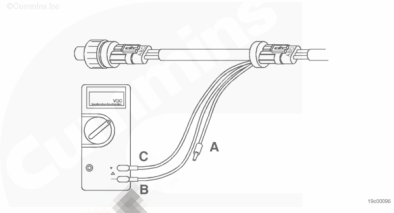
- ECM casing (clean, non-painted surface).
- Engine block (clean, non-painted surface).
- Starter negative (-) post.
- Alternator negative (-) post.
- Chassis grounds.

All resistance values should measure less than 1 ohm. If resistance values exceed 1 ohm, clean grounding cables and grounding surfaces, then reconnect. Repair or replace

grounding cables or wires if necessary.

Voltage Check

This test **must** be performed with the sensor or actuator connected to the wiring harness.



With the sensor or actuator disconnected from the wiring harness, measure the voltage at the engine harness connector of the component.

Connect the sensor or actuator to the wiring harness and measure the voltage with all the components connected. Use a breakout cable or back-probe the connector with the multimeter leads when performing this check.

The voltage to the component should be within 0.5 volts of the original voltage measured. If the voltage drops more than 0.5 volts, check for intermittent connections, cut wires, or corroded relay connections between the actuator and the ECM.

Sensor Accuracy Check



When a sensor circuit is shorted high or shorted low, the sensor value will be locked to a default value when the fault code is active. The default value will usually be set to a value that is within the standard operating range of the sensor. When monitoring the sensor values with a service tool it will appear as if the sensor is reading a correct value even when the fault code is active.

Be aware when troubleshooting intermittent circuit fault codes that the value displayed with a service tool could be a default sensor reading. Always use the sensor signal voltage measurement when troubleshooting intermittent circuit fault codes.

If further investigation is necessary, use the Data Monitor/Logger feature in an electronic service tool to monitor the inputs and outputs of a running engine and to capture data to a log file. The data logger feature in an

electronic service tool will allow for information to be captured during the intermittent event and can reviewed at a later time.

Last Modified: 27-Jan-2020

ANADOLU ISUZU AFTER SALES

Select Service Tools

Recommended Cummins® Service Tools

- No Cummins® service tools required.

Additional Service Items

- Spray cleaner
- Small pry bar
- Light

Preparatory Steps

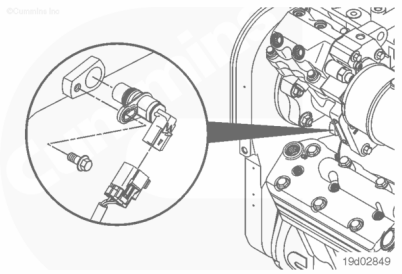
⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

- Disconnect the batteries. See equipment manufacturer service information.

Remove

The camshaft position sensor reports the speed and position of the camshaft to the engine control module (ECM).



The camshaft position sensor is located on the gear housing, below the fuel pump.

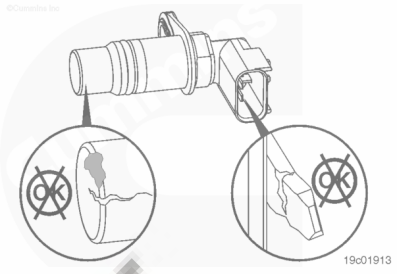
Use the following procedure for the location of camshaft position sensor. Refer to Procedure 100-002 in Section E. (/qs3/pubsys2/xml/en/procedures/425/425-100-002.html)

Disconnect camshaft position sensor from the engine harness.

Remove camshaft position sensor from the mounting location.

Inspect for Reuse

Inspect camshaft position sensor for debris, cracks, or other damage from contact with the camshaft gear.

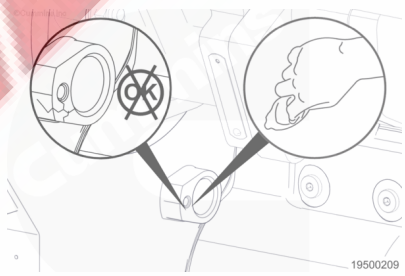


If there is debris on camshaft position sensor, clean camshaft position sensor.

If camshaft position sensor is chipped, cracked, extruded, or otherwise damaged, replace camshaft position sensor.

If camshaft position sensor retainer is bent or distorted and can **not** be returned to its original position, camshaft position sensor should be replaced.

Inspect camshaft position sensor bore and mounting surface for corrosion or damage.

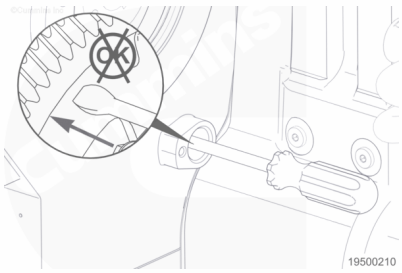


If corrosion is found, it should be removed. Use care to keep corrosion on the outside of the engine. Lightly scrape the camshaft position sensor bore and mounting surface to remove any corrosion buildup. Do **not** use a file to remove the buildup material. The camshaft position sensor bore can be damaged. Wipe the camshaft position sensor bore and mounting surface clean with a cloth saturated with a spray cleaner.

If the mounting surface or camshaft position sensor bore is damaged and camshaft position sensor will **not** insert fully into the camshaft position sensor bore, the component will need to be repaired or replaced.

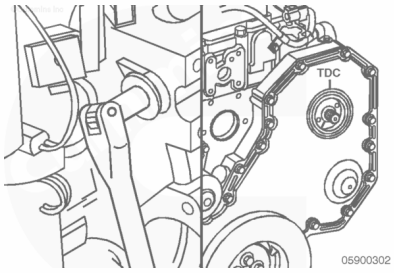
⚠ CAUTION ⚠

Minimal force is required to check the camshaft gear. If too much force is applied, damage to the engine may occur.



Use a small pry bar to carefully attempt to move the camshaft gear laterally. If the camshaft gear moves, it should be inspected. Refer to Procedure 001-012 in Section 1. (/qs3/pubsys2/xml/en/procedures/425/425-001-012.html)

Locate the valve set marks on the outside of the vibration damper and alignment mark on the gear cover.

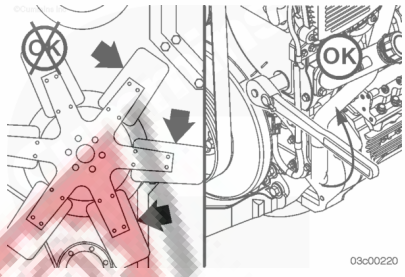


Two complete revolutions of the crankshaft are required to inspect the camshaft gear.

Use the following procedure for instructions on barring the engine. Refer to Procedure 000-017 in Section 0. (/qs3/pubsys2/xml/en/procedures/425/425-000-017.html)

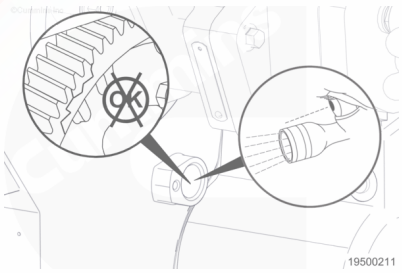
⚠ WARNING ⚠

Do not pull or pry on the fan to manually rotate the engine. To do so can damage the fan blades. Damaged fan blades can cause premature fan failures which can result in serious personal injury or property damage



Crankshaft rotation is **clockwise**, as viewed from the front of the engine.

Use a light to observe the camshaft gear through the senor camshaft position sensor bore while barring the engine two complete revolutions.

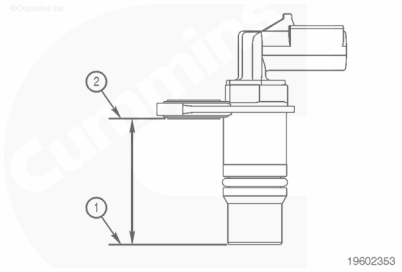


Stop rotating the engine with a solid portion of the camshaft gear, between two notches, centered in camshaft position sensor bore.

If the camshaft gear is cracked, appears bent, or has any damage, it should be replaced. Refer to Procedure 001-012 in Section 1. (/qs3/pubsys2/xml/en/procedures/425/425-001-012.html)

Measure

Sensor air gap is **not** adjustable.



Air gap can be measured using a depth micrometer or dial caliper. First measure from camshaft position sensor mounting surface to the surface of the camshaft gear. Record the measurement. Bar the crankshaft 180 degrees and repeat the measurement. Record the measurement. Repeat this process for two full crankshaft revolutions. If the minimum and maximum values recorded vary by more than 0.051 mm [0.002 inches] the camshaft gear is warped or

loose, or the camshaft is moving. For accurate results, these measurements **must** be made on the solid portion of the camshaft gear, **not** in the notches of the camshaft gear.

Second, measure camshaft position sensor from the mounting flange to the end of camshaft position sensor.

Subtract camshaft position sensor length (second measurement) from the minimum measured camshaft gear depth (first measurement).

Air gap is the difference in these numbers.

Air Gap		
mm		in
0.2	MIN	0.009
2.25	MAX	0.089

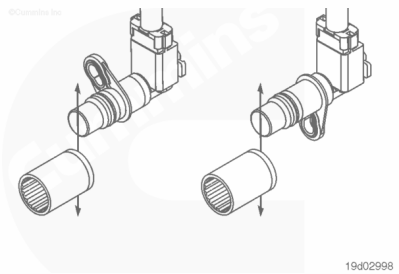
Maximum target runout: 0.5 mm [0.02 in].

If air gap is out of specifications, this indicates an issue with either camshaft position sensor, camshaft gear, or the mounting component.

If air gap is in specification, but increasing or decreasing the air gap corrects the issue, this indicates an issue with camshaft position sensor.

Test

Connect camshaft position sensor to the engine harness.



Turn keyswitch ON.

Connect INSITE™ electronic service tool.

Use INSITE™ electronic service tool monitor mode to read camshaft position sensor (engine speed backup sensor) state.

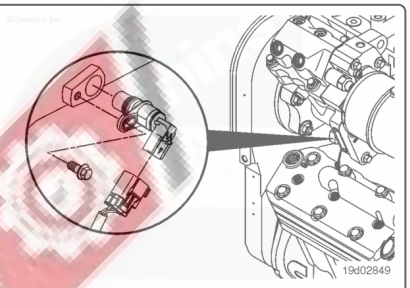
Using the ratchet drive side of the socket tool that was used to remove camshaft position sensor from the engine, place it flush on camshaft position sensor so that the edge of the socket is on the edge of camshaft position sensor. Slowly slide the socket in a perpendicular direction to the marked line on camshaft position sensor or in a perpendicular direction to the mounting bracket of camshaft position sensor.

The camshaft position sensor should transition from low to high, high to low, or the state will show triggered.

If camshaft position sensor state does **not** transition, check the supply and return circuits before replacing camshaft position sensor.

Install

Lubricate the o-ring with clean engine oil before installation.



Install camshaft position sensor by pressing firmly on the top of camshaft position sensor until the o-ring is fully seated.

Install and tighten the capscrew.

Torque Value: 10 n•m [89 in-lb]

Connect camshaft position sensor to the engine harness.

Push connectors together until they lock.

An audible click will be heard as the connectors lock in place.

Finishing Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

- Connect the batteries. See equipment manufacturer service information.

ANADOLU ISUZU POWER SALES

Last Modified: 01-Nov-2016


ANADOLU ISUZU
AFTER SALES

Select Service Tools

Recommended Cummins® Service Tools

- No Cummins® service tools required.

Additional Service Items

- Spray cleaner
- Small pry bar
- Light
- Depth micrometer or dial caliper

Preparatory Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

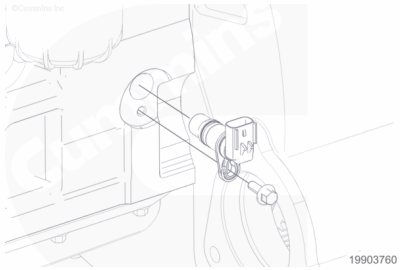
- Disconnect the batteries. See equipment manufacturer service information.

Remove

Disconnect crankshaft position sensor from the engine harness. Push down on the button toward the rear of the connector and disconnect from crankshaft position sensor.

Remove the capscrew that secures crankshaft position sensor to the cylinder block.

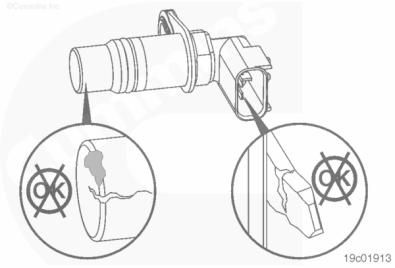
Remove crankshaft position sensor from the mounting location.



ANADOLU ISUZU
OEM PARTS

Inspect for Reuse

Inspect crankshaft position sensor for debris or cracks.

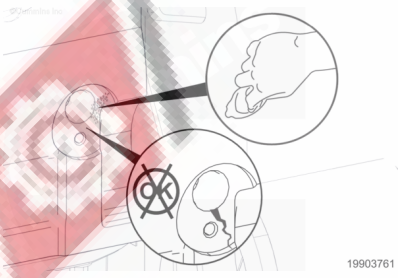


If there is debris on crankshaft position sensor, clean crankshaft position sensor.

If crankshaft position sensor is chipped, cracked, extruded, or otherwise damaged, replace crankshaft position sensor.

If crankshaft position sensor retainer is bent or distorted and can **not** be returned to its original position, crankshaft position sensor should be replaced.

Inspect crankshaft position sensor bore and mounting surface for corrosion or damage.

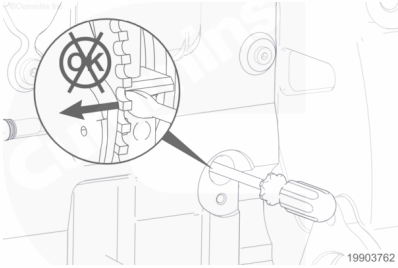


If corrosion is found, it should be removed. Use care to keep corrosion on the outside of the engine. Lightly scrape crankshaft position sensor bore and mounting surface to remove any corrosion buildup. Do **not** use a file to remove the buildup material. crankshaft position sensor bore may be damaged. Wipe crankshaft position sensor bore and mounting surface clean with a cloth saturated with a spray cleaner.

If the mounting surface or crankshaft position sensor bore are damaged and crankshaft position sensor will **not** insert fully into crankshaft position sensor bore, the component will need to be repaired or replaced.

⚠ CAUTION ⚠

Minimal force is required to check the crankshaft position sensor tone wheel. If too much force is applied, damage to the engine may occur.

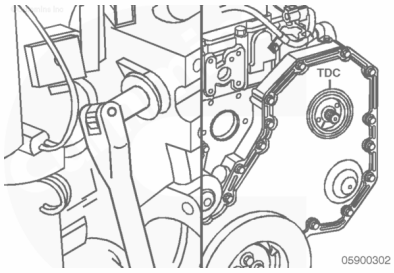


Use a small pry bar to carefully attempt to move the crankshaft position sensor tone wheel laterally. If the crankshaft position sensor tone wheel moves, it should be inspected. Refer to Procedure 001-071 in Section 1. (/qs3/pubsys2/xml/en/procedures/425/425-001-071.html)

Locate the valve set marks on the outside of the vibration damper and the alignment mark on the gear cover.

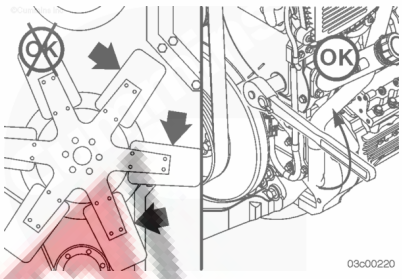
One complete revolution of the crankshaft is required to inspect the crankshaft position sensor tone wheel.

Use the following procedure for instructions on barring the engine. Refer to Procedure 000-017 in Section 0. (/qs3/pubsys2/xml/en/procedures/425/425-000-017.html)



⚠ WARNING ⚠

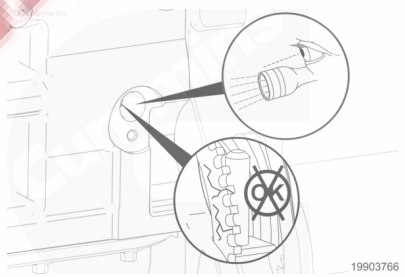
Do not pull or pry on the fan to manually rotate the engine. To do so can damage the fan blades. Damaged fan blades can cause premature fan failures which can result in serious personal injury or property damage.



The crankshaft rotation is **clockwise**, as viewed from the front of the engine.

Use a light to observe the crankshaft position sensor tone wheel through crankshaft position sensor bore while barring the engine one complete revolution.

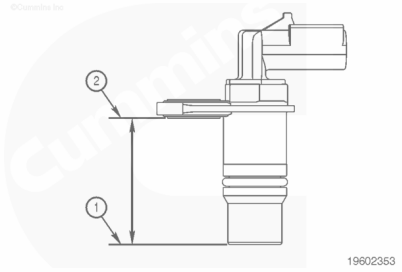
Stop rotating the engine with a solid portion of the crankshaft position sensor tone wheel, between two notches, centered in crankshaft position sensor bore.



If the crankshaft position sensor tone wheel is cracked, has damaged teeth or appears bent, it should be replaced. Refer to Procedure 001-071 in Section 1. (/qs3/pubsys2/xml/en/procedures/425/425-001-071.html)

Measure

Sensor air gap is **not** adjustable.



Air gap can be measured using a depth micrometer or dial caliper.

First measure from crankshaft position sensor mounting surface to the surface of crankshaft position tone wheel. Record the measurement. Bar the crankshaft 90 degrees. Repeat the measurement. Record the measurement. Repeat this process for one full crankshaft revolution. If the minimum and maximum values recorded vary by more than 0.051 mm

[0.002 inches], the crankshaft position sensor tone wheel is warped or loose, or the crankshaft is moving. For accurate results, these measurements **must** be made on the solid portion of crankshaft position sensor tone wheel, **not** in the notches of the tone wheel.

Second, measure crankshaft position sensor from the mounting flange to the end of crankshaft position sensor.

Subtract crankshaft position sensor length (second measurement) from the minimum measured crankshaft position sensor tone wheel depth (first measurement).

Air gap is the difference in these numbers.

Air Gap		
mm		in
0.2	MIN	0.009
2.25	MAX	0.089

Maximum target runout: 0.5 mm [0.02 in].

If air gap is out of specification, this indicates an issue with either crankshaft position sensor, crankshaft position sensor tone wheel, or the mounting component.

If air gap is in specification, but increasing or decreasing the air gap corrects the issue, this indicates an issue with crankshaft position sensor.

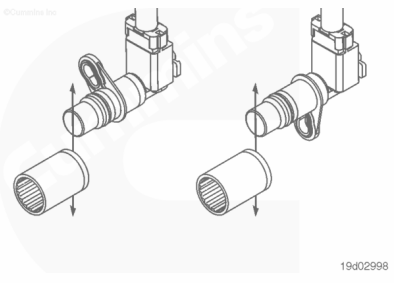
Test

Connect crankshaft position sensor to the engine harness.

Turn Keyswitch ON.

Connect INSITE™ electronic service tool.

Use INSITE™ electronic service tool monitor mode to read crankshaft position sensor (engine speed) state.



Using the ratchet drive side of the socket tool used to remove crankshaft position sensor from the engine, place it flush on crankshaft position sensor so the edge of the socket is on the edge of crankshaft position sensor. Slowly slide the socket in a perpendicular direction to the marked line on crankshaft position sensor or in a perpendicular direction to the mounting bracket of crankshaft position sensor.

The crankshaft position sensor should transition from low to high, high to low, or the state will show triggered.

If crankshaft position sensor state does **not** transition, check the supply and return circuits before replacing crankshaft position sensor.

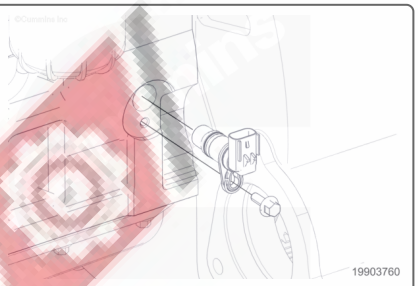
Install

Install a new o-ring onto crankshaft position sensor.

Apply clean engine oil to the o-ring.

Install the crankshaft position sensor into the mounting hole.

Install and tighten the capscrew.



Torque Value: 25 n•m [221 in-lb]

Connect crankshaft position sensor to the engine harness.

Slide the lock tab sideways to lock the connector to crankshaft position sensor.

Finishing Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

- Connect the batteries. See equipment manufacturer service information.

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Last Modified: 01-Nov-2016

Select Service Tools

Recommended Cummins® Service Tools

- No Cummins® Service Tools required.

Additional Service Items

- No additional service items required.

General Information

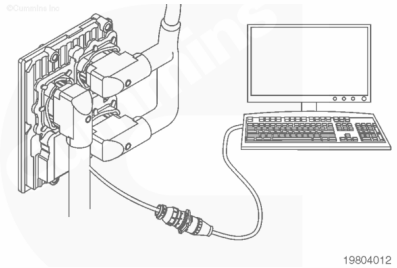
The exhaust gas recirculation (EGR) valve differential pressure sensor has two ports that sense a pressure drop across the EGR gas entrance to the intake connection.

The EGR valve differential pressure sensor is mounted on the intake side of the engine, near the EGR valve.

Use the following procedure for a detailed component location view. Refer to Procedure 100-002 in Section E. (/qs3/pubsys2/xml/en/procedures/425/425-100-002.html)

Initial Check

Use an electronic service tool to monitor the value of the EGR differential pressure sensor with the keyswitch in the ON position and the engine off.



The sensor should meet the following specification:

EGR Differential Pressure		
kpa		in-hg
-3	MIN	-0.90
3	MAX	0.90

If the value is **not** within specification, remove the EGR differential pressure sensor. Inspect the EGR supply ports in the intake connection for blockage. Refer to Procedure 010-080 in Section 10. (/qs3/pubsys2/xml/en/procedures/425/425-010-080.html)

Preparatory Steps

⚠ WARNING ⚠

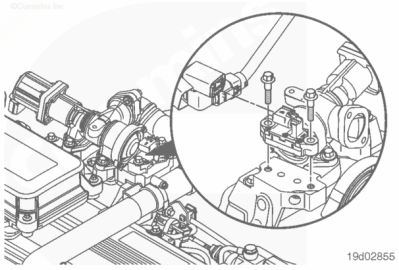
Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

- Disconnect the batteries. See equipment manufacturer service information.
- Clean the area around the EGR differential pressure sensor.

Remove

Disconnect the EGR differential pressure sensor from the engine harness.

Remove the two capscrews from the base of the sensor. Remove the sensor from the engine.

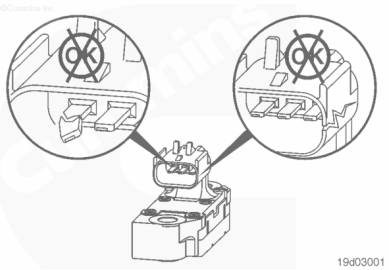


Clean and Inspect for Reuse

Inspect the engine harness connector and sensor for the following:

- Cracked or broken connector shell
- Missing or damaged connector seals
- Dirt, debris, or moisture in or on the connector pins
- Corroded, bent, broken, pushed back, or expanded pins
- Chipped, cracked, extruded, or damaged sensor.

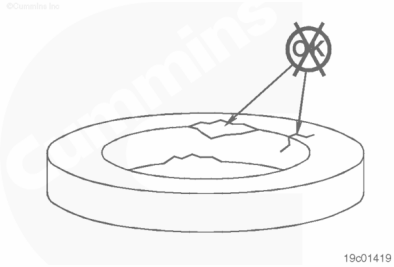
Clean, repair, or replace parts, as necessary.



Inspect the o-rings for cracks or other damage.

ANADOLU ISUZU AFTER SALES

Replace the o-rings if cracks or other damage is found.

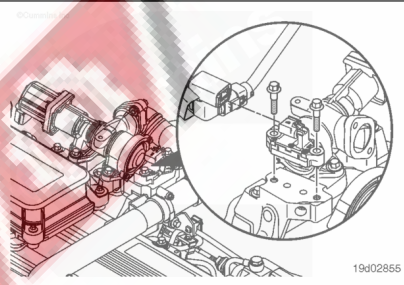


Install

Make sure the sensor has o-rings in the two grooves at the base of the sensor.

Install the sensor into the engine. Tighten the sensor.

Torque Value: 18 n•m [159 in-lb]



Finishing Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

- Connect the batteries. See equipment manufacturer service information.
- Operate the engine. Check for leaks.

ANADOLU ISUZU AFTER SALES

Last Modified: 03-Apr-2018

Select Service Tools

Recommended Cummins® Service Tools

- No Cummins® service tools required.

Additional Service Items

- Deep well socket

General Information

The exhaust gas pressure sensor monitors the exhaust gas pressure and passes the information on to the engine control module (ECM) through the engine harness. If the exhaust gas pressure sensor reading becomes too low, it will cause a derate condition.

The exhaust gas pressure sensor is located on the exhaust gas recirculation (EGR) cooler on the exhaust-side of the engine.

Preparatory Steps

⚠ WARNING ⚠

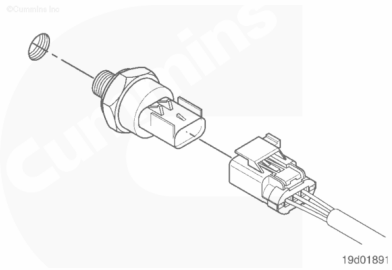
Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

- Disconnect the batteries. See equipment manufacturer service information.

Remove

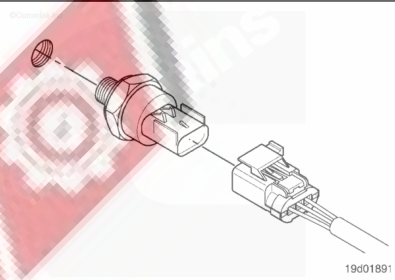
Slide the locking tab on the connector sideways. Push down on the button toward the rear of the connector. Disconnect it from the sensor.

Remove the sensor from the engine.



Install

Note : Make sure the new sensor has an o-ring.



Lubricate the o-ring. Use clean engine oil.

Install a new sensor into the engine.

Use a deep well socket to tighten the sensor, being careful **not** to overtighten.

Tighten the sensor.

Torque Value: 18 n•m [159 in-lb]

Push the connectors together until they lock.

Slide the locking tab to the lock position.

Operate the engine. Verify proper operation.

Finishing Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

- Connect the batteries. See equipment manufacturer service information.

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ANADOLU ISUZU
AFTER SALES

Select Service Tools

Recommended Cummins® Service Tools

- No Cummins® Service Tools required.

Additional Service Items

- No additional service items required.

General Information

The exhaust gas recirculation (EGR) temperature sensor is used to measure the temperature of the exhaust gas that exits the EGR cooler.

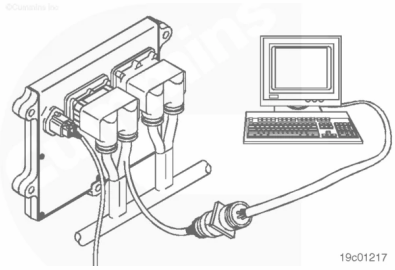
The EGR temperature sensor is located on the EGR crossover tube.

Use the following procedure for a detailed component location view. Refer to Procedure 100-002 in Section E. (/qs3/pubsys2/xml/en/procedures/425/425-100-002.html)

Initial Check

Use an electronic service tool to monitor the value of the EGR temperature sensor with the keyswitch ON and engine OFF.

Note : The value of the EGR temperature sensor should be checked when the engine is cold.



The value of the EGR temperature sensor should read within 5.5°C or 10°F of the local ambient air temperature.

Replace the EGR temperature sensor if the value is out of specification.

Preparatory Steps

⚠ WARNING ⚠

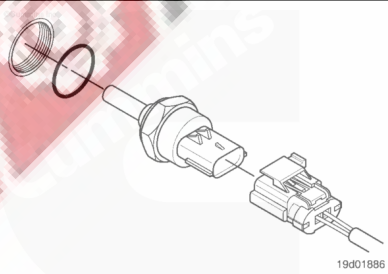
Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

- Disconnect the batteries. See equipment manufacturer service information.
- Clean the area around the EGR temperature sensor.

Remove

Disconnect the EGR temperature sensor from the engine harness.

Remove the sensor from the engine.

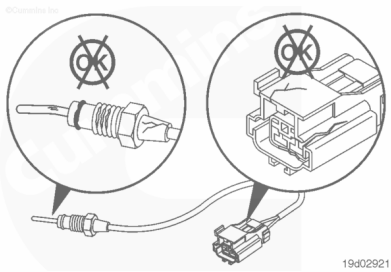


Clean and Inspect for Reuse

Inspect the engine harness connector and sensor for the following:

- Cracked or broken connector shell
- Missing or damaged connector seals
- Dirt, debris, or moisture in or on the connector pins
- Corroded, bent, broken, pushed back, or expanded pins
- Chipped, cracked, extruded, or damaged sensor.

Clean, repair, or replace parts, as necessary.



Install

Check to make sure the new sensor has an o-ring.

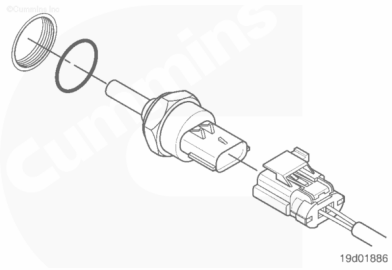
Lubricate the o-ring. Use clean engine oil.

ANADOLU ISUZU PARTS SALES

Install the new sensor into the engine.

Tighten the sensor.

Torque Value: 15 n•m [133 in-lb]



Finishing Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

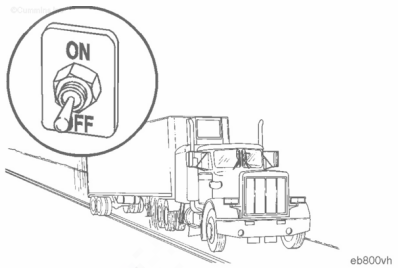
- Connect the batteries. See equipment manufacturer service information.
- Operate the engine. Check for leaks.

ANADOLU ISUZU AFTER SALES

Last Modified: 10-Aug-2016

General Information

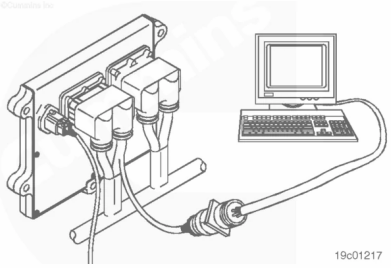
The fan control switch circuit signals the system that the operator is requesting the engine fan to be engaged. The fan on and off circuit consists of the fan control switch signal, the switch return, and the OEM cab-mounted toggle switch. This circuit is considered “fail safe”, meaning when the circuit is open, the engine fan will be engaged by the ECM.



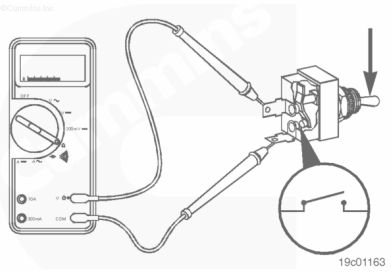
Note : This procedure is **only** valid if the fan control switch is wired through the ECM and the feature manual fan switch is enabled in the ECM. If the fan control switch is wired in series with the fan control relay, the ECM could log fan circuit errors during normal operation. Please verify the circuit is wired properly before performing this procedure.

Resistance Check

If an electronic service tool is available, monitor the fan control switch for proper operation. If **not** operating properly, follow the troubleshooting procedures in this section.

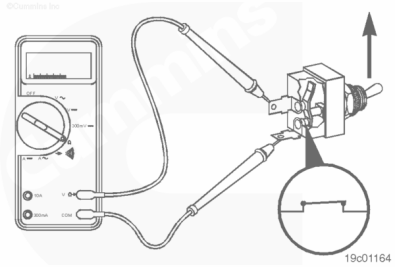


Locate the fan control switch. Label the wires with the location of the switch or the wire number. Remove the electrical connectors from the switch. Adjust the multimeter to measure resistance. Touch one multimeter probe to one of the terminals on the switch. Touch the other multimeter probe to the other terminal of the switch.



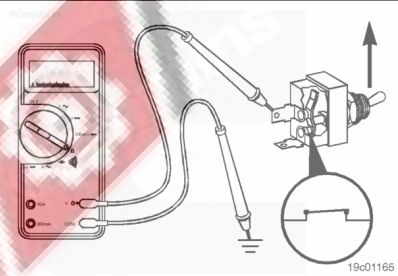
Move the switch to the ON position and measure the resistance. The multimeter **must** show an open circuit (100k ohms or more). If the circuit is **not** open, the switch has failed. Refer to the OEM troubleshooting and repair manual for replacement procedures.

Place the switch in the OFF position and measure the resistance. The multimeter **must** show a closed circuit (10 ohms or less). If the circuit is **not** closed, the switch has failed. Refer to the OEM troubleshooting and repair manual for replacement procedures. If the resistance value is correct, the switch **must** still be checked for a short circuit to ground.



Check for Short Circuit to Ground

Touch one of the multimeter probes to one of the switch terminals. Touch the other probe to chassis ground. Move the switch to the OFF position and measure the resistance. The multimeter **must** show an open circuit (100k ohms or more). If the circuit is **not** open, the switch has failed. Refer to the OEM troubleshooting and repair manual for replacement procedures. If the switch passes all of the previous checks, the circuit **must** be checked for an open circuit, a short circuit to ground, a short circuit from pin to pin, and a short circuit to an external voltage source.



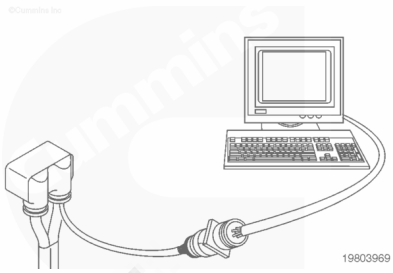
ANADOLU ISUZU AFTER SALES

Last Modified: 29-Jun-2015

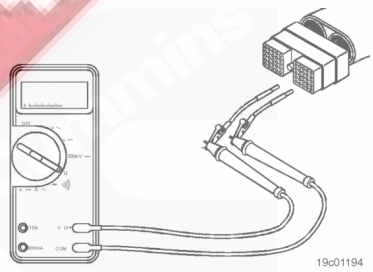
Resistance Check

⚠ CAUTION ⚠

Proper leads and/or a Cummins® approved circuit testing tool must be used when working with electrical connectors to prevent pin expansion and damage to the connector.



If electronic service tool is available, monitor the fan control switch circuit for proper operation. If **not**, follow the troubleshooting procedures in this section.



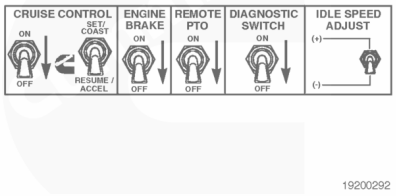
Disconnect the original equipment manufacturer (OEM) harness engine interface connector. To determine the location of the connector, see the corresponding engine wiring diagram. Insert one of the test leads into the switch return pin of the OEM harness connector and connect the alligator clip to the multimeter probe. Insert the other lead into the fan control switch signal pin of the OEM harness connector and connect the alligator clip to the other multimeter probe.

Move the fan control switch to the OFF position. The multimeter **must** show a closed circuit (10 ohms or less). If the circuit is **not** closed, inspect the fan control switch, switch return wire, and the fan control switch signal wire for an open circuit, provided that the switch has been previously checked. Refer to the OEM troubleshooting and repair manual for repair procedures. If the resistance is within the specification, the fan control switch, switch return (-) wire, and the fan control signal wire **must** be checked for a short circuit to ground, a short circuit from pin-to-pin, and a short circuit to an external voltage source.

Check for Short Circuit to Ground

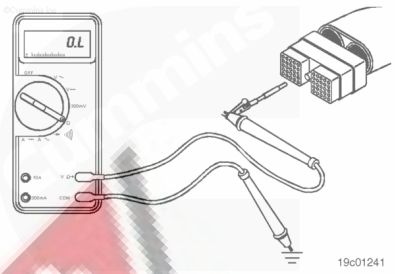
To isolate the fan control switch circuit when checking for an electrical short, disconnect the OEM harness from the ECM and fan control switch. Disconnect the clutch position

switch/engine protection override switch and the accelerator pedal assembly. Set all cab panel switches to the OFF or neutral position. Set the service brake using the trailer brake hand valve.



19200292

Adjust the multimeter to measure resistance. Insert a test lead into the fan control switch signal pin of the OEM harness connector and connect it to a multimeter probe. Touch the other multimeter probe to the engine block ground. Measure the resistance.

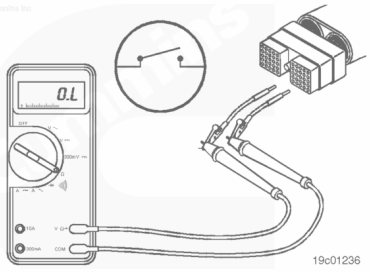


19c01241

The multimeter **must** show an open circuit (100k ohms or more). If the circuit is **not** open, there is a short circuit to ground in the fan switch control circuit, provided that the switch has been previously checked. Repair or replace the wire connected to the fan control switch signal in the OEM harness according to the vehicle manufacturer's procedure.

Check for Short Circuit from Pin to Pin

Isolate the fan control switch circuit by setting the switches as in the previous section. Set the fan control switch to the ON position. Insert the lead into the fan control switch signal pin. Connect the alligator clip to the multimeter. With the other lead inserted into the switch return pin, measure the resistance. The multimeter **must** show an open circuit (100k ohms or more).

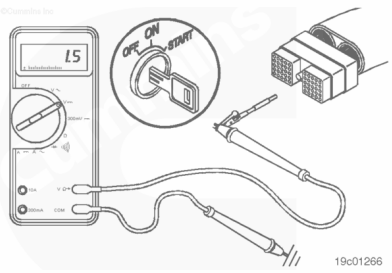


19c01236

Remove the lead from the fan control switch signal pin and check all other pins. Measure the resistance. The multimeter **must** show an open circuit (100k ohms or more). If the circuit is **not** open, there is a short circuit between the fan control switch circuit and any pin that shows a closed circuit, provided the switch has previously been checked. Repair or replace the wires in the OEM harness. Refer to Procedure 019-071 (/qs3/pubsys2/xml/en/procedures/99/99-019-071.html).

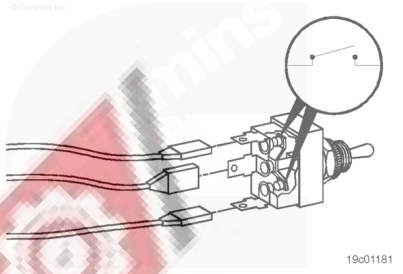
Check for Short Circuit to External Voltage Source

Turn the keyswitch to the ON position. Set the fan control switch to OFF. Adjust the multimeter to measure VDC. Insert a test lead into the fan control switch signal pin and attach it to a multimeter probe. Touch the other multimeter probe to the engine block ground. Measure the voltage. The voltage **must** be 1.5 VDC or less.



19c01266

If the voltage is **not** correct, there is an external voltage source connected to the circuit, or there is a short circuit between the fan control switch circuit and a wire carrying power in the OEM harness. Remove the voltage source or repair the wiring in the OEM harness according to the vehicle manufacturer's procedures.


19c01181

Connect all components after completing the repair.

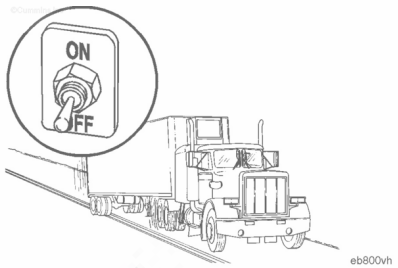
Note : If the fan control switch circuit was approved in all of the previous tests, it is functioning correctly.

ANADOLU ISUZU AFTER SALES

Last Modified: 25-Jun-2015

General Information

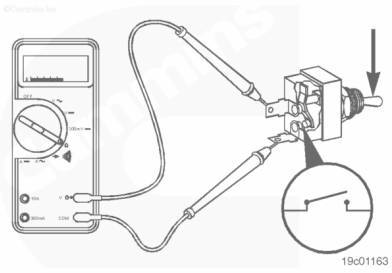
The maximum engine speed switch is an OEM installed switch that allows a driver to select a lower, programmable maximum engine speed. Certain applications such as one that uses a hydraulic system may need to be protected from an overspeed condition. The operator may toggle this switch and limit the maximum engine RPM to a lower value that is safe for the hydraulic system to operate in.



Note : The switch is now programmable, meaning the speed limit and normal positions can either be open or closed depending on the configuration. Confirm which configuration the specific switch is and adjust the troubleshooting failure criteria before deeming the switch failed.

Resistance Check

If a recommended Cummins® electronic service tool or equivalent is available, monitor the maximum engine speed switch for proper operation. If **not**, follow the troubleshooting procedures in this section.

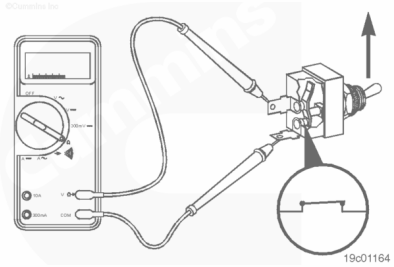


Locate the maximum engine speed switch. Label the wires with the location of the switch or the wire number. Remove the electrical connectors from the switch. Adjust the multimeter to measure resistance. Touch one multimeter probe to one of the terminals on the switch. Touch the other multimeter probe to the other terminal of the switch.

Place the switch in the open position and measure the resistance. The multimeter **must** show an open circuit (100k ohms or more). If the circuit is **not** open, the switch has failed. Refer to the OEM troubleshooting and repair manual for replacement procedures.

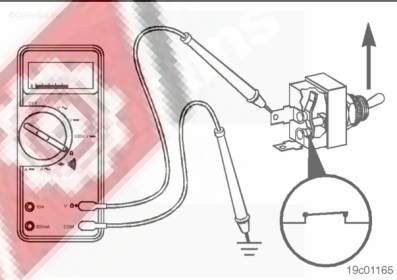
Place the switch in the closed position and measure the resistance. The multimeter **must** show a closed circuit (10 ohms or less). If the circuit is **not** closed, the switch has failed. Refer to the OEM troubleshooting and repair manual

for replacement procedures. If the resistance value is correct, the switch **must** still be checked for a short circuit to ground.



Check for Short Circuit to Ground

Touch one of the multimeter probes to one of the switch terminals. Touch the other probe to chassis ground. Move the switch to the closed position and measure the resistance. The multimeter **must** show an open circuit (100k ohms or more). If the circuit is **not** open, the switch has failed. Refer to the OEM troubleshooting and repair manual for replacement procedures. If the switch passes all of the previous checks, the circuit **must** be checked for an open circuit, a short circuit to ground, a short circuit from pin to pin, and a short circuit to an external voltage source.



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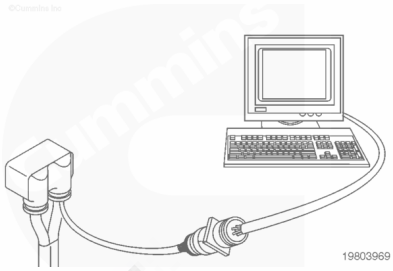
AFTER SALES

Last Modified: 27-Jan-2020

Resistance Check

⚠ CAUTION ⚠

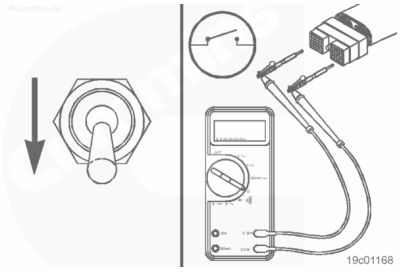
Proper leads and/or a Cummins® approved circuit testing tool must be used when working with electrical connectors to prevent pin expansion and damage to the connector.



If electronic service tool is available, monitor the maximum engine speed switch circuit for proper operation. If **not**, follow the troubleshooting procedures in this section.

Disconnect the original equipment manufacturer (OEM) harness engine interface connector. To determine the location of the connector, see the corresponding engine wiring diagram. Insert one of the test leads into the switch return pin of the OEM harness connector and connect the alligator clip to the multimeter probe. Insert the other lead into the maximum engine speed switch signal pin of the OEM harness connector and connect the alligator clip to the other multimeter probe.

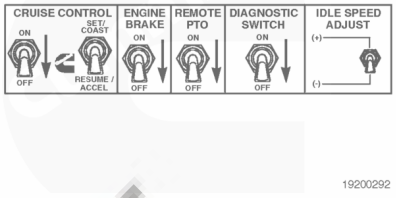
Note : The maximum engine speed switch is programmed by the OEM. The open or closed position of the switch can represent “Normal” or “Speed Limit” depending on how the OEM programs the switch. Before continuing to troubleshoot refer to the OEM troubleshooting and repair manual to determine how the switch is programmed and apply the defective switch criteria accordingly when performing the troubleshooting.



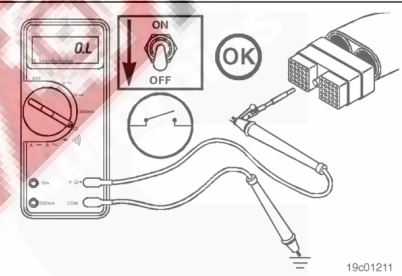
Move the maximum engine speed switch to the normal position. The multimeter **must** show a closed circuit (10 ohms or less). If the circuit is **not** closed, inspect the switch return wire and the maximum engine speed switch signal wire for an open circuit, provided that the switch has been previously checked. Refer to the OEM troubleshooting and repair manual for repair procedures. If the resistance is within the specification, the switch return wire and the maximum engine speed switch signal wire **must** be checked for a short circuit to ground, a short circuit from pin-to-pin, and a short circuit to an external voltage source.

Check for Short Circuit to Ground

To isolate the maximum engine speed switch circuit when checking for an electrical short, disconnect the OEM harness from the ECM and the OEM harness from the maximum engine speed switch. Disconnect the clutch pedal position switch/engine protection override switch and the accelerator pedal assembly switch. Set all cab panel switches to the OFF or neutral position. Set the service brake using the trailer brake hand valve.



Adjust the multimeter to measure resistance. Insert a test lead into the maximum engine speed switch signal pin of the OEM harness connector and connect it to a multimeter probe. Touch the other multimeter probe to the engine block ground.

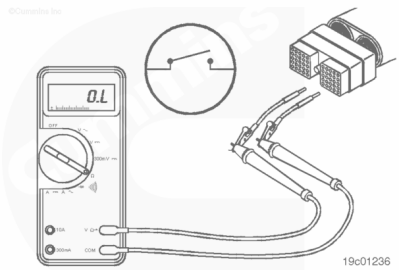


Measure the resistance. The multimeter **must** show an open circuit (100k ohms or more). If the circuit is **not** open, there is a short circuit to ground in the maximum engine speed switch circuit, provided that the switch has been previously checked.

Repair or replace the wire connected to the maximum engine speed switch signal pin in the OEM harness according to the vehicle manufacturer's procedure.

Check for Short Circuit from Pin to Pin

Isolate the maximum engine speed switch circuit by setting the switches as in the previous section. Set the maximum engine speed switch to the normal position. Insert the lead into the maximum engine speed switch signal pin. Connect the alligator clip to the multimeter. With the other lead inserted into the switch return pin, measure the resistance. The multimeter **must** show an open circuit (100k ohms or more).



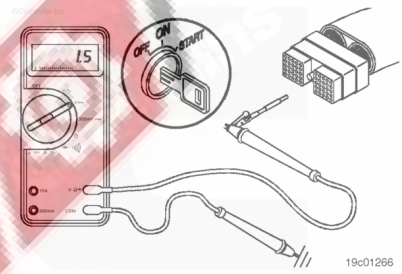
Remove the lead from the maximum engine speed switch signal pin and check all other pins. Measure the resistance. The multimeter **must** show an open circuit (100k ohms or

more). If the circuit is **not** open, there is a short circuit between the manual fan switch circuit and any pin that shows a closed circuit, provided the switch has previously been checked.

Repair or replace the wires in the OEM harness. Refer to Procedure 019-071 (/qs3/pubsys2/xml/en/procedures/99/99-019-071.html).

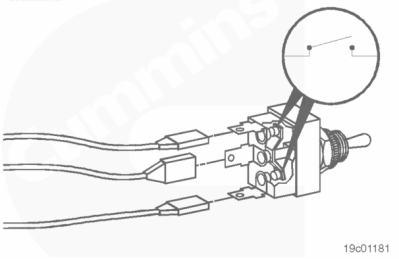
Check for Short Circuit to External Voltage Source

Turn the keyswitch to the ON position. Set the maximum engine speed switch to the normal position. Adjust the multimeter to measure VDC. Insert a test lead into the maximum engine speed switch signal pin and attach it to a multimeter probe. Touch the other multimeter probe to the engine block ground. Measure the voltage. The voltage **must** be 1.5 VDC or less.



If the voltage is **not** correct, there is an external voltage source connected to the circuit, or there is a short circuit between the maximum engine speed switch circuit and a wire carrying power in the OEM harness.

Remove the voltage source or repair the wiring in the OEM harness according to the OEM troubleshooting and repair manual. Connect all components after completing the repair.



Note : If the maximum engine speed switch circuit was approved in all of the previous tests, it is functioning correctly.

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Last Modified: 25-Jun-2015

Select Service Tools

Recommended Cummins® Service Tools

- No Cummins® Service Tools required.

Additional Service Items

- Pliers
- Loctite® 5699, or equivalent

General Information

The turbocharger speed sensor is located on the turbocharger between the compressor and turbine housings.

Use the following procedure for a detailed component location view. Refer to Procedure 100-002 in Section E. (/qs3/pubsys2/xml/en/procedures/425/425-100-002.html)

Preparatory Steps

⚠ WARNING ⚠

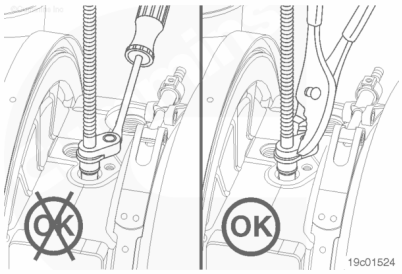
Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

- Disconnect the batteries. See equipment manufacturer service information.
- Clean the area around the turbocharger speed sensor.

Remove

⚠ CAUTION ⚠

When removing the turbocharger speed sensor, use a twisting motion while pulling upward. Prying on the sensor body with a screwdriver can lead to broken sensors and could result in unwarranted turbocharger replacement. Pliers are recommended for turbocharger speed sensor removal.



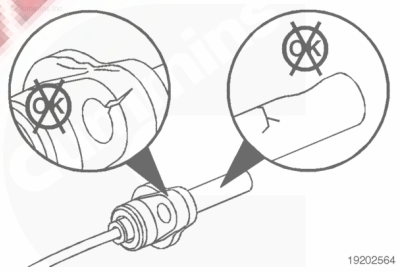
Lift up on the locking tab. Pull the electrical connectors apart.

Remove the mounting capscrew.

Use pliers to remove the turbocharger speed sensor. Use a twisting motion while pulling upward.

Clean and Inspect for Reuse

Inspect the turbocharger speed sensor body and wiring harness for signs of melting or other damage.

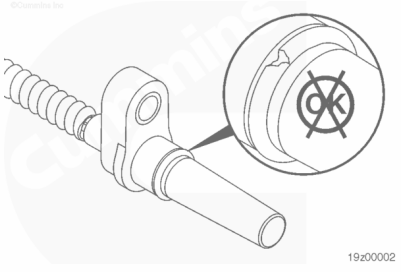


Inspect the engine harness connector and sensor for the following:

- Cracked or broken connector shell
- Missing or damaged connector seals
- Dirt, debris, or moisture in or on the connector pins
- Corroded, bent, broken, pushed back, or expanded pins
- Chipped, cracked, extruded, or damaged sensor.

Clean, repair, or replace parts, as necessary.

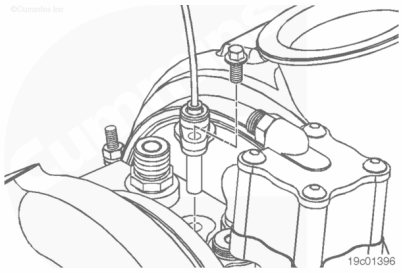
If the turbocharger speed sensor is being removed due to an oil leak, inspect the turbocharger speed sensor o-ring for signs of damage. If the o-ring is cut or damaged, the o-ring **must** be replaced.



If there are no cuts or damage evident to the o-ring, it is possible to reseal and prevent oil leaks. To do this, apply Loctite® 5699, or equivalent, to the o-ring and the area where the o-ring sits on the speed sensor, prior to assembly.

Install

If installing a new turbocharger speed sensor, make sure the new turbocharger speed sensor has a new o-ring installed.



If the turbocharger speed sensor was removed due to an oil leak, it is possible to reuse the turbocharger speed sensor and either replace or inspect the o-ring for reuse (as described in the Inspection section above).

Apply Loctite® 5699, or equivalent, to the o-ring. This helps seal and prevent oil leaks.

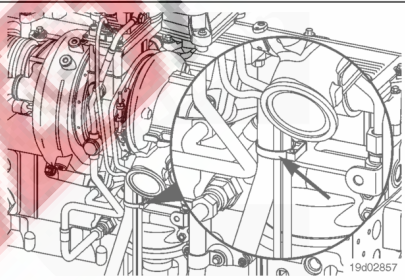
Install the turbocharger speed sensor onto the turbocharger.

Tighten the mounting capscrew.

Torque Value: 9 n•m [80 in-lb]

⚠ CAUTION ⚠

The turbocharger speed sensor harness must be tied up and away from any heat sources and hard or sharp surfaces. Failure to do so will cause damage to the harness.



⚠ CAUTION ⚠

Do not install cable ties directly over the sensor connector. Doing so can damage the connector. Tie the speed sensor wiring harness on either side of the connectors.

Secure the turbocharger speed sensor wiring harness to the turbocharger actuator harness.

Finishing Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

- Connect the batteries. See equipment manufacturer service information.
- Operate the engine. Check for leaks.

Last Modified: 10-Aug-2016



Select Service Tools

Recommended Cummins® Service Tools

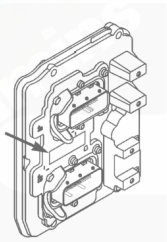
- Multimeter, Part Number 3164488

Additional Service Items

- Electrical Breakout Harness Cable, Part Number 3163531

General Information

The fuel lift pump is controlled by the engine control module (ECM). The ECM supplies power to the fuel lift pump without the use of a relay or fuse.



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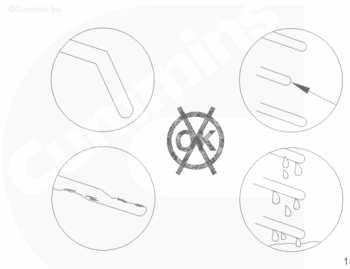
Initial Check

Inspect the engine harness, lift pump power connector, and pins for the following:



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- Loose connector
- Corroded pins
- Bent or broken pins
- Pushed back or expanded pins
- Moisture in or on the connector
- Missing or damaged connector seals
- Dirt or debris in or on the connector pins
- Connector shell broken
- Wire insulation damage
- Damaged connector locking tab.

Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19. (/qs3/pubsys2/xml/en/procedures/99/99-019-361.html)

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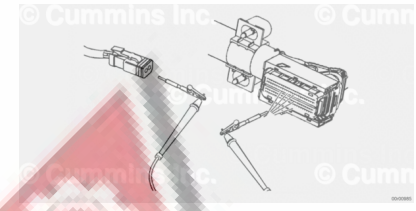
Use the following procedure for the proper replacement or repair of connectors, pins, or harness. Refer to Procedure 019-043 in Section 19. (/qs3/pubsys2/xml/en/procedures/425/425-019-043.html)

Resistance Check



Check for an open circuit in the fuel lift pump circuit. Disconnect the 2 pin fuel lift pump power connector at the fuel lift pump.

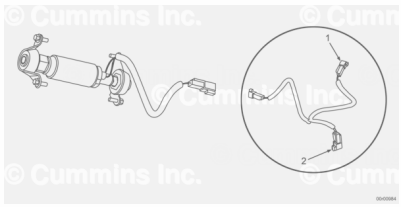
Disconnect the engine wiring harness ECM connector.

Measure the resistance of the fuel lift pump circuit between the supply and return at the 2 pin fuel lift pump connector.

Measure the resistance of the fuel lift pump supply and return circuits between these two connectors.

The resistance **must** be 10 ohms or less. If the resistance is greater than 10 ohms, repair or replace the engine harness.

Voltage Check



Turn the keyswitch ON. The circuit **must** be loaded to measure the voltage.

1. Disconnect the fuel lift pump power connector from engine harness connector (1).
2. Connect electrical breakout harness cable, Part Number 3163531 to the fuel lift pump and engine harness electrical connector.
3. Connect multimeter test leads (2) to the open connector on the cable, electrical breakout harness.
4. Turn engine keyswitch ON and measure voltage drop.
5. The voltage indicated on the multimeter (2) should be within one volt of battery voltage.

Only measure voltage during the first 30 seconds of the keyswitch being ON. If measurements are **not** done within allotted time, the keyswitch **must** be cycled.

Voltage Drop	Within + 1 VDC of battery voltage

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- If battery voltage is **not** within specified voltage values, then a malfunctioning fuel lift pump has been detected.
- If battery voltage is **not** indicated, check multimeter for a malfunction and retest. If a second check yields no voltage reading, then a malfunctioning wiring harness has been detected.
- Check the ECM for the proper calibration. If calibration is correct and up to date, and there is still **not** battery voltage, contact a Cummins® Authorized Repair Location.

Last Modified: 12-Feb-2021

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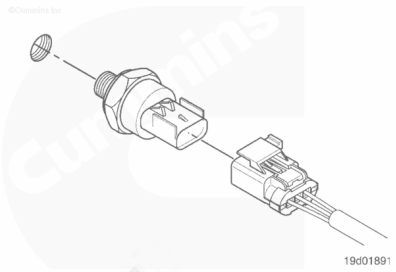
General Information

Some original equipment manufacturers (OEMs) can choose to install an additional pressure sensor.

The OEM pressure sensor monitors an OEM-defined pressure and passes that information on to the electronic control module (ECM) through the OEM harness. The ECM uses this information to determine the state of an OEM switched output device.

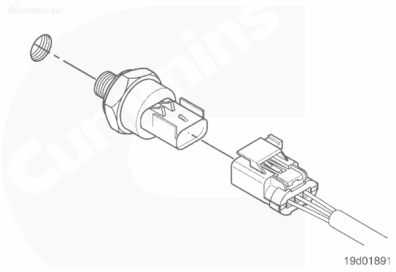
Refer to the OEM troubleshooting and repair manual for the location of the OEM pressure sensor.



Inspect for Reuse

Inspect the OEM pressure sensor for damaged or broken connector pins.

Refer to the OEM troubleshooting and repair manual for removal and installation instructions.



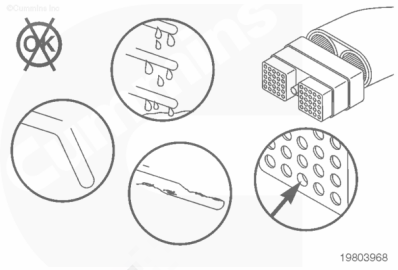
ANADOLU ISUZU AFTER SALES

Last Modified: 30-May-2008

Initial Check

Disconnect the original equipment manufacturer (OEM) pressure sensor connector from the OEM harness. Disconnect the OEM harness engine interface connector. To determine the location of the connector, see the corresponding engine wiring diagram.

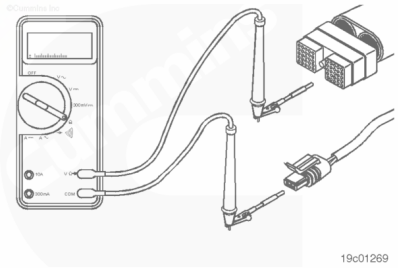
Check the OEM pressure sensor connector and OEM harness connectors for broken, bare, or melted wires; loose, dirty, damaged, or missing pins; and other visible signs of damage.



Resistance Check

⚠ CAUTION ⚠

Proper leads and/or a Cummins® approved circuit testing tool must be used when working with electrical connectors to prevent pin expansion and damage to the connector.

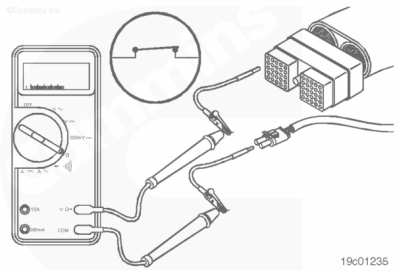


Disconnect the OEM harness engine interface connector. Disconnect the OEM pressure sensor from the OEM harness. Set the multimeter to measure resistance.

Insert a test lead into the OEM pressure sensor signal pin of the OEM harness connector. Connect the alligator clip to a multimeter probe. Insert the second test lead to the signal pin of the OEM pressure sensor harness connector and connect the clip to the other multimeter probe. Measure the resistance.

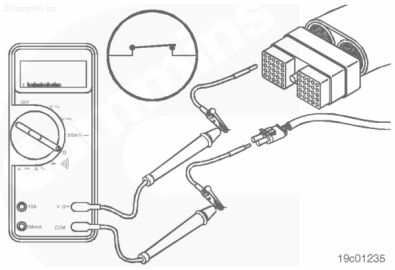
The multimeter **must** show a measurement of 10 ohms or less (closed circuit).

If the measured value is more than 10 ohms, there is an open circuit in the signal wire.



Repair or replace the OEM harness. Refer to Procedure 019-071 (/qs3/pubsys2/xml/en/procedures/99/99-019-071.html).

Repeat the resistance check for the return wire. Measure the resistance from the OEM pressure sensor return pin of the OEM harness connector to the OEM pressure sensor return pin of the harness connector.

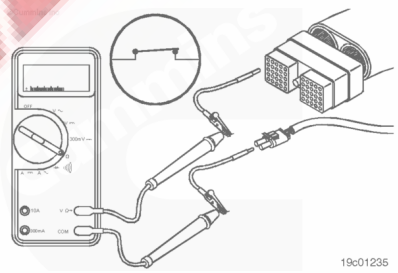


The multimeter **must** show a measurement of 10 ohms or less (closed circuit).

If the measured value is more than 10 ohms, there is an open circuit in the return wire.

Repair or replace the OEM harness. Refer to Procedure 019-071 (/qs3/pubsys2/xml/en/procedures/99/99-019-071.html).

Repeat the resistance check for the 5 volt supply wire. Measure the resistance from the OEM pressure sensor 5 volt supply pin of the OEM harness connector to the OEM pressure sensor 5 volt supply pin of the harness connector.



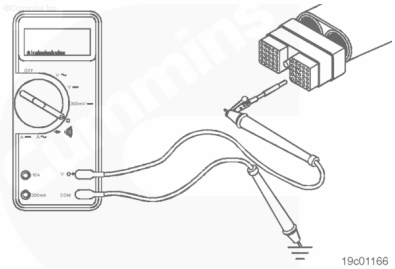
The multimeter **must** show a measurement of 10 ohms or less (closed circuit).

If the measured value is more than 10 ohms, there is an open circuit in the 5 volt supply wire.

Repair or replace the OEM harness. Refer to Procedure 019-071 (/qs3/pubsys2/xml/en/procedures/99/99-019-071.html).

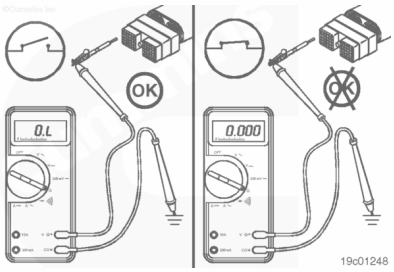
Check for Short Circuit to Ground

Disconnect the OEM harness engine interface connector. Disconnect the OEM pressure sensor from the OEM harness. Set the multimeter to measure resistance.



Insert the test lead into the OEM pressure sensor signal pin of the OEM harness connector. Touch the other multimeter probe to engine block ground. Measure the resistance.

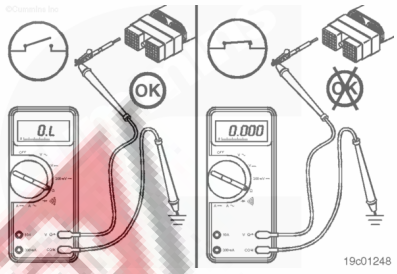
The multimeter **must** show a measurement of 100k ohms or more (open circuit).



If the measured value is less than 100k ohms, there is a short circuit to ground in the signal wire.

Repair or replace the OEM harness. Refer to Procedure 019-071 (/qs3/pubsys2/xml/en/procedures/99/99-019-071.html).

Repeat the short-to-ground check for the return wire. Measure the resistance from the OEM pressure sensor return pin of the OEM harness connector to engine block ground.

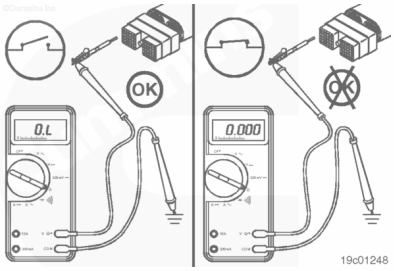


The multimeter **must** show a measurement of 100k ohms or more (open circuit).

If the measured value is less than 100k ohms, there is a short circuit to ground in the return wire.

Repair or replace the OEM harness. Refer to Procedure 019-071 (/qs3/pubsys2/xml/en/procedures/99/99-019-071.html).

Repeat the short-to-ground check for the 5 volt supply wire. Measure the resistance from the OEM pressure sensor 5 volt supply pin of the OEM harness connector to engine block ground.



The multimeter **must** show a measurement of 100k ohms or more (open circuit).

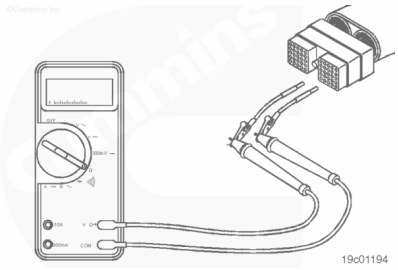
If the measured value is less than 100k ohms, there is a short circuit to ground in the 5 volt supply wire.

Repair or replace the OEM harness. Refer to Procedure 019-071 (/qs3/pubsys2/xml/en/procedures/99/99-019-071.html).

Check for Short Circuit from Pin to Pin

Disconnect the OEM harness engine interface connector. Disconnect the OEM pressure sensor from the OEM harness. Set the multimeter to measure resistance.

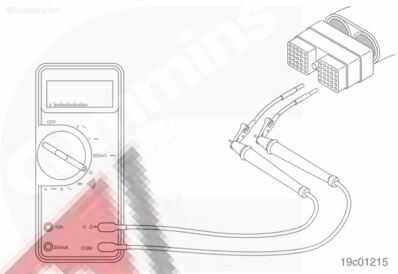
Measure the resistance from the OEM pressure sensor signal pin in the OEM harness connector to all other pins in the connector.



The multimeter **must** show a measurement of 100k ohms or more (open circuit).

If the measured value is less than 100k ohms, there is a short circuit between the signal wire and any other pin that measured a closed circuit.

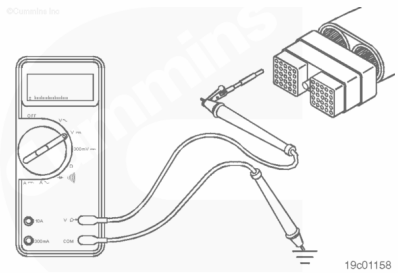
Repair or replace the OEM harness. Refer to Procedure 019-071 (/qs3/pubsys2/xml/en/procedures/99/99-019-071.html).



Check for Short Circuit to External Voltage Source

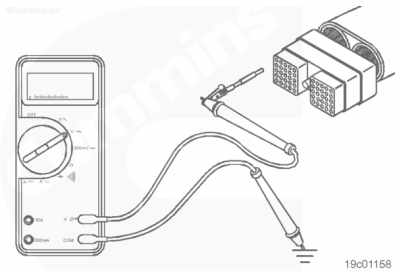
Disconnect the OEM harness engine interface connector. Disconnect the OEM pressure sensor from the OEM harness. Set the multimeter to measure VDC. Turn the vehicle keyswitch to the ON position.

Insert the test lead connected to the positive (+) multimeter probe into the OEM pressure sensor signal pin of the OEM harness connector. Touch the negative (-) multimeter probe to engine block ground and measure the voltage.



If there is voltage present, there is a short circuit from the signal wire to an external voltage source.

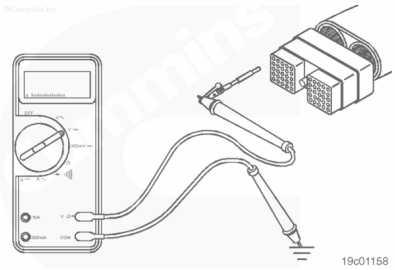
Repair or replace the OEM harness. Refer to Procedure 019-071 (/qs3/pubsys2/xml/en/procedures/99/99-019-071.html).



Repeat the short to external voltage source check for the return wire. Measure the voltage from the OEM pressure sensor return pin of the OEM harness connector to engine block ground.

If there is voltage present, there is a short circuit from the return wire to an external voltage source.

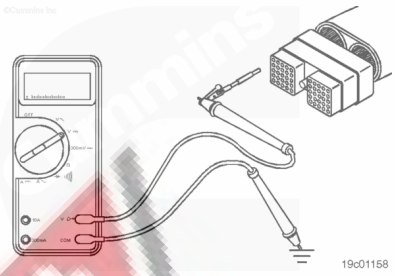
Repair or replace the OEM harness. Refer to Procedure 019-071 (/qs3/pubsys2/xml/en/procedures/99/99-019-071.html).



Repeat the short to external voltage source check for the 5 volt supply wire. Measure the voltage from the OEM pressure sensor 5 volt supply pin of the OEM harness connector to engine block ground.

The multimeter **must** show a voltage of less than 5.5 VDC. If the voltage is greater than 5.5 VDC, there is a short circuit from the 5 volt supply wire to an external voltage source.

Repair or replace the OEM harness. Refer to Procedure 019-071 (/qs3/pubsys2/xml/en/procedures/99/99-019-071.html).



Last Modified: 29-Jun-2015

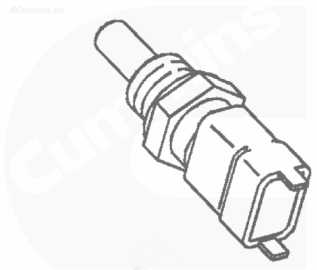
ANADOLU ISUZU AFTER SALES

General Information

Some original equipment manufacturers (OEMs) can choose to install an additional temperature sensor.

The OEM temperature sensor monitors an OEM-defined temperature and passes that information on to the electronic control module (ECM) through the OEM harness. The ECM uses this information to determine the state of an OEM switched output device.

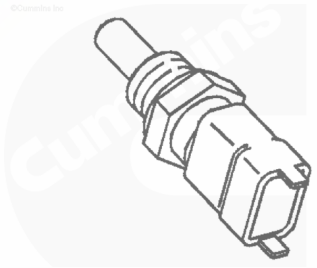
Refer to the OEM troubleshooting and repair manual for the location of the OEM temperature sensor.



Inspect for Reuse

Inspect the OEM temperature sensor for damaged or broken connector pins.

Refer to the OEM troubleshooting and repair manual for removal and installation instructions.



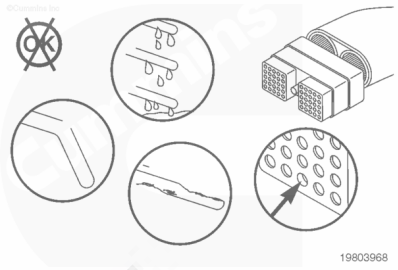
ANADOLU ISUZU AFTER SALES

Last Modified: 30-May-2008

Initial Check

Disconnect the original equipment manufacturer (OEM) temperature sensor connector from the OEM harness. Disconnect the OEM harness engine interface connector. To determine the location of the connector, see the corresponding engine wiring diagram.

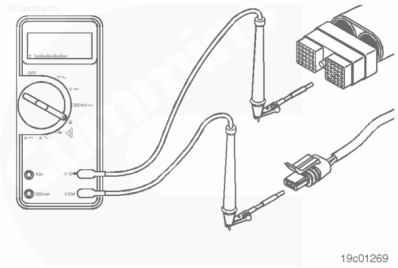
Check the OEM temperature sensor connector and OEM harness connectors for broken, bare, or melted wires; loose, dirty, damaged, or missing pins; and other visible signs of damage.



Resistance Check

⚠ CAUTION ⚠

Proper leads and/or a Cummins® approved circuit testing tool must be used when working with electrical connectors to prevent pin expansion and damage to the connector.

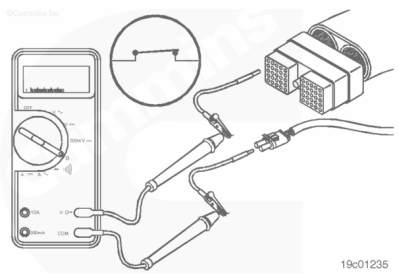


Disconnect the OEM harness engine interface connector. Disconnect the OEM temperature sensor from the OEM harness. Set the multimeter to measure resistance.

Insert a test lead into the OEM temperature sensor signal pin of the OEM harness connector. Connect the alligator clip to a multimeter probe. Insert the second test lead to the signal pin of the OEM temperature sensor harness connector and connect the clip to the other multimeter probe. Measure the resistance.

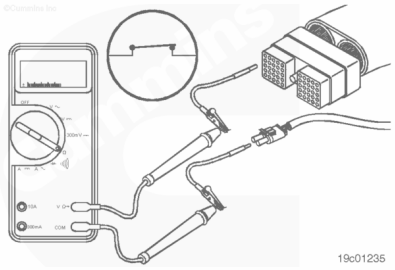
The multimeter **must** show a measurement of 10 ohms or less (closed circuit).

If the measured value is more than 10 ohms, there is an open circuit in the signal wire.



Repair or replace the OEM harness. Refer to Procedure 019-071 (/qs3/pubsys2/xml/en/procedures/99/99-019-071.html).

Repeat the resistance check for the return wire. Measure the resistance from the OEM temperature sensor return pin of the OEM harness connector to the OEM temperature sensor return pin of the harness connector.



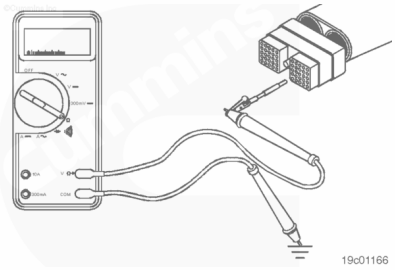
The multimeter **must** show a measurement of 10 ohms or less (closed circuit).

If the measured value is more than 10 ohms, there is an open circuit in the return wire.

Repair or replace the OEM harness. Refer to Procedure 019-071 (/qs3/pubsys2/xml/en/procedures/99/99-019-071.html).

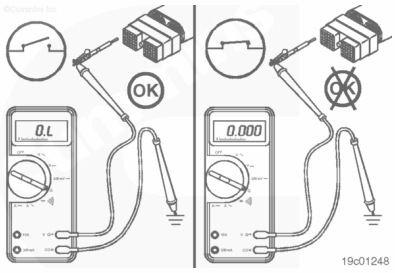
Check for Short Circuit to Ground

Disconnect the OEM harness engine interface connector. Disconnect the OEM temperature sensor from the OEM harness. Set the multimeter to measure resistance.



Insert the test lead into the OEM temperature sensor signal pin of the OEM harness connector. Touch the other multimeter probe to engine block ground. Measure the resistance.

The multimeter **must** show a measurement of 100k ohms or more (open circuit).



If the measured value is less than 100k ohms, there is a short circuit to ground in the signal wire.

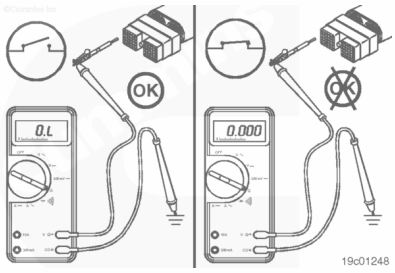
Repair or replace the OEM harness. Refer to Procedure 019-071 (/qs3/pubsys2/xml/en/procedures/99/99-019-071.html).

Repeat the short-to-ground check for the return wire. Measure the resistance from the OEM temperature sensor return pin of the OEM harness connector to engine block ground.

The multimeter **must** show a measurement of 100k ohms or more (open circuit).

If the measured value is less than 100k ohms, there is a short circuit to ground in the return wire.

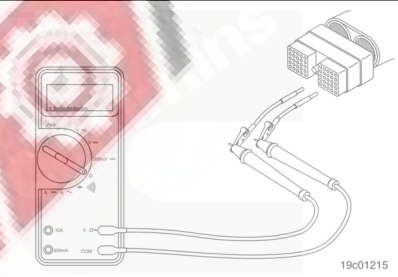
Repair or replace the OEM harness. Refer to Procedure 019-071 (/qs3/pubsys2/xml/en/procedures/99/99-019-071.html).



Check for Short Circuit from Pin to Pin

Disconnect the OEM harness engine interface connector. Disconnect the OEM temperature sensor from the OEM harness. Set the multimeter to measure resistance.

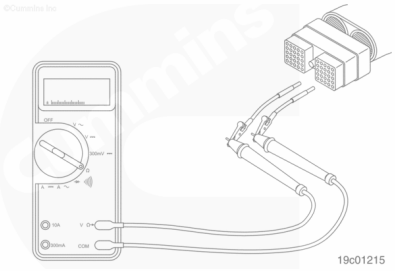
Measure the resistance from the OEM temperature sensor signal pin in the OEM harness connector to all other pins in the connector.



The multimeter **must** show a measurement of 100k ohms or more (open circuit).

If the measured value is less than 100k ohms, there is a short circuit between the signal wire and any other pin that measured a closed circuit.

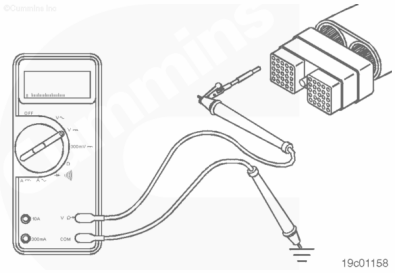
Repair or replace the OEM harness. Refer to Procedure 019-071 (/qs3/pubsys2/xml/en/procedures/99/99-019-071.html).



Check for Short Circuit to External Voltage Source

Disconnect the OEM harness engine interface connector. Disconnect the OEM temperature sensor from the OEM harness. Set the multimeter to measure VDC. Turn the vehicle keyswitch to the ON position.

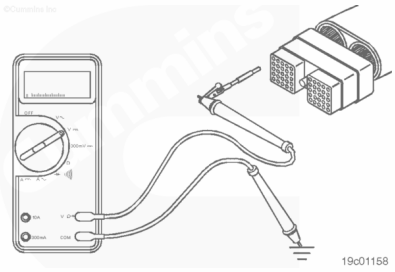
Insert the test lead connected to the positive (+) multimeter probe into the OEM temperature sensor signal pin of the OEM harness connector. Touch the negative (-) multimeter probe to engine block ground and measure the voltage.



ANADOLU ISUZU GENUINE PARTS

The multimeter **must** show voltage of 5.5 VDC or less. If the voltage is incorrect, there is a short circuit from the signal wire to an external voltage source.

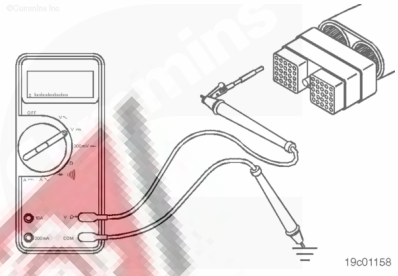
Repair or replace the OEM harness. Refer to Procedure 019-071 (/qs3/pubsys2/xml/en/procedures/99/99-019-071.html).



Repeat the short to external voltage source check for the return wire. Measure the voltage from the OEM temperature sensor return pin of the OEM harness connector to engine block ground.

The multimeter **must** show voltage of 5.5 VDC or less. If the voltage is incorrect, there is a short circuit from the return wire to an external voltage source.

Repair or replace the OEM harness. Refer to Procedure 019-071 (/qs3/pubsys2/xml/en/procedures/99/99-019-071.html).



Last Modified: 29-Jun-2015

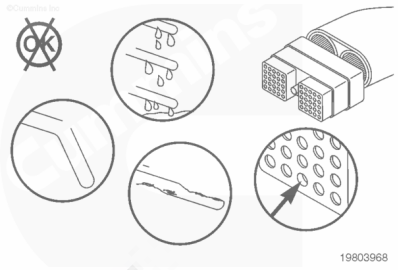
ANADOLU ISUZU AFTER SALES

Initial Check

Disconnect the intake air heater control relay from the original equipment manufacturer (OEM) harness.

Disconnect the OEM harness engine interface connector. To determine the location of the connector, see the corresponding engine wiring diagram.

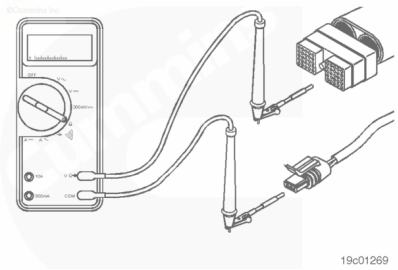
Check the intake air heater control relay and harness connector for broken, bare, or melted wires; loose, dirty, damaged, or missing pins; and other visible signs of damage.



Resistance Check

⚠ CAUTION ⚠

Proper leads and/or a Cummins® approved circuit testing tool must be used when working with electrical connectors to prevent pin expansion and damage to the connector.



Disconnect the OEM harness engine interface connector. Disconnect the intake air heater control relay from the OEM harness. Set the multimeter to measure resistance.

Insert a test lead into the intake air heater control relay signal pin of the OEM harness connector. Connect the alligator clip to a multimeter probe. Insert the second test lead to the signal pin of the intake air heater control relay harness connector and connect the clip to the other multimeter probe. Measure the resistance.

The multimeter **must** show a measurement of 10 ohms or less (closed circuit).

If the measured value is more than 10 ohms, there is an open circuit in the signal wire. Repair or replace the OEM harness. Refer to the OEM troubleshooting and repair manual.

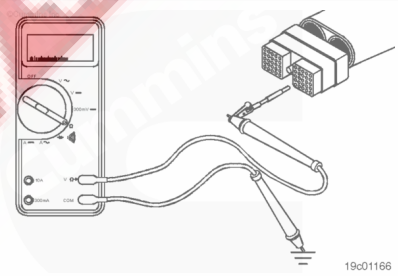
Repeat the resistance check for the return wire. Measure the resistance from the intake air heater control relay return pin of the OEM harness connector to the intake air heater control relay return pin of the harness connector.

The multimeter **must** show a measurement of 10 ohms or less (closed circuit).

If the measured value is more than 10 ohms, there is an open circuit in the return wire. Repair or replace the OEM harness. Refer to the OEM troubleshooting and repair manual.

Check for Short Circuit to Ground

Disconnect the OEM harness engine interface connector. Disconnect the intake air heater control relay from the OEM harness. Set the multimeter to measure resistance.



Insert the test lead into the intake air heater control relay signal pin of the OEM harness connector. Touch the other multimeter probe to engine block ground. Measure the resistance.

The multimeter **must** show a measurement of 100k ohms or more (open circuit).

If the measured value is less than 100k ohms, there is a short circuit to ground in the signal wire. Repair or replace the OEM harness. Refer to the OEM troubleshooting and repair manual.

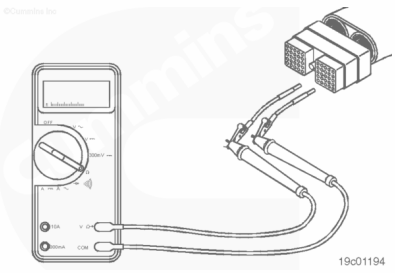
Repeat the short to ground check for the return wire. Measure the resistance from the intake air heater control relay return pin of the OEM harness connector to engine block ground.

The multimeter **must** show a measurement of 100k ohms or more (open circuit).

If the measured value is less than 100k ohms, there is a short circuit to ground in the return wire. Repair or replace the OEM harness. Refer to the OEM troubleshooting and repair manual.

Check for Short Circuit from Pin to Pin

Disconnect the OEM harness engine interface connector. Disconnect the intake air heater control relay from the OEM harness. Set the multimeter to measure resistance.



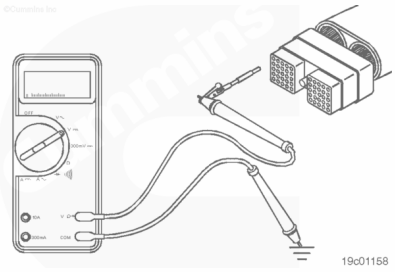
Measure the resistance from the intake air heater control relay signal pin in the OEM harness connector to all other pins in the connector.

The multimeter **must** show a measurement of 100k ohms or more (open circuit).

If the measured value is less than 100k ohms, there is a short circuit between the signal wire and any other pin that measured a closed circuit. Repair or replace the OEM harness. Refer to the OEM troubleshooting and repair manual.

Check for Short Circuit to External Voltage Source

Disconnect the OEM harness engine interface connector. Disconnect the intake air heater control relay from the OEM harness.



Set the multimeter to measure VDC. Turn the keyswitch to the ON position.

Insert the test lead connected to the positive (+) multimeter probe into the intake air heater control relay signal pin of the OEM harness connector. Touch the negative (-) multimeter probe to engine block ground and measure the voltage.

If voltage is present, there is a short circuit from the signal wire to an external voltage source. Repair or replace the OEM harness. Refer to the OEM troubleshooting and repair manual.

Repeat the short to external voltage source check for the return wire. Measure the voltage from the intake air heater control relay return pin of the OEM harness connector to engine block ground.

If voltage is present, there is a short circuit from the return wire to an external voltage source. Repair or replace the OEM harness. Refer to the OEM troubleshooting and repair manual.

Last Modified: 29-Jun-2015

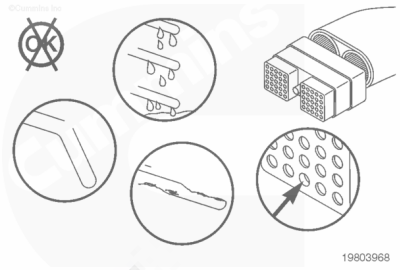


Initial Check

Disconnect the transmission shift modulator from the OEM harness.

Disconnect the OEM harness connector from the ECM connector.

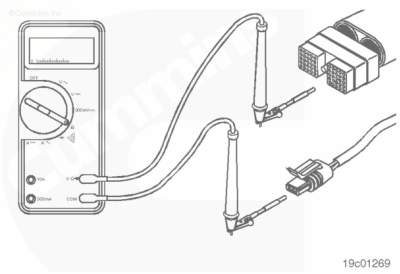
Check the transmission shift modulator and harness connector for broken, bare, or melted wires; loose, dirty, damaged, or missing pins; and other visible signs of damage.



Resistance Check

⚠ CAUTION ⚠

Proper leads and/or a Cummins® approved circuit testing tool must be used when working with electrical connectors to prevent pin expansion and damage to the connector.



Disconnect the OEM harness connector from the ECM connector. Disconnect the transmission shift modulator from the OEM harness. Set the multimeter to measure resistance.

Insert a test lead into the transmission shift modulator signal pin of the OEM harness connector. Connect the alligator clip to a multimeter probe. Insert the second test lead to the signal pin of the transmission shift modulator harness connector and connect the clip to the other multimeter probe. Measure the resistance.

The multimeter **must** show a measurement of 10 ohms or less (closed circuit).

If the measured value is more than 10 ohms, there is an open circuit in the signal wire. Repair or replace the OEM harness. Refer to the OEM troubleshooting and repair manual.

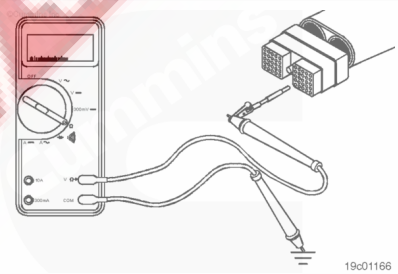
Repeat the resistance check for the return wire. Measure the resistance from the transmission shift modulator return pin of the OEM harness connector to the transmission shift modulator return pin of the harness connector.

The multimeter **must** show a measurement of 10 ohms or less (closed circuit).

If the measured value is more than 10 ohms, there is an open circuit in the return wire. Repair or replace the OEM harness. Refer to the OEM troubleshooting and repair manual.

Check for Short Circuit to Ground

Disconnect the OEM harness connector from the ECM connector. Disconnect the transmission shift modulator from the OEM harness. Set the multimeter to measure resistance.



Insert the test lead into the transmission shift modulator signal pin of the OEM harness connector. Touch the other multimeter probe to engine block ground. Measure the resistance.

The multimeter **must** show a measurement of 100k ohms or more (open circuit).

If the measured value is less than 100k ohms, there is a short circuit to ground in the signal wire. Repair or replace the OEM harness. Refer to the OEM troubleshooting and repair manual.

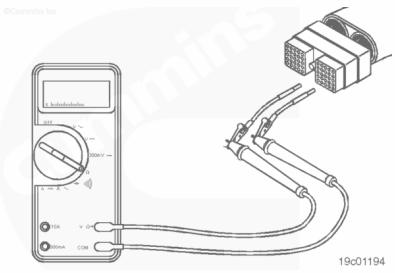
Repeat the short to ground check for the return wire. Measure the resistance from the transmission shift modulator return pin of the OEM harness connector to engine block ground.

The multimeter **must** show a measurement of 100k ohms or more (open circuit).

If the measured value is less than 100k ohms, there is a short circuit to ground in the return wire. Repair or replace the OEM harness. Refer to the OEM troubleshooting and repair manual.

Check for Short Circuit from Pin to Pin

Disconnect the OEM harness connector from the ECM connector. Disconnect the transmission shift modulator from the OEM harness. Set the multimeter to measure resistance.



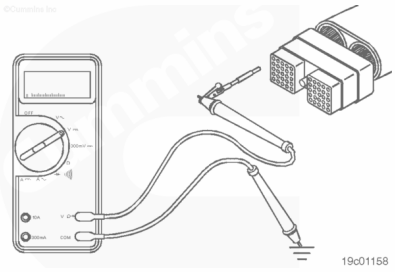
Measure the resistance from the transmission shift modulator signal pin in the OEM harness connector to all other pins in the connector.

The multimeter **must** show a measurement of 100k ohms or more (open circuit).

If the measured value is less than 100k ohms, there is a short circuit between the signal wire and any other pin that measured a closed circuit. Repair or replace the OEM harness. Refer to the OEM troubleshooting and repair manual.

Check for Short Circuit to External Voltage Source

Disconnect the OEM harness connector from the ECM connector. Disconnect the transmission shift modulator from the OEM harness.



Set the multimeter to measure VDC. Turn the keyswitch to the ON position.

Insert the test lead connected to the positive (+) multimeter probe into the transmission shift modulator signal pin of the OEM harness connector. Touch the negative (-) multimeter probe to engine block ground and measure the voltage.

The voltage **must** be 5.5-VDC or less.

If the voltage is incorrect, there is a short circuit from the signal wire to an external voltage source. Repair or replace the OEM harness. Refer to the OEM troubleshooting and repair manual.

Repeat the short to external voltage source check for the return wire. Measure the voltage from the transmission shift modulator return pin of the OEM harness connector to engine block ground.

If voltage is present, there is a short circuit from the return wire to an external voltage source. Repair or replace the OEM harness. Refer to the OEM troubleshooting and repair manual.

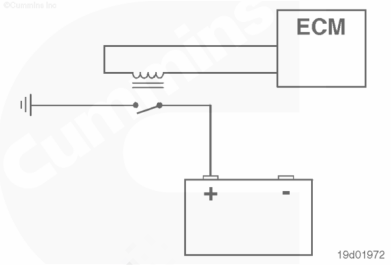
Last Modified: 17-Sep-2012



General Information

The ECM can control a starter lockout relay or an OEM relay.

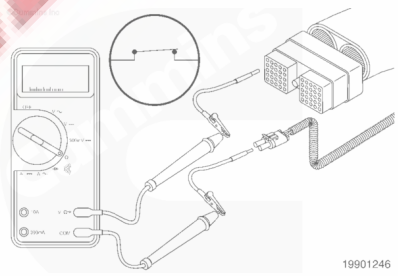
Refer to the vehicle manufacturer's publications for more information on troubleshooting and repair of the starter lockout relay or OEM relay.



Resistance Check

⚠ CAUTION ⚠

Proper leads and/or a Cummins® approved circuit testing tool must be used when working with electrical connectors to prevent pin expansion and damage to the connector.



Disconnect the original equipment manufacturer (OEM) harness engine interface connector. To determine the location of the connector, see the corresponding engine wiring diagram. Disconnect the OEM wiring at the starter lockout or OEM relay. Set the multimeter to measure resistance.

Insert a test lead into the starter lockout relay signal/switched output relay number 1 signal pin of the OEM harness connector and connect the alligator clip to a multimeter probe. Touch the other test lead to the starter lockout relay signal/switched output relay number 1 signal terminal at the component. Measure the resistance.

The multimeter **must** show 10 ohms or less (closed circuit).

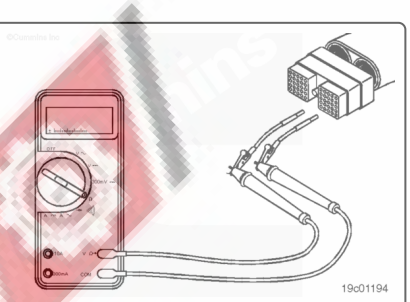
Check the return pin. Insert a test lead into the starter lockout relay signal/switched output relay number 1 return pin of the OEM harness connector and connect the alligator clip to a multimeter probe. Touch the other test lead to the starter lockout relay signal/switched output relay number 1 return terminal at the component. Measure the resistance.

The multimeter **must** show 10 ohms or less (closed circuit).

If the circuit is closed, it **must** still be checked for a short circuit from pin to pin.

If the circuit is **not** closed, there is a connection problem or an open circuit in the harness.

Check for Short Circuit from Pin to Pin



Check for a short circuit between the starter lockout relay signal/switched output relay number 1 signal pin and all other pins in the OEM harness connector.

Disconnect the OEM harness engine interface connector.

Set the multimeter to measure resistance.

Disconnect the starter lockout or OEM relay from the OEM harness.

Insert a test lead into the signal pin of the OEM harness connector, and connect the alligator clip to a multimeter probe. Insert the second test lead to the first pin in the OEM harness connector, and connect the alligator clip to the other multimeter probe.

Measure the resistance from the signal pin to all other pins in the connector, one at a time.

The multimeter **must** show 100k ohms or more (open circuit) at all pins.

If any pin-to-pin check shows a closed circuit, there is a short circuit between the applicable pins that measured a closed circuit.

Repair or replace the OEM harness. Refer to the OEM troubleshooting and repair manual.

ANADOLU ISUZU PARTS

Last Modified: 29-Jun-2015

Select Service Tools

Recommended Cummins® Service Tools

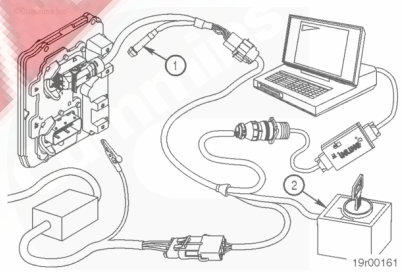
- No Cummins® service tools required.

Additional Service Items

- No additional service items required.

General Information

Engine Control Module (ECM) ROM Boot Procedure:



- Install the calibration cable with ROM boot switch.
- With the keyswitch (2) in the OFF position, press the ROM boot switch (1), located on the ECM-specific calibration adapter harness, and hold.
- Switch the keyswitch to the ON position while holding the ROM boot switch down, wait for five seconds.
- Release the ROM boot switch.
- Recalibrate the ECM. Refer to Procedure 019-032 in Section 19. (/qs3/pubsys2/xml/en/procedures/105/105-019-032.html)
- Remove the ROM boot cable from the ECM.

For general tool information, including the correct installation configuration, see the ECM-specific calibration adapter cable with ROM boot switch in the ECM Bench Calibration Base Harness, Bulletin 3377791.

ANADOLU ISUZU
AFTER SALES

Last Modified: 03-Feb-2017

Select Service Tools

Recommended Cummins® Service Tools

- Digital multimeter, Part Number 3164489

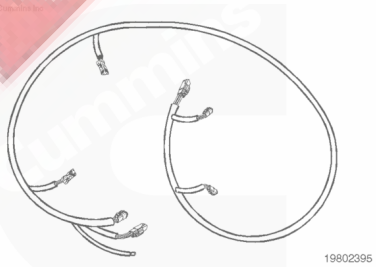
Additional Service Items

- Appropriate test lead(s)

General Information

⚠ CAUTION ⚠

Proper leads and/or a Cummins® approved circuit testing tool must be used when working with electrical connectors to prevent pin expansion and damage to the connector.



The engine data link consists of circuitry located in the engine wiring harness which transmits digital information between the engine control module (ECM) and other devices on the engine and chassis. On older engines, the engine data link circuitry supports J1587/J1708 protocol. On newer engines, the engine data link circuitry supports J1939 protocol.

The engine data link provides an access point for a service tool, such as a recommended Cummins® electronic service tool or equivalent, to communicate with the ECM. A service tool can communicate with the ECM on the engine data link free from data link traffic from other electronic devices that can be present on the OEM data link.

The data link network on model year 2016 and newer engines can operate at either 250K baud or 500K baud rates. Baud rate refers to the speed at which information is broadcasted on a data link network. Only one baud rate can be set for any data link network. The default baud rate for model year 2016 and newer engines is 500K baud. The default baud rate for model year 2015 and older engines is 250K baud.

Applications equipped with data link networks capable of supporting 500K baud data link speeds are differentiated by the key pattern on the 9 pin data link connector. This connector is also a different color from the 9 pin connectors that support only 250K baud data link speeds. An adapter tool, Part Number 5299126, is available in order to connect to applications equipped with 500K baud data link networks through the 9 pin connector.

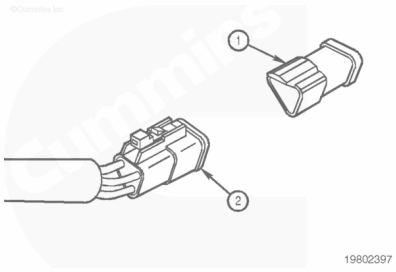
SAE J1939 Backbone Harness Overview:

SAE J1939 has strict guidelines that **must** be followed for successful communication. Understanding some fundamentals about SAE J1939 will help make sure these guidelines are followed.

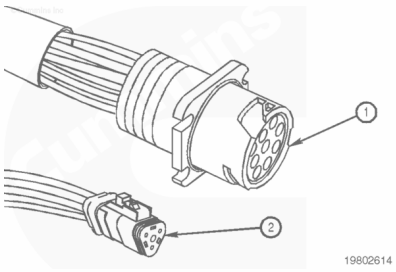
The main component of an SAE J1939 system is a backbone harness. The harness can be up to 40 m [131 ft] long. The backbone harness is terminated at each end with 120 ohm resistors.

A maximum of 30 different devices can be attached to the SAE J1939 backbone at once. Each device, such as the data link adapter, is connected to the backbone through a stub which can be up to 1 m [3.2 ft] in length. The stub connector is a 3-pin plug.

The terminating resistor caps (1) **must** be in place on the OEM backbone harness plugs (2) to maintain proper communication. Each resistor is 120 ohms and is located in a removable cap. This resistance is required when communicating with a recommended Cummins® electronic service tool or equivalent over the J1939 data link.



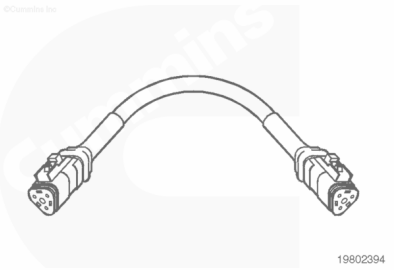
Some engine harnesses include a complete SAE J1939 backbone harness. If this is supplied, connection to a recommended Cummins® electronic service tool or equivalent is accomplished either by a 9-pin data link connector (1), Part Number 4918416, or a 3-pin receptacle (2), Part Number 3165141.



To check for the J1939 backbone, turn the keyswitch to the OFF position. Measure the resistance from the SAE J1939 data link positive (+) pin to the SAE J1939 data link negative (-) pin of the 3-pin Deutsch™ connector.

The multimeter will show 60 ohms when the engine harness has provided a backbone on the data link bus.

If the engine harness does **not** supply the J1939 backbone harness and the data link connector is a 3-pin receptacle, a mini-backbone harness will have to be added.



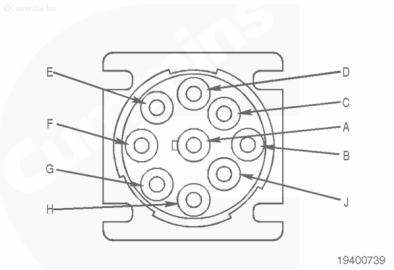
Engine Data Link Connectors

The engine data link connector available on the engine harness will depend upon the data link circuitry in the engine harness and the vintage of the engine. Engine data link connectors available on Cummins® engines are summarized in the table below.

Connector Type	Data Link Protocols Supported
2-pin Weather Pack™	J1587/J1708
3-pin Deutsch™	J1939
6-pin Deutsch™	J1587/J1708
9-pin Deutsch™	J1587/J1708, J1939

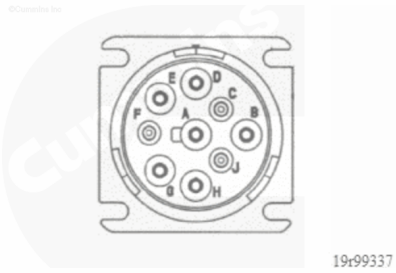
Each connector type is described in more detail in the following information.

The 9-pin Deutsch™ connector can supply SAE J1587/SAE 1708 and SAE J1939 communications at 250k baud data link speed, and battery voltage. The following are pin-outs for the 9-pin connector:



Type I (250k)	
Pin	**Signal**
A	Ground
B	Unswitched Battery
C	J1939 data link (+)
D	J1939 data link (-)
E	J1939 data link (shield) (**not** applicable for Marine)
F	J1708 data link (+)
G	J1708 data link (-)
H	Open
J	Open

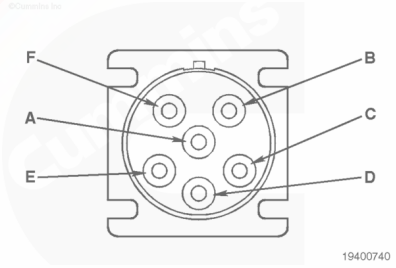
A similar 9-pin Deutsch™ connector can also supply SAE J1939 communications at 500K baud data link speed, and battery voltage. The following are pin-outs for the 9-pin connector:



19r99337

Type II Green (500K)	
Pin	**Signal**
A	Ground
B	Unswitched Battery
C	J1939 data link (+)
D	J1939 data link (-)
E	J1939 data link (shield) (**not** applicable for Marine)
F	J1708 data link (+)
G	J1708 data link (-)
H	Open
J	Open

The 6-pin Deutsch™ connector, Part Number 3824805, is found on some engines. This connector supplies SAE J1587/J1708, as well as the battery voltage. The following are pin-outs for the 6-pin connector:



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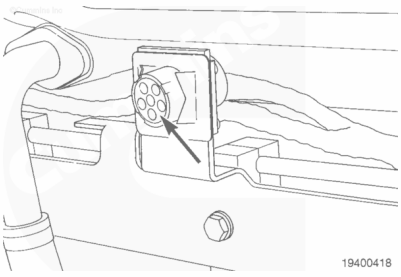
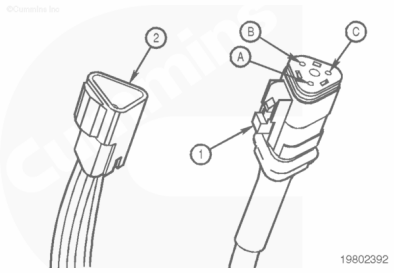
Pin	Signal
A	J1708 data link (+)
B	J1708 data link (-)
C	Unswitched battery (+)
D	Open
E	Ground
F	Open

Note : For CELECT Plus™ engines, do **not** use the in-cab 6-pin data link connector to calibrate the ECM. Use the data link connector found on the engine.


19400418

The 3-pin SAE J1939 Deutsch™ connectors are also found on some Cummins® engine harnesses. Two possible types of 3-pin connectors can be present: A 3-pin plug (1), Part

Number 3824288; and a 3-pin receptacle (2), Part Number 3824290. The following are the pin-outs for the 3-pin connector:



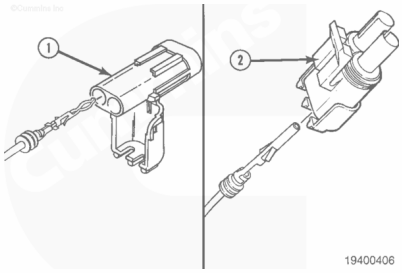
Pin	Signal
A	J1939 data link (+)
B	J1939 data link (-)
C	J1939 data link (shield)

The 3-pin connector **only** supports the SAE J1939 data link.

To meet the SAE J1939 standard, the 3-pin receptacle connector **must** be within 0.66 m [2.16 ft] of the ECM. Use of the J1939 mini-backbone harness, Part Number 3163096, may be required for proper termination resistance. The mini-backbone harness is required when **no** backbone is provided on the data link. Gender changer cable, Part Number 3163597, may be required to connect the mini-backbone harness to the engine harness or service tool cable.

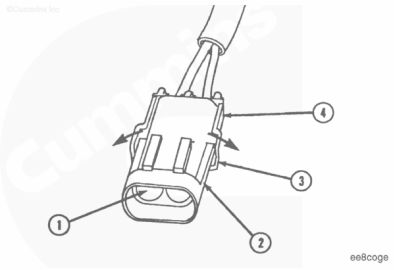
Note : If there is 60 ohm resistance measured between pins A and B of the 3-pin connector, a backbone is on the data link.

The 2-pin connector is on many older engines, and **only** supplies SAE J1587/J1708 support (no battery voltage supply). The following are the pin-outs for the 2-pin connector:



Pin	Signal
A	J1587/J1708 data link (+)
B	J1587/1708 data link (-)

Some engines have a 2-pin service tool power supply Weather Pack™ receptacle located in the engine harness. It can be used to power up any service tool device.

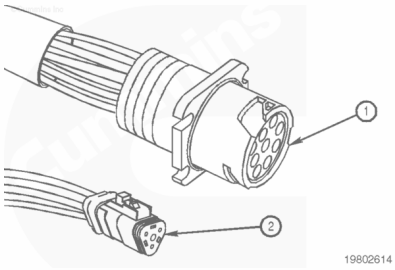


Pin	Signal
A	Unswitched battery (+)
B	Ground (-)

Resistance Check

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.



⚠ CAUTION ⚠

For the J1939 engine data link, use test lead, Part Number 3822758, on the ECM connector to avoid damage to the connector pins. Use test lead, Part Number 3824811, for the 9-pin Deutsch™ connector. Use test lead, Part Number 3823993 for the 3-pin Deutsch™ connector pin receptacle or test lead, Part Number 3823994 for the 3-pin Deutsch™ connector.

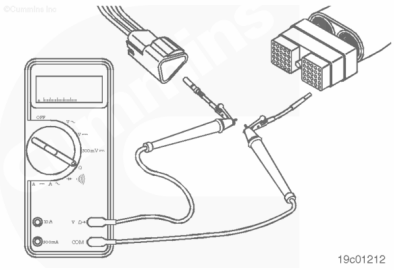
⚠ CAUTION ⚠

For the J1587/J1708 engine data link, use test lead, Part Number 3622758, on the ECM connector to reduce the possibility of damage to the connector pins. Use test lead 3824800 for the 6-pin Deutsch™ connector. Use test lead 3823995 for the 2-pin Packard™ connector.

Determine the type of engine data link available on the engine, either J1939 or J1587/J1708. Follow the instructions provided to measure the resistance for the type of engine data link identified.

J1939 Engine Data Link

- Disconnect the batteries.
- Disconnect the engine harness connector from the ECM. Turn the keyswitch to the OFF position.



Insert a test led into the SAE J1939 data link positive (+) pin of the engine harness ECM connector, and connect it to the multimeter probe. Insert the other test lead into the SAE J1939 data link positive (+) pin of the 3-pin or 9-pin Deutsch™ connector, and connect it to the multimeter.

Measure the resistance. The multimeter **must** show a closed circuit (10 ohms or less).

If the circuit is **not** closed, repair or replace the engine harness.

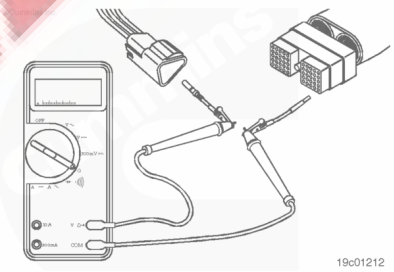
See the Troubleshooting and Repair manual for additional information.

Insert the multimeter lead into the SAE J1939 data link negative (-) of the engine harness ECM connector. Touch the other lead to the SAE J1939 data link negative (-) pin of the 3-pin or 9-pin Deutsch™ connector. Measure the resistance. The multimeter **must** show a closed circuit (10 ohms or less).

If the circuit is **not** closed, repair or replace the engine harness.

See the Troubleshooting and Repair manual for additional information.

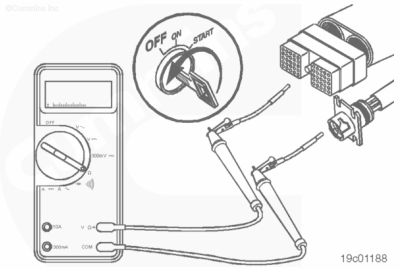
If the values are correct, the circuit **must** still be checked for a short circuit to ground and a short circuit from pin-to-pin.



Remove the lead from the SAE J1939 data link negative (-) pin of the engine harness ECM connector and insert it into the SAE J1939 data link (shield) pin. Touch the negative multimeter lead to the SAE J1939 data link (shield) pin of the 3-pin or 9-pin Deutsch™ connector. Measure the resistance.

The multimeter **must** show a closed circuit (10 ohms or less). If more than 10 ohms are measured in any of these steps, there could be an open circuit in the SAE J1939 data link (shield) pin, the SAE J1939 data link negative (-) pin, or the SAE J1939 data link positive (+) pin, or the polarity is **not** correct.

J1587/J1708 Engine Data Link



Turn the keyswitch to the OFF position. Disconnect the engine harness from the ECM.

Insert a test lead into the SAE J1587 data link positive (+) pin of the engine harness ECM connector and connect it to a multimeter probe. Insert the other test lead into the SAE J1587 data link positive (+) pin of the 2-pin or 6-pin connector and connect it to the other multimeter probe. Measure the resistance. The multimeter **must** show a closed circuit (10 ohms or less).

If the circuit is **not** closed, repair or replace the engine harness.

See the Troubleshooting and Repair manual for additional information.

Remove the test lead from the SAE J1587 data link positive (+) pin and insert it into the SAE J1587 data link negative (-) pin of the ECM connector. Remove the other test lead from the SAE J1587 data link positive (+) pin and insert it into the SAE J1587 data link negative (-) pin of the 2-pin or 6-pin connector. Measure the resistance. The multimeter **must** show a closed circuit (10 ohms or less).

If the circuit is **not** closed, repair or replace the engine harness.

See the Troubleshooting and Repair manual for additional information.

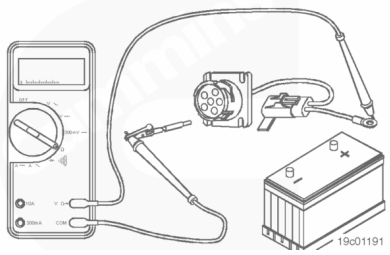
Remove the test lead from the SAE J1587 data link negative (-) pin and insert it into the battery negative (-) pin of the 6-pin Deutsch™ connector. Remove the test lead from the SAE J1587 data link negative (-) pin of the engine connector and disconnect it from the multimeter probe. Touch the multimeter probe to the engine block ground. Measure the resistance. The multimeter should show a closed circuit (10 ohms or less).

If the circuit is not closed, repair or replace the engine harness.

See the Troubleshooting and Repair manual for additional information.

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.



⚠ CAUTION ⚠

Use test lead, Part Number 3824811, for the 6-pin Deutsch™ connector.

Disconnect the batteries.

Measure the resistance from the positive (+) battery terminal to battery positive (+) of the 6-pin Deutsch™ connector. The multimeter **must** show a closed circuit (10 ohms or less).

If the circuit is **not** closed, repair or replace the engine harness.

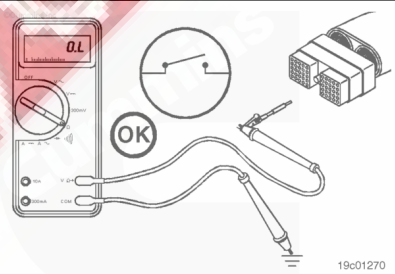
See the Troubleshooting and Repair manual for additional information.

If the values are correct, the circuit **must** still be checked for a short circuit to ground and a short circuit from pin-to-pin.

Check for Short Circuit to Ground

⚠ CAUTION ⚠

For the J1939 engine data link, use test lead, Part Number 3822758, on the ECM connector to avoid damage to the connector pins.



⚠ CAUTION ⚠

For the J1587/J1708 engine data link, use test lead, Part Number 3822758, on the ECM connector to avoid damage to the connector pins.

Determine the type of engine data link available on the engine, either J1939 or J1587/J1708. Follow the instructions provided for short circuit to ground check for the type of engine data link identified.

J1939 Engine Data Link

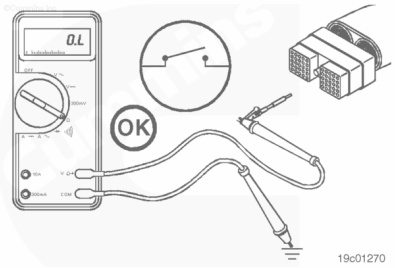
Disconnect the engine harness connector from the ECM. Insert a test lead into SAE J1939 data link positive (+) pin of the engine harness ECM connector and connect it to a multimeter probe. Touch the other multimeter probe to engine block ground.

Measure the resistance. The multimeter **must** show an open circuit (100k ohms or more).

If the circuit is **not** open, repair or replace the engine harness.

See the Troubleshooting and Repair manual for additional information.

Remove the test lead from the SAE J1939 data link positive (+) pin and insert it into the SAE J1939 data link negative (-) pin of the ECM connector. Measure the resistance from the SAE J1939 data link negative (-) pin of the engine harness ECM connector to the engine block ground. The multimeter **must** show an open circuit (100k ohms or more).



If the circuit is **not** open, repair or replace the engine harness.

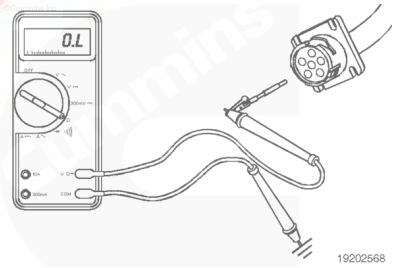
See the Troubleshooting and Repair manual for additional information.

If less than 100k ohms is measured in any of the previous steps, there is a short to circuit to ground. Repair or replace the engine harness.

See the Troubleshooting and Repair manual for additional information.

J1587/J1708 Engine Data Link

Disconnect the engine harness connector from the ECM.



Insert a test lead into the SAE J1587 data link positive (+) pin of the engine harness ECM connector and connect it to a multimeter probe. Touch the other multimeter probe to the engine block ground. Measure the resistance. The multimeter **must** show an open circuit (100k ohms or more).

If the circuit is **not** open, repair or replace the engine harness.

See the Troubleshooting and Repair manual for additional information.

Remove the test lead from the SAE J1587 data link positive (+) pin and insert it into the SAE J1587 data link negative (-) pin of the engine harness ECM connector. Touch the other multimeter probe to the engine block ground. Measure the resistance from the SAE J1587 data link negative (-) pin of the engine harness ECM connector to the engine block ground. The multimeter **must** show an open circuit (100k ohms or more).

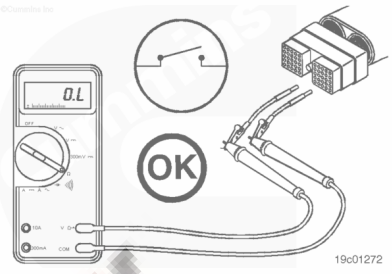
If the circuit is **not** open, repair or replace the engine harness.

See the Troubleshooting and Repair manual for additional information.

Check for Short Circuit from Pin-to-Pin

⚠ CAUTION ⚠

For the J1939 engine data link, use test lead, Part Number 3822758, on the ECM connector to avoid damage to the connector pins.



⚠ CAUTION ⚠

For the J1587/J1708 engine data link, use test lead, Part Number 3822758, on the ECM connector to avoid damage to the connector pins.

J1939 Engine Data Link

Disconnect the engine harness connector from the ECM.

Insert a test lead into the SAE J1939 data link positive (+) pin of the engine harness ECM connector and connect it to the multimeter probe. Insert the other test lead into another pin in the connector of the engine harness ECM connector and connect it to the other multimeter probe.

Measure the resistance from the SAE J1939 data link positive (+) pin to the first pin in the connector. The multimeter **must** show an open circuit (100k ohms or more).

If the circuit is **not** open, repair or replace the engine harness.

See the Troubleshooting and Repair manual for additional information.

Remove the lead from the first pin in the connector and measure the resistance from the SAE J1939 data link positive (+) pin of the engine harness ECM connector to all other pins in the connector, one at a time. The multimeter **must** show an open circuit (100k ohms or more) at all pins.

If the circuit is **not** open, repair or replace the engine harness.

See the Troubleshooting and Repair manual for additional information.

Remove the test lead from the J1939 data link positive (+) pin and insert it into the J1939 data link (shield) pin of the engine harness ECM connector. Insert the other test lead into another pin in the connector. Measure the resistance.

The multimeter **must** show an open circuit (100k ohms or more).

If the circuit is **not** open, repair or replace the engine harness.

See the Troubleshooting and Repair manual for additional information.

Measure the resistance from the SAE J1939 data link (shield) pin to all other pins in the connector, one at a time. The multimeter **must** show an open circuit (100k ohms or more).

If the circuit is **not** open, repair or replace the engine harness.

See the Troubleshooting and Repair manual for additional information.

Remove the test lead from the SAE J1939 data link (shield) pin and insert it into the SAE J1939 data link negative (-) pin of the engine harness ECM connector. Insert the other test lead into another pin in the connector. Measure the resistance.

The multimeter **must** show an open circuit (100k ohms or more).

If the circuit is **not** open, repair or replace the engine harness.

See the Troubleshooting and Repair manual for additional information.

Measure the resistance from the SAE J1939 data link negative (-) pin of the engine harness connector to all other pins in the connector, one at a time. The multimeter **must** show an open circuit (100k ohms or more).

If the circuit is **not** open, repair or replace the engine harness.

See the Troubleshooting and Repair manual for additional information.

ANADOLU ISUZU PARTS

J1587/J1708 Engine Data Link

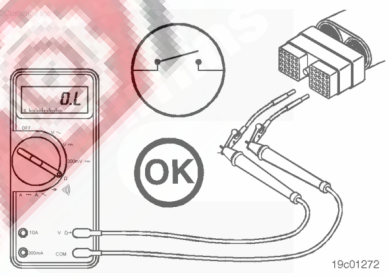
Disconnect the engine harness connector from the ECM.

Insert a test lead into the SAE J1587 data link positive (+) pin of the engine harness ECM connector and connect it to the multimeter probe. Insert the other test lead into another multimeter probe. Measure the resistance. The multimeter **must** show an open circuit (100k ohms or more).

If the circuit is **not** open, repair or replace the engine harness.

See the Troubleshooting and Repair manual for additional information.

Remove the lead from the first pin in the connector and test all other pins in the connector. Measure the resistance from the SAE J1587 data link positive (+) pin of the engine harness ECM connector to all other pins in the connector, one at a time. The multimeter **must** show an open circuit (100k ohms or more).



Remove the test lead from the SAE J1587 data link positive (+) pin of the engine harness ECM connector and insert it into the SAE J1587 data link negative (-) pin.

Measure the resistance from the SAE J1587 data link negative (-) pin to all other pins in the connector. The multimeter **must** show an open circuit (100k ohms or more) at all pins.

If the circuit is **not** open, repair or replace the engine harness.

See the Troubleshooting and Repair manual for additional information.

ANADOLU ISUZU

Last Modified: 27-Jan-2020

Select Service Tools

Recommended Cummins® Service Tools

- No Cummins® Service Tools required.

Additional Service Items

- No additional service items required.

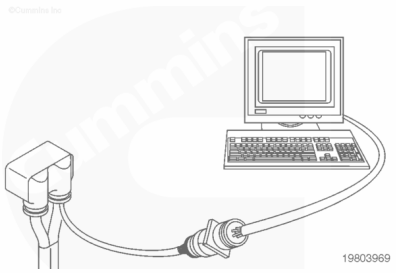
General Information

The aftertreatment diesel particulate filter (DPF) differential pressure sensor is a combination sensor that monitors the differential pressure across the DPF, as well as the pressure at the outlet of the DPF.

The aftertreatment DPF differential pressure sensor is located on the aftertreatment DPF.

Initial Check

Use INSITE™ electronic service tool to monitor the value of the aftertreatment DPF differential pressure sensor with the keyswitch in the ON position and the engine OFF.



The value of the aftertreatment DPF differential pressure should meet the following specification with the keyswitch in the ON position and the engine OFF.

At ambient temperature 25°C [77°F] and below, the reading should be between 0.61 and 0.77 VDC.

At ambient temperature 26°C [78°F] and above, the reading should be between 0.642 and 0.738 VDC.

If either value is out of specification, inspect the aftertreatment DPF differential pressure tubes for blockage. Refer to Procedure 011-041 in Section 11. (/qs3/pubsys2/xml/en/procedures/425/425-011-041-tr.html)

ANADOLU ISUZU PARTS SALES

If the aftertreatment DPF differential pressure tubes are **not** blocked, and if either sensor reading is out of specification, replace the aftertreatment DPF differential pressure sensor.

Preparatory Steps

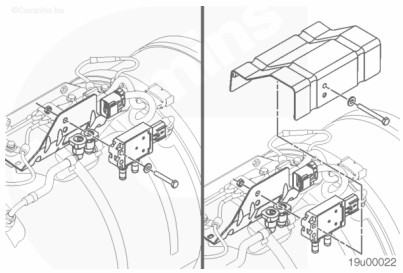
⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

- Disconnect the batteries. See equipment manufacturer service information.

Remove

DPF Mounted Aftertreatment DPF Differential Pressure Sensor:



Note : If the DPF is equipped with a heat shield, there is a spacer located between the heat shield and DPF differential pressure sensor. Note the location and orientation of this spacer before removal.

To remove the DPF differential pressure sensor:

- Disconnect the sensor connector from the aftertreatment interface harness.
- Remove the mounting capscrew.

If the DPF is equipped with a heat shield, the DPF differential pressure sensor mounting bolts are used to secure the heat shield as well. Refer to Procedure 011-032 in Section 11. (/qs3/pubsys2/xml/en/procedures/425/425-011-032.html)

If equipped with a remote mounted aftertreatment DPF differential pressure sensor:

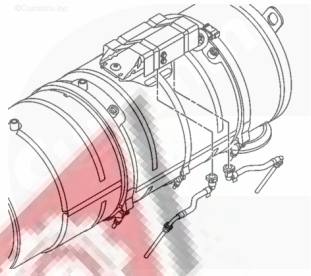
GRAPHIC NOT FOUND

- Depending on the original equipment manufacturer (OEM) installation it can be easier to access the aftertreatment DPF differential pressure sensor if the

aftertreatment DPF differential pressure sensor insulation box frame is removed.

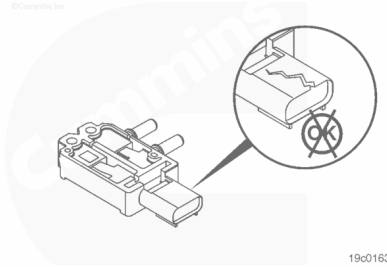
- Remove the fasteners that secure the aftertreatment DPF differential pressure sensor insulation box frame.
- Slide the aftertreatment DPF differential pressure sensor insulation box down the aftertreatment DPF differential pressure sensor tubes. See equipment manufacturer service information.

Remove the quick disconnect fittings of the differential pressure sensor tubes from the aftertreatment differential pressure sensor by pressing in the locking tangs on the quick-disconnect fitting.



Clean and Inspect for Reuse

Inspect the inside of the tube connections on the sensor for plugging or soot buildup. If plugging or soot buildup is seen, the aftertreatment DPF differential pressure tubes must be cleaned. Refer to Procedure 011-041 in Section 11. (/qs3/pubsys2/xml/en/procedures/425/425-011-041-tr.html)



Inspect the aftertreatment interface harness connector and sensor for the following:

- Cracked or broken connector
- Missing or damaged connector seals
- Dirt, debris, or moisture in or on the connector pins
- Corroded, bent, broken, pushed back, or expanded pins
- Chipped, cracked, extruded, or damaged sensor.

Repair or replace parts as necessary.

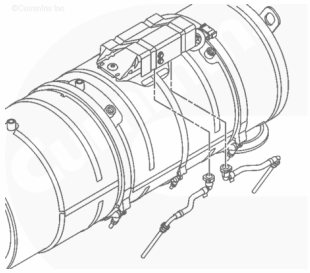
If equipped with a remote mounted aftertreatment DPF differential pressure sensor, inspect the aftertreatment DPF differential pressure sensor insulation box and cage for damage. Replace if damage is found.

GRAPHIC NOT FOUND

Install

DPF Mounted Aftertreatment DPF Differential Pressure Sensor:

If equipped with a DPF mounted aftertreatment DPF differential pressure sensor, install the quick disconnect fittings of the differential pressure sensor tubes to the aftertreatment differential pressure sensor.



DPF Mounted Aftertreatment DPF Differential Pressure Sensor:

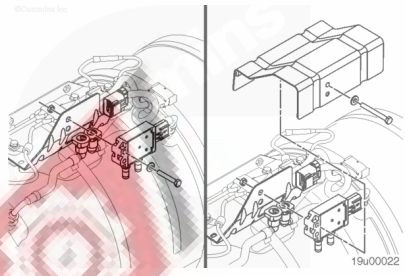
Install the aftertreatment DPF differential pressure sensor onto the mounting bracket.

If the aftertreatment DPF is equipped with a heat shield, the heat shield must be installed at the same time as the DPF differential pressure sensor. Refer to Procedure 011-032 in Section 11. (/qs3/pubsys2/xml/en/procedures/425/425-011-032.html)

Install and tighten the mounting capscrew.

Torque Value: 14 n•m [124 in-lb]

Connect the wiring aftertreatment interface harness to the aftertreatment DPF differential pressure sensor.



Remote Mounted Aftertreatment DPF Differential Pressure Sensor:

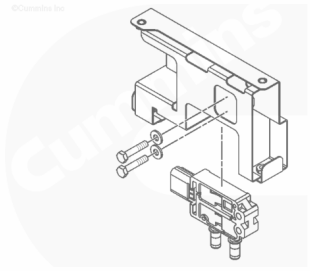
If equipped with a remote mounted aftertreatment DPF differential pressure sensor, install the aftertreatment DPF differential pressure sensor insulation box cage onto the chassis. See equipment manufacturer service information.

Install the aftertreatment DPF differential pressure sensor onto the mounting bracket.

Install and tighten the mounting capscrews.

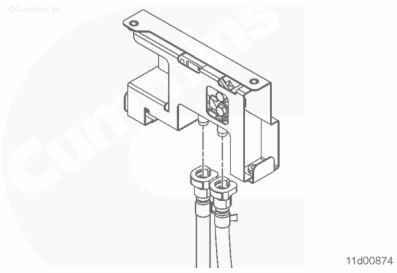
Torque Value: 14 n•m [124 in-lb]

Connect the aftertreatment interface harness to the aftertreatment DPF differential pressure sensor.



Remote Mounted Aftertreatment DPF Differential Pressure Sensor:

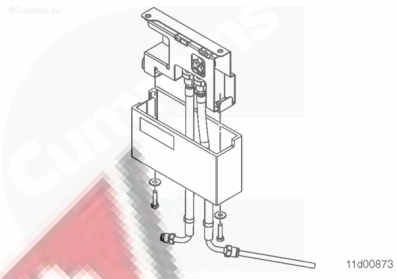
Install the quick-disconnect fittings of the differential pressure sensor tubes to the aftertreatment differential pressure sensor.



Remote Mounted Aftertreatment DPF Differential Pressure Sensor:

Slide the aftertreatment DPF differential pressure sensor insulation box up the aftertreatment DPF differential pressure sensor tubes.

Install the capscrews that secure the aftertreatment DPF differential pressure sensor insulation box.



Torque Value: 14 n•m [124 in-lb]

Finishing Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

- Connect the batteries. See equipment manufacturer service information.
- Operate the engine. Check for leaks.

ANADOLU ISUZU AFTERSALES

Last Modified: 26-Jan-2021

Select Service Tools

Recommended Cummins® Service Tools

- No Cummins® Service Tools required.

Additional Service Items

- No additional service items required.

General Information

The crankcase pressure sensor is used to monitor the pressure in the crankcase.

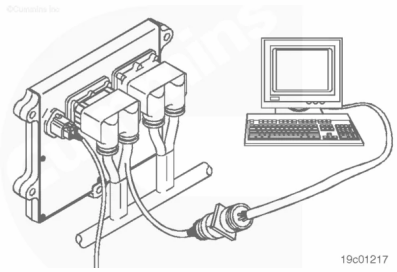
The crankcase pressure sensor is located near the crankcase ventilation filter. Use the following procedure for a detailed component location view. Refer to Procedure 100-002 in Section E. (/qs3/pubsys2/xml/en/procedures/425/425-100-002.html)

Depending on the breather system used, the crankcase pressure sensor will be located:

1. On top of the rocker lever cover
2. At the rear of the engine, on the external crankcase ventilation filter housing that mounts to the flywheel housing.

Initial Check

Use INSITE™ electronic service tool to monitor the value of the crankcase pressure sensor with the keyswitch ON and the engine **not** running.



The crankcase pressure sensor value should read as follows:

Measurements		
	kpa	in-hg
Crankcase Pressure Sensor	0 ±0.63	0 ±0.18

ANADOLU ISUZU AFTER SALES

If the crankcase pressure value is out of specification, replace the crankcase pressure sensor.

Preparatory Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

- Disconnect the batteries. See equipment manufacturer service information.
- Clean the area around the crankcase pressure sensor.

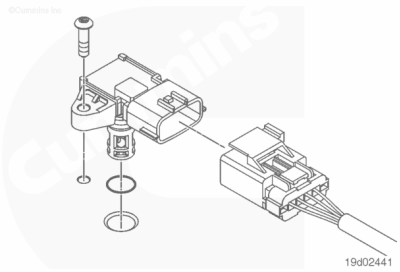
Remove

Disconnect the pressure sensor connector from the engine harness.

Remove the mounting capscrew.

Remove the sensor from the engine by pulling straight up on the sensor.

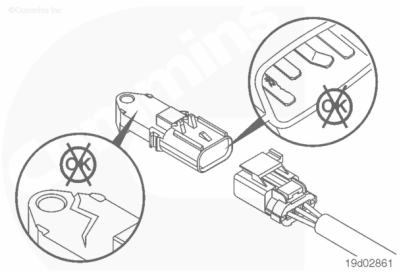
Be careful **not** to damage the o-ring when removing the sensor.



Clean and Inspect for Reuse

Inspect the engine harness connector and crankcase pressure sensor for the following:

- Cracked or broken connector shell
- Missing or damaged connector seals
- Dirt, debris, or moisture in or on the connector pins
- Corroded, bent, broken, pushed back, or expanded pins
- Chipped, cracked, extruded, or damaged sensor



ANADOLU ISUZU AFTER SALES

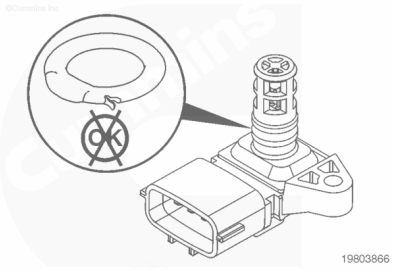
- Connector base between the sensor body and the connector shell.

Clean, repair, or replace parts, as necessary.

Inspect the crankcase pressure sensor o-ring for the following:

- Swollen o-ring
- Nicks or cuts in the o-ring.

Replace the o-ring if any damage is found.



Install

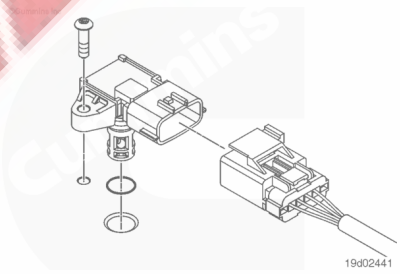
Lubricate the o-ring with clean engine oil before installation.

Install the crankcase pressure sensor by pressing firmly on the top of the sensor until the o-ring is fully seated.

Install and tighten the mounting capscrew.

Torque Value: 7 n•m [62 in-lb]

Connect the engine harness to the crankcase pressure sensor.



Finishing Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

- Connect the batteries. See equipment manufacturer service information.
- Operate the engine. Check for leaks.

ANADOLU ISUZU AFTER SALES


ANADOLU ISUZU
AFTER SALES

Select Service Tools

Recommended Cummins® Service Tools

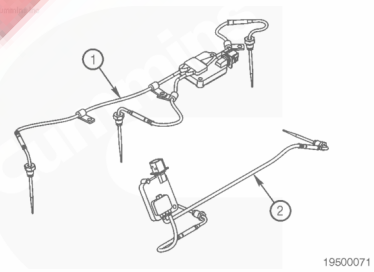
- Anti-seize, Part Number 3824397, or equivalent

Additional Service Items

- Small screwdriver
- Contact cleaner

General Information

Due to the number of various aftertreatment configurations, this procedure has been written to be generic. **Not** all illustrations within this procedure will represent the application being serviced.



19500071

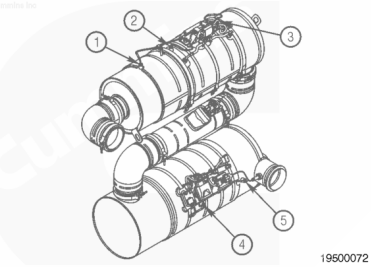
Due to the similarities between the aftertreatment diesel particulate filter (DPF) temperature sensor assembly and aftertreatment selective catalytic reduction (SCR) catalyst temperature sensor assembly, this procedure will cover both components.

The aftertreatment DPF temperature sensor assembly (1) is located on the aftertreatment DPF and consists of a module and three temperature sensor probes.

The aftertreatment SCR catalyst temperature sensor assembly (2) is located on the aftertreatment SCR catalyst and consists of a module and two temperature sensor probes.

The temperature sensor module and temperature sensor probes are **not** serviceable separately and **must** be replaced as an assembly.

Aftertreatment exhaust gas temperature sensor assemblies are used to measure the temperature of exhaust gas in the aftertreatment system.



19500072

The aftertreatment diesel oxidation catalyst (DOC) intake temperature sensor probe (1) is located closest to the turbocharger outlet.

The aftertreatment DPF intake temperature sensor probe (2) is located between the aftertreatment DOC and aftertreatment DPF.

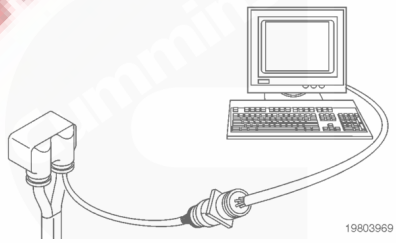
The aftertreatment DPF outlet temperature sensor probe (3) is located in the outlet of the aftertreatment DPF.

The aftertreatment SCR catalyst intake temperature sensor probe (4) is located in the intake of the aftertreatment SCR catalyst.

The aftertreatment SCR catalyst outlet temperature sensor probe (5) is located in the outlet of the aftertreatment SCR catalyst.

Initial Check

Use an electronic service tool to monitor the value of the aftertreatment exhaust gas temperature sensors with the keyswiitch in the ON position and the engine OFF.



The engine **must** be off long enough for coolant temperature to be equal to the local ambient air temperature.

The aftertreatment exhaust gas temperature sensors should read within 10°C or 50°F of the local ambient air temperature on a cold engine.

Replace any aftertreatment exhaust gas temperature sensor assembly with values out of specification.

Preparatory Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

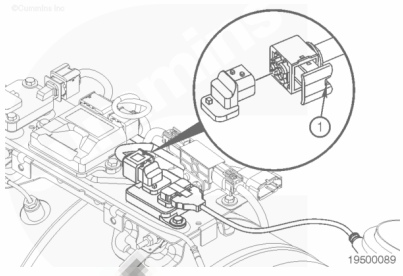
- Disconnect the batteries. See equipment manufacturer service information.
- Remove the sensor table heat shield, if equipped. Refer to Procedure 011-032 in Section 11. (/qs3/pubsys2/xml/en/procedures/425/425-011-032.html)

ANADOLU ISUZU GENUINE PARTS

Remove

⚠ WARNING ⚠

During regeneration, exhaust gas temperature can reach 800 °C [1500°F], and exhaust system surface temperature can exceed 700 °C [1300°F], which is hot enough to ignite or melt common materials, and to burn people. The exhaust and exhaust components can remain hot after the vehicle has stopped moving. To avoid the risk of fire, property damage, burns or other serious personal injury, allow the exhaust system to cool before beginning this procedure or repair and make sure that no combustible materials are located where they are likely to come in contact with hot exhaust or exhaust components.



⚠ CAUTION ⚠

Excessive force applied to the locking slide will result in damage to the connector.

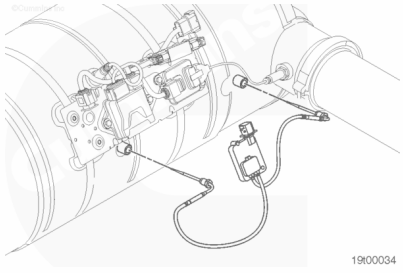
Disconnect the aftreatment exhaust gas temperature sensor from the aftertreatment interface harness.

To assist in removing the connector, a small screwdriver can be inserted into the top notch (1) on the locking slide for leverage as the locking slide is pulled out by hand.

If the locking slide does **not** move freely, clean the connector using contact cleaner to free it of debris.

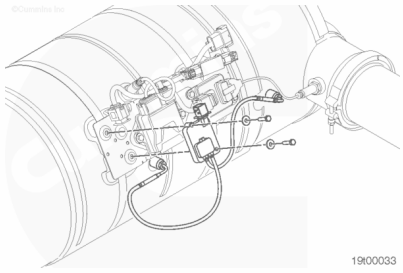
Loosen the retaining nut. Remove the aftertreatment exhaust gas temperature sensor probe from the aftertreatment system.

If removing more than one aftertreatment exhaust gas temperature sensor probe at a time, record the location where it was installed to make sure it is installed in the same location.



Remove wire ties securing the exhaust gas temperature sensor probe wires to the sensor table.

Remove the bolts securing the exhaust gas temperature sensor assembly to the sensor table.



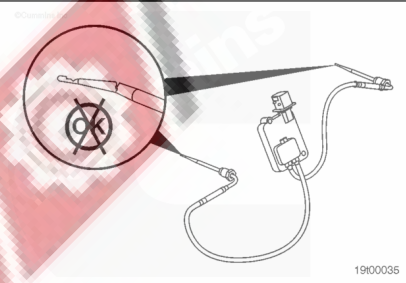
Clean and Inspect for Reuse

Inspect the exhaust gas temperature sensor assembly sensors for damaged or exposed wires, bent or broken pins, damaged connectors, or damaged threads.

Inspect the tip of the sensor for cracks, dents, kinks, and carbon buildup.

Inspect the exhaust gas temperature sensor module body for cracks or any other damage.

Replace the sensor assembly if damage is found.

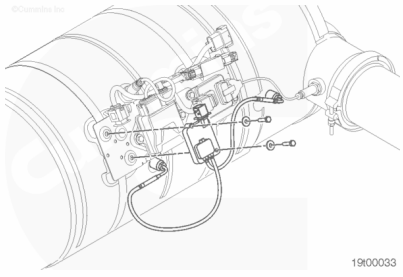


Install

Install the exhaust gas temperature sensor assembly to the sensor table.

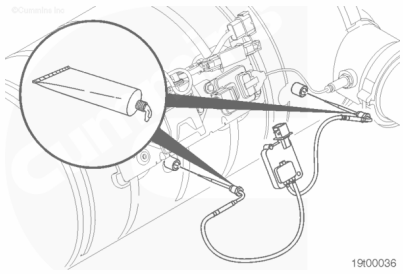
Install and tighten the mounting bolts.

Torque Value: 14 n•m [124 in-lb]



⚠ CAUTION ⚠

If the temperature sensor wire connectors are not connected to the proper locations after installation, damage can occur to the aftertreatment system.



Apply a coating of anti-seize, Part Number 3824397, or equivalent, to the sensor probe threads prior to assembly.

ANADOLU ISUZU AFTER SALES

Install the aftertreatment exhaust gas temperature sensor probe.

Tighten the nut that secures the sensor probe to the aftertreatment system.

Install new wire ties securing the exhaust gas temperature sensor probe wires to the sensor table.

Make sure the exhaust gas temperature sensor probe wires are properly secured so they do **not** come into contact with hot components and areas of wear that can result in damage.

Torque Value: 30 n•m [22 ft-lb]

Finishing Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

- Connect the batteries. See equipment manufacturer service information.
- Install the sensor table heat shield, if equipped. Refer to Procedure 011-032 in Section 11. (/qs3/pubsys2/xml/en/procedures/425/425-011-032.html)
- Operate the engine. Check for fault codes.

ANADOLU ISUZU GENUINE PARTS

Last Modified: 10-Aug-2016

Select Service Tools

Recommended Cummins® Service Tools

- NOx Sensor Module Diagnostic Kit, Part Number 5298821
- Battery adapter cable, Part Number 3823955
- Anti-seize compound, Part Number 3824879

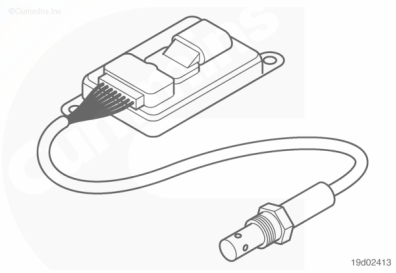
Additional Service Items

- Small screwdriver
- Contact cleaner

General Information

⚠ WARNING ⚠

The aftertreatment system will stay hot to touch for long periods of time after the engine has been shut down. To reduce the possibility of personal injury, avoid direct contact of hot components with your skin.



⚠ CAUTION ⚠

The exhaust catalyst will stay hot to the touch for long periods of time after the engine has been switched off.

⚠ CAUTION ⚠

The NOx sensor will stay hot to the touch for long periods of time after the engine has been switched off. The NOx sensor will also be hot if the engine keyswitch is ON.

⚠ CAUTION ⚠

Do not underseal or coat/paint any part of the NOx sensor.

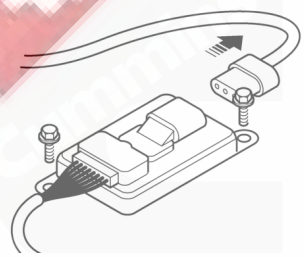
The aftertreatment outlet NOx sensor is located after the aftertreatment selective catalytic reduction (SCR) catalyst.

The aftertreatment outlet NOx sensor is made up of two parts: a small electronic module and a wired connection to the sensor body installed in the exhaust system. The two parts are permanently connected and can **not** be separated.

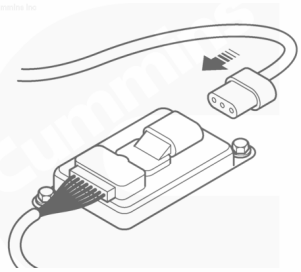
The aftertreatment outlet NOx sensor is available in both 12 and 24 volt configurations. The electronic module for the 24 volt version is larger than the module for the 12 volt version. The original equipment manufacturer (OEM) wiring harness connector on the aftertreatment outlet NOx sensor is always black in color.

Test

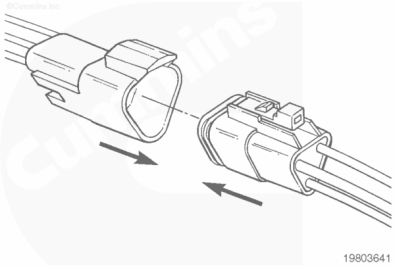
Unplug the NOx sensor from the engine harness.



Connect NOx Sensor Module Diagnostic Kit, Part Number 5298821, to the NOx sensor module.



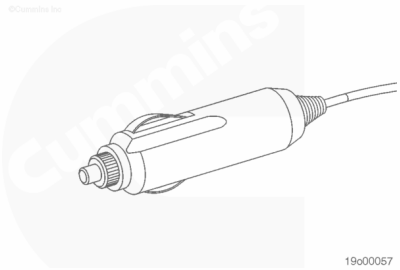
Connect the service tool data link (3 pin Deutsch™) to the engine Society of Automotive Engineers (SAE) J1939 data link connection, located on the driver's side of the engine.



Use the vehicle 12 VDC to supply power to the service tool.

Note : Battery adapter cable, Part Number 3823955, can be used to provide power from the vehicle battery supply.

ANADOLU ISUZU AFTER SALES



For Fault Codes 3681 and 3682, the following conditions **must** be met before checking the status of the active fault code.

Start the engine. Allow the NOx sensor to reach operating temperature.

This diagnostic runs when the exhaust gas temperature of the aftertreatment intake outlet NOx sensor is above 200°C or 392°F and the engine is running. Use INSITE™ electronic service tool to monitor the exhaust gas temperature.

Note : For the aftertreatment outlet NOx sensor, there is also a 60 second delay after the exhaust gas temperature reaches 200°C or 392°F

For Fault Codes 2771 and 3232, the following conditions **must** be met before checking the status of the active fault code.

This diagnostic runs continuously when the keyswitch is in the ON position.

Note : If the service tool is being used on a 24 volt sensor, battery adapter cable, Part Number 3823955, will need to be used to provide power from the vehicle battery supply.

Check for inactive fault codes after the above conditions have been met for the active fault code.

- Check to see if any of the active fault codes listed (2771, 3232, 3681, and 3682) now display as inactive.
- If the active fault codes now display as inactive, the sensor is operating normally and should **not** be replaced. The source of the fault code is located within the wiring isolated by the service tool.

ANADOLU ISUZU
E-SERVICE

Preparatory Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

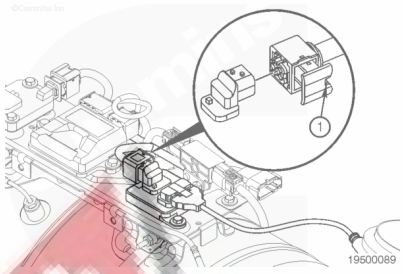
- Disconnect the batteries. See equipment manufacturer service information.

- Remove the sensor table heat shield, if equipped. Refer to Procedure 011-032 in Section 11. (/qs3/pubsys2/xml/en/procedures/425/425-011-032.html)

Remove

⚠ CAUTION ⚠

Excessive force applied to the locking slide will result in damage to the connector.



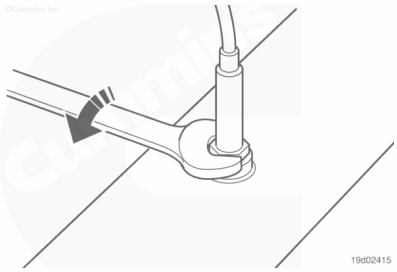
Disconnect the aftertreatment outlet NOx sensor from the aftertreatment interface harness.

To assist in removing the connector, a small screwdriver can be inserted into the top notch (1) on the locking slide for leverage as the locking slide is pulled out by hand.

If the locking slide does not move freely, clean the connector using contact cleaner to free it of debris.

Remove the two retaining capscrews.

Loosen the retaining nut. Remove the aftertreatment outlet NOx sensor from the exhaust system.



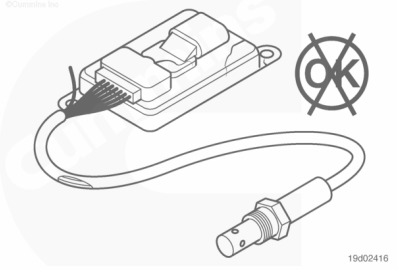
Clean and Inspect for Reuse

⚠ CAUTION ⚠

Do not clean the NOx sensor with any kind of fluid.

⚠ CAUTION ⚠

Do not immerse the NOx sensor in water or any kind of chemical wash.



ANADOLU ISUZU AFTER SALES

⚠ CAUTION ⚠

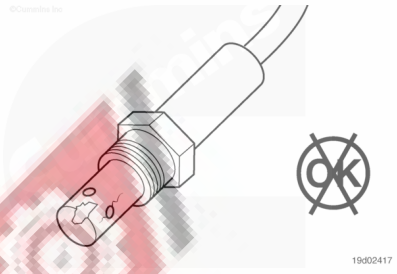
Do not jet-wash or steam clean the NOx sensor.

Inspect the NOx sensor for damage to the wiring or the body of the sensor.

Replace the aftertreatment outlet NOx sensor if any damage is found.

Inspect the tip of the NOx sensor for damage.

Replace the aftertreatment outlet NOx sensor if any damage is found.

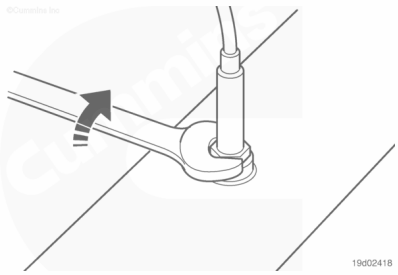


Install

Apply a light coating of anti-seize compound, Part Number 3824879, to the threads of the NOx sensor.

Install the NOx sensor to the exhaust system. Tighten the retaining nut.

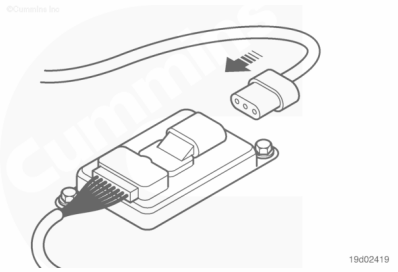
Torque Value: 50 n•m [37 ft-lb]



Connect the aftertreatment outlet NOx sensor to the aftertreatment interface harness.

Install the retaining capscrews.

Torque Value: 14 n•m [124 in-lb]



Finishing Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

- Install the sensor table heat shield, if equipped. Refer to Procedure 011-032 in Section 11. (/qs3/pubsys2/xml/en/procedures/425/425-011-032.html)
- Connect the batteries. See equipment manufacturer service information.
- Operate the engine. Check for leaks.

Last Modified: 01-Nov-2016

ANADOLU ISUZU AFTER SALES

Select Service Tools

Recommended Cummins® Service Tools

- NOx Sensor Module Diagnostic Kit, Part Number 5298821
- Battery adapter cable, Part Number 3823955
- Anti-seize compound, Part Number 3824879, or equivalent

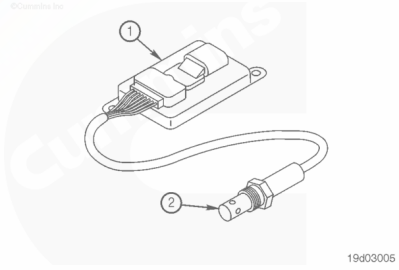
Additional Service Items

- Small screwdriver
- Contact cleaner

General Information

⚠ WARNING ⚠

The exhaust and exhaust components can remain hot after the engine has been shut down or secured. To avoid the risk of fire, property damage, burns or other serious personal injury, allow the exhaust system to cool before beginning this procedure or repair. Make sure that no combustible materials are located where they might come in contact with hot exhaust or exhaust components.



19d03005

⚠ WARNING ⚠

The NOx sensor will stay hot to touch for long periods of time after the engine has been switched OFF. The NOx sensor will also be hot if the engine keyswitch is ON.

⚠ WARNING ⚠

Improper practices, carelessness, or ignoring the warnings can cause burns, cuts, mutilation, asphyxiation, or other personal injury or death.

⚠ CAUTION ⚠

Do not underseal or coat/paint any part of the NOx sensor. Failure to do so can result in sensor damage.

The aftertreatment intake NOx sensor is located after the turbocharger, and is mounted to either the exhaust outlet connection or in the downpipe (per original equipment manufacturer (OEM) preference).

The aftertreatment outlet NOx sensor is made up of two parts: (1) a small electronic module with a wired connection to the (2) sensor body installed in the exhaust system. These two parts are permanently connected and can **not** be separated.

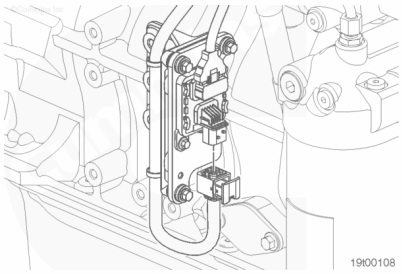
The aftertreatment intake NOx sensor is available in both 12 volt and 24 volt configurations. The electronic module for the 24 volt version is larger than the module on the 12 volt version. The wiring harness connector on the aftertreatment intake NOx sensor is keyed differently from the aftertreatment outlet NOx sensor.

Due to the number of different sensor mounting locations, this procedure has been written to be generic. The Remove and Install sections of this procedure are common regardless of the intake NOx sensor mounting configuration.

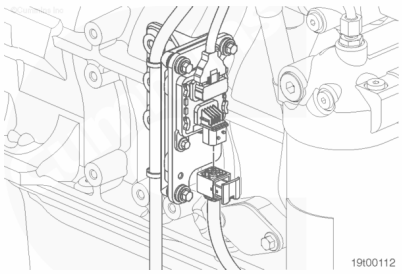
ANADOLU ISUZU AFTER SALES

Test

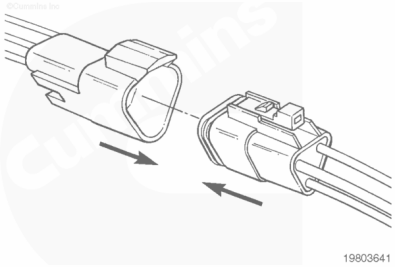
Unplug the NOx sensor from the engine harness.



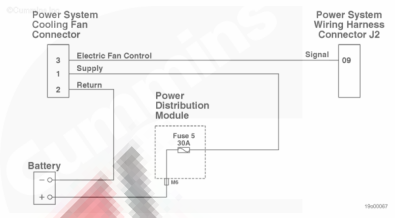
Connect NOx Sensor Module Diagnostic Kit, Part Number 5298821, to the NOx sensor module.



Connect the service tool data link (3 pin Deutsch™) to the engine Society of Automotive Engineers (SAE) J1939 data link connection, located on the driver's side of the engine.



Use the vehicle 12 VDC to supply power to the service tool.



Note : Battery adapter cable, Part Number 3823955, can be used to provide power from the vehicle battery supply.

For Fault Codes 3681 and 3682, the following conditions must be met before checking the status of the active fault code.

Start the engine. Allow the NOx sensor to reach operating temperature.

This diagnostic runs when the exhaust gas temperature of the aftertreatment intake outlet NOx sensor is above 200°C or 392°F and the engine is running. Use INSITE™ electronic service tool to monitor the exhaust gas temperature.

Note : For the aftertreatment outlet NOx sensor, there is also a 60 second delay after the exhaust gas temperature reaches 200°C or 392°F

For Fault Codes 2771 and 3232, the following conditions must be met before checking the status of the active fault code:

This diagnostic runs continuously when the keyswitch is in the ON position.

Note : If the service tool is being used on a 24 volt sensor, battery adapter cable, Part Number 3823955, will need to be used to provide power from the vehicle battery supply.

Check for inactive fault codes after the above conditions have been met for the active fault code.

- Check to see if any of the active fault codes listed (2771, 3232, 3681, and 3682) now display as inactive.
- If the active fault codes now display as inactive, the sensor is operating normally and should **not** be replaced. The source of the fault code is located within the wiring isolated by the service tool.

Preparatory Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

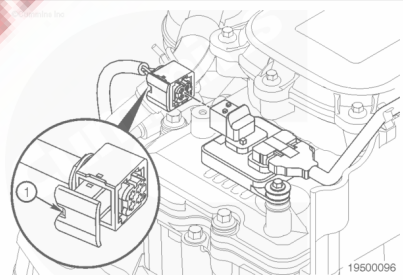
- Disconnect the batteries. See equipment manufacturer service information.

Remove

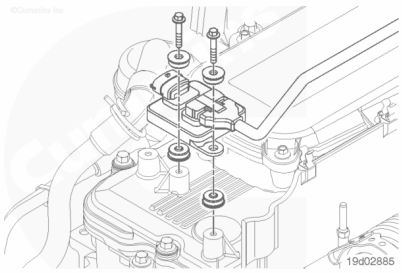
Disconnect the aftertreatment intake NOx sensor from the engine wiring harness.

To assist in removing the connector, a small screwdriver can be inserted into the top notch (1) on the locking slide for leverage as the locking slide is pulled out by hand.

If the locking slide does **not** move freely, clean the connector using contact cleaner to free it of debris.



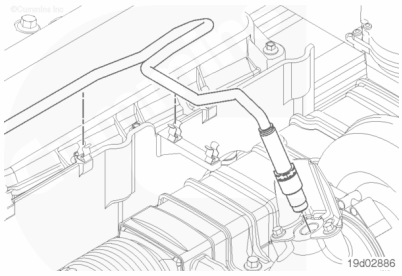
Remove the capscrews and isolators that secure the aftertreatment intake NOx sensor to the valve cover.



Note : Notice the wire routing of the sensor so it can be installed correctly to avoid hot areas and wear areas.

If applicable or required, remove the NOx sensor heat shield. Refer to Procedure 011-032 in Section 11. (/qs3/pubsys2/xml/en/procedures/425/425-011-032.html)

Loosen the retaining fastener. Remove the aftertreatment intake NOx sensor from the exhaust outlet connection.



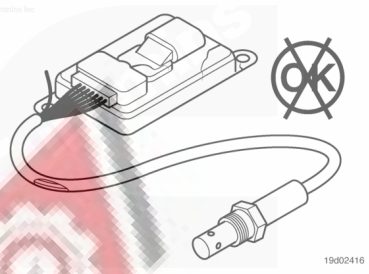
Disconnect any wire ties securing the wire between the sensor body and electronic module.

Remove the sensor from the engine.

Clean and Inspect for Reuse

⚠ CAUTION ⚠

Do not clean the NOx sensor with any kind of fluid. Damage to the sensor can occur.



⚠ CAUTION ⚠

Do not immerse the NOx sensor in water or any kind of chemical wash. Damage to the sensor can occur.

⚠ CAUTION ⚠

Do not jet wash or steam clean the NOx sensor. Damage to the sensor can occur.

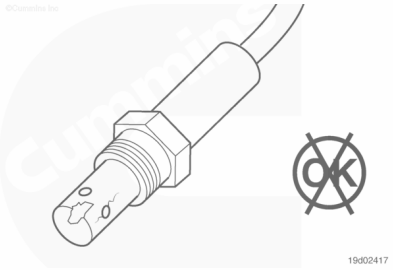
Inspect the NOx sensor for damage to the wiring or to the body of the sensor.

Inspect the electrical connector pins in the sensor and engine wire harness for signs of corrosion.

Use the following procedure for repair of the engine harness. Refer to Procedure 019-043 in Section 19. (/qs3/pubsys2/xml/en/procedures/425/425-019-043.html)

Replace the aftertreatment intake NOx sensor if any damage is found.

Note : This sensor is placed before the aftertreatment diesel particulate filter. It is **not** uncommon to have soot on the tip of the sensor. Do **not** try to clean the intake NOx sensor tip unless directed by fault codes or other troubleshooting symptoms.



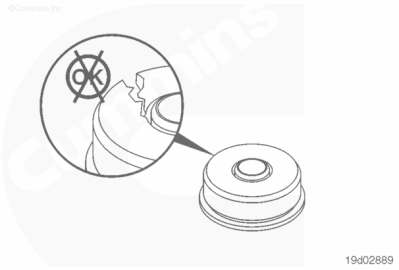
Inspect the tip of the NOx sensor for damage.

Replace the NOx sensor if any damage is found.

Inspect the NOx sensor for oil spray on the tip of the sensor. Refer to Procedure 010-033 in Section 10. (/qs3/pubsys2/xml/en/procedures/425/425-010-033.html)

Inspect the isolators for cracked or damaged grommets.

Replace the isolator if damage is found.

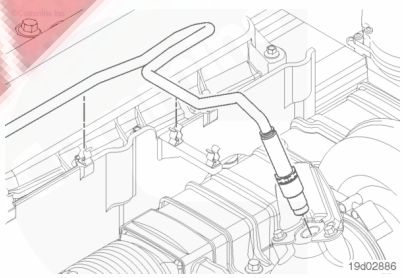


Install

Apply a light coating of anti-seize compound, Part Number 3824879, or equivalent, to the threads of the NOx sensor.

Install the NOx sensor to the exhaust system. Tighten the retaining nut.

Torque Value: 50 n•m [37 ft-lb]



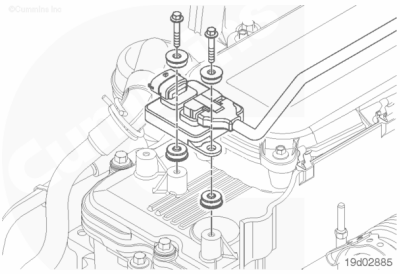
Route the intake NOx sensor wire in the same orientation as removed.

Install the NOx sensor heat shield if removed. Refer to Procedure 011-032 in Section 11. (/qs3/pubsys2/xml/en/procedures/425/425-011-032.html)

Install the NOx sensor and isolators.

Tighten the capscrews.

Torque Value: 4.4 n•m [39 in-lb]



Connect the aftertreatment intake NOx sensor to the wire harness.

GRAPHIC NOT FOUND

Connect any ties used to support the aftertreatment intake NOx sensor wire.

ANADOLU ISUZU GENUINE SALES

Finishing Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

- Connect the batteries. See equipment manufacturer service information.
- Operate the engine. Check for leaks.

ANADOLU ISUZU AFTER SALES

Last Modified: 01-Nov-2016

Select Service Tools

Recommended Cummins® Service Tools

- No Cummins® Service Tools required.

Additional Service Items

- No additional service items required.

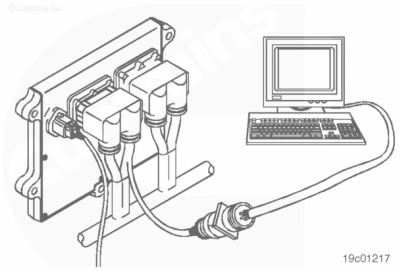
General Information

The turbocharger compressor intake pressure/temperature sensor is a combination sensor that monitors the temperature and pressure of the air entering the turbocharger.

The sensor is located in the original equipment manufacturer (OEM) intake piping, in between the air cleaner and turbocharger.

Initial Check

Use an electronic service tool to monitor the value of the turbocharger compressor intake pressure/temperature sensor with the key on and the engine not running.



The value of the turbocharger compressor air intake temperature sensor should be checked when the engine is cold, and should read within 5.5 C [10 F] of the local ambient air temperature.

The value of the turbocharger compressor intake pressure should read within 1 kPa [0.3 in-hg] of the local barometric air pressure. Refer to Procedure 018-028 in Section V. (/qs3/pubsys2/xml/en/procedures/99/99-018-028.html)

Replace the turbocharger compressor intake pressure/temperature sensor if either value is out of specification.

ANADOLU ISUZU PARTS SALES

Preparatory Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

- Disconnect the batteries. See equipment manufacturer service information.
- Clean the area around the turbocharger compressor intake pressure/temperature sensor.

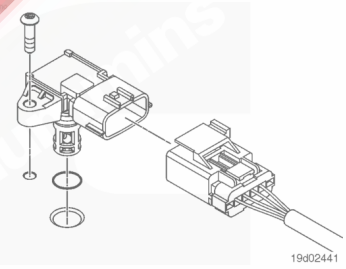
Remove

Disconnect the sensor connector from the engine harness.

Remove the mounting capscrew.

Remove the sensor from the engine by pulling straight up on the sensor.

Be careful **not** to damage the o-ring when removing the sensor.

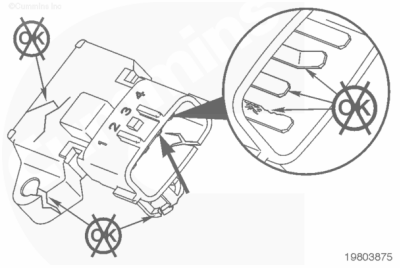


Clean and Inspect for Reuse

Inspect the engine harness connector and turbocharger compressor intake pressure/temperature sensor for the following:

- Cracked or broken connector shell
- Missing or damaged connector seals
- Dirt, debris, or moisture in or on the connector pins
- Corroded, bent, broken, pushed back, or expanded pins.

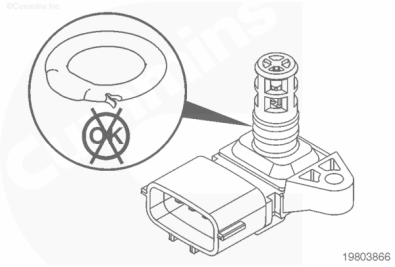
Clean, replace, or repair the connector or turbocharger compressor intake pressure/temperature sensor if damaged.



Inspect the turbocharger compressor intake pressure/temperature sensor o-ring the following:

- Swollen o-ring
- Nicks or cuts in or on the o-ring.

Replace the o-ring if any damage is found.

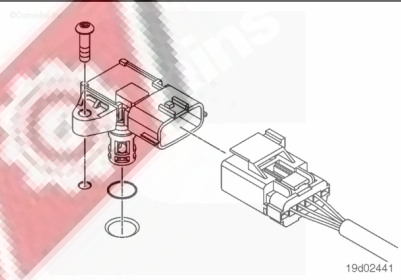


Install

Lubricate the o-ring with clean engine oil before installation.

Install the turbocharger compressor intake pressure/temperature sensor by pressing firmly on the top of the sensor until the o-ring is fully seated.

Install and tighten the mounting capscrew.



Torque Value: 7 n•m [62 in-lb]

Finishing Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

- Connect the batteries. See equipment manufacturer service information.
- Operate the engine. Check for leaks.

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Last Modified: 10-Aug-2016

Select Service Tools

Recommended Cummins® Service Tools

- No Cummins® service tools required.

Additional Service Items

- No additional service items required.

General Information

Turn the keyswitch to the ON position.

- Verify the POWER lamp is illuminated on the data link adapter.



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Check the settings in INSITE™ electronic service tool that the data link adapter being connected is selected.

Note : Use the Auto Configure function to assist with data link configuration.

Check the communication port selected for other devices.

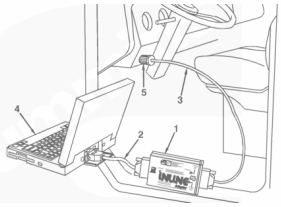
If any are detected, disable. If necessary, contact administration support for assistance.


19800902

Inspect all the component connectors or cable connectors to make sure there is no pin damage.

On Vehicle Communication Setup

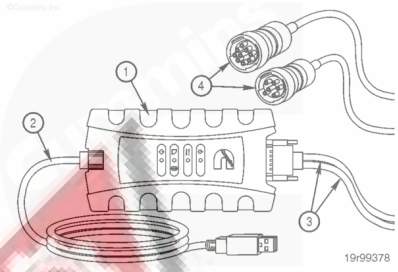
1. Data link adapter
2. Universal serial bus (USB) or personal computer (PC) serial cable
3. Data link adapter cable
4. PC with INSITE™ electronic service tool
5. Vehicle data link adapter connector.



Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19. (/qs3/pubsys2/xml/en/procedures/99/99-019-361.html)

- If damage is found, the component or cable **must** be repaired or replaced.
- Connect the cables to the computer, data link adapter, and vehicle.

Data Link Adapter Identification Diagram and Error Information



1. Data link adapter
2. USB or PC serial cable
3. Data link adapter cable
4. PC with INSITE™ electronic service tool (not shown)
5. Vehicle data link adapter connector.

Verify that the data link adapter is communicating with the selected protocol.

For INSITE™ electronic service tool errors 5200, 5202, and 5023:

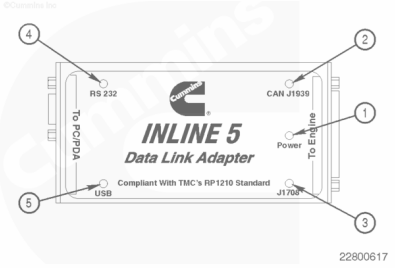
- Verify that the power light is on or flashing.
- Verify the communication light is on or flashing when transferring information from the computer to the electronic control module (ECM).

For INSITE™ electronic service tool errors 5201 or 5204 (Data Link J1587/J1708 connections):

- Verify that the specified protocol light is flashing.

If it is **not** flashing, check the voltage level from the engine. Go to the appropriate wiring diagram for details.

Data Link Adapter Identification Diagram - INLINE™ 4, 5, and 6.

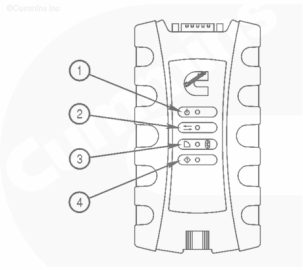


1. Power light
2. J1939 communication light
3. J1708 communication light
4. RS-232 To PC light
5. USB To PC light (INLINE™ 5 and 6 **only**).

The INLINE™ 4, 5, and 6 is an RP1210A compliant data link adapter that will support both J1587/J1708, and J1939 protocol. It can be used with either a COM port or USB port. The INLINE™ 4, 5, and 6 **must** be configured correctly

within INSITE™ electronic service tool to define the COM or USB port being used on the PC and the type of data link protocol that is available, either J1587/J1708, or J1939.

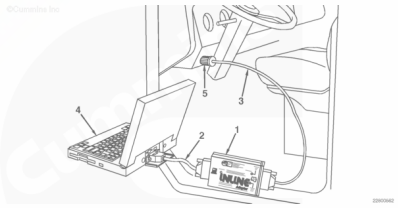
Data Link Adapter Identification Diagram - INLINE™ 7



1. Power light
2. Communication light
3. Communication-type light/indicator
4. Fault light.

The INLINE™ 7 is a RP1210A, RP1210B, and RP1210C compliant data link adapter that will support J1587/J1708 as well as J1939 (250K, 500K, or 1MB Baud Rate). It can **only** be connected to the PC via USB, WIFI, or Bluetooth connection. The tool **must** be configured correctly within INSITE™ electronic service tool to define the connection type on the PC and the type data link protocol that is available, either J1587/J1708 or J1939.

On Vehicle Communication Setup

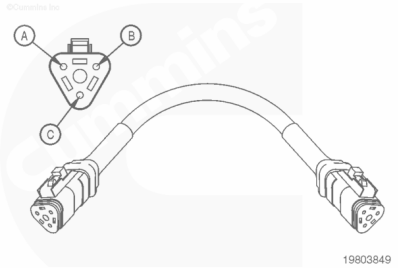


1. Data link adapter
2. USB or PC serial cable
3. Data link adapter cable
4. PC with INSITE™ electronic service tool
5. Vehicle data link adapter connector.

For Data Link J1939 connections:

- Verify that the selected protocol light is flashing.
- If it's **not** flashing, check the resistance measurement from the engine.
- Use the appropriate wiring diagram and the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19. (/qs3/pubsys2/xml/en/procedures/99/99-019-360.html)

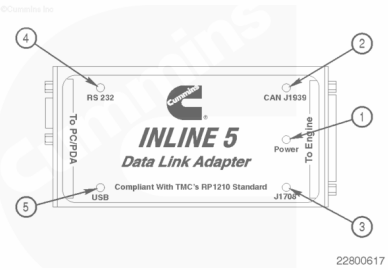
Note : There is no flashing light when using the 3 pin on-engine connector.



Mini Backbone Cable Pin Identification

A. J1939 data link supply
B. J1939 data link return
C. J1939 data link shield.

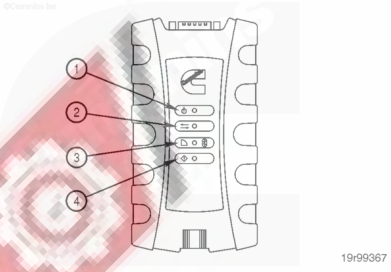
Data Link Adapter Identification Diagram - INLINE™ 4, 5, and 6.



1. Power light
2. J1939 communication light
3. J1708 communication light
4. RS-232 To PC light
5. USB To PC light (INLINE™ 5 and 6 **only**).

If a connection is **not** established, replace the data link adapter and cables to establish a connection.

Data Link Adapter Identification Diagram - INLINE™ 7



1. Power light
2. Communication light
3. Communication-type light/indicator
4. Fault light.

If a connection is **not** established, replace the data link adapter and cables to establish a connection.

If after replacing the data link and cables, a connection is still **not** established:



- Close INSITE™ electronic service tool program
- Shut down the computer
- Inspect the the cables to the computer, data link adapter, and vehicle connection
- Start the computer
- Start the INSITE™ electronic service tool
- Attempt to communicate with the ECM.

If all steps have been completed and checked again, close INSITE™ electronic service tool and contact a Cummins® Authorized Repair Location.

Last Modified: 14-Mar-2017

Select Service Tools

Recommended Cummins® Service Tools

- No Cummins® Service Tools required.

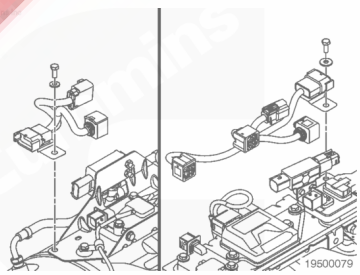
Additional Service Items

- Small screwdriver
- Contact cleaner

General Information

The diesel particulate filter (DPF) and selective catalytic reduction (SCR) catalyst are each equipped with an aftertreatment interface harness.

This harness provides original equipment manufacturer (OEM) with a single connection point between the OEM wiring harness and aftertreatment sensors.



Preparatory Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

- Disconnect the batteries. See equipment manufacturer service information.
- Remove the sensor table heat shield, if equipped. Refer to Procedure 011-032 in Section 11. (/qs3/pubsys2/xml/en/procedures/425/425-011-032.html)

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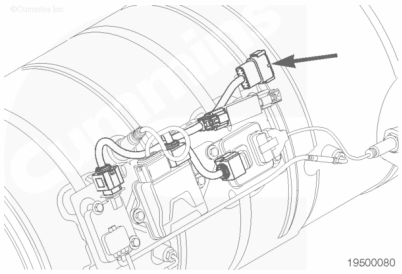
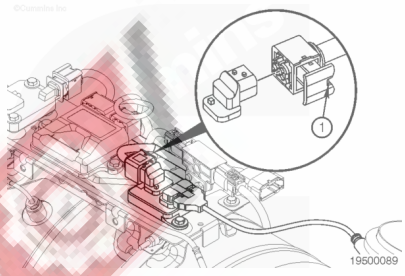
Remove

Disconnect the OEM harness from the aftertreatment interface harness.



⚠ CAUTION ⚠

Excessive force applied to the locking slide will result in damage to the connector.



Disconnect the aftertreatment sensors from the aftertreatment interface harness.

To assist in removing the connector, a small screwdriver can be inserted into the top notch (1) on the locking slide for leverage as the locking slide is pulled out by hand.

If the locking slide does not move freely, clean the connector using contact cleaner to free it of debris.

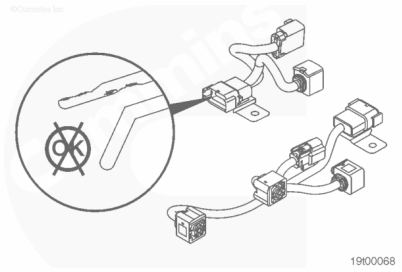
Remove the aftertreatment interface harnesses from the sensor table.

Inspect for Reuse

Inspect the aftertreatment interface harness.

If there is an open circuit or short circuit, determine the location of the damaged wiring.

Repair broken and/or damaged wires or replace, if necessary.

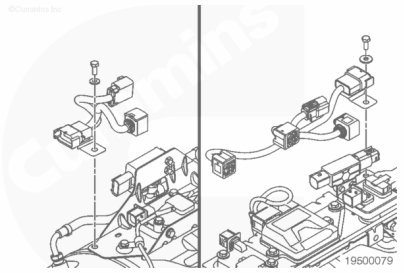


Install

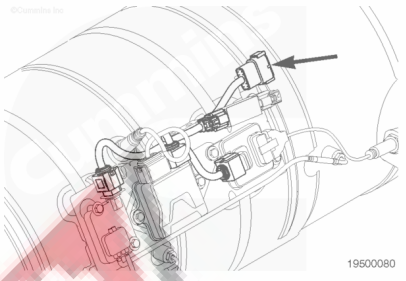
ANADOLU ISUZU AFTER SALES

Install the aftertreatment interface harnesses to the sensor table using wire ties.

Connect the aftertreatment sensors to the aftertreatment interface harness.



Connect the OEM harness from the aftertreatment interface harness.



Finishing Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

- Install the sensor table heat shield, if equipped. Refer to Procedure 011-032 in Section 11. (/qs3/pubsys2/xml/en/procedures/425/425-011-032.html)
- Connect the batteries. See equipment manufacturer service information.
- Operate the engine. Check for fault codes.

ANADOLU ISUZU AFTER SALES

Last Modified: 10-Aug-2016

Select Service Tools

Recommended Cummins® Service Tools

- No Cummins® Service Tools required.

Additional Service Items

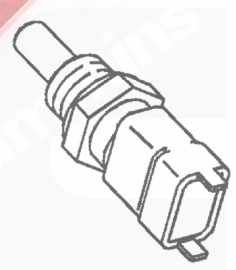
- No additional service items required.

General Information

Original equipment manufacturers (OEMs) are required to install an ambient air temperature sensor.

The OEM ambient air temperature sensor monitors the ambient air temperature and passes that information on to the engine control module (ECM) through the OEM harness.

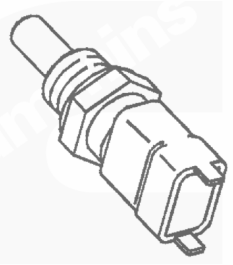
See equipment manufacturer service information for the location of the OEM temperature sensor.



Inspect for Reuse

Inspect the OEM ambient air temperature sensor for damaged or broken connector pins.

See equipment manufacturer service information for removal and installation instructions.



ANADOLU ISUZU AFTER SALES

Last Modified: 10-Aug-2016


ANADOLU ISUZU
AFTER SALES

Select Service Tools

Recommended Cummins® Service Tools

- Engine control module (ECM) connector electrical circuit tester, Part Number 2892510
- Test lead, Part Number 3164113
- ECM Connector Repair Kit, Part Number 2892512
- Retainer removal tool, Part Number 4918919
- Terminal removal tool, Part Number 4918921
- Wiring stripping tool, Part Number 3400045, or equivalent
- Wiring Harness Repair Kit, Part Number 5298734
- Wire crimping tool, Part Number 3163109, or equivalent
- Heat gun, Part Number 3822860, or equivalent

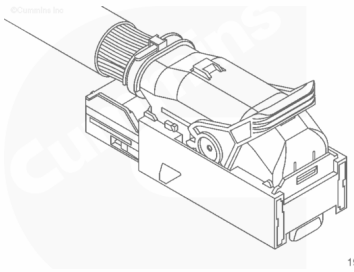
Additional Service Items

- Wire cutters

General Information

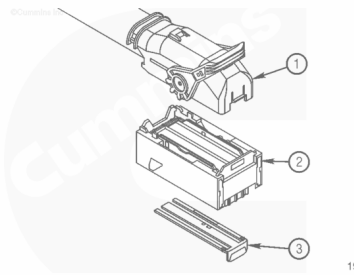
This connector is used to attach the engine wiring harness and the original equipment manufacturer (OEM) harness to the ECM.

Note : The engine harness connector and the OEM connector are keyed differently, so they can **not** be used interchangeably.



The Delphi® 96 Way ECM connector is made up of three components:

1. Backshell
2. Connector body
3. Locking comb.



Preparatory Steps

⚠ WARNING ⚠

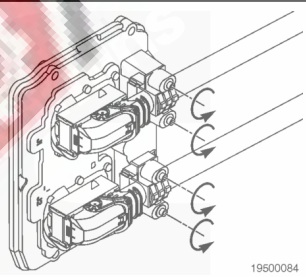
Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

- Disconnect the batteries. See equipment manufacturer service information.

Remove

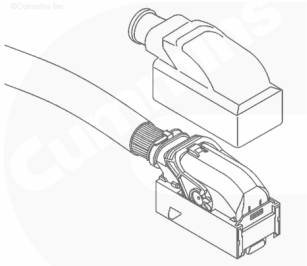
Unbolt the wire harness hold down clamp from the ECM.

Note : Do **not** remove wire ties securing the hold down clamp to the wire harness.



If equipped, fold the dust boot back to gain access to the ECM connector or remove it if necessary.

Note : If the dust boot is removed, the it **must** be installed at the conclusion of the repair.

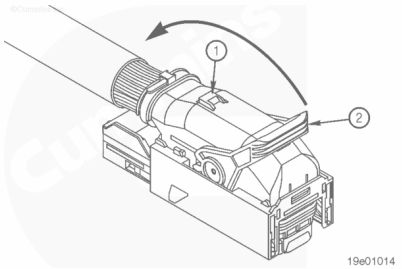


⚠ CAUTION ⚠

Damage to the backshell will occur if the locking tab is not depressed prior to lifting of the lever.

Remove the connector from the ECM by pressing down on the locking tab (1) and pulling up on the lever (2).

Note : Do **not** close the lever after the connector has been removed from the ECM. Attempting to do so will cause damage.



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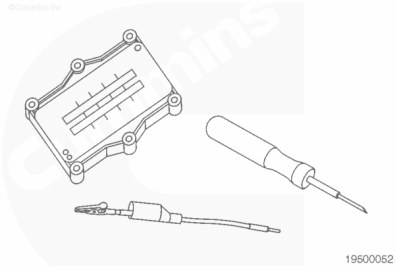
Test

⚠ CAUTION ⚠

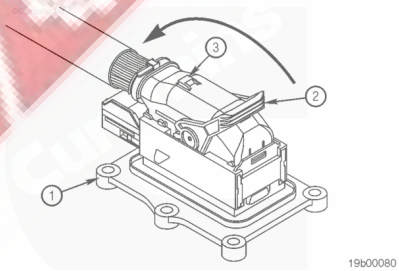
Do not insert test leads into the ECM connector terminals. Doing so may cause terminals to spread and cause intermittent electrical connections.



To perform pin-out diagnostic checks, use ECM connector electrical circuit tester, Part Number 2892510, and test lead, Part Number 3164113.

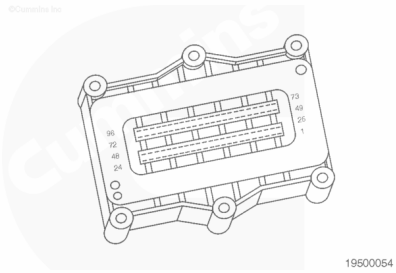
All diagnostic test leads, connector repair tools, and repair terminals can be found in ECM Connector Repair Kit, Part Number 2892512.

Attach the electrical circuit tester, Part Number 2892510, to the ECM (1) connector by placing the electrical circuit tester into the ECM connector and pulling back on the locking lever (2) until the connector is fully seated and the lever locking tab (3) is engaged.



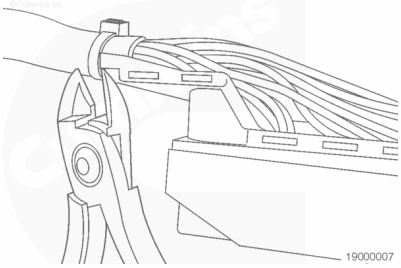
Use electrical circuit tester, Part Number 2892510, to help identify terminal number locations.

See the appropriate wiring diagram for circuit terminal locations.

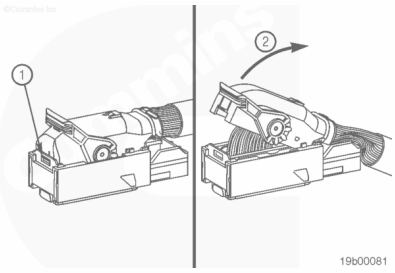


Pin Replacement

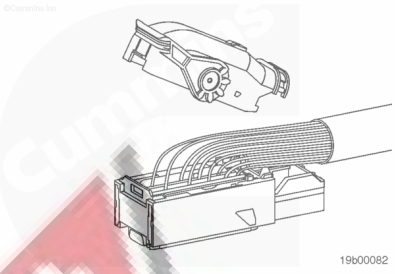
Cut the wire tie securing the wire bundle to the backshell.



Remove the connector backshell by pressing in on the backshell locking tab (1). Pivot the front of the backshell upward (2).

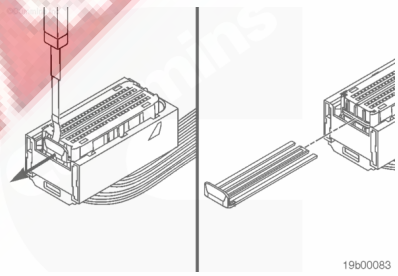


Pull the backshell forward, then upward to release the backshell mounting tabs from the connector body.



Gently release the locking comb by using retainer removal tool, Part Number 4918919, to separate the locking comb from the connector body.

Fully remove the locking comb by hand.



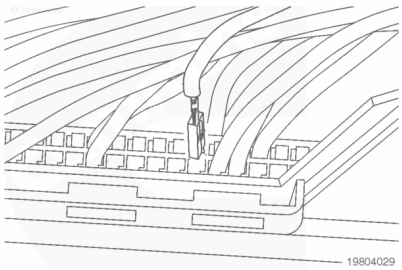
Removing Terminal

Replace one terminal wire at a time. If more than one terminal wire **must** be replaced, attach an identification tag to each wire removed.

If more than four terminals are damaged and need to be replaced, the engine wiring harness is to be replaced.

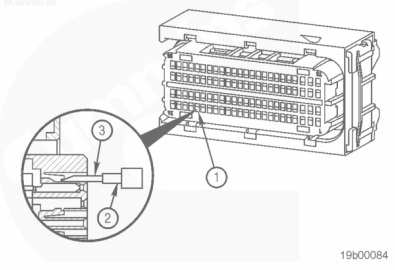
See the appropriate wiring diagram for terminal locations.

See the appropriate wiring harness repair kit in the Service Tools procedure in Section 19 for the correct repair wire.



⚠ CAUTION ⚠

If the wire is difficult to remove, do not pull hard on the wire, otherwise, the locking tang of the terminal will stick or the terminal will pull off the wire and remain in the connector.



Insert terminal removal tool, Part Number 4918921, into the larger access cavity (1).

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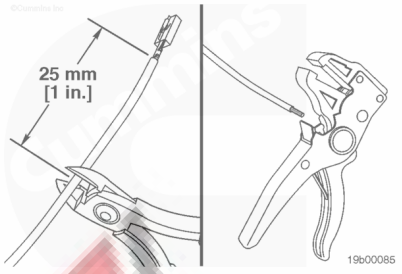
With the beveled side of the tool facing away from the terminal cavity (2), rotate the tool slightly to release the terminal from the locking tang (3).

Carefully pull the wire from the connector. If it is difficult to remove, repeat the entire process.

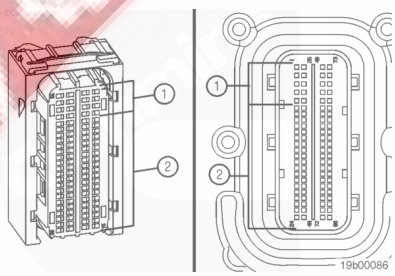
Use wire cutters to remove 25 mm [1 in] of the terminal and wire to be replaced.



Use wire stripping tool, Part Number 3400045, or equivalent, to remove 6 mm [0.25 in] of insulation from the wire.

Note : It will be necessary to remove the wire ties securing the wire harness hold down clamps to the wire harness. Wire ties **must** be replaced at the conclusion of the repair.

There are two electrical connector repair terminals available for the ECM connector.

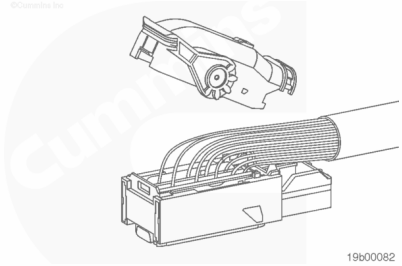


Part Number 4918916, identified by a grey wire with a red stripe, is used to repair 16 gauge wires used in cavities 1-4, 25-28, 49-52, and 73-76 (1).

Part Number 2892507 is used to repair 20 gauge wires used in cavities 5-24, 29-48, 53-72, and 77-96 (2).

See Wiring Harness Repair Kit, Part Number 5298734, for the appropriate repair terminal.

In some applications, there may **not** be enough clearance to route the repair terminal butt-splice connection into the wire harness convolute. The repair terminal will need to be cut to appropriate length to allow the butt-splice connection to be located under the backshell.



Note : The repair wire is 203 mm [8 in] long.

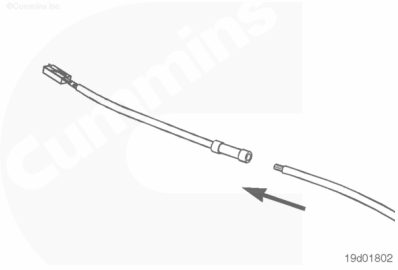
Use a wire cutter to cut the electrical connector repair terminal to an appropriate length so it can be attached to the original wire lead, using a butt-splice, under the connector backshell.

Note : If more than four terminals are damaged and need to be replaced, the wiring harness is to be replaced.

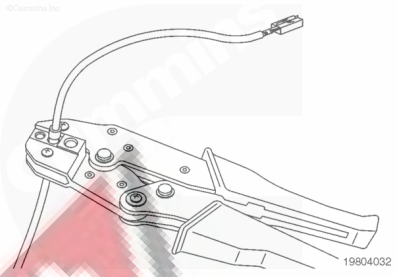
Before installing the new repair wire, perform a test fit to make sure the wire is the correct size.

Install the repair wire on the bare wire.

Make sure the bare wire extends into the splice connector properly.

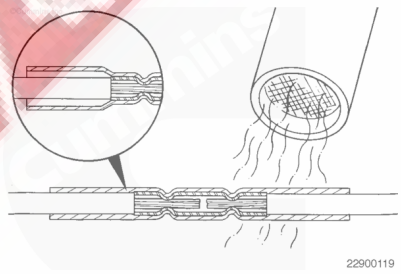


Use wire crimping tool, Part Number 3163109, or equivalent, to crimp the repair wire onto the bare wire.



Use heat gun, Part Number 3822860, or equivalent, to heat the shrink tubing around the wire.

The tubing will shrink and make the connection waterproof.



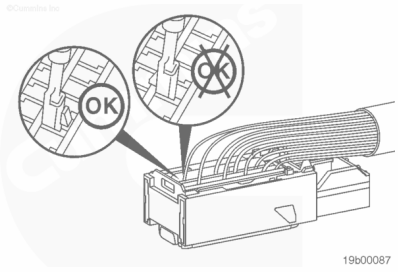
Inserting Terminal

The wire terminals have locating features that only allow the terminal to be inserted in one orientation.

Insert the wire from the top of the connector.

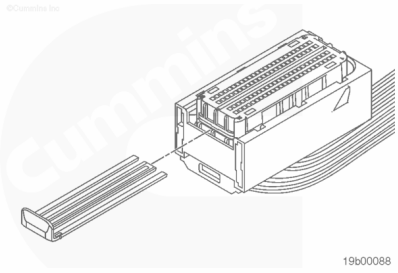
Push the wire into the connector until the terminal locks into place.

Pull on the wire gently to make sure the terminal is locked into the connector.



Insert the locking comb.

Note : The locking comb should slide into place without excessive force. If it is difficult to install the locking comb, check to ensure all pins are fully engaged.



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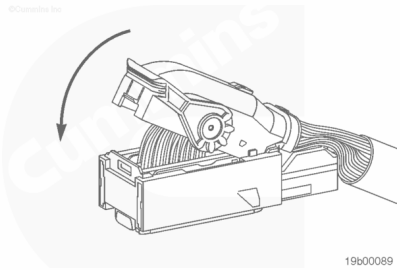
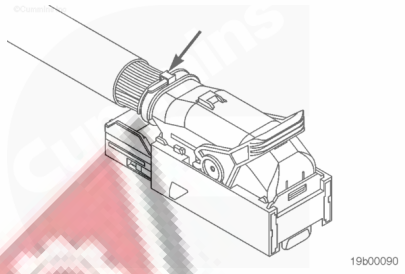
Note : Make sure the lever on the backshell is in the open position before installing the backshell onto the connector body.

Position the wire bundle into place. Install the backshell mounting tabs into the connector body.

Pivot the front of the backshell downward until the locking tab engages with the connector body.

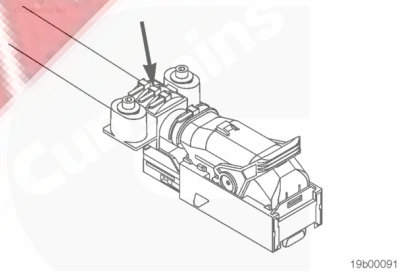


Install a wire tie to secure the wire bundle to the connector backshell.



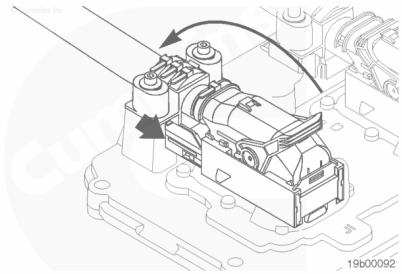
If the harness hold down clamps were removed from the harness, loosely attach the hold down clamps to the wire harness using wire ties.

Once the connector has been attached to the ECM and the hold down clamp has been attached to the ECM, the wire ties can be pulled tight, securing the hold down clamp to the wire harness.



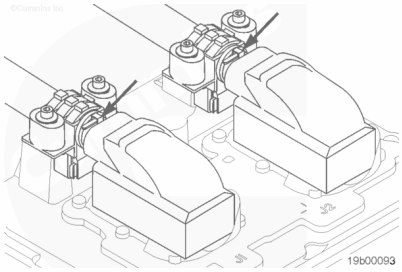
Install

Install the connector to the ECM by placing the connector into the ECM receptacle and pulling back on the locking lever until the connector is fully seated and the lever locking tab is engaged.



If equipped, fold the dust boot back into place over the ECM connector.

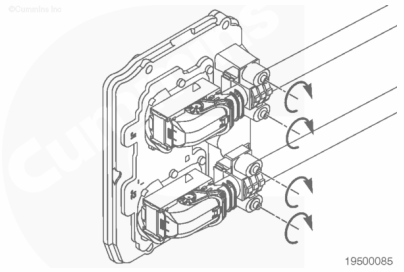
If the dust boot was removed, install it over the ECM connector. Secure it to the harness using a wire tie.



ANADOLU ISUZU AFTER SALES

⚠ CAUTION ⚠

Do not over-tighten the harness hold-down clamp mounting screws or damage to the ECM will occur.



Install the harness hold-down clamps.

Torque Value: 8 n•m [71 in-lb]

Note : If the wire ties securing the harness hold-down clamp to the wire harness were removed, new wire ties **must** be installed.

Finishing Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

- Connect the batteries. See equipment manufacturer service information.
- Operate the engine. Check for loose components and fault codes.

ANADOLU ISUZU AFTER SALES

Last Modified: 11-Jun-2020

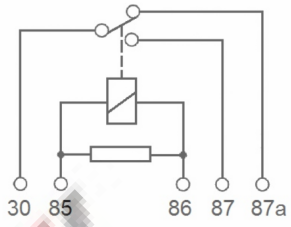
Resistance Check

Coil Side Circuit

Turn keyswitch to OFF position.

Remove relay from wiring harness.

Measure resistance of relay between pins 85 to 86. Refer to Procedure 019-360 in Section 19. (/qs3/pubsys2/xml/en/procedures/99/99-019-360.html)



Resistance	Description
12 VDC Systems: 30 to 130 ohms 24 VDC Systems: 200 to 400 ohms	Resistance is correct.

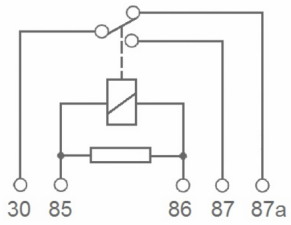
If resistance values are out of specification, relay will **not** function properly and **must** be replaced.

Contact Side Circuit

Turn keyswitch to OFF position.

Remove relay from wiring harness.

Measure resistance of relay between pins 30 to 87. Refer to Procedure 019-360 in Section 19. (/qs3/pubsys2/xml/en/procedures/99/99-019-360.html)



Condition	Resistance	Description
Connect battery voltage to pin 85 and ground to pin 86	<10 ohms	Resistance is correct.
Disconnect battery voltage to pin 85 and ground to pin 86	>100K ohms	Resistance is correct.

If resistance values are out of specification, relay will **not** function properly and **must** be replaced.

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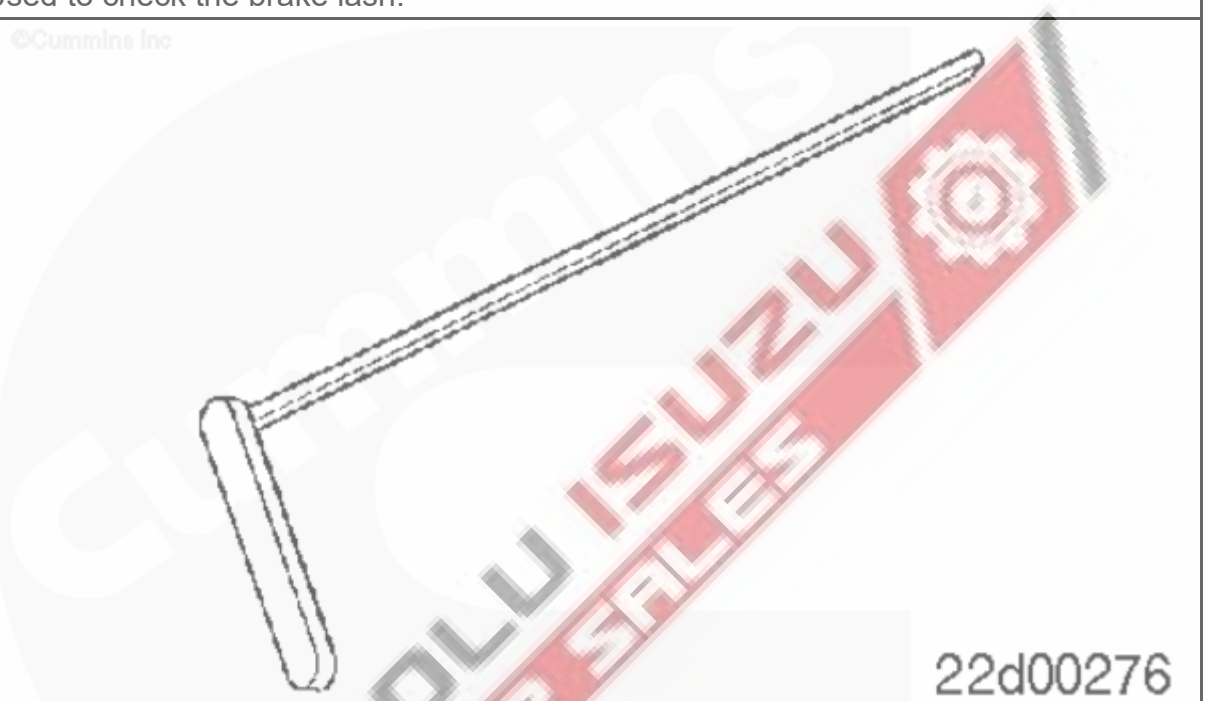
Vehicle Braking

Tool Number 3163681
Feeler Gauge Used to check the brake lash.

Tool Number 3164489
Deluxe Digital Multimeter This digital multimeter includes the functions of frequency, capacitance and temperature (with a built-in temperature module). Also included are these functions: rpm, Dwell, duty cycle and pulse width and comes with test leads, protective boot, inductive pick-up, bead-type temperature probe. Nylon carrying case available separately, Part Number 3164497.

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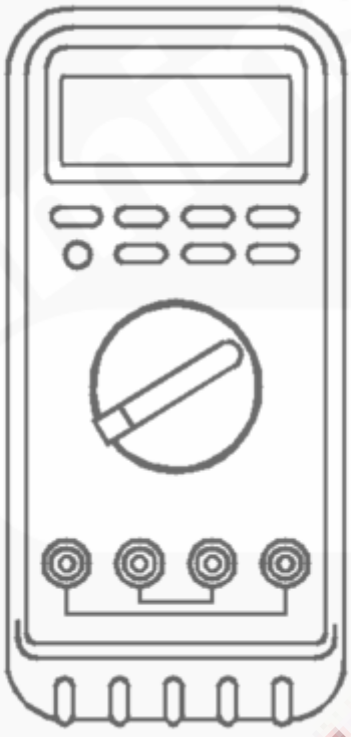
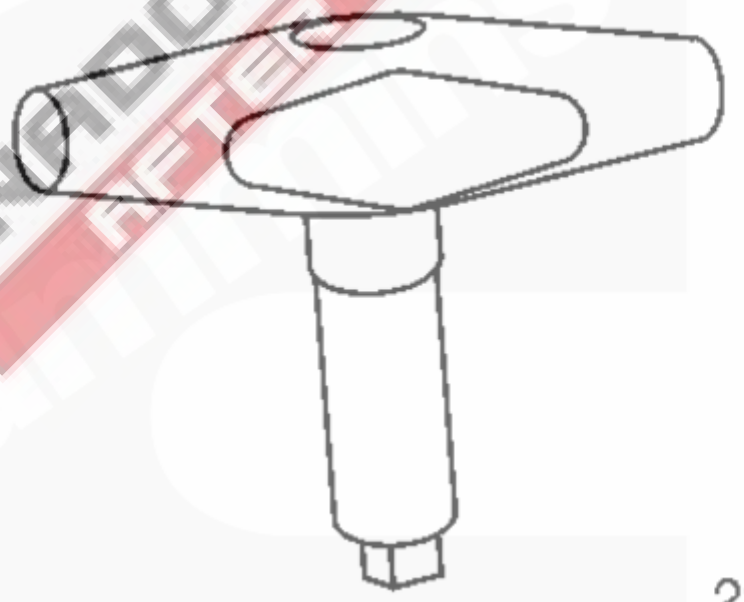


SP000709

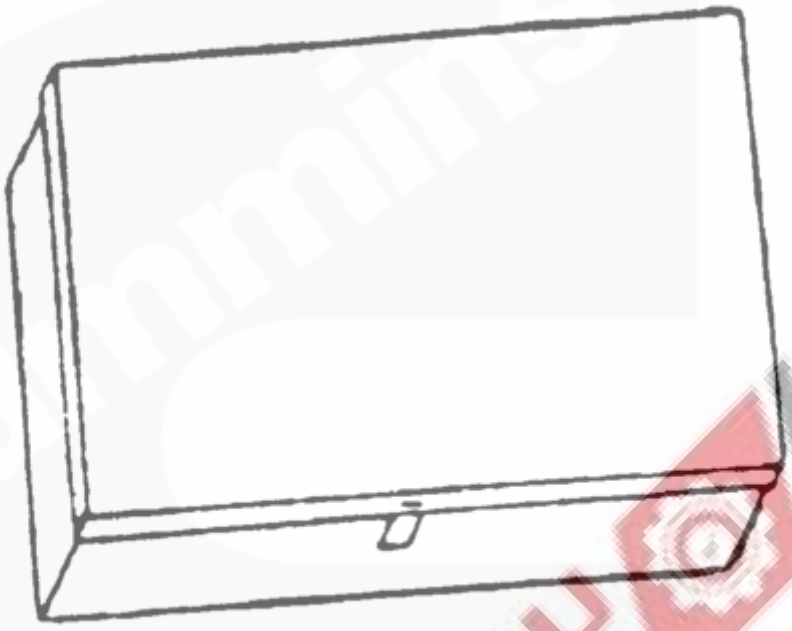
Tool Number 3376592
Torque Wrench Used to torque the adjusting screws to the correct torque.



22d00277

Tool Number 4919115
Electrical Test Lead Kit

Contains various test leads for testing electrical circuits. Reference Bulletin 3400282 for kit contents.

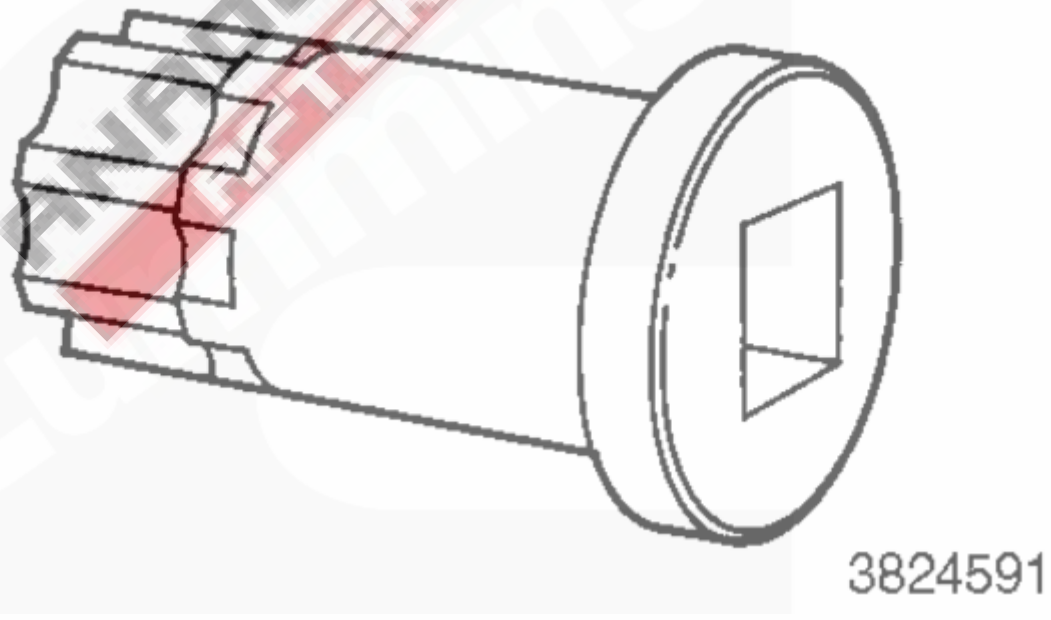


Tool Number

5299073

Engine Barring Gear

Used to engage the flywheel ring gear to rotate the crankshaft.




ANADOLU ISUZU
AFTER SALES

Select Service Tools

Recommended Cummins® Service Tools

- Bracket, Part Number 4890404
- Barring tool, Part Number 5299073
- Torque wrench, Part Number 3376592

Additional Service Items

- Feeler gauge

Preparatory Steps

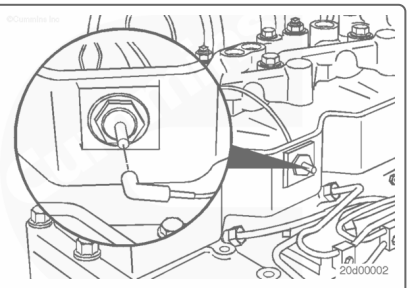
⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

- Disconnect the batteries. See equipment manufacturer service information.
- Remove the exhaust gas recirculation (EGR) connection tube. Refer to Procedure 011-025 in Section 11. (/qs3/pubsys2/xml/en/procedures/425/425-011-025-tr.html)
- Remove the rocker lever cover. Refer to Procedure 003-011 in Section 3. (/qs3/pubsys2/xml/en/procedures/425/425-003-011-om.html)

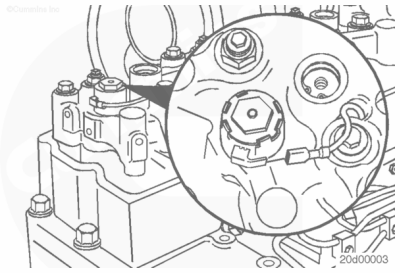
Remove

Disconnect the wiring harness from the electrical connectors in the rocker lever housing.



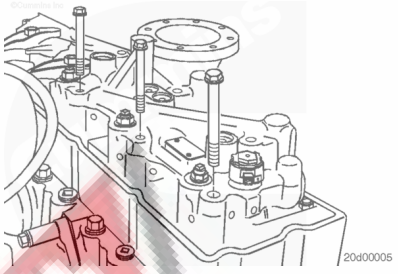
Note : It is easier to remove the wire from the rocker lever housing after the brake is removed.

Unplug the wires from the brake solenoid.



Note : Use **only** grade 12.9 mounting capscrews for engine brake assemblies. Verify all mounting capscrews are grade 12.9. If any capscrews are found that are **not** grade 12.9, replace the capscrews.

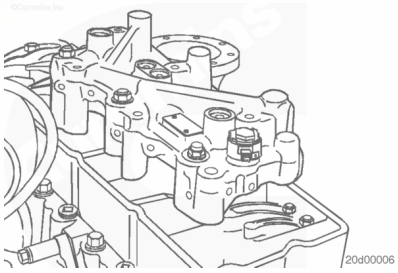
Remove the six mounting capscrews and flat washers from one or both of the engine brake assemblies, as required.



Note : Engines with an engine serial number (ESN) of 73001424 and higher use a bracket underneath the mounting capscrews above cylinders 1 and 4 in place of a hardened washer. This bracket is used to route the solenoid wire away from moving parts and prevent wire chaffing.

Remove the brake assembly or assemblies, as required.

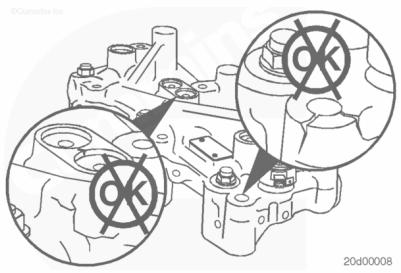
Remove the adjusting cap from the exhaust rocker arms.



Clean and Inspect for Reuse

⚠ WARNING ⚠

When using solvents, acids, or alkaline materials for cleaning, follow the manufacturer's recommendations for use. Wear goggles and protective clothing to reduce the possibility of personal injury.



⚠ WARNING ⚠

Some solvents are flammable and toxic. Read the manufacturer's instructions before using.

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Clean the engine brake assembly. Use solvent and a brush.

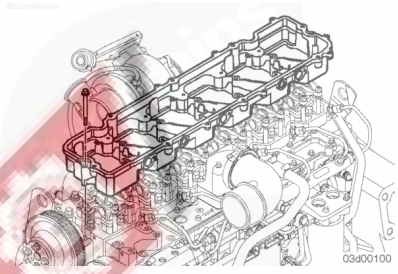
Inspect the engine brake assembly for cracks or any other damage.

Install

If necessary, check and set the valve lash prior to installing the engine brake. Refer to Procedure 003-004 in Section 3. (/qs3/pubsys2/xml/en/procedures/425/425-003-004-tr.html)

If necessary, install the rocker lever housing and mounting bolts. Refer to Procedure 003-013 in Section 3. (/qs3/pubsys2/xml/en/procedures/425/425-003-013.html)

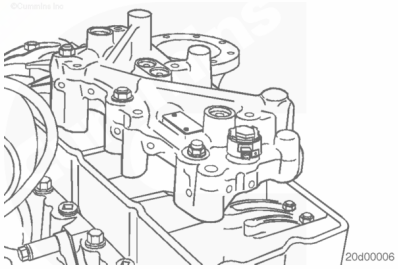
Install the engine brake specific crossheads and rocker lever hold-downs.



Note : Make sure the oil supply adapter at the intake manifold stud is fitted into the oil supply hole in the brake assembly.

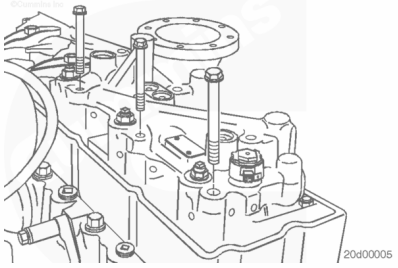
At the intake mounting stud (cylinder 1 and/or cylinder 4) lubricate the oil adapter and o-ring. Use lubricating oil.

Install the engine brake overhead assembly.



⚠ CAUTION ⚠

Use only grade 12.9 mounting capscrews for engine brake assemblies. Verify all mounting capscrews are grade 12.9. If any capscrews are found that are not grade 12.9, replace the capscrews.

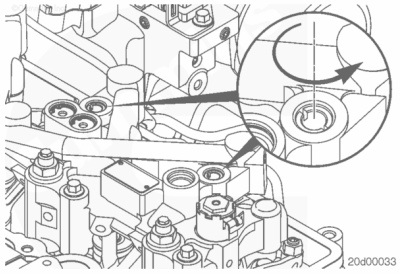


Install the six 10 mm mounting capscrews (three for the front brake assembly, three for the rear brake assembly) with flat washers at the brake mounting spacers (exhaust side of engine). Hand tighten.

Note : Engines with an engine serial number (ESN) of 73001424 and higher use a bracket underneath the mounting capscrews above cylinders numbers 1 and 4 in place of a hardened washer. This bracket is used to route the solenoid wire away from moving parts and prevent wire chaffing.

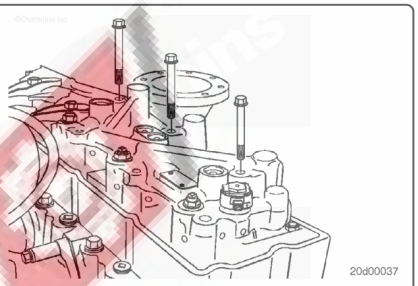
Note : Do **not** tighten the capscrews to their final torque specification at this time.

Turn the adjusting sleeves in the engine brake housing until they make contact with the rocker arm pedestals. No preload **must** be imparted on the housing.



Install the six 10 mm mounting capscrews (three for the front brake assembly, three for the rear brake assembly) with flat washers (intake side of the engine).

Note : Engines with an engine serial number (ESN) of 73001424 and higher use a bracket underneath the mounting capscrews above cylinders 1 and 4 in place of a hardened washer. This bracket is used to route the solenoid wire away from moving parts and prevent wire chaffing.



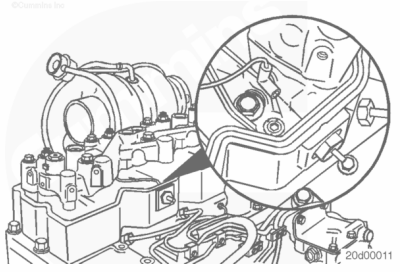
Tighten the six 10 mm mounting capscrews for the front brake assembly and six 10 mm mounting capscrews for the rear brake assembly.

Note : No tightening sequence is required but the capscrews can be tightened in a crossing sequence.

Torque Value: 32 n•m [24 ft-lb]

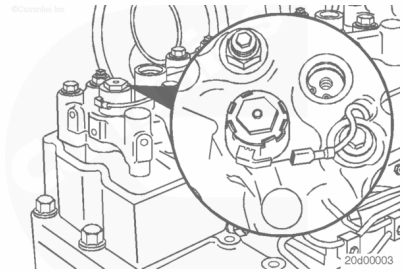
Install the wires to the terminals on the inside of the spacer.

Note : The longer wire **must** be connected to the front engine brake solenoid. It is possible to install the wires in the incorrect orientation, which will result in an interference with the rocker levers.



Note : On engines equipped with a bracket to prevent the wire from chaffing, secure the wire to bracket, Part Number 4890404.

Connect the wires from the terminals on the inside of the spacer to the solenoid.

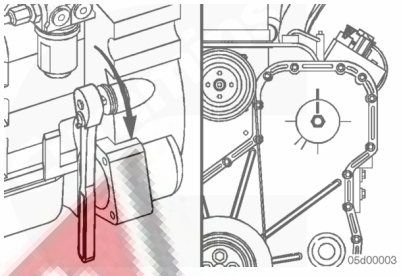


Adjust

Remove the plastic fuel pump drive cover located on the front of the engine.

GRAPHIC NOT FOUND

Use barring tool, Part Number 5299073, to rotate the crankshaft to align the mark on the fuel pump gear with the top dead center mark on the gear cover.



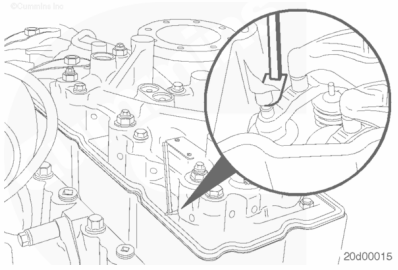
When the engine is in the top dead center position, brake lash can be set on cylinders 1, 3, and 5.

GRAPHIC NOT FOUND

Use two wrenches to hold the adjusting nut. Loosen the lock nuts on the brake at cylinders 1, 3, and 5.

Brake Lash - Feeler Gauge Method

Insert the appropriate brake lash feeler gauge between the brake slave piston and exhaust crosshead pin on cylinder 1.



Brake Lash - Feeler Gauge	
Tool Part Number	**Lash Specification**
3163681	2.286 mm [0.090 in]

Note : If the correct size feeler gauge is **not** available there is an alternate dial indicator method for setting the brake lash following in this procedure.

Use the 0.68 N•m [6 in-lb] torque wrench, Part Number 3376592, to tighten the adjusting nut until the torque wrench "clicks" or until drag is felt on the feeler gauge.

GRAPHIC NOT FOUND

Remove the feeler gauge. Use two wrenches to hold the adjusting nut. Tighten the locknut.

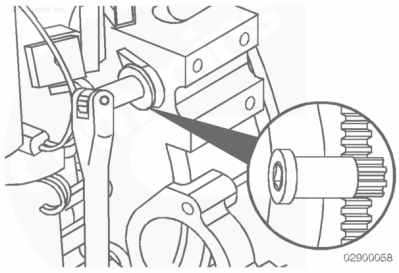
GRAPHIC NOT FOUND

Torque Value: 35 n•m [26 ft-lb]

Repeat for cylinders 3 and 5.

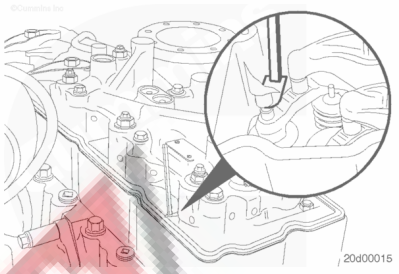
Use engine barring tool, Part Number 5299073, to rotate the crankshaft 360 degrees to align the mark on the fuel pump gear with the mark on the gear cover 180 degrees away from top dead center.

When the engine is in position, brake lash can be set on cylinders 2, 4, and 6.



Insert the appropriate brake lash feeler gauge between the brake sleeve piston and exhaust crosshead pin on cylinder 2.

Brake Lash - Feeler Gauge	
Tool Part Number	**Lash Specification**
3163681	2.286 mm [0.090 in]



Use 6 in-lb torque wrench, Part Number 3376592, to tighten the adjusting nut until the torque wrench "clicks" or until drag is felt on the feeler gauge.

GRAPHIC NOT FOUND

Remove the feeler gauge. Use two wrenches to hold the adjusting nut. Tighten the locknut.

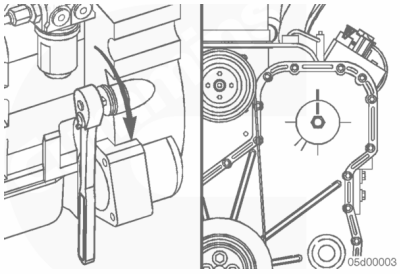
Torque Value: 35 n•m [26 ft-lb]

Repeat for cylinders 4 and 6.



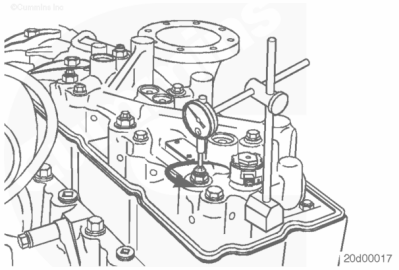
The following method can be used instead of the feeler gauge method if a feeler gauge of the proper size is **not** available.

Use barring tool, Part Number 5299073, or equivalent, to rotate the crankshaft to align the mark on the fuel pump gear with the top dead center mark on the gear cover.



Brake Lash - Dial Indicator

Tighten the backlash adjusting nut on cylinder 1 until resistance is felt. Place the dial indicator tip on the adjusting nut and zero the dial indicator. Turn the lash adjusting nut in a **counterclockwise** direction until the appropriate lash is reached.



ANADOLU ISUZU DEALER SALES

Measurements		
	mm	in
Brake Lash Specification	2.286	0.090

Use two wrenches to hold the adjusting nut and tighten the locknut.

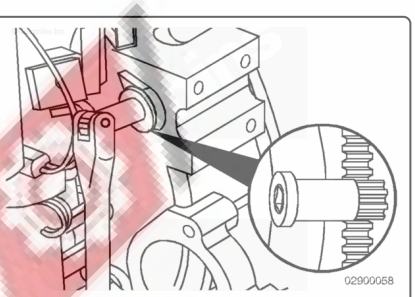
GRAPHIC NOT FOUND

Torque Value: 35 n•m [26 ft-lb]

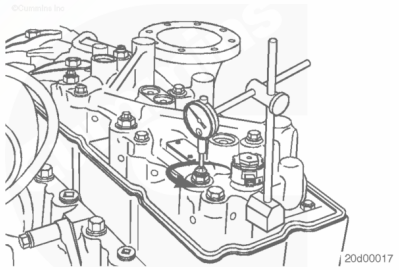
Repeat for cylinders 3 and 5.

Use barring tool, Part Number 5299073, or equivalent, to rotate the crankshaft 360 degrees to align the mark on the fuel pump gear with the mark on the gear cover that is 180 degrees away from top dead center.

When the engine is in position, brake lash can be set on cylinders 2, 4, and 6.



Tighten the backlash adjusting nut on cylinder number 2 until resistance is felt. Place the dial indicator tip on the adjusting nut. Zero the dial indicator. Turn the lash adjusting nut in a **counterclockwise** direction until the appropriate lash is reached.



Measurements		
	mm	in
Brake Lash Specification	2.286	0.090

Use two wrenches to hold the adjusting nut. Tighten the locknut.

GRAPHIC NOT FOUND

Torque Value: 35 n•m [26 ft-lb]

Repeat for cylinders 4 and 6.

Install the plastic fuel pump drive cover located on the front of the engine.

GRAPHIC NOT FOUND

Finishing Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

- Install the rocker lever cover. Refer to Procedure 003-011 in Section 3. (/qs3/pubsys2/xml/en/procedures/425/425-003-011.html)
- Install the EGR connection tube. Refer to Procedure 011-025 in Section 11. (/qs3/pubsys2/xml/en/procedures/425/425-011-025.html)
- Connect the batteries. See equipment manufacturer service information.
- Operate the engine. Verify proper engine brake operation.

Last Modified: 17-Nov-2016

ANADOLU ISUZU AFTER SALES

Select Service Tools

Recommended Cummins® Service Tools

- No Cummins® Service Tools required.

Additional Service Items

- No additional service items required.

Preparatory Steps

⚠ WARNING ⚠

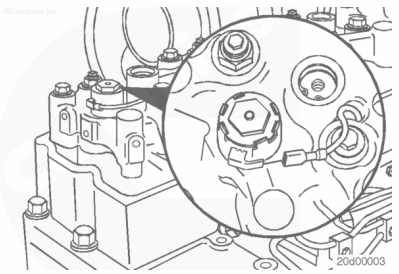
Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

- Disconnect the batteries. See equipment manufacturer service information.
- Remove the exhaust gas recirculation (EGR) connection tube. Refer to Procedure 011-025 in Section 11. (/qs3/pubsys2/xml/en/procedures/425/425-011-025.html)
- Remove the rocker lever cover. Refer to Procedure 003-011 in Section 3. (/qs3/pubsys2/xml/en/procedures/425/425-003-011.html)

Remove

Disconnect the engine brake wiring harness from the solenoid.

Remove the solenoid. Discard the o-rings.



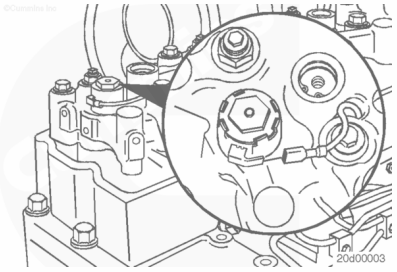
Install

Install new o-rings and the solenoid.

Tighten the solenoid.

Torque Value: 20 n•m [177 in-lb]

Connect the engine brake wiring harness to the solenoid.



Finishing Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

- Install the rocker lever cover. Refer to Procedure 003-011 in Section 3. (/qs3/pubsys2/xml/en/procedures/425/425-003-011.html)
- Install the EGR connection tube. Refer to Procedure 011-025 in Section 11. (/qs3/pubsys2/xml/en/procedures/425/425-011-025.html).
- Connect the batteries. See equipment manufacturer service information.
- Operate the engine, check for leaks, and verify proper engine brake operation.

ANADOLU ISUZU

Last Modified: 10-Aug-2016

Select Service Tools

Recommended Cummins® Service Tools

- No Cummins® Service Tools required.

Additional Service Items

- No additional service items required.

Preparatory Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

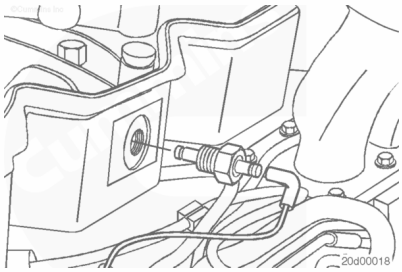
- Disconnect the batteries. See equipment manufacturer service information.
- Remove the exhaust gas recirculation (EGR) connection tube. Refer to Procedure 011-025 in Section 11. (/qs3/pubsys2/xml/en/procedures/425/425-011-025.html)
- Remove the rocker lever cover. Refer to Procedure 003-011 in Section 3. (/qs3/pubsys2/xml/en/procedures/425/425-003-011.html)

Remove

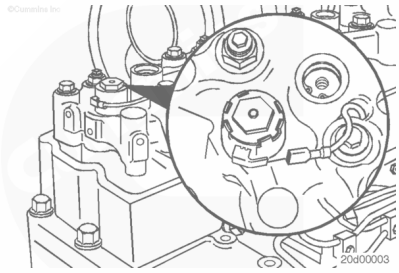
Remove the engine plug connector at the engine brake spacer.

Remove the engine receptacle connector retaining nut and o-ring.

Remove the engine receptacle from the engine brake spacer.



Disconnect the solenoid wires.

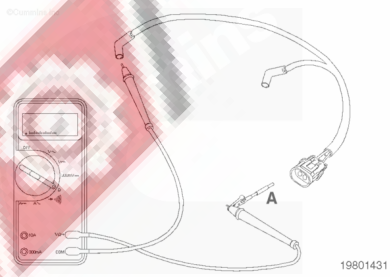


Resistance Check

Insert a test lead into pin A in the brake harness.

Insert the other test lead into the corresponding engine pass-through terminal connector in the brake harness.

Measure the resistance. The multimeter **must** read a closed circuit (10 ohms or less).



Remove the test lead from pin A and insert it into pin B.

GRAPHIC NOT FOUND

Insert the other test lead into the corresponding engine pass-through terminal connector.

Measure the resistance. The multimeter **must** read a closed circuit (10 ohms or less).

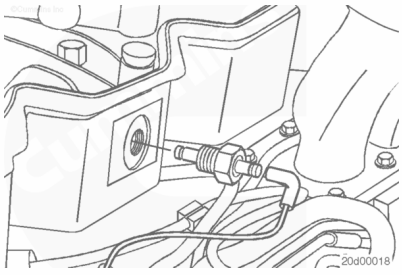
If the resistance values are **not** correct, inspect the wires for an open circuit.

Install

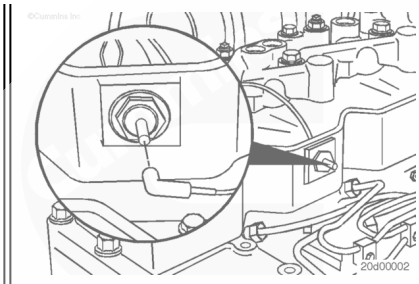
Install the engine receptacle into the engine brake spacer.

Install the engine receptacle connector retaining o-ring. Tighten the nut.

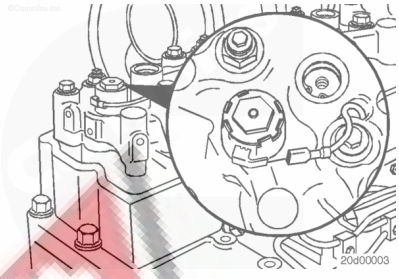
Torque Value: 11 n•m [97 in-lb]



Install the engine plug connector at the rocker lever housing.



Connect the solenoid wires.



Finishing Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

- Install the rocker lever cover. Refer to Procedure 003-011 in Section 3. (/qs3/pubsys2/xml/en/procedures/425/425-003-011.html)
- Install the EGR connection tube. Refer to Procedure 011-025 in Section 11. (/qs3/pubsys2/xml/en/procedures/425/425-011-025.html)
- Connect the batteries. See equipment manufacturer service information.
- Operate the engine. Verify proper engine brake operation.

ANADOLU ISUZU

Last Modified: 10-Aug-2016

General Information

The following publications can be purchased.

Bulletin Number	Title of Publication
5411267	L9 CM2350 L119B Service Manual
5411270	L9 CM2350 L119B Fault Code Troubleshooting Manual
5411271	L9 CM2350 L119B Wiring Diagram
5411268	L9 CM2350 L119B Operation and Maintenance Manual
5411268	L9 CM2350 L119B Owners Manual
3379000	Air for Your Engine
3379001	Fuels for Cummins® Engines
3379009	Operation of Diesel Engines in Cold Climates
3666132	Cummins® Coolant Requirements and Maintenance
3810340	Cummins® Engine Oil and Oil Analysis Recommendations
4021566	Diesel Exhaust Fluid (DEF) Specifications for Cummins® Selective Catalytic Reduction (SCR) Systems

ANADOLU ISUZU AFTER SALES

Last Modified: 04-Nov-2016

Contact Information

Service literature can be obtained from the appropriate location listed below:

- Any Cummins® Distributor
- Iron Mountain Fulfillment Services
  - Help Desk (U.S.): 1-800-646-5609
  - Help Desk (Outside U.S.): 1-630-283-2420
  - Email: CECOteam@ironmountain.com
- QuickServe® Online Store
  - https://store.cummins.com (https://store.cummins.com)

Last Modified: 11-Feb-2020

ANADOLU ISUZU AFTER SALES

General Information

Cummins is pleased to announce the availability of a parts catalog compiled specifically for you. Unlike the generic versions of parts catalogs that support general high volume parts content; Cummins Customized catalogs contain only the new factory parts that were used to build your engine.

The catalog cover, as well as the content, is customized with you in mind. You can use it in your shop, at your worksite, or as a coffee table book in your RV or boat. The cover contains your name, company name, address, and telephone number.

This new catalog was designed to provide you with the exact information you need to order parts for your engine. This will be valuable for customers that do not have easy access to Cummins QuickServe Online.

Additional Features of the Customized Catalog include:

- Engine Configuration Data
- Table of Contents
- Separate Option and Parts Indexes
- Service Kits (when applicable)
- ReCon Part Numbers (when applicable)

Ordering the Customized Parts Catalog

Ordering by Telephone

- North American Distributors, Original Equipment Manufacturers and Cummins Factory personnel order by calling Iron Mountain Fulfillment Services (IMFS) at 1-800-646-5609.
- International Distributors and Original Equipment Manufacturers order the CPC from their regional Cummins Parts Distribution Centers (PDC).
- International PDC orders are called into Iron Mountain at (++) 630-283-2420.
- Retail Credit Card Orders require a 2 step ordering process.

Ordering On-Line

Access the Cummins QSOL store at https://store.cummins.com

- Find the Customized Parts Catalog button located on the left of the homepage
- Select format. Your Price is also shown here
- Finalize Shopping Cart and Check Process as described on the website

BUBOLU ISUZU PARTS SALES

North America call Iron Mountain Fulfillment Services (IMFS) at 800-646-5609, International customers call (++) 630-283-2420. Provide IMFS the catalog detail as described on the website. This step is required until we have our On Line form available.

Required information needed for your Customized Parts Catalog Order.

- Customer Name
- Street Address
- Company Name (optional)
- Telephone no.
- Credit Card No.
- Cummins Engine Serial Number (located on the engine data plate)

Unfortunately not all Cummins Engines can be supported by Customized Parts Catalogs. Engines older than 1984 or newer than 3 months may not have the necessary parts information to compile a catalog. We will contact you if this occurs and explain why we are unable to fill your order.

Customized Parts Catalogs are produced specifically for a single customer. This means they are not returnable for a refund. If we make an error and your catalog is not useable, we will correct that error by sending you a new catalog.

Last Modified: 18-Dec-2013

ANADOLU ISUZU AFTER SALES

Specifications

Listed below are the general specifications for the engine covered in this manual:

Horsepower	See engine dataplate.
Firing Order	1-5-3-6-2-4
Crankshaft Rotation (viewed from front of engine)	**Clockwise**
Displacement	8.9 liters [540 in^3]
Bore and Stroke	114 mm [4.49 in] x 144.5 mm [5.69 in]
Dry Weight	769 kg [1695 lb]
Wet Weight	803 kg [1770 lb]

Overhead Adjustment

Intake Valve Adjustment	0.305 mm [0.012 in]
Exhaust Valve Adjustment	0.559 mm [0.022 in]
Engine Brake Adjustment	2.286 mm [0.090 in]

ANADOLU ISUZU

Last Modified: 01-Nov-2016

Specifications

Maximum Fuel Return Line Pressure	30 kPa [4.3 psi]
Maximum Fuel Inlet Restriction at Gear Pump Inlet (Dirty Filter, Loaded Condition)	254 mm-hg [10 in-hg]
Maximum Fuel Inlet Restriction at Original Equipment Manufacturer (OEM) Connection (Dirty Filter, Loaded Condition)	203 mm-hg [8 in-hg]

Minimum Gear Pump Pressure

During Cranking Condition	105 kPa [15 psi]
During Rated Condition	483 kPa [70 psi]
Maximum Filter Pressure Drop	80 kPa [11.7 psi]
Minimum Lift Pump Flow	100 mL [3.4 fl-oz] in 10 seconds
Minimum Engine Cranking Speed	150 rpm

ANADOLU ISUZU AFTER SALES

Last Modified: 05-Aug-2016

Specifications

Oil Pressure

At Low Idle (minimum allowable)	69 kPa [10 psi]
At Rated Speed (minimum allowable)	207 kPa [30 psi]
Regulated Oil Rifle Pressure	379 kPa [55 psi]
Lubricating Oil Filter Capacity	3.78 liters [4 qt]

Oil Pan Capacity, Low to High

Standard Oil Pan	15.1 to 18.9 liters [16 to 20 qt]
High Capacity Oil Pan	21.2 to 25 liters [22.4 to 26.4 qt]

Total System Capacity (Oil Pan and New Oil Filter)

Standard Oil Pan	22.7 liters [24 qt]
High Capacity Oil Pan	28.8 liters [30.4 qt]

Note : If the type/oil capacity of each lubricating oil pan is **not** known:

- Contact a Cummins® Authorized Repair Location.
- Determine the capacity of the oil pan option for the engine being serviced by using QuickServe™ Online and the engine serial number.
- Fill the lubricating oil pan to the smallest oil pan capacity listed for the engine being serviced. Then add 0.95 liters [1 qt] of oil at a time until it reaches the high mark on the dipstick. Record the number of liters/quarts added, so the capacity is known the next time the oil is drained.
- Different dipstick, dipstick tube, and oil suction tube options are available for standard and high capacity oil pans. Oil pan change may require dipstick calibration.

Last Modified: 09-Jan-2019

Specifications

Coolant Capacity (engine only)	15.6 liters [16.5 qt]
Standard Modulating Thermostat Range	79 to 95°C [175 to 203°F]
Minimum Recommended Pressure Cap	90 kPa [13 psi]
Minimum Fill Rate (without low-level alarm)	11.4 liters/min [3 gpm]
Maximum Deaeration Time	25 minutes
Maximum Top Tank Coolant Temperature	107°C [225°F]

Winterfronts

Minimum allowed air passage area	774 cm^2 [120 in^2]

ANADOLU ISUZU AFTER SALES

Last Modified: 02-Jan-2020

Specifications

⚠ CAUTION ⚠

Engine intake air must be filtered to prevent dirt and debris from entering the engine. If the air intake piping is damaged or loose, unfiltered air will enter the engine and cause premature wear.

Maximum Intake Restriction

Clean Air Filter Element	254 mm H_2O [10 in H_2O]
Dirty Air Filter Element	635 mm H_2O [25 in H_2O]
Charge Air Cooler Restriction (maximum)	89 mm-hg [3.5 in-hg]

Last Modified: 05-Aug-2016

ANADOLU ISUZU AFTER SALES

Specifications

Maximum Exhaust Restriction:

Clean Aftertreatment Diesel Particulate Filter	229 mm-hg [9.0 in-hg]
Dirty Aftertreatment Diesel Particulate Filter	406 mm-hg [16.0 in-hg]

Last Modified: 05-Aug-2016

ANADOLU ISUZU AFTER SALES

Batteries (Specific Gravity)

Specific Gravity at 27°C [80°F]	State of Charge
1.260 to 1.280	100 percent
1.230 to 1.250	75 percent
1.200 to 1.220	50 percent
1.170 to 1.190	25 percent
1.110 to 1.130	Discharged

Last Modified: 05-Aug-2016

ANADOLU ISUZU AFTER SALES

Specifications

Single Cylinder

Piston Displacement	318 cc [19.4 C.I.D.]
Bore	85 mm [3.346 in]
Stroke	56 mm [2.204 in]
Drive Ratio	1:1
Cooling	Engine coolant
Lubrication	Engine lubricating oil

Plumbing Line Sizes

Coolant Inlet and Outlet	3/4 x 116 STOR
Air Inlet	25.4 mm [1 in] Nominal
Air Outlet	M27 x 2 STOR
Unloader Port	M10 x 1 STOR
Governor Mounting Direct	M8 x 1.25
Height, Overall (Approximate)	217.4 mm [8.56 in]
Width, Overall (Approximate)	142 mm [5.59 in]
Length, Overall (Approximate)	216 mm [8.50 in]
Weight (Approximate)	15 kg [35.0 lb]

Twin Cylinder

Piston Displacement	500 cc [30.5 C.I.D.]
Bore	75 mm [2.95 in]
Stroke	56 mm [2.204 in]
Drive Ratio	1:1

Cooling	Engine coolant
Lubrication	Engine lubricating oil

Last Modified: 05-Aug-2016

ANADOLU ISUZU AFTER SALES

Specifications

Engine Blowby Specifications	30.5 cm H_2O [12.0 in H_2O]

Last Modified: 05-Aug-2016

ANADOLU ISUZU AFTER SALES

General Information

Cummins Filtration™, which produces Fleetguard® products, is a division of Cummins Inc. Fleetguard® filters are developed through joint testing at Cummins Inc. and Cummins Filtration™ Fleetguard® filters are standard on new Cummins® engines. Cummins Inc. recommends their use.

Fleetguard® products meet all Cummins® Source Approval Test standards to provide the quality filtration necessary to achieve the engine's design life. If other brands are substituted, the purchaser should insist on products that the supplier has tested to meet Cummins Inc. high-quality standards.

Cummins Inc. can **not** be responsible for problems caused by non-genuine filters that do **not** meet Cummins Inc. performance or durability requirements.

Lubricating Oil Filter [1]	
Cummins® Part Number	3401544
Cummins Filtration™ Part Number	LF9009
Cummins® Part Number	5444774
Cummins Filtration™ Part Number	LF14009
Fuel Filter (Pressure-Side) Hex Drive Base [2]	
Cummins® Part Number	5303743
Cummins Filtration™ Part Number	FF63009
Fuel Filter (Suction-Side, with Water In Fuel Sensor)[2]	
Cummins® Part Number	4934879
Cummins Filtration™ Part Number	FS1065
Crankcase Breather Element	
Cummins® Part Number	4939749
Cummins Filtration™ Part Number	CV5060300
Aftertreatment Diesel Exhaust Fluid (DEF) Dosing Unit Filter	
Cummins® Part Number	2880298

[1]Either a LF9009 or LF14009 lubricating oil filter **must** be used. Do **not** use an LF3000 lubricating oil filter. Engine durability will be reduced by the use of the incorrect lubricating oil filter.

[2]The fuel system requires the use of two fuel filters.

The suction-side filter **must** have the following characteristics:

- Water separating
- 10 micron rating
- Water in fuel sensor with shunt resistor

- Water drain valve
- Engine mounted or chassis mounted.

The pressure-side filter **must** have the following characteristics:

- 5 micron rating
- Engine mounted or chassis mounted.

Last Modified: 28-May-2019

ANADOLU ISUZU
AFTER SALES

Tension Chart

SAE Belt Size	Belt Tension Gauge Part No.		Belt Tension New		Belt Tension Range Used*	
	Click-type	Burroughs	N	lbf	N	lbf
0.380 in	3822524		620	140	270 to 490	60 to 110
0.440 in	3822524		620	140	270 to 490	60 to 110
1/2 in	3822524	ST-1138	620	140	270 to 490	60 to 110
11/16 in	3822524	ST-1138	620	140	270 to 490	60 to 110
3/4 in	3822524	ST-1138	620	140	270 to 490	60 to 110
7/8 in	3822524	ST-1138	620	140	270 to 490	60 to 110
4 rib	3822524	ST-1138	620	140	270 to 490	60 to 110
5 rib	3822524	ST-1138	670	150	270 to 530	60 to 120
6 rib	3822525	ST-1293	710	160	290 to 580	65 to 130
8 rib	3822525	ST-1293	890	200	360 to 710	80 to 160
10 rib	3822525	3823138	1110	250	440 to 890	100 to 200
12 rib	3822525	3823138	1330	300	530 to 1070	120 to 240
12 rib K section	3822525	3823138	1330	300	890 to 1070	200 to 240
31 rib	-	3164750	1668	375	1330 to 1560	300 to 350

Note : This chart does not apply to automatic belt tensioners.

* A belt is considered used if it has been in service for ten minutes or longer.

* If used belt tension is less than the minimum value, tighten the belt to the maximum used belt value.

ANADOLU ISUZU

Last Modified: 25-Jan-2010



Conversion Chart

Fraction	inch	mm	Fraction	inch	mm
1/64	0.0156	0.397	33/64	0.5156	13.097
1/32	0.0313	0.794	17/32	0.5313	13.494
3/64	0.0469	1.191	35/64	0.5469	13.891
1/16	0.0625	1.588	9/16	0.5625	14.288
5/64	0.0781	1.984	37/64	0.5781	14.684
3/32	0.0938	2.381	19/32	0.5938	15.081
7/64	0.1094	2.778	39/64	0.6094	15.478
1/8	0.1250	3.175	5/8	0.6250	15.875
9/64	0.1406	3.572	41/64	0.6406	16.272
5/32	0.1563	3.969	21/32	0.6563	16.669
11/64	0.1719	4.366	43/64	0.6719	17.066
3/16	0.1875	4.763	11/16	0.6875	17.463
13/64	0.2031	5.159	45/64	0.7031	17.859
7/32	0.2188	5.556	23/32	0.7188	18.256
15/64	0.2344	5.953	47/64	0.7344	18.653
1/4	0.2500	6.350	3/4	0.7500	19.050
17/64	0.2656	6.747	49/64	0.7656	19.447
9/32	0.2813	7.144	25/32	0.7813	19.844
19/64	0.2969	7.541	51/64	0.7969	20.241
5/16	0.3125	7.938	13/16	0.8125	20.638
21/64	0.3281	8.334	53/64	0.8281	21.034
11/32	0.3438	8.731	27/32	0.8438	21.431
23/64	0.3594	9.128	55/64	0.8594	21.828
3/8	0.3750	9.525	7/8	0.8750	22.225
25/64	0.3906	9.922	57/64	0.8906	22.622
13/32	0.4063	10.319	29/32	0.9063	23.019
27/64	0.4219	10.716	59/64	0.9219	23.416
7/16	0.4375	11.113	15/16	0.9375	23.813
29/64	0.4531	11.509	61/64	0.9531	24.209
15/32	0.4688	11.906	31/32	0.9688	24.606
31/64	0.4844	12.303	63/64	0.9844	25.003
1/2	0.5000	12.700	1	1.0000	25.400

Conversion Factor: 1 inch = 25.4 mm

ANADOLU ISUZU

Last Modified: 03-Mar-2004



Conversion Chart

Quantity	U.S. Customary		Metric		From U.S. Customary To Metric Multiply By	From Metric To U.S. Customary Multiply By
	Unit Name	Abbreviation	Unit Name	Abbreviation		
Area	sq. inch	in^2	sq. millimeters	mm^2	645.16	0.001550
			sq. centimeters	cm^2	6.452	0.155
	sq. foot	ft^2	sq. meter	m^2	0.0929	10.764
Fuel Consumption	pounds per horsepower hour	lb/hp-hr	grams per kilowatt hour	g/kW-hr	608.277	0.001645
Fuel Performance	miles per gallon	mpg	kilometers per liter	km/l	0.4251	2.352
	gallons per mile	gpm	liters per kilometer	l/km	2.352	0.4251
Force	pounds force	lbf	Newton	N	4.4482	0.224809
Length	inch	in	millimeters	mm	25.40	0.039370
	foot	ft	millimeters	mm	304.801	0.00328
Power	horsepower	hp	kilowatt	kW	0.746	1.341
Pressure	pounds force per sq. inch	psi	kilopascal	kPa	6.8948	0.145037
	inches of mercury	in Hg	kilopascal	kPa	3.3769	0.29613

ANADOLU ISUZU AFTERSALES

	inches of water	in H_2O	kilopascal	kPa	0.2488	4.019299
	inches of mercury	in Hg	millimeters of mercury	mm Hg	25.40	0.039370
	inches of water	in H_2O	millimeters of water	mm H_2O	25.40	0.039370
	bars	bars	kilopascals	kPa	100.001	0.00999
	bars	bars	millimeters of mercury	mm Hg	750.06	0.001333
Temperature	fahrenheit	°F	centigrade	°C	(°F-32) ÷1.8	(1.8 x °C) +32
Torque	pound force per foot	ft-lb	Newton-meter	N•m	1.35582	0.737562
	pound force per inch	in-lb	Newton-meter	N•m	0.113	8.850756
Velocity	miles/hour	mph	kilometers /hour	kph	1.6093	0.6214
Volume: liquid displacement	gallon (U.S.)	gal.	liter	l	3.7853	0.264179
	gallon (Imp*)	gal.	liter	l	4.546	0.219976
	cubic inch	in^3	liter	l	0.01639	61.02545
	cubic inch	in^3	cubic centimeter	cm^3	16.387	0.06102
Weight (mass)	pounds (avoir.)	lb	kilograms	kg	0.4536	2.204623
Work	British Thermal Unit	BTU	joules	J	1054.5	0.000948
	British Thermal Unit	BTU	kilowatt-hour	kW-hr	0.000293	3414
	horsepower hours	hp-hr	kilowatt-hour	kW-hr	0.746	1.341

ANADOLU ISUZU PARTS SALES


ANADOLU ISUZU
AFTER SALES

Conversion Chart

N•m	ft-lb	N•m	ft-lb	N•m	ft-lb
1	9 in-lb	55	41	155	114
5	44 in-lb	60	44	160	118
6	53 in-lb	65	48	165	122
7	62 in-lb	70	52	170	125
8	71 in-lb	75	55	175	129
9	80 in-lb	80	59	180	133
10	89 in-lb	85	63	185	136
11	97 in-lb	90	66	190	140
12	106 in-lb	95	70	195	144
14	124 in-lb	100	74	200	148
15	133 in-lb	105	77	205	151
16	142 in-lb	110	81	210	155
18	159 in-lb	115	85	215	159
20	15 ft-lb	120	89	220	162
25	18	125	92	225	165
30	22	130	96	230	170
35	26	135	100	235	173
40	30	140	103	240	177
45	33	145	107	245	180
50	37	150	111	250	184

NOTE: To convert from Newton-Meters to Kilogram-Meters divide Newton-Meters by 9.803.

ANADOLU ISUZU SERBEST

Last Modified: 03-Mar-2004

Torque Table

Size		Torque		Torque	
Thread	Actual Thread O.D.	In Aluminum Components		In Cast Iron or Steel Components	
in	**in**	**N•m**	**ft-lb**	**N•m**	**ft-lb**
1/16	0.32	5	45 in-lb	15	10
1/8	0.41	15	10	20	15
1/4	0.54	20	15	25	20
3/8	0.68	25	20	35	25
1/2	0.85	35	25	55	40
3/4	1.05	45	35	75	55
1	1.32	60	45	95	70
1-1/4	1.66	75	55	115	85
1-1/2	1.90	85	65	135	100

Last Modified: 03-Mar-2004

ANADOLU ISUZU AFTER SALES

General Information

NOTE ON SELECTING TAP-DRILL SIZES: The tap drill sizes shown on this card give the theoretical tap drill size for approximately 60% and 75% of full thread depth. Generally, it is recommended that drill sizes be selected in the 60% range as these sizes will provide about 90% of the potential holding power. Drill sizes in the 75% range are recommended for shallow hole tapping (less than 1 1/2 times the hole diameter) in soft metals and mild steel.



Tap Size 60%	Tap Size 75%	Drill Size
		48
		1.95mm
		5/64
	3-48	47
		2.00mm
	M2.5x.45	2.05mm
		46
3-48	3056	45
		2.10mm
M2.5x.45	M2.6x.45	2.15mm
3-56	4-36	44
		2.20mm
M2.6x.45		2.25mm
4-36	4-40	43
		2.30mm
		2.35mm
4-40	4-48	42
		3/32
	M3x.6	2.40mm
4-48		41
		2.45mm
		40
M3x.6	M3x.5	2.50mm
		39
	5-40	38
M3x.5		2.60mm
5-40	5-44	37
		2.70mm
5-44	6-32	36
		2.75mm
		7/64
		35
		2.80mm
		34
6-32	6-40	33
	M3.5x6	2.90mm
M3.5x6		32
6-40		3.00mm
		31
		3.10mm
		1/8
		3.20mm
	M4x.75	3.25mm
		30
	M4x.7	3.30mm
M4x.75		3.40mm
M4x.7	8-32	29
		3.50mm
	8-36	28
8-32		9/64
		3.60mm
8-36		27
		3.70mm
	M4.5x.75	26
	10-24	3.75mm
		25
		3.80mm
M4.5x.75		24
		3.90mm
		23
		5/32
10-24		22
	M5x1	4.00mm
	10-32	21
		20
	M5x.9	4.10mm
M5x1	M5x.8	4.20mm
10-32		19
M5x.9		4.25mm
M5x.8		4.30mm
		18
		11/64
		17

Tap Size 60%	Tap Size 75%	Drill Size
		4.40mm
	12-24	16
		4.50mm
	M5.5x.9	15
12-24	12-28	4.60mm
		14
		13
		4.70mm
M5.5x.9		4.75mm
12-28		3/16
		12
		4.80mm
		11
		4.90mm
		10
		9
	M6x1	5.00mm
		8
		5.10mm
	1/4-20	7
		13/64
		6
M6x1		5.20mm
		5
	M6x.75	5.25mm
		5.30mm
1/4-20		4
M6x.75		5.40mm
	1/4-28	3
		5.50mm
		7/32
		5.60mm
1/4-28		2
		5.70mm
		5.75mm
		1
		5.80mm
		5.90mm
		A
		15/64
	M7x1	6.00mm
		B
		6.10mm
		C
M7x1		6.20mm
		D
	M7x.75	6.25mm
		6.30mm
		E
		1/4
M7x.75		6.40mm
		6.50mm
	5/16-18	F
		6.60mm
		G
		6.70mm
		17/64
	M8x1.25	6.75mm
5/16-18		H
		6.80mm
		6.90mm
	5.16-24	I
M8x1.25	M8x1	7.00mm
		J
		7.10mm
5/16-24		K
		9/32
M8x1		7.20mm
		7.25mm
		7.30mm
		L
		7.40mm
		M

Tap Size 60%	Tap Size 75%	Drill Size
		7.50mm
		19/64
		7.60mm
		N
		7.70mm
	M9x1.25	7.75mm
		7.80mm
		7.90mm
	3/8-16	5/16
M9x1.25	M9x1	8.00mm
		O
		8.10mm
M9x1		8.20mm
		P
		8.25mm
		8.30mm
3/8-16	1/8-27NPT	21/64
		8.40mm
	3/8-24	Q
	M10x1.5	8.50mm
		8.60mm
		R
3/8-24		8.70mm
1/8-27NPT		11/32
	M10x1.25	8.75mm
M10x1.5		8.80mm
		S
		8.90mm
M10x1.25	M10x1	9.00mm
		T
		9.10mm
		23/64
M10x1		9.20mm
		9.30mm
	7/16-14	U
		9.40mm
	M11x1.5	9.50mm
		3/8
		V
		9.60mm
		9.70mm
		9.75mm
M11x1.5		9.80mm
7/16-14		W
		9.90mm
	7/16-20	25/64
		10.00mm
7/16-20		X
	M12x1.75	10.20mm
		Y
		13/32
		Z
M12x1.75	M12x1.5	10.50mm
	1/2-13	27/64
M12x1.5	M12x1.25	10.75mm
M12x1.25		11.00mm
1/2-13		7/16
1/4-18NPT		
		11.25mm
		11.50mm
		29/64
		11.75mm
		11.50mm
	1/2-20	29/64
	9/16-12	15/32
	M14x2	12.00m
		12.25mm
9/16-12		31/64
M14x2	M14x1.5	12.50mm
	9/16-18	1/2
M14x1.5	M14x1.25	12.75mm
M14x1.25		13.00mm
9/16-18		33/64

Tap Size 60%	Tap Size 75%	Drill Size
		13.25mm
	5/8-11	17/32
	M15x1.5	13.50mm
M15x1.5		13.75mm
5/8-11		35/64
	M16x2	14.00mm
		14.25mm
	5/8-18	9/16
M16x2	M16x1.5	14.50mm
5/8-18		37/64
		14.75mm
M16x1.5		15.00mm
		19.32
		15.25mm
		39/64
	M17x1.5	15.50mm
M17x1.5	M18x2.5	15.75mm
		5/8
M18x2.5	M18x2	16.00mm
M18x2		16.25mm
	3/4-10	41/64
	M18x1.5	16.50mm
3/4-10	M19x2.5	21/32
M18x1.5		16.75mm
M19x2.5		17.00mm
		43/64
		17.25mm
3/4-16	3/4-16	11/16
	M20x2.5	17.50mm
		17.75mm
		45/64
M20x2.5	M20x2	18.00mm
M20x2		18.25mm
		23/32
	M20x1.5	18.50mm
		47/64
M20x1.5		18.75mm
		19.00mm
		3/4
		19.25mm
	7/8-9	49/64
	M22x2.5	19.50mm
7/8-9		25/32
		19.75mm
M22x2.5	M22x2	20.00mm
	7/8-14	51/64
M22x2		20.25mm
	M22x1.5	20.50mm
7/8-14		13/16
		20.75mm
M22x1.5	M24x3	21.00mm
		53/64
		21/25mm
		27/32
M24x3		21.50mm
		21.75mm
		55/64
	M24x2	22.00mm
	1"-8	7/8
M24x2		22.25mm
	M24x1.5	22.50mm
1"-8		57/64
M24x1.5		22.75mm
	M25x2	23.00mm
	1"-12	29/32
M25x2		23.25mm
1"x12	1"-14	59/64
	M25x1.5	23.50mm
M20x1.5		23.75mm
1"-14		15/16

17800013

AMPOOL TUBULAR


ANADOLU ISUZU
AFTER SALES

Specifications

Barometric Pressure at Altitude					
Pressure				Altitude	
kPa	PSI	mm Hg	in Hg	m	ft.
103.2	14.96	773.9	30.47	-152	-500
101.3	14.69	760.0	29.92	0	0
99.5	14.43	746.3	29.38	152	500
97.7	14.17	733.0	28.86	305	1000
96.0	13.92	719.8	28.34	458	1500
94.2	13.66	706.6	27.82	610	2000
92.5	13.42	693.9	27.32	762	2500
90.8	13.17	681.2	26.82	914	3000
89.2	12.93	668.8	26.33	1067	3500
87.5	12.69	656.3	25.84	1219	4000
85.9	12.46	644.3	25.37	1372	4500
84.3	12.23	632.2	24.89	1524	5000
82.8	12.01	620.7	24.44	1677	5500
81.2	11.78	609.1	23.98	1829	6000
79.7	11.56	597.8	23.54	1982	6500
78.2	11.34	586.5	23.09	2134	7000
76.7	11.13	575.5	22.66	2286	7500
75.2	10.91	564.4	22.22	2438	8000
73.8	10.71	553.8	21.80	2591	8500
72.4	10.50	543.1	21.38	2743	9000
71.1	10.31	532.8	20.98	2896	9500
69.7	10.11	522.5	20.57	3048	10,000
67.1	9.73	502.8	19.80	3353	11,000
64.4	9.34	483.1	19.02	3658	12,000
62.0	8.99	464.7	18.30	3963	13,000
59.5	8.63	446.3	17.57	4267	14,000
57.2	8.30	429.0	16.89	4572	15,000
54.9	7.96	411.7	16.21	4877	16,000

Last Modified: 18-Mar-2009



CITIPORT



WORKSHOP MANUAL

ECAS

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1 Important instructions and explanations

1.1 Safety instructions and hazard notes

ECAS is a system for fails performance in vehicles. Changes to the system's settings may only be performed by suitably qualified persons in command of the required specialist knowledge.

ECAS was designed only for control of the air suspension system in vehicles.

When the ignition is turned on, or while diagnosis starts, unexpected movements of the vehicle may occur.

If you work on the air suspension system, advise other persons by attaching an information sign to the steering wheel of the vehicle.

Following points have to be observed when welding work is performed on the vehicle:

- The electronic systems must be disconnected from the power supply (interrupt terminals 31, 15, and 30).
- System components (ECU, sensors, actuators, lines etc.) must never come into contact with welding and ground electrodes.

Never drive while the vehicle is lowered onto the buffer, because the vehicle may be badly damaged.

1.2 Requirements for the operation of ECAS

- Compressed air supply must be sufficient.
- Power supply has to be ensured.

Only draw on information from the approved circuit diagrams identified by a ten-digit WABCO number for work on the ECAS system.

Circuit diagrams without a WABCO-number may be incorrect. They must be considered as diagrams that have not been approved by WABCO.

WABCO does not assume any warranty for systems whose structure differs from the one described here.

You require WABCO's approval for the following actions:

- Use of components other than those shown in the circuit diagrams (cables, valves, sensors),
- Integration of any appliances by other manufacturers in the system, or
- Settings for functions that are not system functions.

The structure of the ECAS system is shown defined by several circuit diagrams chapter 11.

1.3 Explanation of symbols

Potential risks:
Personal injury or material loss

Additional instructions, information, tips

- List

– Step

2 Introduction

The name ECAS stands for Electronically Controlled Air Suspension.

ECAS is an electronically controlled air suspension system with a large number of functions.

Air suspension systems have been used in motor vehicles since the mid 50s – especially in buses. Air suspension systems are used in them as a standard and are increasingly being used in trucks and trailers. The advantages of air suspension over mechanical suspension (steel springs) are listed below:

- Increase in ride comfort due to lower spring rate and low natural frequency
- constant vehicle height irrespective of the load
- precise load-dependent activation of the brakes through use of the air bellows pressure as control pressure for the proportioning valve
- Kneeling function (lowering of one side of the vehicle to facilitate entry and exit)

The control system was initially designed with pure mechanically operating leveling valves, soon afterwards electromechanical control systems were developed . This served to enhance ease of operation and to facilitate raising/lowering processes.

ECAS is the most advanced development in this direction. Using electronic control units enabled decisive improvements in the conventional system; it enabled many functions for the first time ever:

- Reduction of the air consumption – none while the vehicle is moving. Air savings of approximately 25 % were determined using ECAS compared to a conventional air suspension system in low-floor buses for scheduled route services.
- High speed of all control processes due to large valve cross-sections (nominal size 7 per air bellows).
- Easy installation. Only one air line is required from the solenoid valve block to each bellows and one to the storage tank.
- Raising/ lowering function and kneeling conform to the legal requirements
- High system flexibility for different kneeling types
- Extensive safety concept, error storage and diagnostics capabilities.

In mechanically controlled air suspension systems, the device that measures the level also controls the air spring. With ECAS, an electronic system takes over control, regulating the air springs by means of solenoid valves informed by measured values from sensors.

Apart form controlling the normal level, the electronic unit also covers control of the other functions: working together with control switches and sensors for the tyre deflection compensation, the ECU achieve this without the need for numerous additional valves required by conventional air suspension control.

ECAS at different configuration levels can be fitted in various bus types .

The ECAS system in a bus consists of the following components:

- an ECAS electronic unit (ECU)
- a solenoid valve (solo vehicle)
- 3 distance sensors
- optionally 1 pressure sensor
- Operating switches
- Sidewalk detector

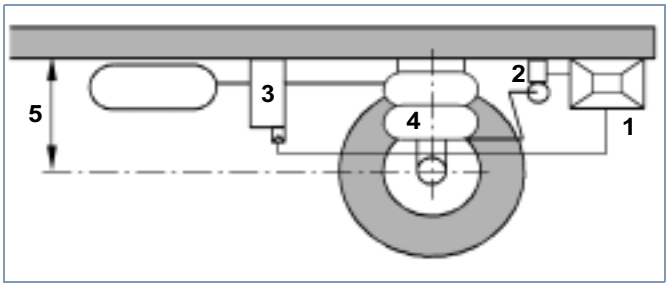


Abb. Example ECAS base system

1 ECU (electronics)
2 Distance sensor
3 Solenoid valve
4 Air-suspension bellows
5 Distance body/axle

ECAS with CAN bus

The most recent generation of the ECAS systems has CAN bus capability. Here the electronic systems are networked by means of a CAN bus and information is transmitted via SAE-CAN identifiers.

The CAN Bus (Controller Area Network) is a serial databus system, which was developed for networking controllers in automobiles with the aim to reduce cable harnesses. Instead of using an electrical circuit for each transmitted signal, the "bus" is based on a communication platform which regulates the relaying of messages between several devices.

The "BUS network" in the MB CITARO city bus is used for illustration. In principle, however, this description also applies to other well-known vehicle manufacturers.

The "CAN-BUS Vehicle" in accordance with ISO 11898 forms the basis for the CITARO BUS system. Four "Flexibly Programmable Controls", representing the link to the four Sub-BUS systems, are connected to this vehicle CAN-BUS.

Because the sensors, actuators and switches are distributed throughout the vehicle, a large amount of cabling was previously required to connect the relevant devices to the corresponding control electronics. The increasing use of complex control systems and their interactive access to sensor and switching statuses necessitated the design of a system that makes the operating states, etc. mutually transparent for the electronic systems.

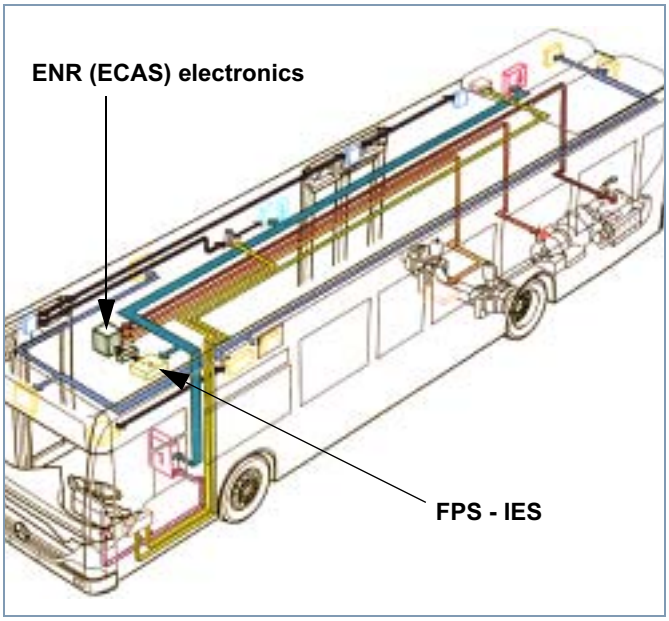
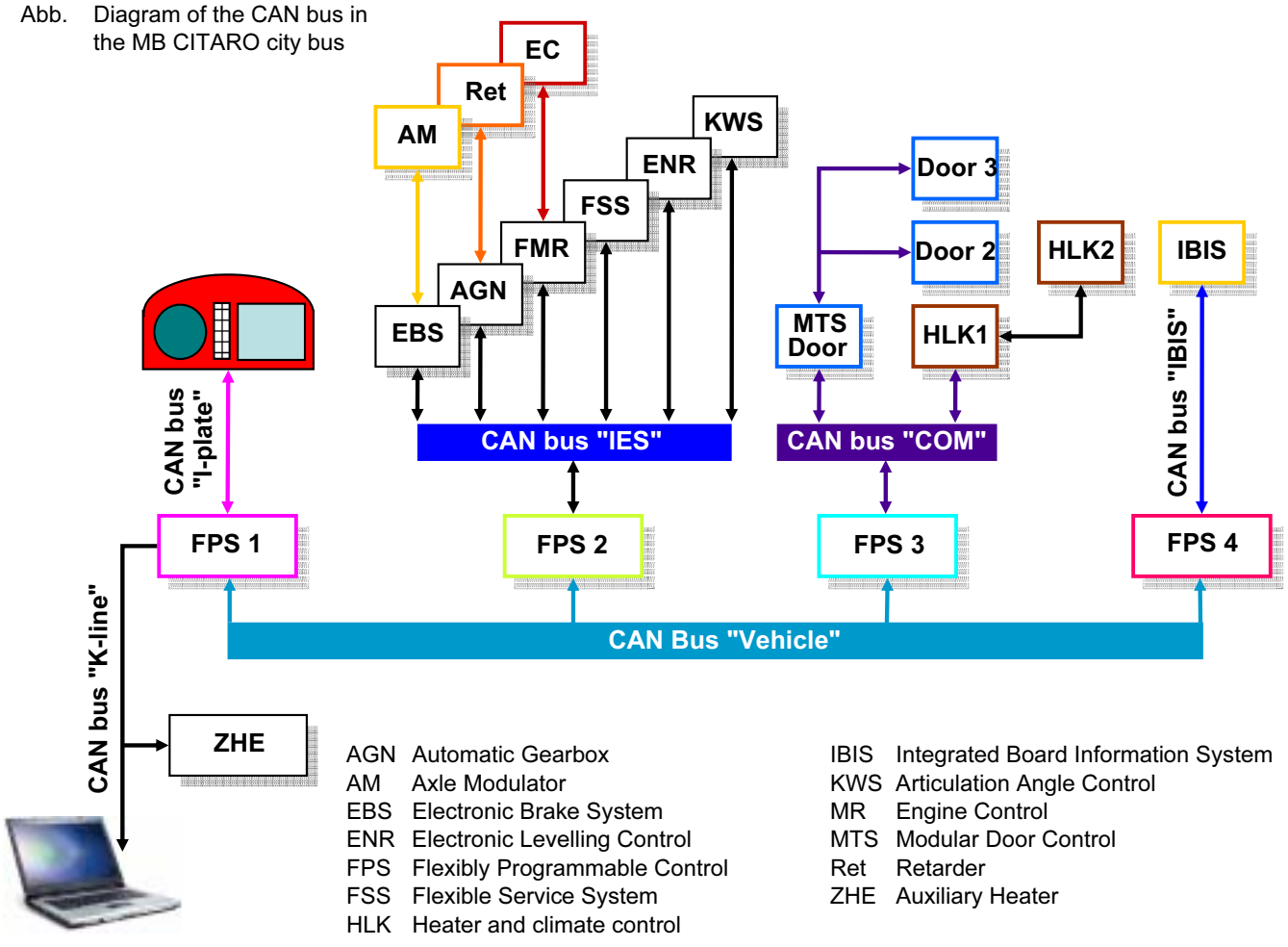


Abb. Illustration of the CAN bus in the MB CITARO city bus

Abb. Diagram of the CAN bus in the MB CITARO city bus



AGN	Automatic Gearbox
AM	Axle Modulator
EBS	Electronic Brake System
ENR	Electronic Levelling Control
FPS	Flexibly Programmable Control
FSS	Flexible Service System
HLK	Heater and climate control
IBIS	Integrated Board Information System
KWS	Articulation Angle Control
MR	Engine Control
MTS	Modular Door Control
Ret	Retarder
ZHE	Auxiliary Heater

The Flexibly Programmable Controls serve as an interface to provide each individual system a precise process I/O image, i.e. information on the inputs and outputs in the overall system, via a CAN data bus.

One of these SUB-CAN BUS systems is the CAN-BUS "IES". The ENR (ECAS) and various other systems, such as the electronic brake system EBS, are currently connected to it.

The systems are connected to their sub-systems via a system bus. The ECAS system is integrated in a vehicle system based on the CAN-BUS to ISO 11898.

The electronics provide the connection with the vehicle electrics via a CAN data bus and via separate inputs and outputs.

When this highly standardised technology was introduced, the vehicle manufacturers specified that the system suppliers are responsible for the systems.

2.1 System configuration

ECAS has a modular structure to ensure that different vehicle types can be equipped with the system. The choice of system components to be used is determined by what is required of the system.

With the most basic configuration level, only one axle is equipped with the ECAS air suspension and only one height sensor monitors the body height. With this configuration, the support bellows of a tandem axle can be interconnected.

However, if the body is to be kept parallel to the axle even when the load is distributed unevenly in the vehicle, it is necessary to arrange distance sensors on both sides and to control the support bellows of the axle or tandem axle by separate solenoid valves.

A vehicle with full air suspension is usually equipped with three distance sensors. The front axle, for example, has one distance sensor and the rear axle has two in this configuration.

Vehicles are also equipped with four distance sensors however. This applies mainly to vehicles with independent wheel suspension. With two front distance sensors it is possible to implement cornering detection and ESAC. The mean value from the two distance sensor signals is used for ECAS control.

The two bellows of the axles with only one distance sensor are interconnected by a restrictor to enable pressure equalisation. During brief changes in the direction of travel however, this restrictor prevents rapid pressure equalisation. This prevents exhaust of the bellows on the outermost side of the curve, thereby reducing tilt of the vehicle against the curve direction. If cornering is detected, automatic level correction is interrupted or is not started. This prevents correction of any rolling movements of the vehicle body occurring at this moment. The transverse restrictor is deactivated analogous to deactivation during kneeling. Calculation of this lateral acceleration is based on the front wheel speed information that is is transmitted from the EBS to the ECAS-ECU via the CAN-BUS.

In an articulated bus the axle of the trailer section is equipped with two additional distance sensors and its own control electronics.

A further breakdown of possible system configurations, illustrated by a circuit diagram and part numbers, is provided in the appendix.

Pressure test connections

The support bellows should be fitted with pressure test connections so that the control pressure of the LSV can be measured when testing the braking system.

These test connections also provide a makeshift solution for filling the support bellows in the event of a fault in the air suspension system. With the assistance of a tyre inflation hose, the vehicle can usually be driven to the workshop under it's own power.

3 System functions

Although ECAS offers a wide range of functions, not all of them need to be implemented in any given system. The respective vehicle manufacturer is responsible for the system configuration and for setting all the parameters, both of which must never be changed without prior consent from the manufacturer.

3.1 Functions of the ECAS-ECU

3.1.1 Controlling the nominal level

Nominal level control is the basic function of ECAS. The continuous comparison of the actual values supplied by the distance sensors with the nominal values stored in the ECU keeps ECAS permanently informed of the vehicle's current ride height. If deviations exceed a certain tolerance range, solenoid valves are triggered and the actual level is adjusted to the nominal level by means of air intake or air exhaust of the air suspension bellows.

Unlike with conventional air suspension, the ride height is not only adjusted to the vehicle's normal level but any other preselected level. This means any level level that was set is maintained regardless of the number of passengers who who get on or off the bus.

In the event of greater level changes, the solenoid valves are pulsed (CAN II), shortly before the nominal level is reached, relative to the lifting speed and the distance to nominal level in order to prevent overshooting.

All control processes can be executed in parallel on the different axles (front and rear axle simultaneously) within the tolerance limits.

3.1.2 Normal level 1/2/3

Normal level 1 is the level that was defined by the vehicle manufacturer for normal driving. The normal level 1 determines the ride comfort, road safety and body height, which must comply with the legally prescribed limits.

Normal level 2 is level that deviates from normal level 1 as an adjustment to special driving conditions. Speed-dependent adjustment to this level is also possible. The height of normal level 2 is permanently defined by a set value (parameter) in the electronic unit. A switch is used to choose between normal level 1 and normal level 2.

For safety reasons, it is possible to automatically adjust the level to normal level 1 as soon as the vehicle exceeds a certain speed threshold (20 km/h for example); the level is then readjusted to the previous level once the speed drops below a lower speed threshold (10 km/h for example).

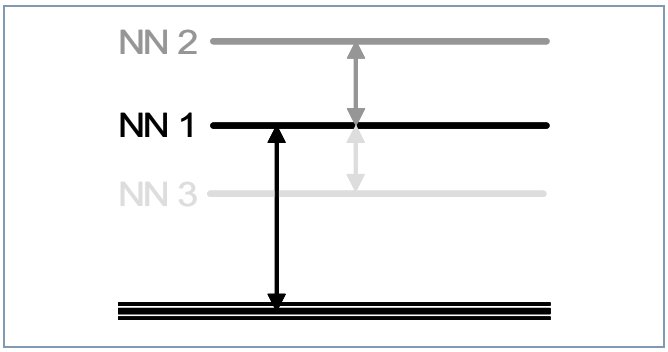


Abb. Illustration of the ride height

Special aspects with regard to CAN II electronic systems

- CAN II electronic systems also permit setting parameters for normal level 3 as a speed-dependent level
- Customer Level: Independent parameters can be set for levels on rear axle left and rear axle right.
- All levels are obtained via CAN identifier ASC2_… .

Manual level adjustment using switches/ pushbuttons

In certain cases it may be necessary to set a certain level which differs from normal levels 1/2. Pushbuttons can be used for lifting and lowering. When these are actuated, the bus is raised or lowered at the selected axle(s) by means of a preselector switch.

Height limitation

The electronic unit automatically discontinues height limitation when programmed (calibrated) values for the upper or lower limit positions are reached.

3.1.3 Kneeling

Kneeling is a special function for buses. The regulations for kneeling systems are described in section 35d of the StVZO (road traffic regulations). Kneeling describes a process whereby the bus is lowered to make it easier for passengers to get on and off. Depending on the parameter settings of the electronic control unit, this can take place towards on one side on both axles at the axle with one distance sensor (usually the front axle). ECAS provides the option to take the door position into account and to safeguard the lowering process by means of a contact strip that is monitored by ECAS. If the contact strip reacts during a kneeling process, the bus reverts to normal level.

Diverse kneeling function actuation types are possible depending on the electric wiring and the parameter settings of the electronic unit.

Supply pressure monitoring

One precondition for kneeling is the availability of sufficient supply pressure to quickly raise a lowered and fully laden vehicle back to normal level. If the supply pressure has dropped below a value monitored by a pressure switch, ECAS will not permit kneeling in order not to prolong the time spent at bus stops.

3.1.4 Traction help with 3-axle vehicles (6 × 2)

When the traction help function is activated in three-axle vehicles, the axle load of the drive axle is increased by relieving the trailing axle. This makes it possible to transfer greater drive torque on slippery road surfaces.

The permissible pressure and the permissible ride height are monitored during traction help action and corrected, if necessary. All manual and automatic level changes are still possible during this process.

Traction help is categorised into 5 types. The respective type of traction help is parameterised (with or without time limit, speed and load limit, with or without forced pause) in accordance with the applicable legal provisions.

In 6x2 vehicles with a lifting or trailing axle, and depending on the functions of the ECAS system, it is possible to pursue different control strategies for the supporting bellows pressures in the rear axle unit between the driven and the lifting/trailing axle.

Pressure ratio control

It is possible to define 2 pressure ratio settings between drive axle and trailing axle. The selected pressure ratio is abandoned in the event of overloading. In this case, the pressure is adjusted to a level matching the ratio of the permissible pressures.

Optimal traction

In this event, the load is predominantly placed on the drive axle bellows. Is is ensured that there is always sufficient residual pressure in the unloaded support bellows to prevent the bellows from becoming crushed.

Pressure equality control

Behaviour as with 4×2 vehicles. The bellows of the drive and the trailing axle have the same pressure.

3.2 Control algorithm

Level control is a function that controls the distance between vehicle body and axle. The level (ride height) control is the basic function of ECAS.

It may be necessary to readjust that distance because of disturbance factors, or because the nominal value changes.

Long control times are the result of slow readjustments of the actual value to the new nominal value. High control accuracy is here achieved at the expense of speed.

When speeding up the readjustment process, the time required for reaching new nominal value is reduced, the system's tendency to overshoot increases.

The large nominal width of the ECAS solenoid valves, which is beneficial for adjusting major differences in nominal values, is detrimental if the differences in nominal values are minor. The latter increases the tendency to overshoot.

As far as the correct design of the pneumatic system is concerned, the attempt must be made to achieve a pressure drop at the ECAS solenoid valve in every operating condition. This means the pressure on the supply pressure input side must be greater than the pressure at the bellows pressure output side.

During rapid level changes the effect of the vibration damper plays a particularly important role. The result is a force counteracting the motion of the vehicle body, preventing oscillation of the vehicle body and the wheel from losing contact with the road. The damper counteracts level changes in the same manner.

If the level is to be increased, air is blown into the bellows. The pressure in the bellows increases as a result, initially to accelerate the sluggish mass of the body and later to overcome the damper force.

Once the solenoid valves are closed and the nominal level has been reached, the proportion of the pressure required to overcome the damper force causes an imbalance. The air in the bellows expands until the pressure multiplied by the bellows surface area corresponds to the static load again. The additional volume created by this expansion raises the body beyond the nominal level.

To prevent this overshooting of the nominal level, the air intake is already reduced before the nominal level is reached. The lifting speed is reduced and overshooting is prevented altogether when perfectly tuned. Because the solenoid valve can only pass or block the air flow, without being able to throttle the air flow, the solenoid current of the ECAS solenoid valve is pulsed, briefly interrupting the air-flow and thereby simulating the effect of throttling.

The ECU computes the pulse length relative to the the difference between the nominal level and the actual level, as well as the lifting speed. A long lifting path results in a long pulse since the danger of overshooting is not yet present; a high lifting speed, on the other hand, reduces the pulse length.

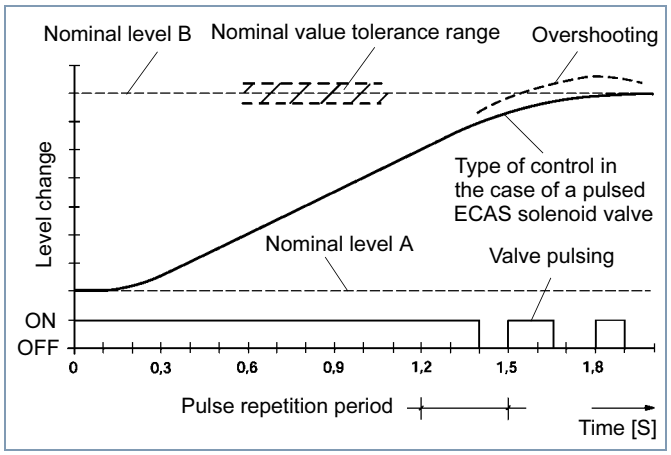


Abb. Type of control in the case of nominal value changes

The extent to which the two parts of the calculation become effective is determined by factors that can be parameterised:

Pulse length = lifting path × proportional coefficient – lifting speed × proportional coefficient

The pulse length is re-computed for each pulse repetition period. A computed pulse length which exceeds the pulse repetition period (normally 0.3 sec) causes the solenoid to be energised continuously ('continuous pulse'). The shortest pulse length to be executed is 75 ms (0.075 sec) pulse times would jeopardize the switching process of the solenoid valve.

3.2.1 Self-learning controller

Another type of controller works in a self-learning manner. With this method, the solenoid valves are no longer pulsed and this leads to a longer service life for the ECAS solenoid valves.

In the case of non-CAN electronic systems, the pulse times are obtained my means of defined coefficients. If CAN electronic systems are installed, the pulse time is adjusted according to the changing vehicle mechanics (determination of dead time).

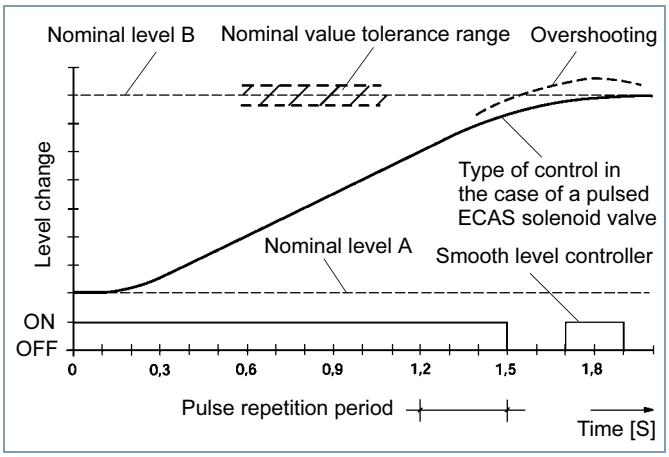


Abb. Type of control in the case of a nominal level change with a self-learning controller

This type of control is used with all CAN electronic systems. ECAS learns the overshoot behaviour after the very first control process. With regard to subsequent control processes, switch-off already occurs before the nominal level is reached. The vehicle body then accurately "swings" into the nominal level.

The smooth level controller is responsible for preventing overshooting in vehicles with a very light body.

These learning processes are not performed with every control process; they are only performed under specific conditions:

- Vehicle at a standstill
- The duration of the control process must be at least 0.6 seconds. Then there must be a pause of at least 4 seconds.
- The control process must be initiated manually (e.g. kneeling or normal level).

The raising or lowering speed is used to determine when the open solenoid valves need to be closed for the subsequent ride height to be as close as possible to the nominal level. The learned overshoot behaviour is saved to the electronic unit as characteristic curves at the moment the ignition is switched off.

NOTE: After each calibration process (or in the condition as delivered) the level adjustments are initially carried out using the preset standard characteristic curves until the actual control behaviour has been learnt for the first time.

Should the control behaviour be agitated, the controller is quickly adjusted to the vehicle by pressing the kneeling pushbutton several times.

4 Legal Requirements

Regulations for ECAS in the bus

part 30 StVZO in conjunction with part 35d StVZO

Guidelines for powered access aids in buses (extract)

1. Range of application

These guidelines apply to buses equipped with powered entry aids.

2. Definition of terms

.....

2.2 Kneeling system

A kneeling system within the meaning of these guidelines is a facility for raising and lowering the bodies of buses.

.....

3. Requirements

.....

3.2 Kneeling system

3.2.1 Actuation

An additional, lockable switching device is required to activate a kneeling system.

3.2.2 Actuation types

Both manual and automatic control must be implemented for lifting and lowering the vehicle body.

Manual control devices

The manual control device for the lowering process must be designed so that it automatically returns to zero position when enabled during lowering. Here the lowering process must be stopped immediately and reversed into lifting process. A renewed lowering process must only be possible starting from the vehicle body's normal position (position while the vehicle is moving).

Automatic control device

In the case of an automatic control device, the driver must be able to stop the lowering process by means of an emergency switch within his immediate reach and so convert the lowering into a lifting process.

Renewed start-up of the lowering process must only be possible starting from the vehicle body's normal position (position while the vehicle is moving).

3.2.3 Lowering of the vehicle body

The lowering process may only take place when the vehicle is travelling at a speed below 5 km/h. It must be ensured that the bus cannot start driving while the body is lowered.

In the case of automatic control of the lowering process, it must be ensured that the process can only be initiated when the passenger doors are closed. Furthermore, a substantial part of the lowering process controlled by an automatic control device must be completed (at least 80 % of the height) before the passenger doors are completely opened.

Remark:
This new version now permits kneeling while the doors are open (VkBl. 1999 page 246).

3.2.4 Lifting and lowering the vehicle body

The lifting process may not start while a passenger door is still completely opened. The raising process should be interrupted when the reversing device of a door reacts.

5 Components

5.1 Overview


Control electronics (ECU)



Angle-of-rotation sensor / Distance sensor


Pressure sensor


ECAS solenoid valve

The ECAS system essentially consists of the following components:

- Control electronics (ECU)
- Distance sensor(s),
- Pressure sensor(s) (optional): The use of pressure switches or pressure sensor(s) is optional, i.e. it depends on the selected system variant.
- ECAS solenoid valve(s)
- Pneumatic components (air suspension bellows; possibly lifting bellows; pressure limiting valves; pipes; compressed air reservoir).

The pneumatic components are not described here since they correspond to the pneumatic components in a conventional air suspension system and do not require any particular explanation in the context of ECAS.

5.2 The Electronic Control Unit (ECU)

The electronic control unit is the heart of the ECAS system. The individual components are connected with the ECU via plug connections. The ECU is located inside the bus.

Function

The design of the ECU includes a microprocessor that only processes digital signals. Memory is allocated to this processor for data management. The outputs to the solenoid valves are switched via driver modules.

Tasks of the ECU

- Constant monitoring and conversion of the incoming sensor signals into numerical values (counts or timer ticks),
- Comparing these values (actual values) with the stored values (nominal values),
- Computation of the required control response in the event of a deviation and control of the solenoid valves,
- management and storage of the parameterised, calibrated and otherwise defined nominal values (normal levels, memory, etc.),
- the data exchange with the operating unit and the diagnostic unit via the CAN-BUS,
- monitoring the function of all system components and the axle loads (in systems with pressure sensors),
- output and storage of messages, as well as checking the plausibility of received signals in order to detect faults.

In order to ensure swift control responses to any changes in actual values, the microprocessor runs a certain program in cycles that take only the fraction of a second (25 milliseconds). One programme cycle performs all the tasks described above. This programme is permanently written into a program module (ROM). However, it uses numerical values (parameters) which are written to a freely programmable memory. These parameters affect the computing operation and thus the control responses of the ECU. They are used to transmit the system configuration and the other preset values pertaining to the vehicle and functions to the computer program.

5.2.1 ECAS 4×2/6×4 (without CAN)



Product no.: 446 055 . . . 0

Connection: terminal strip 35-pin

Diagnosis: K-line ISO 9141 / JED 677
Diagnostic card, PC Diagnosis

Indicators: lamps for errors, warnings and kneeling

System integration: logical connection (analogue) to the door control

Kneeling: kneeling to the side or the front is possible

5.2.2 ECAS 4×2/6×2 CAN



Product no.: 446 170 0. 0

Connection: connector 15/15-pin or 15/18-pin

Diagnosis: K-line ISO 9141 / JED 677
Diagnostic card, PC Diagnosis

5.2.3 ECAS 4×2/6×4 CAN II and 6×2 CAN II



Product no.: 446 170 2 . . 0

Connection: connector 18/15/9-pin

Diagnosis: CAN SAE J 1939 (KWP2000)
PC Diagnosis

Indicators: Indication via display (SAE J 1939)

System integration: CAN interface (SAE J 1939)

Sensors: support for angle-of-rotation sensor and acceleration sensor

Functionality: additional ECAS functionality (such as smooth level controller, measurands and parameters in quantities)

This generation of ECAS electronic units provides additional functions such as optimal traction, pressure ratio control and pressure equality control for 6x2 vehicles, axle load indication / passenger detection, as well as an anti-tilt function. Series production for buses started in 2004.

Diagnosis of these electronic control units is only be possible using a PC. The reasons for this are the increased functional range and the completely revised design of the electronic control unit, including a structure of parameter sets. No provision is made for use of a Diagnostic-Controller card.

5.3 Sensors

The starting point of the control process is the sensor. These sensors pick up the quantities to be controlled, and transmit them to the ECU via the sensor cable.

! You must always install at least one distance sensor in the ECAS system.

Pressure sensor(s) are used for controlling additional functions.

5.3.1 Distance sensor

The distance sensor acts as an actual value transmitter for continuous detection of any changes in the height of the superstructure. The inductive measuring principle is used.

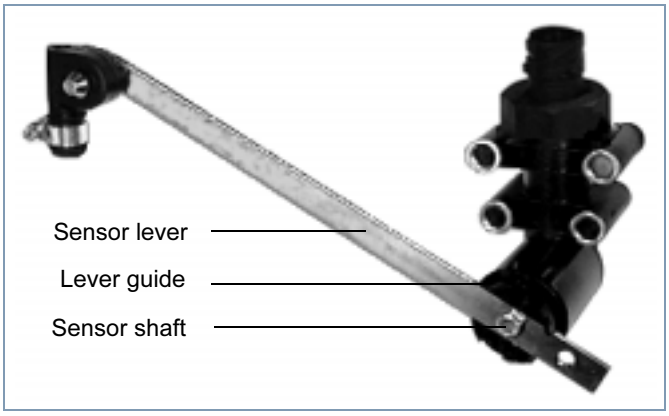


Abb. Distance sensor 441 050 0.. 0 and lever 441 050 718 2

With distance sensor 441 050 0.. 0 a rotary motion is transferred to the inside of the sensor by a lever. This movement is translated, following crank mechanism logic, without play into a linear movement of the armature in the coil. The 'dipping movement' of the ferro-magnetic armature into the stationary coil causes a phase displacement between current and voltage. The ECU receives these signals and converts them into count values or timer tick values.

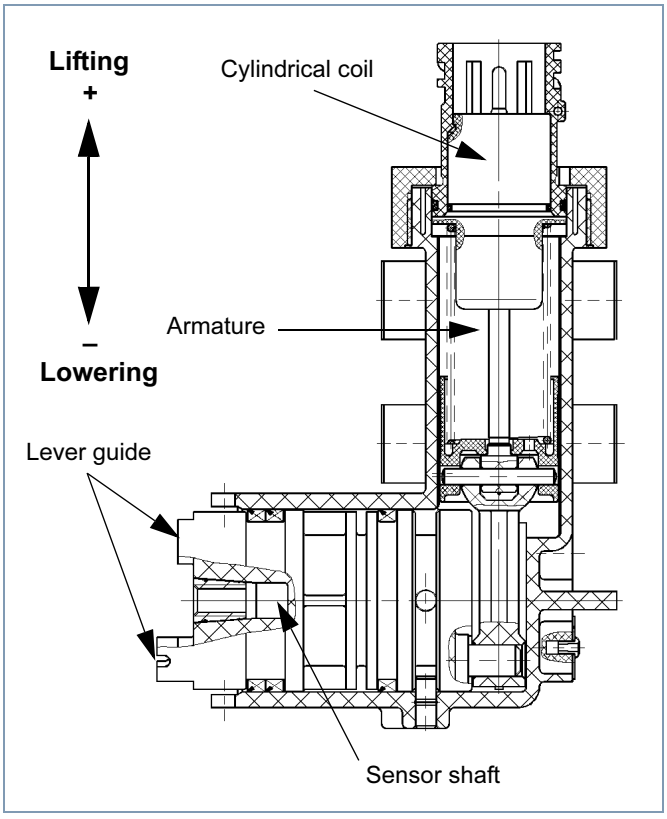


Abb. Sectional view of the distance sensor 441 050 0.. 0

The angle-of-rotation sensor 441 050 0.. 0 is a distance sensor in which the change in inductance is generated by the rotary movement of the sensor shaft.

The motion of the sensor lever, which is attached to the cross connector, causes the sensor shaft to be rotated into the magnetic field within a coil. One half of the sensor shaft consists of a ferro-magnetic material and the other half of a non-conducting magnetic material. When the ferro-magnetic part of the sensor shaft is turned into the magnetic field, the inductance changes.

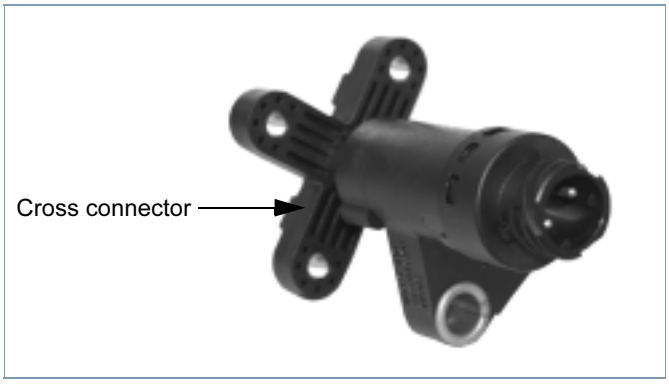


Abb. Angle or rotation sensor sensor 441 050 1.. 0

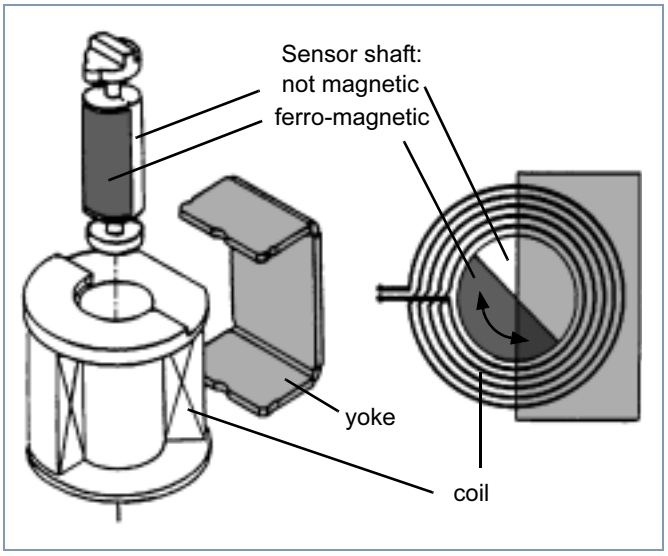


Abb. Function of the angle-of-rotation sensor 441 050 1.. 0

If the distance sensor needs to be checked, the resistance can be measured to verify proper function of the coil. The resistance must be approximately 120 ohm. The coil's induction is evaluated more than 50 times a second by a special evaluation circuit within the ECU. The ECU also monitors the sensor for proper function.

! It is not possible to test the distance sensor function using a voltage meter.

The distance sensor is located on the vehicle frame near the axle whose air suspension bellows are to be controlled.

A distance sensor (1-point control) is usually installed above the centre of the steering axle. Driving axles may also be equipped with 2 distance sensors as an alternative to the single sensor variant.

– Install the sensors so that they lie as far apart from one another as possible to achieve optimal controlling action of the individual distance sensors (2-point control on one axle).

The distance sensor is permanently linked to the axle to be controlled by means of a linkage. The rod has rubber end pieces acting as dampers and compensators.

With CAN II electronic units, the type of the installed sensors must be specified in the parameter settings (options parameter 2.5).

The ECAS ECU converts the respective sensor value into counts within a byte range between 0 and 255 counts. More recent ECAS ECUs have been changed to 16 bit processing. The sensor values are here specified as timer ticks (range from 0 to 65.535).

Instruction for installation

The optimum resolution range of the distance sensor is between + 50° and – 50° while the sensor lever is horizontal (initial position 90°) at normal level.

! The maximum deflection range of the lever (+/- 50°) should not be exceeded.

The length of the sensor lever is selectable. However, the length must be identical for all distance sensors on an axle.

Short sensor lever
A short sensor lever ensures a high resolution of the measured values even when the change in height is slight. However, it can only cover a small range of settings.

Long sensor lever
A long sensor lever covers a wide range of settings at the expense of the resolution of measured values. The objective is the best possible utilisation of the deflection angle.

! Cranking of the lever must be avoided because this might result in impermissible tilting torques acting on the sensor shaft. For this reason, all swivelling axles must be aligned in parallel.

There is only one variant of distance sensor for installation on the right and left-hand sides. The sensor level can, however, be mounted in steps of 90 degrees on the sensor shaft which can be turned in the sensor housing without stops. For accurate operation and accurate measured value acquisition, the sensor shaft must be properly aligned.

In the case of distance sensor 441 050 0.. 0 this is achieved by 2 lugs on the sensor shaft guiding the sensor lever. These projections point toward the right at right angles relative to the direction of armature movement (as shown in the illustration). This permits the best possible utilisation of the distance sensor's measuring range.

In the case of angle-of-rotation sensor 441 050 1.. 0 the sensor lever is screwed to the cross connector or the lever of the sensor shaft.

! It is important that the distance sensor lever moves freely across the whole of its setting range, and that the lever can only move within that range (i.e. does not overshoot).

After installing the distance sensors to the vehicle body, use the diagnostic software to check the measured values delivered by the distance sensors during lifting and lowering of the vehicle body. The displayed counts or timer tick values are represented in the "Control" menu:

- LIFTING increases the induction and causes an increase in counts or timer tick values
- LOWERING decreases the induction and causes reduction of counts or timer tick values.

5.3.2 Pressure sensor



Abb. Pressure sensor 441 040 0.. 0 and 441 044 1.. 0

The pressure sensor is required for the tyre impression compensation and for traction help. Traction help through axle load relief can only be implemented in 3-axle buses.

The pressure sensor produces a voltage output that is proportional to the applied pressure. The measuring range lies between 0 and 10 bar; a pressure of 16 bar must not be exceeded.

The signal voltage is sent to the ECU via a connecting plug. The sensor must also be fed with a supply voltage from the ECU via a third conductor.

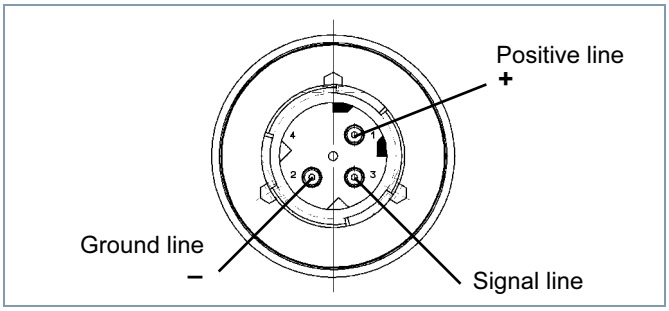


Abb. Electrical connection of the pressure sensor

The cable harness must be encased in a hose or similar material in such a way that the housing - which is otherwise waterproof - can ”breathe“.

Under no circumstances should the pressure sensor be connected to the connecting line of the air suspension solenoid valve because this could result in incorrect readings during air intake and air exhaust processes.

If air suspension bellows with two threaded ports, as offered by renowned manufacturers of air suspension systems, cannot be used, a special connector must be fitted. This connector can consist of a T-shaped pipe union into which a tube is soldered in the pressure sensor connection; this tube protrudes into the air spring interior and there picks up the "stabilised" bellows pressure.

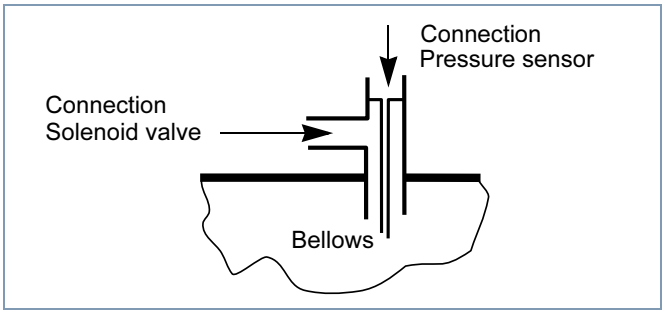


Abb. Sensing the bellows pressure

5.4 ECAS solenoid valve

Special solenoid valve blocks have been developed for the ECAS system. The space and installation time required are kept to a minimum by combining several solenoid valves in one compact block.

Controlled by the electronics as an actuator, the solenoid valves convert the applied voltage into an air intake/ exhaust process, i.e. they increase, lower or maintain the air volume in the air suspension bellows.

Pilot valves are used to achieve a large air throughput. The solenoids initially switch those valves with a small nominal width whose control air is then routed to the piston surfaces of the actual switching valves (NW 10 and/or NW 7).

The solenoid valves are integrated in a modular system: The same housing is equipped with different valve parts and solenoids, depending on the application.

In a solo bus, one axle is usually equipped with two distance sensors, the other with one. The designation 1 distance sensor and 2 distance sensor axles are used for the purpose of distinction since there is no definitive allocation to front or rear axle.

5.4.1 Valve for the axle with two distance sensors



Abb. Solenoid valve 472 900 053 0

This solenoid valve has three solenoids. One solenoid (41) controls a central breather valve (also called a central 3/2 directional control valve), the others control the connection between the two air bellows (2/2 directional control valves) and the central breather valve.

This valve permits the implementation of what is called a 2-point control, in which case distance sensors on both sides of an axle are used for separately controlling the height on either side of the vehicle to keep the body horizontal in spite of uneven load distribution.

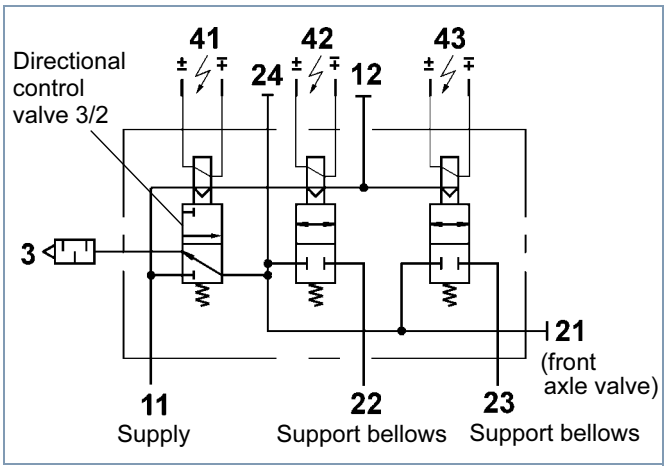


Abb. Circuit diagram of the solenoid valve 472 900 053 0

Design of the valve

Solenoid 41 actuates a pilot valve (1), and the actuating pressure from this valve flows through hole (2) and acts on piston valve (3) of the breather valve. The pilot valve is supplied through connection 11 (supply) and the connecting hole (4).

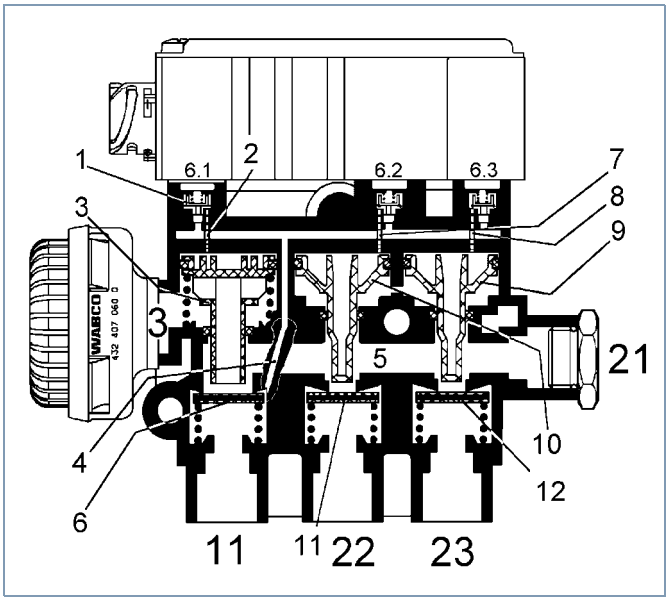


Abb. Sectional view of the solenoid valve 472 900 053 0

This drawing shows the breather valve in its venting position in which air from chamber (5) can flow to connection 3 via the hole of the piston valve (3).

When a current is applied to solenoid 41, the control piston (3) is pushed down, which initially causes the hole of the control piston to be closed by the valve plate (6).

The valve plate is then pushed down from its seat (hence the name seat valve) so that air can flow from the air supply into the chamber (5).

The two other valves connect the air suspension bellows with the chamber (5). Depending on whether solenoid 42 or 43 is energised, air is applied to the control plungers (9) or (10) through holes (7) and (8), thereby opening the valve plates (11) and (12) to connections 22 and 23.

A solenoid valve can be connected to connection 21 for control of the second vehicle axle.

5.4.2 Valve for an axle with one distance sensor

This valve is similar to the valve with two distance sensors, but it contains fewer parts.

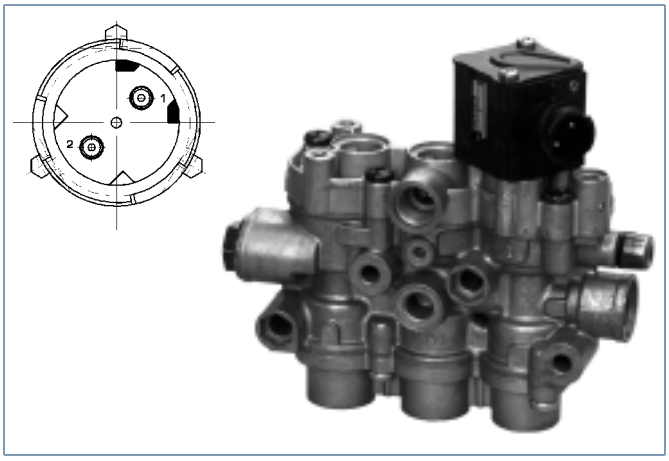


Abb. Front axle valve with DIN bayonet 472 900 058 0

Since connection 14 is connected to connection 21 of the valve described above, no vent valve is required, only a pilot valve (1) is used. The piston valves (3) of both air suspension bellows valves are pressurised via two connecting holes (2) so that each pressurising or venting process is effected evenly for both bellows via chamber (5).

If the solenoid is not energised, the valves are closed, as shown in the illustration. At this time, the only connection between the bellows is the transverse throttle (7) through which any difference in pressures can gradually be compensated.

The valve is connected to the air supply via connection 12. This connection is required to enable the pilot valve to displace the control piston.

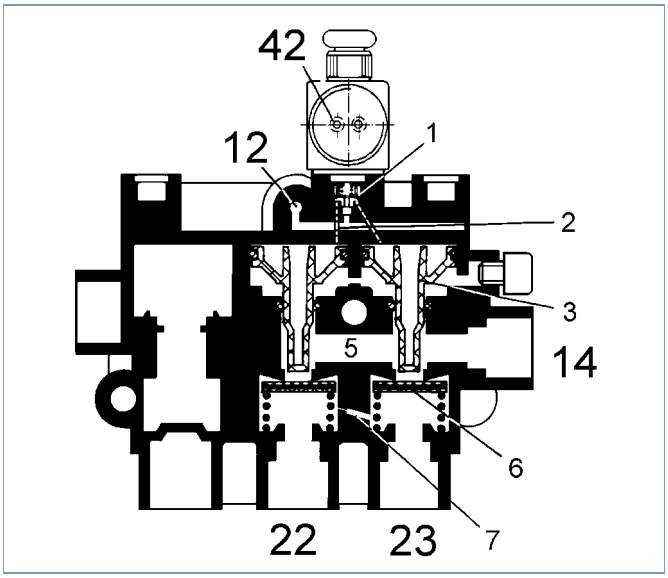


Abb. Sectional view 472 900 058 0

5.4.3 Valve for bus with kneeling

To lower one side, the axle valve must be able to separately control the bellows by means of a distance sensor (1 distance sensor axle), i.e. it requires a pilot valve with a solenoid for each of the directional control valves 2/2 .

The path must also be blocked off by the transverse throttle so that air cannot be exchanged between the bellows during kneeling.



Abb. Solenoid valve 472 900 056 0

The valve shown in the diagram includes both valves described above in a single block, enhanced by the aforementioned functions.

The valve described above for the 2-distance sensor axle is already arranged in the rear valve level. Upstream is the valve for the 1-distance sensor axle; it has a switchable transverse throttle, whose solenoids are

located in front of the valve connections, as seen in the illustration.

The schematic diagram shows the two valve levels next to each other.

The left part of the illustration corresponds to the valve for the 2 distance sensor axle. The right part controls the 1 distance sensor axle, whereby both bellows (at connections 26 and 27) are controlled by separate solenoids. The connection via the transverse throttle (1) can be blocked off by the solenoid 63.1.

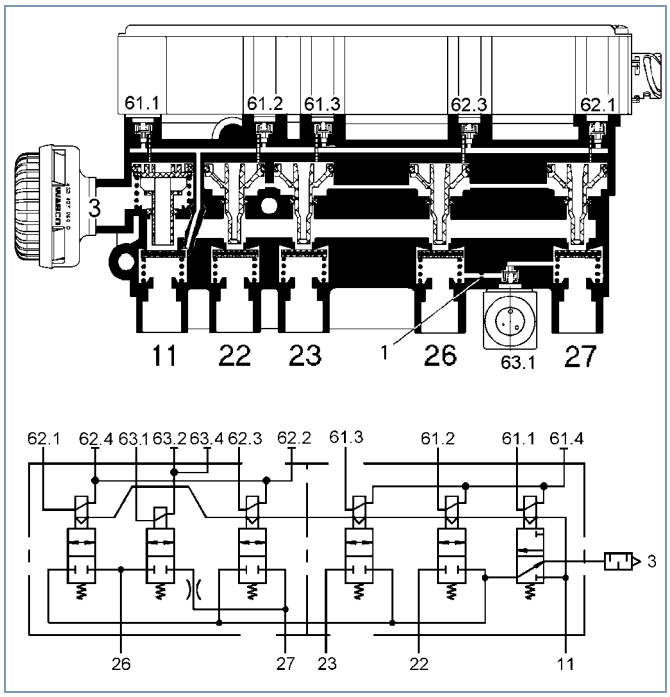


Abb. Section view and circuit diagram 472 900 056 0

5.4.4 Interchangeability of the ECAS solenoid valves

It is possible to distinguish one generation of ECAS solenoid valve from another on the basis of the valve solenoids' design. There are more than 60 variants of the ECAS solenoid valve. The product group 472 900 … 0 comprises the FA, RA valves and RA/LA valves for systems with basic control and pressure ratio control/ traction control. The product group 472 905 … 0 includes the RA/LA valves for pressure equality control.

The solenoid valve generation ECAS III is grouped in the product line 472 880 … 0 and supersedes the ECAS solenoid valves of the product line 472 900 … 0.



Abb. Rear axle valve with DIN bayonet 472 880 030 0

As a general rule, the variants can be categorised into groups sharing the same functions. The main differences between devices in the same group pertain to the electrical and pneumatic interface.

If need be (i.e. repair is required), pipe couplings according to DIN may also be used for devices with specially shaped connection threads (required by special pipe connection systems) should the corresponding pipe couplings not be on hand.

However, problems of greater magnitude arise if the electrical connections to the valve solenoids are configured differently. For example, solenoid control can be implemented as an individual control with a thread or as a valve block control with a connection bayonet. The connection bayonet may vary from one type to another (KOSTAL or DIN bayonet). There can be different contact arrangements even within the same bayonet type, and this may rule out interchangeability. In this case, the only thing to do is to replace the corresponding cable at the same time.

6 Safety concept

6.1 Messages on the display

In order to monitor the function of the system, the ECU regularly checks most of the electrical connections with the individual components and compares the voltage and resistance values with the specified values.

This test is not possible for inputs that are fed into the electronics via the vehicle CAN-BUS, as is the case with the input of the switch for normal level II for example.

In addition, the sensor signals are checked for their plausibility. For example, an unchanged level in spite of air-intake by a bellows is implausible and therefore classified as incorrect.

Detected errors are indicated to the driver by means of a display in the instrument panel.



Abb. Instrument panel with display

Detected errors trigger different responses depending on the type of error. If the electronic unit detects a system fault, a fault message is transmitted on the CAN bus. As a response to a request, an error code is output with a description of the faulty components and the type of fault (e.g. distance sensor 2-distance sensor axle left: interruption). A corresponding fault number can be displayed in the driver's display.

Slight and clearly identifiable faults that do not cause the system to shutdown.
System faults which still permit restricted use of the system (examples):

- Failure of a distance sensor if the same axle has another distance sensor.
- Failure of the CAN-BUS information on the speed signal of the sidewalk detector or the pressure sensor.
- Fault in the WABCO data stored in the ECU.

The error/fault is displayed on the display if applicable and stored in the non-volatile memory of the electronic control unit. The function of the system is maintained to the extent possible; the functionality is restricted however. After the fault has been eliminated, the system returns to normal operation.

Faults that cause a temporary shutdown of the system no longer exist in the new ECAS-CAN electronic units.
This means, limited control is executed even when a plausibility fault is present.

The fault criterion 'plausibility fault' is met once an initiated or active control process fails to respond within a period set in parameter 14. This can be caused by one of the following types of fault:

- The solenoid valve does not pressurise the air suspension bellows.
- The solenoid valve does not exhaust the bellows.
- The solenoid valve remains in an air intake or exhaust position even though the control process has been completed.
- defective compressed air supply
- the air suspension bellows has burst
- blocked or kinked lines.

The electronic unit cannot directly measure a fault since there are no sensors at the inlets and outlets of the solenoid valve; it can only conclude that a fault is present when the feedback from the distance sensors deviates from the plausible response.

6.2 Signal lamp messages

Signal lamps in the instrument panel are used to communicate the messages to the driver in older vehicles without a display in the instrument panel.

The fault lamp lights up (minor error) or flashes depending on what the message conveys.

A second lamp, called warning lamp, indicates to the driver a level that deviates from the normal level.

Both lamps light up for two seconds after the ignition has been turned on to indicate proper function of the lamps to the driver.

	Warning lamp yellow	Fault lamp red
Steady light For two seconds after turning on the ignition (time for the driver to check the lamps).	The nominal level deviates from the normal level. Lifting/Lowering required.	**A minor fault is present** (e.g. no speed signal or the level can only monitored with restrictions. Undervoltage (between 7.5 and 18 volt) **Plausibility fault** (e.g. body is not lifted even though the solenoid is energised)
Flashing The sidewalk detector is activated (warning lamp and fault lamp alternately flash for 1/2 a second.)	Supply pressure too low	**A severe fault is present.** It is not possible to monitor or control the level.
	Sidewalk detector defective (flashing 1/2 second, fault lamp is steadily lit	**The electronic unit is in service mode.**

7 Diagnosis

The ECAS system is maintenance-free. The system monitors itself by means of the fault routines in the ECU program. Further system checks are only required for parts which the ECU itself is unable to check (sensor linkage, signal lamps etc.).

If the ECU detects a fault, this is indicated to the driver (on a display for example), and it is only at this point that the system needs to be tested in the workshop. The most up-to-date means of diagnosis is represented by the PC Diagnosis which has replaced the Diagnostic Controller.

7.1 Diagnosis by means of the PC

To diagnose ECAS you need either

- a PC or a laptop,
- a Diagnostics Interface,
- a connection cable to the vehicle
- the Diagnostic Software "ECAS Bus …"

7.1.1 PC / laptop

WABCO can offer you a laptop that is resistant to impact and dirt, and is therefore suitable for workshop use. It can also be delivered upon request with preinstalled diagnostics software. The "Toughbook" can be procured from WABCO under order number 446 302 040 0.



Abb. "Toughbook" laptop (order number 446 302 040 0)

The Diagnostic Software will also run on all standard PCs with an operating system Microsoft Windows 2000 or higher.

There are no special hardware requirements. The PC should, however, have a free USB port or a free serial port (COM interface 9-pin).

7.1.2 Diagnostic Interface Set

The WABCO Diagnostic-Interface Set with the order number 446 301 021 0 (serial) or 446 301 022 0 (USB) is required for setting up diagnosis of the control unit. The set comprises the interface and a connecting cable to the PC or Laptop.

One of two Diagnostic Interfaces is connected to the vehicle via the central diagnostic socket of the vehicle.

Diagnostic Interface Set (USB) 446 301 022 0



The set includes:

- Diagnostic Interface,
- USB connecting cable to PC/Notebook

Diagnostic Interface Set (serial) 446 301 021 0

As an alternative to the diagnostics interface with a USB connection, WABCO offers a diagnostic interface with serial connection.

7.1.3 Diagnostic Software

There are three ways to obtain the Diagnostic Software for the ECAS system.

USB flash drive version 446 301 XXX 0

Single download 246 301 XXX 0

The XXX value in the order number stands for the currently available language version of the Diagnostic Software:

- 246 301 **861** 0 ECAS bus A
- 246 301 **539** 0 ECAS- bus Citaro
- 246 301 **410** 0 ECAS- bus

Part of a WABCO System Diagnostics subscription

For the diagnosis of multiple WABCO systems, WABCO offers you four different Diagnostic Software subscriptions via the internet. These contain numerous diagnostic programs at a very low price. The most recent version of the programs can be downloaded from the internet at any time ready for immediate use.

The means of graphic representation provided by the PC make diagnosis clear and structured. Thanks to detailed repair information and circuit diagrams with measured

values, successful diagnosis and repair is made easy and fast.

The Diagnostic Software may be may be used by any user for the purpose of diagnosis. If parameters need to be changed or a calibration needs to be carried out, authorisation (PIN) is required. This PIN is obtained by completing corresponding training at the WABCO University. More information on WABCO University training courses, visit www.wabco-auto.com and click the "WABCO University/Training" button.

7.1.4 Important Diagnostic Software menus

Main menu



Once the Diagnostic Software has started successfully, you are in the main menu of the Diagnostic Software.

Successful communication with the ECAS ECU is indicated in the status line at the bottom right margin of the window: A green lamp symbol lights up and the corresponding connection of the cable to the Diagnostic Interface is indicated. The toolbar buttons are also active.

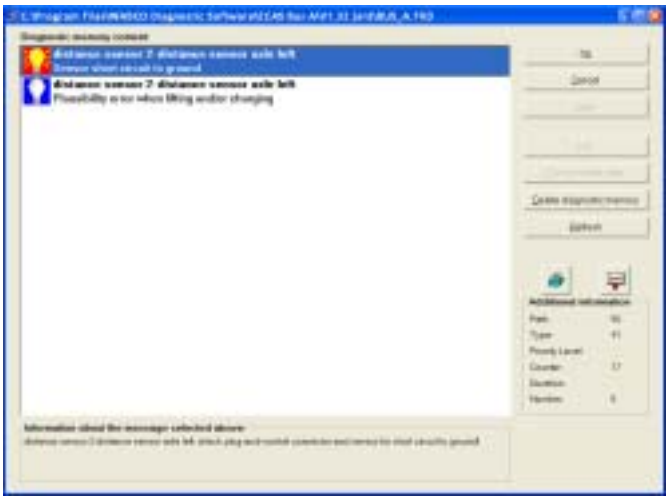
The ECU data, current messages, the configuration and the current measured values are displayed in the corresponding fields of the main menu.

! When the Diagnostic Software is not connected to the ECAS-ECU:

– Click the second button in the toolbar "Start diagnosis".

The option "Establish diagnostic connection when starting" can be activated in the "Options" menu, menu item "Settings", tab "Program options".

Messages (diagnostic memory)



In the messages menu, the messages stored in the diagnostic memory are displayed. Current messages are marked by a red symbol.

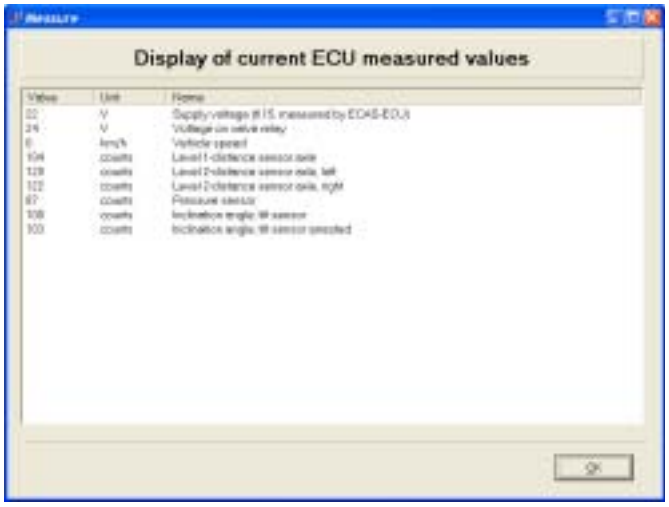
The messages in the diagnostic memory can be printed as a protocol, stored and deleted on the PC, and it is possible to call further information on the messages.

Control (Lift / Lower)



The "Control" menu is used to select the air suspension bellows of the axles and to initiate air intake or exhaust for these bellows. The actual level and pressure values are displayed during this process.

Measured values



The "Measured values" menu displays the currently measured values of the ECU, such as voltage, levels, pressures and tilt angle.

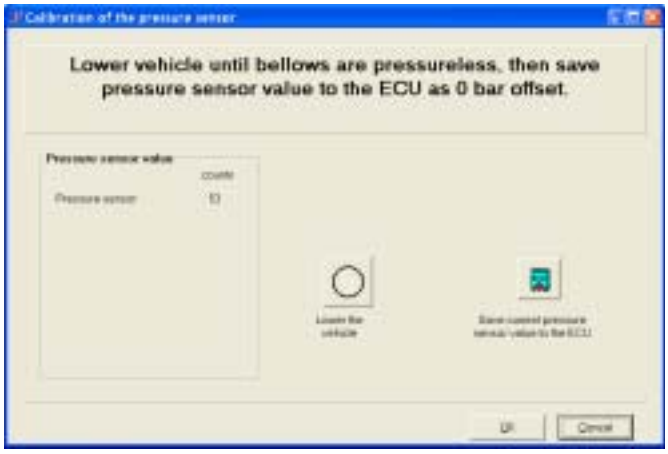
Calibrate the distance sensors



The menu item "Calibrate the distance sensors" is called from the "System" menu.

Please refer to the chapter "Calibration" for further information on calibrating the distance sensors.

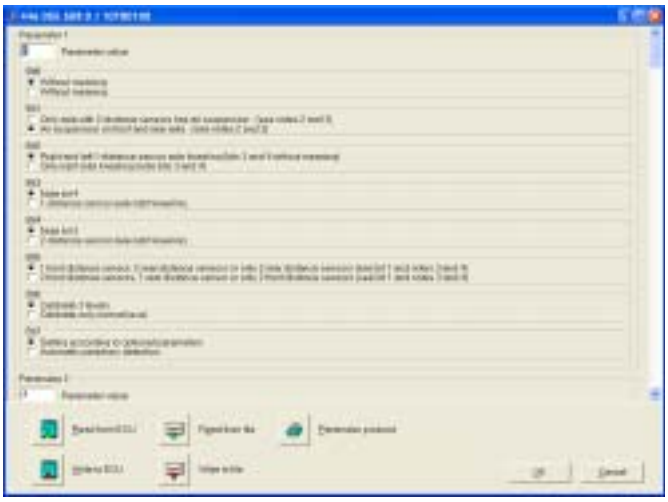
Calibrate the pressure sensors



The menu item "Calibrate the pressure sensors" is called from the "System" menu.

Please refer to the chapter "Calibration" for further information on calibrating the pressure sensors.

Setting parameters



The menu item "Setting parameters" is called from the "System" menu.

Please refer to the chapter "Setting parameters" for further information on setting parameters.

7.2 Connecting the diagnostics

Connection adapter



35-pin 446 300 327 0

25-pin 446 300 317 0
only for 4×2 vehicles

Diagnostic cable, adapter plug



Diagnostic cable
894 604 303 2

Adapter plug
446 300 31X 0

Vehicle with central diagnostic socket in accordance with ISO 9141

The diagnostic socket must match the pin assignment in accordance with ISO 9141 illustrated below. To start diagnosis, plug the connecting cable into the ISO socket of the vehicle.

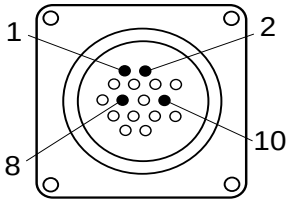


Abb. Assignments of the diagnostic socket

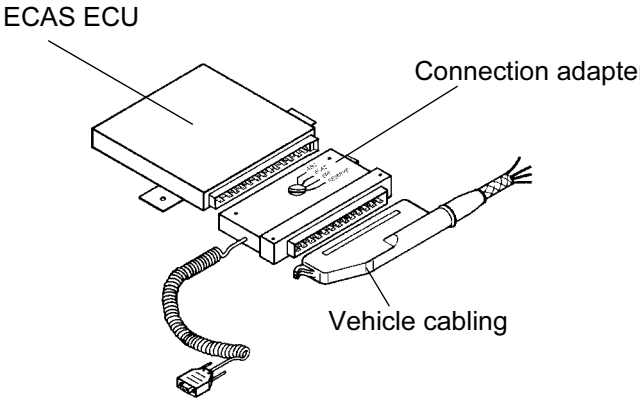
1 Battery Plus terminal - terminal 30
2 Battery Minus terminal - terminal 31
8 Diagnostic K-line
10 Diagnostic L-line

Vehicle without central diagnostic socket in accordance with ISO 9141

If the vehicle is not equipped with an ISO 9141 diagnostic socket, the diagnostics can be connected using a connection adapter (accessory).

– Connect the 9-pin connector of the connecting cable or the connection adapter to the Diagnostic Interface. This provides both the diagnostic connection and the electrical power supply.

The connection adapter is connected between vehicle cabling and the electronic unit while the ignition is switched off.



! After the diagnosis has been completed, the connection adapter must be removed again!

Pin assignment of the DB-9 connector "Diagnostic Input":

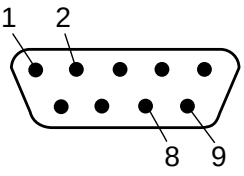


Abb. Assignments of the diagnostic socket

1 Battery Plus (terminal 30)
2 Battery Minus - (terminal 31)
8 Diagnostic K-line
9 Diagnostic L-line

7.3 Diagnosis with the WABCO Diagnostic Controller

Diagnosis by means of the Diagnostic Controller has been replaced by the PC Diagnosis and can not be used for the diagnosis of ECAS systems with CAN.

This Diagnostic Controller is not only used for the start-up procedure but can also be used for locating faults, for actuating solenoid valves, lamp testing, checking test values and measured values, manipulating the control unit's data, and for functional testing.

Diagnostic Controller with program card



Diagnostic Controller
446 300 320 0

Program card
446 300 894 0

7.3.1 Menu Program card 446 300 894 0

Certain menu items can only be activated if the PIN was entered under the menu item 4 "Special functions" beforehand. This PIN is obtained by completing corresponding training at the WABCO University.

* if installed/depends on parameter settings
** The parameters can only be edited after entering the PIN
*** only possible after entering the PIN

- 1 Diagnosis
  - Front section
  - Rear section
- 1 Fault finding
- 2 Control
  - 1 Lift/Lower
  - 2 Air intake valve
  - 3 Lamp test
  - 4 Throttle test*
  - 5 Kneeling function
- 3 Test and measured values
  - 1 Distance sensor values
  - 2 Pressure sensor value*
  - 3 Speed
  - 4 Switch positions
  - 5 Operating voltages
- 4 Control device data
  - 1 Parameters**
  - 2 WABCO data
  - 3 Overshoot data
  - 4 Print
    - 1 Print faults
    - 2 Print parameters
  - 5 Transfer parameters
    - 1 Control unit ->Controller
    - 2 Controller ->Control unit ***
- 5 Functional test
- 6 Calibration
  - 1 Calibrate distance sensor
  - 2 Display distance sensor data
  - 3 Calibrate pressure sensor*
  - 4 Display pressure sensor data*
  - 5 Enter data***
  - 6 Transfer data
    - 1 Control unit ->Controller
    - 2 Controller ->Control unit ***
- 2 Multimeter
  - 1 Direct voltage
  - 2 Alternating voltage
  - 3 Resistance
- 3 Options
  - 1 Help text
  - 2 Version
  - 3 testable ECUs
  - 4 Measured value acquisition
- 4 Special functions

8 Setting parameters

The electronic units are supplied with standard parameter sets. These standard parameters in the electronic control unit must be adapted to the respective vehicle. During servicing, it may be necessary to change certain parameters - and may also be requested by the by the vehicle owner.

However, only trained personnel may set parameters in the electronic control unit. If the parameters are to be changed using the WABCO Diagnostic Software, authorisation (PIN 1) is required. This PIN is obtained by completing corresponding training at the WABCO University.

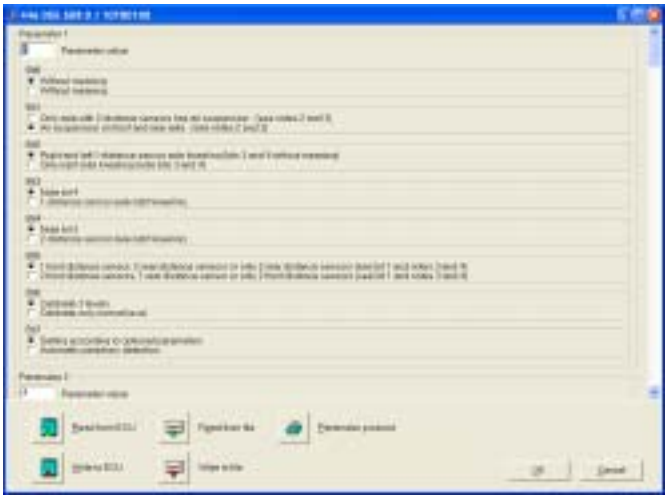


Abb. Menu "Parameters" of the Diagnostic Software

Parameters are set using the Diagnostic Software. In this step, parameter sets can, for example:

- be read in, displayed, and stored from an existing ECU.
- be written into an ECU.
- be manually created, modified, and transferred to the ECU.

– Prior to setting parameters, save the parameter set stored in the ECU to the PC.

This provides a back-up copy which can be used to restore the previous set of parameters in the electronic control unit at any time. This is particularly important if existing sets of parameters are to be modified.

! Parameter changes require the approval of the vehicle manufacturer.

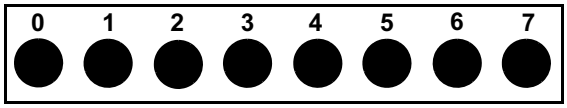
8.1 Option parameters

Option parameters are parameters in which 8 bits (also referred to as "option bits") can be respectively set or not set. These are options that are precisely defined by means of YES or NO, or by means of "1" or "0" in terms of computer language. Option parameters are non-dimensional.

One byte comprises 8 bits, i.e. 8 option parameters. They are uniquely represented as a number between 0 and 255. The binary system of numbers is the basis for this representation.

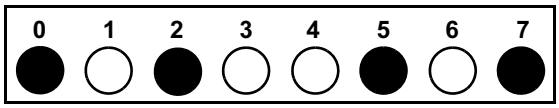
Model representation of numbers 255 and 165 in digitalised form (example)

Eight option parameters make one value parameter.



$2^0 + 2^1 + 2^2 + 2^3 + 2^4 + 2^5 + 2^6 + 2^7$

$1 + 2 + 4 + 8 + 16 + 32 + 64 + 128 = 255$



$2^0 + 0 + 2^2 + 0 + 0 + 2^5 + 0 + 2^7$

$1 + 0 + 4 + 0 + 0 + 32 + 0 + 128 = 165$

One byte can be imagined as follows: Eight lamps are installed on a strip with terminals 0 to 7, symbolically representing 8 bits. If one lamp is on, this equals the number "2 raised to the power of the terminal number". For example: The lamp on terminal 3 is on. This corresponds to $2^3 = 8$. If the lamp is off, this is equal to the figure 0. There are a total of 256 different combinations for illuminating the lamps.

Since an option bit can only be described by means of the condition YES or NO (lamp ON or OFF), 8 option parameters can be said to represent one value parameter. Adding up the values of these 8 option bits produces a number between 0 and 255, by means of which the parameter is uniquely described.

Option parameters represent details regarding functional scope and desired operating mode of the system. These are, for example:

- Distance sensor calibration of the system, configuration detection
- calibration procedure to perform, plausibility checking procedure, switch configuration
- presence of a pressure sensor, traction help configuration
- presence of an LSV solenoid valve, type of normal level selection, etc.

8.2 Value parameters

Value parameters are numerical values defining the nominal, limit, and tolerance values of the system. These values are numbers between 0 and 255. They are proportional values for actual quantities such as: distance, pressure, time, speed.

8.2.1 Counts

Counts are count values of the ECU. Binary numbers form the basis of these counts. The counts range from 0 to 255.

When the parameters – i.e. the nominal values for control – are being set, they are set as counts. To allow the ECU to compare nominal values and actual values, the actual values also need to be provided as counts.

The values picked up by the sensors are based on distances or pressures. They are transmitted to the ECU as voltages or current pulses. The ECU then converts these signals into digital values, the so-called counts (digitisation of the signals). The band width of the voltages and pulse times within the measuring range is divided into equal parts for this purpose. The maximum possible measuring range is divided into 256 steps.

The smaller these steps are, the:

- more accurate are the measured values provided for computation.
- smaller the band width of the measuring range that can be covered.

The greater these steps are, the:

- less accurate are the measured values provided for computation.
- wider the band width of the measuring range that can be covered.

The above information must be taken into account when choosing the lever length for the distance sensor.

8.2.2 Timer ticks

In more recent ECAS electronic systems, 8-bit processing has been changed to 16-bit processing. This opens a wider range of data processing options and thus a much higher resolution for calculating measured values.

The electrical signal transmitted by the distance sensors is now converted into timer ticks by the ECU. The values range from 0 to 65.535.

It is important to observe the difference between the counts of older ECAS electronic systems and the timer ticks when performing calibration.

8.3 Parameters of the ECU 446 055 055 0

8.3.1 Option parameters

Enter the total of the decimal numbers

No.	Meaning	Decimal
0	ECAS unit address if several units are on the address (data) bus	
1	Bit 0 **0** without significance **1** without significance	0 1
	Bit 1 **0** only axle with 2 distance sensors is air-suspended **1** Front and rear axle air-suspended [2) 3)]	0 2
	Bit 2 **0** right and left 1-distance sensor axle kneeling (bits 3 and 4 without significance) **1** only right side kneeling (note bits 3 and 4!)	0 4
	Bit 3 **0** note bit 4! **1** 1-distance sensor axle right kneeling	0 8
	Bit 4 **0** note bit 3! **1** 2-distance sensor axle right kneeling	0 16
	Bit 5 **0** 1 distance sensor on front axle, 2 distance sensors on rear axle [1) 3)] **1** 2 distance sensors on front axle, 1 distance sensor on rear axle (also note bit 1)	0 32
	Bit 6 **0** 3 calibration levels **1** only calibrate normal level	0 64
	Bit 7 **0** Setting according to option parameters **1** automatic periphery detection	0 128
2	Bit 0 **0** Door enabling pin 11 –> high impedance state **1** Door enabling pin 11 –> + UB	0 1
	Bit 1 **0** without significance **1** without significance	0 2
	Bit 2 **0** without pressure sensor [2) 4)] **1** with pressure sensor	0 4
	Bit 3 **0** automatic / manual kneeling by means of switch on pin 21 **1** automatic kneeling pin 21, Manual kneeling pin 23	0 8
	Bit 4 **0** valve monitoring on pin 11 at V > 7 km/h **1** no valve monitoring on pin 11	0 16
	Bit 5 **0** valve monitoring on pin 29 at V > 7 km/h **1** no valve monitoring on pin 29	0 32
	Bit 6 **0** with valve monitoring **1** without valve monitoring	0 64
	Bit 7 **0** without measured value output **1** with measured value output	0 128

No.	Meaning	Decimal
3	Bit 0 **0** without main flow throttle **1** with main flow throttle [2]	0 1
	Bit 1 **0** without transverse throttling **1** with transverse throttling [2]	0 2
	Bit 2 **0** automatic kneeling regardless of door position **1** automatic kneeling, taking door position into account	0 4
	Bit 3 **0** Control of sides that are not kneeled during kneeling **1** no control of sides that are not kneeled during kneeling	0 8
	Bit 4 **0** no level control with brake applied **1** level control permissible with brake applied when door is open	0 16
	Bit 5 **0** without door enabling output pin 11 **1** with door enabling output pin 11 [2]	0 32
	Bit 6 **0** without starting lock output pin 29 **1** with starting lock output pin 29 [2]	0 64
	Bit 7 **0** door opened at 0 V on pin 5 **1** door opened at + UB on pin 5	0 128
4	Bit 0 **0** without fault monitoring of sidewalk detector **1** with fault monitoring of sidewalk detector	0 1
	Bit 1 **0** sidewalk detector as break contact **1** Sidewalk detector as make contact OR without sidewalk detector (set bit 0 to ”0“!)	0 2
	Bit 2 **0** transverse throttling function at V = 0 km/h and at V > 0 km/h **1** Transverse throttling function only at V = 0 km/h	0 4
	Bit 3 **0** with standby for the pins: 11, 18, 29, 32, 35 **1** without standby for the pins: 11, 18, 29, 32, 35 [5]	0 8
	Bit 4 **0** without significance **1** without significance	0 16
	Bit 5 **0** without significance **1** without significance	0 32
	Bit 6 **0** without significance **1** without significance	0 64
	Bit 7 **0** Without significance **1** without significance	0 128

[1] Operation is not possible with only one distance sensor.

[2] With automatic periphery detection, the bit is set accordingly.

[3] If this bit is changed, the ECAS distance sensors must be recalibrated.

[4] After changing this bit from "0" to "1", the pressure sensor must be recalibrated.

[5] PIN 11: Door enabling
PIN 18: Transverse throttling
PIN 29: Starting lock
PIN 32: Kneeling lamp
PIN 35: Main flow throttle

8.3.2 Value parameters

No.	Meaning	Unit
Levels		
5	Normal level 2, 1-distance sensor axle Input: Normal level 2 – lower calibration level	Counts
6	without significance	
7	Normal level 2, 2-distance sensor axle Input: Normal level 2 – lower calibration level	Counts
8	Limit of plausibility fault recognition when lowering 1-distance sensor axle [1]	Counts
9	without significance	
10	Limit of plausibility fault recognition when lowering 2-distance sensor axle [1]	Counts
11	Tolerance for nominal level of the 1-distance sensor axle (> = 3)	Counts
12	without significance	
13	Tolerance for nominal level of the 2-distance sensor axle (> = 3)	Counts
14	permissible right/left deviation in nominal levels (> = 3)	Counts
15	Permissible right/left deviation outside the nominal levels	Counts
16	permissible front/rear deviation outside the nominal levels	Counts
17	without significance	
18	Difference (nominal level - actual level), when difference smaller than, equal, the main flow throttle switches to small cross-section [2]	Counts
19	Difference (normal level 1 - actual level), when difference is exceeded, starting lock is only active during kneeling	Counts
20	Difference (normal level 1 - actual level), when difference is exceeded (front and rear axle), door may be enabled during kneeling	Counts
21	Difference (normal level 1 – kneeling level) by which the 1-distance sensor axle may be lowered during kneeling	Counts
22	without significance	
23	Difference (normal level 1 – kneeling level) by which the 2-distance sensor axle may be lowered during kneeling	Counts
24	Kneeling offset: This is the value by which the 1-distance sensor and 2-distance sensor axle is reversed when the pushbutton is released in the event of manual kneeling (when actual level > kneeling level + 2 × tolerance)	
Speeds		
25	Vehicle speed up to which targeted height changes can be made (must be < = parameter 26, otherwise limited to parameter 26!)	km/h
26	Road speed at which, when exceeded, the normal level is automatically activated (must be> = Parameter 25 **and** > 0 km/h!)	km/h
27	Road speed at which, when exceeded, the old nominal level is set again (must be < parameter 26 , otherwise limited to parameter 26!)	km/h

No.	Meaning	Unit
Control		
28	Control delay when stationary	250 ms
29	Pulse repetition period T	25 ms
30	Buffer recognition time	250 ms
31	Pulse divider	----
32	Proportional coefficient Kpv for desired-level controller 1-distance sensor axle	1/3 counts
33	without significance	
34	Differential coefficient Kph for desired-level controller 2-distance sensor axle	1/3 counts
35	Differential coefficient Kdv for nominal level controller 1-distance sensor axle	1/3 counts
36	without significance	
37	Proportional coefficient Kdh for desired-level controller 2-distance sensor axle	1/3 counts
Times		
38	Delay for plausibility fault recognition	10 sec
39	Standby time (only downward adjustments are permitted, ECAS "OFF")	10 sec
40	Delayed activation of control delay when driving	10 sec
Pressures		
41	Minimum pressure at which, when exceeded, the tyre impression compensation becomes effective	1/20 bar
42	Maximum pressure at which the tyre impression is compensated with the maximum offset	1/20 bar
43	Maximum offset for compensating the tyre impression	1/20 bar
Control delay		
44	Control delay when driving	250 ms

1) Units and tens digits indicate the distance in counts.
Hundreds digit = 0 : Buffer region = lower end position ... lower end position + distance
Hundreds digit = 1 : Buffer region = 0...lower end position + distance

2) Units and tens digits indicate the difference in counts.
Hundreds digit = 0 : Lift from kneeling level to normal level with an appropriate the main flow throttle cross section.
Hundreds digit = 1 : Lift from kneeling level to normal level only with a large main flow throttle cross section. In all other cases, control/lift/lower with the corresponding main flow throttle cross section, taking into account the programmed difference.

8.3.3 Description of the parameters

Parameter 0

Parameter 0 sets the device address that the Diagnostic Controller uses to communicate with the ECU. By default, the address 16 is set for the electronic unit of the bus. However, if two electronic control units are connected to the Diagnostic Controller - as is the case with articulated buses for example - the address 17 is predefined in this parameter for the electronic control unit in the rear section. This allows differentiated diagnosis with the Diagnostic Controller for the desired electronic control unit.

Parameter 1

Bit 0: Is set to "0". The setting "1" is without significance.

Bit 1: Air suspension on front and rear axle
If the bus has air-suspended front and rear axles which are to be controlled with ECAS, then this bit must be set to "1“. If only one axle is to be controlled, as in the rear section for example, "0" is entered. This one axle must have two distance sensors.

Bit 2: Kneeling of the axle with one distance sensor
It is possible to choose between kneeling of an entire axle (left and right), kneeling of a complete side of the vehicle, or kneeling of only one side of an axle.

If only one axle is to lowered left and right, the only axle that can be selected in this case is the axle with only one distance sensor (i.e most likely the front axle). Bit 2 must be set to "0".

If the vehicle is to be kneeled to the right, bit 2 is set to "1". As a result, the setting according to bits 3 and 4 becomes valid.

Bit 3 and bit 4: Kneeling of the right side
Depending on the settings for bits 3 and 4, the following types of kneeling are possible at the axle with one distance sensor (1-distance sensor axle, usually the front axle) and at the axle with two distance sensors (2-distance sensor axle, usually the rear axle):

	Bit 3	Bit 4
Kneeling only of the 1-distance sensor axle right	1	0
Kneeling only of the 2-distance sensor axle right	0	1
Kneeling right both axles	0 1	0 1

Buses with doors on the left side of the vehicle
In general, only right-side kneeling is referred to here since most vehicles are designed for right-hand traffic. ECAS can, of course, be brought to kneel on the left-hand side:as well. This is achieved by a simple workaround: the distance sensors and the solenoid valves are simply connected to the respectively opposite

side. Here the distance sensor of the left side of the vehicle, for example, is not connected to pin 25 (distance sensor 2-distance sensor axle left) but to pin 8 (distance sensor 2-distance sensor axle right); the right sensor is correspondingly connected to pin 25. The same procedure is used for the solenoid valves on the two axles.

Bit 5: Distance sensor arrangement
To ensure the correct assignment of distance sensors to solenoid valve, the position of the distance sensors must be communicated to the electronic control unit by means of bit 5:

If the 2-distance sensor axle is the rear axle and the 1-distance sensor axle is the front axle, bit 5 must be set to "0" and if it is the other way round, it must be set to "1".

If only one axle (with two distance sensors) is controlled, bit 5 must specify the position of this axle: "0" for rear and "1" for front.

Bit 6: Number of calibration levels
If the value "0“ is entered here, the ECU expects three level positions during the calibration process: normal level 1, the highest and the lowest nominal level.

If the value "1“ is set, only the normal level is calibrated. Before calibrating this level alone however, the two other levels must be entered as count values via the Diagnostic Controller.

Bit 7: Automatic periphery detection
If bit 7 = "1", the ECU checks the electrical connections prior to calibration and uses this information to determine which system configuration is being used.

The parameters describing the configurations are automatically set accordingly.

If bit 7 = "0" is set, options apply in accordance with specifications of the entered parameter set.

Parameter 2

Bit 0: Output Enable door
According to German law, no door must be open at the start of kneeling. To meet this requirement, the door control is locked via pin 11 of the ECAS ECU during kneeling and lowering / lifting and subsequently enabled again.

According to the setting of bit 0, enabling occurs either by energising pin 11 (switch from currentless to +Ub – bit 0 = "1") or by terminating the current supply (switch of +Ub to currentless – bit 0 = "0"). The pin can be loaded with currents not exceeding 500 mA.

In the ECU ... 050 0, enabling the door only occurs by switching +Ub to currentless, a different setting is not possible. Bit 0 is without function in this variant should be set to "0".

Bit 1: Without function
Setting this bit does not affect the function. However, the value "0" should be entered for clarity.

Bit 2: System with pressure sensor
If the system has a pressure sensor, in order to perform tyre impression compensation for example, bit 2 should be set to "1", otherwise it should be set to "0".

The ECU 446 055 050 0 is not designed for the connection of a pressure sensor. The setting of bit 2 is therefore insignificant. The value "0" should be set, however, to maintain a clear structure of the parameter set.

Bit 3: Manual / Automatic kneeling
The kneeling process can be initiated either a briefly pressing the button (automatic) or by keeping the button pressed until the lowering process is complete (manual).

The difference between these two types of kneeling is a safety criterion: With manual kneeling, the driver only needs to release the kneeling button (pin 23) to cancel the lowering process if he sees any danger.

To cancel the lowering process during automatic kneeling, the stop button must be pressed or the safety contact-strip ("sidewalk detector") underneath the entrance must be triggered.

To allow the driver to choose between these two types of kneeling, the following options are available for bit 3:

Bit 3 = "0". A switch connected to pin 21 is used to select automatic or manual kneeling. A pushbutton on pin 23 executes the preselected kneeling process.

Of course it is also possible to implement a cable bridge on pin 21 so that a permanently preselected is executed.

Bit 3 = "1". It is possible, for example, to install two pushbuttons in the instrument panel: The button for automatic kneeling is connected to pin 21 and the button for executing manual kneeling is connected to pin 23.

Bit 4: Valve monitoring on pin 11
If bit 4 is set to "0", the connection to the valve or relay connected to pin 11 for enabling the door, is monitored for interruption and short circuit to ground or +Ub. The general valve monitoring must also be activated however (bit 6 = "0").

If bit 4 = "1", this output is not monitored, so there is also no fault memory entry in the event of an interruption - caused by an emergency switch for example.

Bit 5: Valve monitoring on pin 29
If bit 5 is set to "0", the connection to the valve or relay connected to pin 29 for the starting lock, is monitored for interruption and short circuit to ground or +Ub. The general valve monitoring must also be activated however (bit 6 = "0").

If bit 5 = "1", this output is not monitored, so there is also no fault memory entry in the event of an interruption - caused by an emergency switch for example.

With ECU ... 051 0, these outputs are only monitored at speeds above 7 km/h to avoid faults due to the effect of external circuits when stationary.

Bit 6: Monitoring of the solenoid valves

If bit 6 is set to "0", the connected solenoid valves for controlling the air suspension bellows, as well as the valves, configured by bit 4 and 5, for control of the door enabling function and the starting lock are monitored for interruption, short circuit to ground and short circuit to +Ub.

If bit 6 = "1“ is set, the solenoid valves are not monitored and therefore there there is also no entry into the fault memory in the event of a fault.

Bit 7: Measured value output

If bit 7 = "1“ is set, ECU constantly transmits eight measured values, calculated on the basis of the sensor values, to the ECU. The measuring points are defined according to the following assignment:

1 actual value distance sensor 2-distance sensor axle left
2 actual value distance sensor 2-distance sensor axle right
3 actual value distance sensor 1-distance sensor axle
4 actual value pressure sensor
5 nominal value Level 2-distance sensor axle left
6 nominal value Level 2-distance sensor axle right
7 nominal value Level 1-distance sensor axle
8 current vehicle speed

The measured values 1 to 7 are output as counts, the speed is output in km/h.

The values for the nominal level are output according to the tyre impression compensation settings. If a nominal value "Normal level 1" has been preselected and the vehicle is laden, a higher than calibrated value is output when a tyre impression compensation has been defined.

If the system does not have one of the measurement points (point 3 for example in systems with only one controlled axle), the value "0" or "255" is output.

The measured value output must only be applied during the definition of parameters. Since the electronic unit is constantly transmitting data, it is otherwise impossible to start diagnostic operation with the diagnostic program card 446 300 528 2.

To complete the parameter settings, bit 7 must be set to "0".

Parameter 3

Bit 0: Control of a main flow throttle

To prevent overshooting the nominal level during level control processes, provision is made for control of a main flow throttle as an addition measure to adjusting the control parameters described in section "the control algorithm".

This main flow throttle, which is connected between the air-intake valve and the directional control valves 2/2 of the individual air suspension bellows, can be switched from a free position (large cross section) to a throttle position (e.g. ø 2) by a solenoid.

If bit 0 is set to "1", the throttle position is activated at a proximity to the nominal level defined by parameter 17, so that level change can only take slowly beyond this point.

If a main flow throttle is not to be used, bit 0 must be set to "0".

Bit 1: Switchable transverse throttle on the 1-distance sensor axle.

At an axle with only one distance sensor, the two bellows must always be interconnected by at least one transverse throttle. This ensures a slower pressure equalisation between the bellows even when the solenoid valves are closed, and so prevents the vehicle from tilting due to different pressures.

If the bus is to kneel on one side, the pressure on this side must be lowered. Pressure equalisation between the bellows must be prevented at this moment, it must be possible to block the transverse throttle by means of a solenoid valve for the duration of the kneeling.

With bit 1 = "1", a transverse throttle is defined on pin 18 of the ECU. In this case, pin 18 is never switched currentless while a kneeling function is active; in the alternative case, +Ub is applied to pin 18.

If a transverse current flow throttle is not installed, bit 1 must be set to "0“.

Bit 2: Door status during kneeling

According to German law, the door must not be open at the start of a kneeling process.

The status of the door is queried via a signal input of the ECU (pin 5), provided bit 2 = "1" is set. In this case, an automatically started kneeling or a lift/lower command is not executed when the door is open.

This function can be deactivated for buses operating in other countries: if bit 2 = "0" is set, automatic kneeling can be initiated even the door is open. If manual kneeling is required regardless of the door being open, this can be achieved by simple means: Parameter 3, bit 7 is set to "0" and the switching input for the door status, pin 5, is not connected.

Bit 3: Control of left side during kneeling
Depending on the control point of the left distance sensor and the force output by the axle stabiliser, kneeling produces a different level on the left side of the vehicle even though the quantity of air in the left bellows was not changed.

Bit 3 can only be used to define whether the level attained on the left side of the vehicle after a kneeling process should be maintained for the duration that the vehicle is in a kneeling position.

If bit 3 = "0“ is set, control occurs on the left side while the vehicle is in a kneeling position.

If bit 3 = "1“ is set, the left side is only controlled (adjustment only if required) after the right side has been lifted into normal level.

The same applies to the second axle if axle by axle kneeling is carried out.

Bit 4: Level control with applied brake
ECAS does not normally execute control while the brakes are applied since the level change caused by the braking obviously does not have to be readjusted:

The shift in axle loads during braking causes only a brief lowering of the vehicle and the old level is restored on its own accord the next moment. However, if air was fed into the front bellows at the moment the vehicle pitches, it would need to be vented again later.

This is not the case at the bus stop: Here the vehicle is prevented from rolling away by the brakes, but the change in load (passengers getting on or off) may necessitate level adjustment.

To take this circumstance into account, it is possible to perform a level adjustment when the brake if applied, provided the door is also open. In this case bit 4 must be set to "1".

If bit 4 = "0", then no adjustment is made as long as the brakes are applied.

Bit 5: Output Enable door
The door enabling function was already described for the setting of parameter 2, bit 4.

Bit 5 = "1" permits use of the door enabling function on pin 11. If the output is not connected, bit 5 must be set to "0".

Bit 6: Output starting lock
The starting lock function was already described for parameter 2, bit 5.

Bit 6 = "1" permits use of the starting lock function on pin 29. If the output is not connected, bit 6 must be set to "0".

Bit 7: Input Door status
Analogous to the description for parameter 3, bit 2, the execution of automatic kneeling as well as the execution of lifting and lowering processes can be made to depend on the door position.

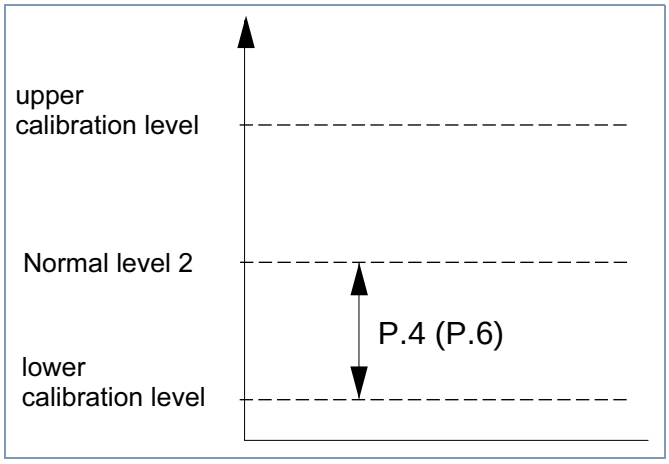
Information on whether a door is open or closed is queried via the signal input pin 5.

In this respect it is optional whether the 'open' status of a door is defined by pin 5 being connected to ground (bit 7 = "0") or by being connected to +Ub (bit 7 = "1"). A closed door is indicated by the respectively other potential or by the pin being potential-free (for ECU 050 0, an additional resistor may be required).

Parameter 4

Height of normal level 2 of the 1-distance sensor axle (counts).
The second normal level, to be set via a switching contact, is entered as a differential (distance) to the lower calibration level.

The P.4 setting is illustrated by the following figure:



Parameter 5

Parameter 5 is without function and is set to zero.

Parameter 6

Height of normal level II of the 2-distance sensor axle (counts). The setting is made analogous to P.4 for the 2-distance sensor axle.

Parameter 7

Plausibility limit at the 1-distance sensor axle (counts). P.7 acts differently depending on the lowest permissible level determined:

- Lower height limit (lowest level) is the rubber buffer
- P.7 is selected greater than 100. The value to be entered is determined by the elasticity of the rubber buffer; an empty vehicle does not compress the rubber buffer as much as a laden vehicle. If the vehicle was calibrated when it was laden, the unladen vehicle will not be able to reach this lowest level,

despite complete exhaust of the bellows and a plausibility error is signalled accordingly.

- The ECU identifies the "rubber buffer“ and terminates the exhaust process when the level drops below the set level (end level + P.7- 100) and there is no further height change during the time specified by P.29 (buffer detection time). This prevents complete exhaust of the bellows. The level reached is stored as the new nominal level.

Recommended setting: If the vehicle was calibrated unladen, a value between 110 and 125 should be parameterised so that no plausibility fault is detected even when the vehicle is tilted, only making contact with the buffer on one side. If the vehicle was calibrated when laden, a value between 120 and 135 is sensible.

- The lowest level is above the rubber buffer
- If the lower height limit is above the rubber buffer, this is communicated by value for P.7 that is below 100. In this case the bus can only be lowered to the calibrated lower level.
- In the event that the body still makes contact with the buffer above this level due to an uneven road surface, the following applies: The exhaust process is terminated as soon as the level drops below the set level (calibration level + P.7) **and** there is no further height change during the time specified by P.29 (buffer detection time). As plausibility problems are generally only possible when the vehicle is severely tilted, we recommend setting the value between 5 and 20, depending on the distance between the calibration level and the buffer.

When, during a lowering process, no downward distance change (at least 1 count) is observed **above** the limit formed by P.7 and stop level within 30 seconds, the ECU detects a plausibility fault.

Especially in buses with right-side kneeling it must be taken into account that the axle stabiliser may prevent adequate lowering. When kneeling level = buffer stop is parameterised without contact being made with the buffer, the ECU detects a plausibility fault.

The distance sensor of the 2-distance sensor axle - a sensor that is not directly attached at the wheel - will also fail to output the lowest level during side kneeling even though the buffer stop has been reached. While axle and body are in parallel when the bus is calibrated on the buffer, they are at an angle during kneeling. If the distance sensor is fitted nearer the middle of the axle, the sensor value during kneeling lies somewhere between the normal level and the lowest level.

Here the only remedy is an increased plausibility limit or the selection of a higher kneeling level that can be read out by the measured value output.

Parameter 8
Parameter 8 is without function and is set to zero.

Parameter 9
Plausibility limit on the 2-distance sensor axle (counts) Analogous P.7 for the 2-distance sensor axle.

Parameter 10
Tolerance of the nominal level at the 1-distance sensor axle (counts). The setting for this parameter together with the proportional and differential coefficients determines the system's adjusting quality at the front axle. See chapter "Control Algorithm".

Parameter 11
Parameter 11 is without function and is set to zero.

Parameter 12
Tolerance of the nominal level at the 2-distance sensor axle (counts). Corresponds to parameter 10 for the 2-distance sensor axle

Parameter 13

Permissible right/left deviation in the nominal level (counts). This parameter acts at the 2-distance sensor axle. It specifies the permissible body tilt e.g. under laterally uneven load distribution.

Values greater than 2 × P.12 are not reasonable and are automatically limited to 2 × P.12 by the ECU.

Parameter 14

Permissible deviation right/left for lifting/lowering process (counts). Unlike P.13, it is not the control process in the range near the nominal level which is being specified but the process during greater level changes. On a vehicle with a greater load on one side, the side which has less weight on it will be raised more rapidly than the other (or the side with the greater load will be lowered more rapidly), thus causing a unintentional inclination as the level is being changed. By pulsing the corresponding bellows, a more even lifting/lowering process is achieved.

The pulse length is determined by the pulse divider (P.30).

Parameter 15

Permissible deviation front/rear for lifting/lowering process (counts).
The level control of the vehicle with tow air-suspended axles should generally be implemented in such a way that the body front and rear reach the new nominal level more or less at the same time. The axle with the shorter path to the new level is lifted/lowered more slowly by means of corresponding air-intake / air-exhaust pulses. Parameter 15 is used to specify the extent to which control is to match an ideally even level change of the two axles.

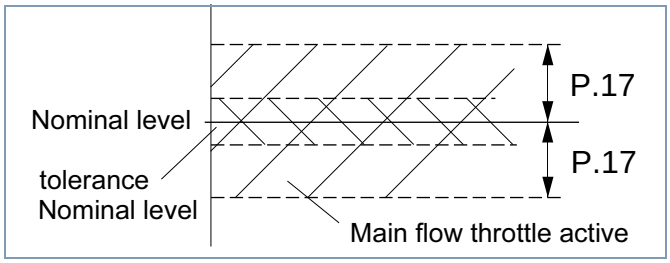
A very low tolerance is therefore not desirable since this will this cause constant pulsing of the solenoid valves during the control process.

Parameter 16

Parameter 16 is without function and is set to zero.

Parameter 17

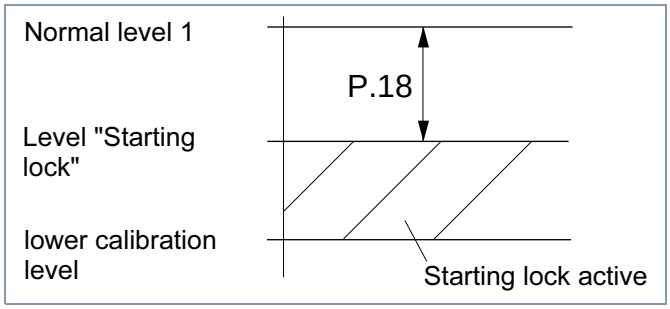
Distance to nominal level for activation of the main flow throttle (counts).
If the system is equipped with a main flow throttle (also see parameter 3, bit 0), it can be used to reduce the air flow as the body approaches the required nominal level thereby decelerating movement beyond this point. This measure can help to prevent overshooting beyond the nominal level and so to avoid the need for corrective control. P.17 specifies at which distance to the nominal level throttling should occur, regardless of whether it is a lifting or lowering movement (should be > 2 × tolerance).



Parameter 18

Level for switching on the starting lock (counts).
After the vehicle has been lowered by means of kneeling, the starting lock is activated as soon as the level drops below normal level. As soon as the level specified in P.18 is exceeded after kneeling, the starting lock is disabled again.

This level is set as a differential to normal level 1 (calibration level) (> 2x tolerance):



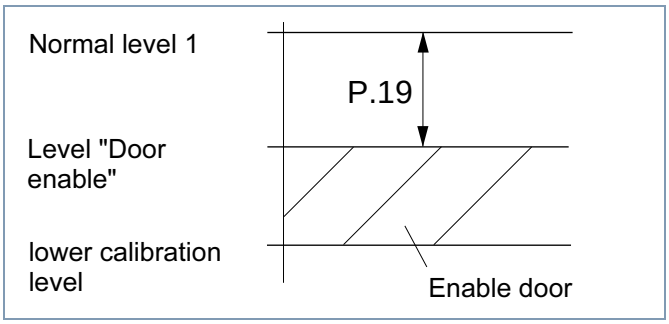
Parameter 19

Level for switching on the door enabling function (counts). In principle, the door is enabled at every level. It is only disabled temporarily during level changes.

To save time during kneeling, it is permissible according to German law to open the door even before the kneeling level is reached, provided the door is not opened by more than 80% upon reaching the kneeling level.

It is therefore only possible to set a level below which it is permitted to enable the door "prematurely" during automatic or manual kneeling.

This level is set relative to normal level 1:



Parameter 20

Kneeling level 1-distance sensor axle (counts). This parameter is used to define for the 1-distance sensor axle the level to which the vehicle is lowered during automatic kneeling.

During manual kneeling, the driver must keep the pushbutton pressed until at least this level (more precisely: kneeling level + 2 x nominal level tolerance) is reached, otherwise lowering is cancelled. Provided this is set via P. 23, the vehicle may even need to be lifted again after such an event.

With ECU ... 051 0, the signal lamp "Kneeling level reached" lights up once this level (+ 2 × tolerance) is reached.

Analogous to parameters 18 and 19, this level is set relative to normal level 1.

Parameter 21

Parameter 21 is without function and is set to zero.

Parameter 22

Kneeling level 2-distance sensor axle (counts). Analogous to P.20 for the 2-distance sensor axle.

Parameter 23

Reversing after kneeling is cancelled (counts)
If the pushbutton is released during manual kneeling before the kneeling level is reached, the lowering movement is immediately cancelled, followed by an upwards movement up to a height specified by P. 23. A reverse process beyond normal level 1 is only carried out up to normal level 2.

Parameter 24

Road speed up to which the raising/lowering commands are accepted (km/h). This parameter can be used to set

the road speed up to which specific level changes can be initiated by the driver.

The maximum speed up to which the driver can change the ride height is the speed specified in parameter 25.

The maximum speed up to which kneeling can be requested is fixed at 5 km/h.

Parameter 25

Automatic normal level (km/h)
For safety reasons, it may be required driving at higher speeds is only possible at the normal levels. P.25 is used to set a speed threshold above which the level is automatically adjusted to the preselected normal level.

The value for P.25 must be greater than the value of P.24 and greater than 0 km/h!

Parameter 26

Automatic return to the old nominal level (km/h)
Generally, it is not desirable that a return to the previous (prior to exceeding the speed threshold P.25) nominal level is initiated at speeds directly below the speed specified by P.25. In this case, constant adjustments would occur at speeds in the region of this threshold (e.g driving in a line of traffic).

It makes more sense to define a second limit speed at some distance to P.25; return to the old nominal level is then controlled below this second speed.

The second speed threshold is freely definable, but is imperative that it is below the value for P.25.

If the level should not return to the old nominal level and the normal level should remain current instead, P.26 is set to zero.

Parameter 27

Control delay when stationary (in 250 ms)
A sensible value for control delay when stationary is generally considered to be one second (4 counts). This control delay allows for a stabilising phase after each adjustment, providing time for the final level position to be reached before another (corrective) adjustment is initiated.

Parameter 28

Pulse repetition period (25 ms)
The function of the pulse repetition period is described in chapter "The control algorithm". A sensible value for P.28 is 300 ms. Accordingly, 12 counts must be entered.

Parameter 29

Buffer recognition time (in 250 ms).
The buffer recognition time should be < 30 sec (< 120 counts) in order to prevent plausibility faults.

See parameter 7.

Parameter 30

Pulse divider (counts)
See P.14. Describes the time fraction of a cycle for the length of which the faster moving vehicle side is pulsed. Pulse times below 75 ms are not executed.

If the value "255" is entered, the solenoid valve on the faster moving vehicle side is closed until the body is once again within the permitted tolerance in accordance with P.14.

Parameter 31

Proportional coefficient Kp for the 1-distance sensor axle (1/3 counts)
Settings for the level controller are described in chapter "The control algorithm".

Parameter 32

P.32 is without function and is set to zero.

Parameter 33

Proportional coefficient Kp for the 2-distance sensor axle (1/3 counts)
Settings for the level controller are described in chapter "The control algorithm".

Parameter 34

Differential coefficient Kd for the 1-distance sensor axle (1/3 counts)
Settings for the level controller are described in chapter "The control algorithm".

Parameter 35

P.35 is without function and is set to zero.

Parameter 36

Differential coefficient Kd for the 2-distance sensor axle (1/3 counts)
Settings for the level controller are described in chapter "The control algorithm".

Parameter 37

Delay of the plausibility fault recognition (in 10 sec)
If ECAS is to carry out a level adjustment immediately after the engine is started, a plausibility fault may occur due to insufficient supply pressure. This can be delayed via P.37 until the compressor has conveyed sufficient air for correct function.

Before this delay period has expired, the right-hand kneeling is terminated by simultaneous adjustment of the left and right side. Although this hardly ever occurs in practice, rolling movements or extreme overshooting may make it noticeable during a test that includes the kneeling function (frequent switching on and off of the ignition).

Parameter 38

Standby period after ignition switched off (10 sec)
A situation could arise where the engine is switched off (having reached its destination) before all passengers have got off the bus.

As the ECAS only works when the ignition is switched on, the level will rise as there is no corrective control.

P. 38 can be used to set a standby period within which ECAS responds to an increase in level and vents the bellows.

Adjustments other than venting are not carried out despite P.38 being set.

Parameter 39

Delay of control in accordance with driving (in 1s)
As soon as the ECU detects a driving speed of the vehicle, a control delay of 60 sec comes into effect to prevent adjustments to uneven road surfaces.

This may be a disadvantage under certain circumstances when starting off from a bus stop:

- when, due to an uneven surface of the bus bay, the vehicle was tilted before starting to drive off and secured against rolling by the service brake being applied, thus preventing a level adjustment while the vehicle was stationary,
- when the input "Brake" is used to intentionally prevent a level adjustment while the door is open to avoid the danger of tripping over the moving edge of the entrance.

in each of the cases above, the bus could have an unfavourable level when starting to drive and this would not be corrected for another 60 seconds.

After leaving the bus stop (start of drive), a single additional level correction is performed once the vehicle is on an even surface and the time specified in P.39 has elapsed. The control delay for the condition "drive" is only reactivated after this adjustment.

Remark: When using this parameter, it must be taken into account that the vehicle may be entering a corner while the adjustment takes place and that the cornering roll will be corrected in this case.

The following parameters are without function in the ECU ... 050 0 because this electronic control unit does not have a tyre impression compensation. The value for the following parameters must therefore be set to zero.

Parameter 40

Pressure value at which, when exceeded, the tyre impression is compensated (in 1/20 bar)
An especially short compression travel of the air spring may be required for buses with particularly high superstructures so that they still comply with the legal provisions regarding maximum vehicle height.

This may cause the body to bottom onto the buffers when the vehicle is heavily laden or the road surface is extremely uneven.

When the vehicle is heavily laden, the tyre impression is also greater however, reducing the overall vehicle height.

A pressure sensor, in combination with the ECU 446 055 051/052/054/055 0, can be used to determine the degree of loading. The distance between axle and body can be increased when load is added, resulting in a longer compression path while the vehicle height remains constant.

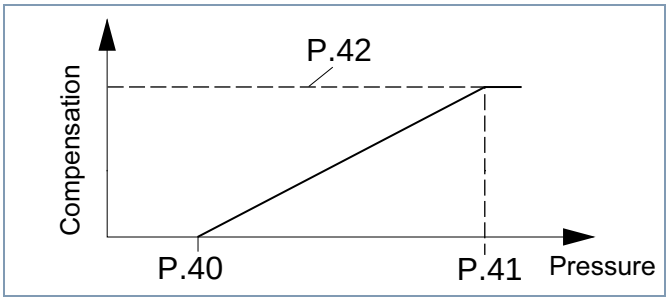
P. 40 is used to set the pressure value above which the compensation should become effective. This is generally the value that is present in the supporting bellows when the vehicle is unladen.

Parameter 41

Pressure for maximum compensation (in 1/20bar)
P.41 describes the pressure in the support bellows at which the greatest tyre impression occurs that should be compensated. Generally, this will be the bellows pressure when the vehicle is fully laden.

Parameter 42

Maximum offset used for compensating the tyre impression (in counts)
Here the normal level offset compensating increased tyre pressure due to increased load is entered. The offset is linearly dependent on the load, i.e the nominal value offset occurs evenly between the lower pressure value in accordance with P.40 (Offset = 0) and loading in accordance with P.41 (Offset = max. value = P.42).



8.4 Sample parameters for ECU CAN I

8.4.1 Option parameters

Enter the total of the decimal numbers

No.	Meaning	Decimal
0	ECAS unit address if several units are on the address (data) bus	
1	Bit 0 **0** rear section **1** Solo bus or front section	0 1
	Bit 1 **0** no kneeling on the 1-distance sensor axle [1) 2)] **1** kneeling on the 1-distance sensor axle	0 2
	Bit 2 **0** no kneeling on the 2-distance sensor axle **1** kneeling on the 2-distance sensor axle	0 4
	Bit 3 **0** one-sided kneeling right on the 1-distance sensor axle **1** two-sided kneeling on the 1-distance sensor axle	0 8
	Bit 4 **0** one-sided kneeling right on the 2-distancesensor axle **1** two-sided kneeling on the 2-distancesensor axle	0 16
	Bit 5 **0** without separate pressure switch for air suspension supply pressure **1** with separate pressure switch for air suspension supply pressure	0 32
	Bit 6 **0** 3 calibration levels **1** only calibrate normal level	0 64
	Bit 7 **0** without pressure sensor for tyre impression compensation [3)] **1** with pressure sensor for tyre impression compensation	0 128
2	Bit 0 **0** without switchable transverse lock **1** with switchable transverse lock	0 1
	Bit 1 **0** vehicle in kneeling position Correction to the current level on the unkneeled side **1** Vehicle in kneeling position: No correction to the current level on the unkneeled side	0 2
	Bit 2 **0** Suppression of automatic level control when brake is applied regardless of door position **1** Suppression of automatic level control when brake is applied only while door is closed	0 4
	Bit 3 **0** Transverse lock only in the case of side kneeling **1** Transverse lock function in the case of side kneeling and at V > 0 km/h	0 8
	Bit 4 **0** Reference level for normal level 2 parameter settings is the lower calibration position **1** Reference level for normal level 2 parameter settings is the lower calibration position	0 16
	Bit 5 **0** no transverse lock function during standby time after ignition is switched off **1** Transverse lock active during standby time after ignition is switched off	0 32
	Bit 6 **0** "Gentle" control function permissible with door open **1** suppress automatic level control if at least one door is open	0 64
	Bit 7 **0** Nominal levels during kneeling are preset by parameters 22 and 23 **1** Lower down to buffer on the side to be kneeled during kneeling	0 128
3	Bit 0 **0** without sidewalk detector **1** with sidewalk detector on ECU plug X1/6	0 1
	Bit 1 **0** without fault monitoring of sidewalk detector **1** with fault monitoring of sidewalk detector	0 2
	Bit 2 **0** sidewalk detector as break contact **1** sidewalk detector as make contact	0 4
	Bit 3 **0** Disregard door position during kneeling **1** Take door position into account during kneeling. Kneeling and at V > 0 km/h	0 8
	Bit 4 **0** not connected	
	Bit 5 **0** not connected	
	Bit 6 **0** not connected	
	Bit 7 **0** not connected	

No.	Meaning	Decimal
4	Bit 0 **0** without measured value output **1** with measured value output	0 1
	Bit 1 **0** with valve monitoring **1** without valve monitoring	0 2
	Bit 2 **0** Emergency operation only via info "Lift" or "Lower" **1** Emergency operation via info "normal level“ (-> raising) or "kneeling“ (-> lowering)	0 4
	Bit 3 **0** Do not change the tyre impression compensation offset during a control process **1** Recalculate the tyre impression compensation offset during a control process	0 8
	Bit 4 **0** not connected	
	Bit 5 **0** not connected	
	Bit 6 **0** not connected	
	Bit 7 **0** not connected	

1) Operation is not possible with only one distance sensor.

2) If this bit is changed, the ECAS distance sensors must be recalibrated.

3) After changing this bit from "0" to "1", the pressure sensor must be recalibrated.

8.4.2 Value parameters

No.	Meaning	Unit
5	Differential normal level 2 on the 1-distance sensor axle (input depends on parameter 2, bit 4)	Counts
6	Differential normal level 2 on the 2-distance sensor axle (input depends on parameter 2, bit 4)	Counts
7	Tolerance for nominal level at the 1-distance sensor axle (must be greater than or equal to 3 counts)	Counts
8	Tolerance for nominal level at the 2-distance sensor axle (must be greater than or equal to 3 counts)	Counts
9	permissible right / left deviation at nominal level on the 2-distance sensor axle (must be greater than or equal to 3 counts)	Counts
10	permissible right / left deviation outside the nominal level on the 2-distancesensor axle (must be greater than or equal to 3 counts)	Counts
11	permissible front/rear deviation outside the nominal levels	Counts
12	Plausibility check limit during lowering at the 1-distance sensor axle	Counts
13	Plausibility check limit during lowering at the 2-distance sensor axle	Counts
14	Period for plausibility check	Counts
15	Delay of plausibility check after "Ignition ON“	10 sec
16	Standby time after "Ignition OFF" -> only downward control is permissible (then ECAS-ECU "OFF")	min
17	V_{limit} Vehicle speed up to which selective height changes can be carried out via the Lift/Lower button (must not be > parameter 18!)	km/h
18	V_{Norm} Vehicle speed at which, when exceeded, automatic adjustment to the normal level occurs (must be > 0, may not be < parameter 17!)	km/h
19	Control delay when stationary	250 ms
20	Control delay when driving	sec
21	Buffer recognition time (should be < parameter 14!)	250 min
22	Differential (normal level 1 – kneeling level) by which the 1-distance sensor axle can be lowered during kneeling	Counts
23	Differential (normal level 1 – kneeling level) by which the 2-distance sensor axle can be lowered during kneeling	Counts
24	Kneeling offset: When the pushbutton is released during manual kneeling, the level is adjusted in the opposite direction by this value (when actual value > kneeling value + 2 × nominal level tolerance)	Counts
25	Differential [normal level 1 - actual level] at which, when exceeded the starting lock is active (only during kneeling)	Counts
26	Pressure at which, when exceeded, the tyre impression compensation at the 1 distance sensor axle becomes active.	1/20 bar
27	Pressure at which the tyre impression compensated by the maximum value at the 1-distance sensor axle	1/20 bar
28	Maximum value by which the tyre impression is compensated at the 1-distance sensor axle	Counts
29	Pressure at which, when exceeded, the tyre impression compensation at the 2 distance sensor axle becomes active.	1/20 bar
30	Pressure at which the tyre impression compensated by the maximum value at the 2-distance sensor axle	1/20 bar
31	Maximum value by which the tyre impression is compensated at the 2-distance sensor axle	Counts
32	Differential [nominal level - actual level], at which, when the door is open, the limitation for the lifting / lowering speed sets in	Counts
33	maximum lifting/lowering speed when the door is open	Counts/ 600 ms
34	Switch-off time of the PWM signal for valve control when the door is open	25 ms
35	PWM periodic time of the PWM signal for valve control when the door is open	25 ms
36	maximum duration of the pulsing control	25 ms

No.	Meaning	Unit
37	Limit value of lateral acceleration at which, when exceeded, cornering is detected (no automatic level corrections when cornering)	0,1 m/s^2
38	Delay for plausibility fault detection	10 sec
39 … 46	unassigned	

8.4.3 Description of the parameters

Parameter 0

Parameter 0 defines the device address that is used to communicate with the electronic control unit.

Parameter 1

Bit 0: Air suspension on front and rear axle
If the bus has air-suspended front and rear axles that are to be controlled by ECAS, then this bit must be set to "1". If only one axle is to be controlled, in the rear section for example, "0“ is entered. This axle must have two distance sensors.

It is possible to choose between kneeling of an entire axle (left and right), kneeling of a complete side of the vehicle, or kneeling of only one side of an axle.

If an axle is to be lowered on the left and the right, bit 3 and 4 must be set to "1“. If the vehicle is to be kneeled on the right side, bits 3 and 4 are set to "0“. In this regard, it is important to take bit 1 and 2 into account.

Bit 1: Kneeling of the axle with one distance sensor

Bit 2: Kneeling of the axle with two distance sensors

Bit 3 and bit 4: Kneeling of the right side
Depending on the settings for bits 3 and 4, the following types of kneeling are possible at the axle with one distance sensor (1-distance sensor axle, usually the front axle) and at the axle with two distance sensors (2-distance sensor axle, usually the rear axle):

	Bit 1	Bit 2	Bit 3	Bit 4
Kneeling only of the 1 distance sensor right	1	0	0	1
Kneeling only of the 2 distance sensors	0	1	0	0
Kneeling right both axles	1	1	0	0

Buses with doors on the left side of the vehicle
In general, only right-side kneeling is referred to here since most vehicles are designed for right-hand traffic. ECAS can, of course, be brought to kneel on the left-hand side:as well. This is achieved by a simple workaround: the distance sensors and the solenoid valves are simply connected to the respectively opposite side. The distance sensor of the left vehicle side, for example, is not connected to pin X2/5 (distance sensor 2 distance sensors left) but to pin X2/8 (distance sensor 2-distance sensor axle right); the right sensor is accordingly connected to pinX2/5. The procedure is identical for the solenoid valves on the two axles.

Bit 5: Presence of a separate pressure switch

Bit 6: Number of calibration levels
If the value "0" is entered here, the ECU expects three level positions during the calibration process: normal level 1, the highest and the lowest nominal level.

If the value "1" is set, only the normal level is calibrated. Before calibrating this level alone however, the two other levels must be entered as count values via the Diagnostic Controller.

Bit 7: Installation of a pressure switch for tyre impression compensation.

Optional parameter 2

Bit 0: Switchable transverse lock
At an axle with only one distance sensor, the two bellows must always be interconnected by at least one transverse throttle. This ensures a slower pressure equalisation between the bellows even when the solenoid valves are closed, and so prevents the vehicle from tilting due to different pressures.

If the bus is to kneel on one side, the pressure on this side must be lowered. Pressure equalisation between the bellows must be prevented at this moment, it must be possible to block the transverse throttle by means of a solenoid valve for the duration of the kneeling.

If bit 1 = "1", a transverse throttle is set on pin X2/14 of the ECU. As long as a kneeling function is active, pin X2/14 is switched currentless in this case; if the other case applies, +Ub is applied to pin X2/14.

If a transverse current flow restrictor is not installed, bit 1 must be set to "0".

Bit 1: Adjustment of the left side during kneeling
Depending on the control point of the left distance sensor and the force output by the axle stabiliser, kneeling produces a different level on the left side of the vehicle even though the quantity of air in the left bellows was not changed.

Bit 1 can now be used to define whether the level change resulting on the left side of the vehicle during lowering is to be compensated.

If bit 1 = "0" is set, the adjustment takes place immediately. If bit 1 = "1" is set, control of the left side, should this be required, will not occur, until the right side has been raised to the normal level.

The same applies to the second axle if axle by axle kneeling is carried out.

Bit 2: Level control with applied brake
ECAS does not normally execute control while the brakes are applied since the level change caused by the braking obviously does not have to be readjusted:

The shift in axle loads during braking causes only a brief lowering of the vehicle and the old level is restored on its own accord the next moment. However, if air was fed into the front bellows at the moment the vehicle pitches, it would need to be vented again later.

This is not the case at the bus stop: Even though the vehicle is secured against rolling, level control may still be required due changes in load (passengers getting on or off).

To take this circumstance into account, it is possible to perform a level adjustment while the brake is applied, provided the door is also open. In this case, bit 2 must be set to "1".

If bit 2 = "0“, then no adjustment is made while the brake is applied.

Bit 3: Transverse lock function
The transverse lock function can either be switched on only during side kneeling (Bit 3 = 0) or during side kneeling **and** at a speed of > 0 km/h (bit 3 = 1).

Bit 4: Reference level for normal level 2
The normal levels 1 front/rear are saved in the electronic unit when the system is put into service. Parameters 5 and 6 are used by the electronic unit to calculate the normal levels 2 front/rear. Depending on the setting for optional parameter 2, bit 4, there are two possible entries for parameters 5 and 6:

a) Parameters 5 and 6 are interpreted as a differential to the determined lower front/rear stop levels that were determined and saved to the electronic control unit (if optional parameter 2, bit 4 = 0).

Example for option parameter 2, bit 4 = 0:
Normal level 1 100 counts
lower stop level : 35 counts
Normal level 2 80 counts

The following must be entered for parameters 5 and 6 respectively:
80 - 35 = 45 counts.

b) The parameters 5 and 6 are interpreted as the distance from normal level 1 (if optional parameter 2, bit 4 = 1). In this regard, normal level 2 can be above or below normal level 1:

Hundreds digit = 0 ->
Normal level 2 = Normal level I + parameter 5/6
Hundreds digit = 1 ->
Normal level 2 = Normal level 1I – (Units and tens digit of parameter 5/6)

1. Example for option parameter 2, bit 4 = 1:
Normal level 1 100 counts
Normal level 2 80 counts

The following must be entered for parameters 5 and 6 respectively: 120 counts.

2. Example for option parameter 2, bit 4 = 1:
Normal level 1 100 counts
Normal level 2 115 counts

The following must be entered for parameters 5 and 6 respectively: 15 counts.

To ensure that a level change at normal level 1 or 2 can definitely occur, the parameters 5 and 6 must be selected so that the resulting level differentials between normal level 1 and normal level 2 are greater than 2 x parameter 7 or 8 (tolerance in nominal level front/rear.

Bit 5: Transverse lock function during the standby period
If bit 5 is set to "0", the transverse lock function is deactivated during the standby time after the ignition is switched off.

If Bit 5 = "1", the transverse lock function is activated during standby after the ignition is switched off.

Bit 6: Automatic level adjustments
In the event that a level adjustment is imperative due to a change in load (passengers getting on or off) even though the brake is applied to secure the vehicle against rolling at a bus stop, provision can be made for an adjustment to be executed despite the brake being applied, provided the door is also open at the same time. In this case, bit 6 must be set to "0". A "gentle adjustment“ is made.

If bit 4 = "1", no adjustment takes place while a door is open.

Bit 7: Nominal level during kneeling
If bit 7 is set to "0", the nominal levels for kneeling are adjusted by ECAS according to the settings for parameters 22 and 23.

If this bit is set to "1", the side to be kneeled is lowered down to the buffer.

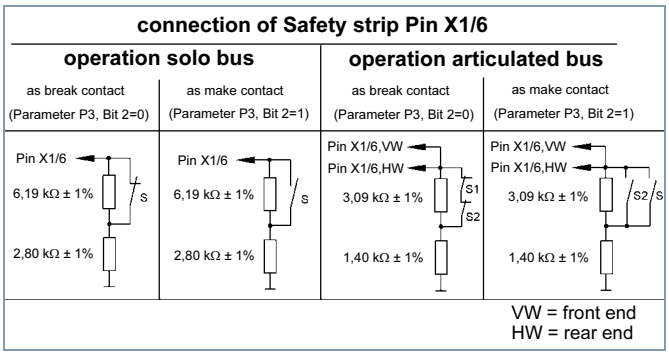
Option parameter 3

Bit 0: Sidewalk detector
If bit 0 = "0", no sidewalk detector is installed to monitor the area below the first step (step edge - kerb) during kneeling.

Bit 0 = "1" means that a sidewalk detector is connected to PIN X1/6.

Bit 1: Fault monitoring of the sidewalk detector
By setting bit 1= "0", fault monitoring of the sidewalk detector is cancelled.

Bit 1 = "1" results in fault monitoring of the sidewalk detector. For this purpose, the sidewalk detector must be connected to resistors.



Bit 2: Sidewalk detector as make or break contact

With bit 2 = "0", ECAS expects a sidewalk detector that acts as a break contact.

Bit 2 = "1" means: The sidewalk detector is a "normally open contact".

Bit 3: door position

The settings of bit 3 are used to take the door position (door open) into account for enabling the kneeling function via the vehicle CAN-BUS or, if the bit is set to "0", the door position is ignored.

Option parameter 4

Bit 0: Measured value output

If bit 0 = "1"is set, the ECU, during normal operation, will transmit continuously measured values derived from sensor values . The measured values are specified in accordance with the chapter "Diagnosis" (1.9).

The ECAS sends the measured value output via the CAN data bus to the FPS. It is then possible to display the measured values on the driver's display or for the Diagnostic Controller to query them via the K-line.

The measured value output should only be used while the parameters are being set - otherwise problems may occur on the data bus.

Bit 1: Valve monitoring

If bit 1 is set to "0", all the connected solenoid valves are monitored for interruption, short circuit to ground and short circuit to $+U_B$.

If bit 1 = "1" is set, the solenoid valves are not monitored and no entry is made into the fault memory should a fault occur.

Bit 2: Emergency operation

Bit 2 = "0" signifies that an emergency function is still possible using an installed Lift / Lower switch when ECAS has stopped operation due to a "severe" fault.

Bit 2 = "1" permits the aforementioned function via a driver-operated switch (must be installed) for Normal level (raising) and Kneeling (lowering).

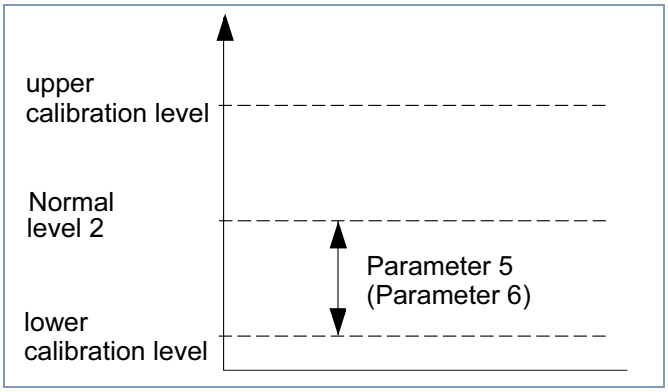
Bit 3: Tyre impression compensation offset

This parameter can be used to define whether the tyre impression compensation is recalculated **during** an ECAS control process.

Bit 4 – 7: Not connected

Parameter 5

Height normal level 2 of the 1-distance sensor axle (counts). The second normal level is entered as a differential (distance) to the lower calibration level.



Parameter 6

Height of normal level 2 of the 2-distance sensor axle (counts). Settings as for parameter 5 for the 2 distance sensors.

Please take options parameter 2 bit 4 into account for P5 and P6!

Parameter 7

Tolerance of the nominal level at the 1-distance sensor axle (counts)
The setting of this parameter determines, together with the proportional and differential coefficients, the control performance of the system at the front axle, see chapter "The control algorithm".

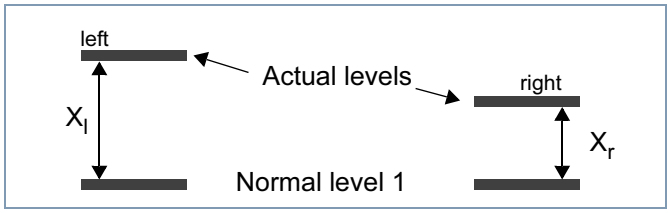
Parameter 8

Tolerance of the nominal level at the 2-distance sensor axle (counts)
Corresponds to parameter 7 for the 2-distance sensor axle.

Parameter 9

Permissible right/left deviation in nominal level (counts)
This parameter acts on the 2 distance sensor axle. It specifies the permissible body tilt, in the event of laterally uneven load distribution for example.

An identical distance to normal level 1 is selected as reference point for uniform raising/lowering right/left, taking into account the permissible deviation (parameter 10).



Parameter 10

Tolerance of the nominal level at the 1-distance sensor axle (counts). The setting of this parameter determines, together with the proportional and differential coefficients, the control performance of the system at the front axle, see chapter "The control algorithm".

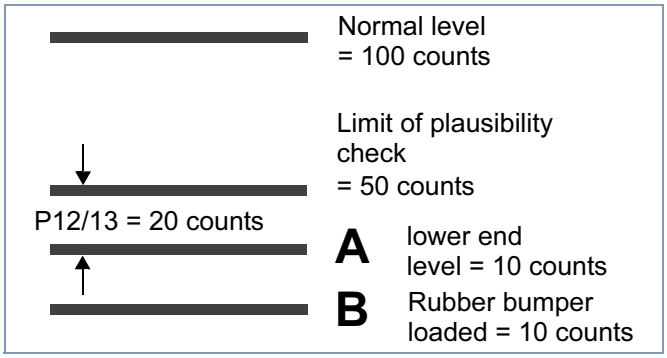
Parameter 11

Tolerance of the nominal level at the 2-distance sensor axle (counts). Corresponds to parameter 10 for the 2-distance sensor axle

Parameter 12

Tolerance at the 1-distance sensor axle (counts). Parameter 12 has a different effect depending what is defined as the lowest permissible level:

- Lower height limit (lowest level) is the rubber buffer
- Parameter 12 is set greater than 100. The value to be entered is determined by the elasticity of the rubber buffer; an empty vehicle does not compress the rubber buffer as much as a laden vehicle. If the vehicle was calibrated when it was laden, the unladen vehicle will not be able to reach this lowest level, even though the bellows have been completely vented, and will signal a corresponding plausibility fault.
- The ECU identifies the "rubber buffer“ and terminates the exhaust process as soon as the level drops below the set level (lower end level + P.12 - 100) **and** there is no further height change over the time specified by parameter 14 (buffer recognition time). This prevents complete exhaust of the bellows. The level reached is stored as the new nominal level.



Recommended setting: If the vehicle was calibrated unladen, a value between 110 and 125 should be parameterised so that no plausibility fault is detected even when the vehicle is tilted and only makes contact with the buffer on one side. If the vehicle was calibrated when laden, a value between 120 and 135 is sensible.

- The lowest level is above the rubber buffer
- If the lower height limit is above the rubber buffer, this is communicated by means of a value less than 100 for parameter 12. In this case, the bus can only be lowered down to the calibrated lower level.
- In the event that the body still makes contact with the buffer above this level due to an uneven road surface, the following applies: The exhaust process is terminated as soon as the level drops below the set level (calibration level + parameter 12) **and** there is no further height change during the time specified by parameter 21 (buffer recognition time). As plausibility problems are generally only possible when the vehicle is severely tilted, we recommend a setting between 5 and 20, depending on the distance between the calibration level and the buffer.

Especially in buses with right-side kneeling it must be taken into account that the axle stabiliser may prevent adequate lowering. When kneeling level = buffer stop is parameterised without contact being made with the buffer, the ECU detects a plausibility fault.

The distance sensor of the 2-distance sensor axle - a sensor that is not directly attached at the wheel - will also fail to output the lowest level during side kneeling even though the buffer stop has been reached. While axle and body are in parallel when the bus is calibrated on the buffer, they are at an angle during kneeling. If the distance sensor is fitted nearer the middle of the axle, the sensor value during kneeling lies somewhere between the normal level and the lowest level.

Here the only remedy is an increased plausibility limit or the selection of a higher kneeling level that can be read out by the measured value output.

Parameter 13

Tolerance at the 2-distance sensor axle (counts)
Corresponds to parameter 12 for the 2-distance sensor axle.

Parameter 14

The electronics is unable to directly detect all the possible errors. Therefore, a plausibility check is used to monitor the vehicle's behaviour.

If the adjusting procedure to be performed is not started or continued within a period that can be set with parameter 14, implausible behaviour is detected. The system reacts as follows:

a) Engine running -> the current adjustment is continued and the level lamps are activated in accordance with the actual level.

b) Engine is at a standstill and at least one brake reservoir pressure is less than 9.5 bar -> the current adjustment is cancelled and the nominal level is retained. The level lamps are activated according to the actual level.

If both brake reservoir pressures are larger than 9.5 bar once more or the engine starts up again, the adjustment is continued.

The system detects whether the engine is running or not via the vehicle's CAN-BUS (engine speed) and also uses it to detect the brake reservoir pressures (circuit 1 and circuit 2).

Parameter 15

Delay of the plausibility fault recognition (in 10 sec)
If ECAS is to carry out a level adjustment immediately after the engine is started, a plausibility fault may occur due to insufficient supply pressure. This can be delayed via parameter 15 until the compressor has conveyed sufficient air for correct function.

Before this delay period has expired, the right-hand kneeling is terminated by simultaneous adjustment of the left and right side. This hardly ever occurs in practice, however it can be noticeable during a test with the kneeling function (frequent switching on and off of the ignition) due to rolling movements.

Parameter 16

Standby period after ignition is switched off (min)
A situation could arise where the engine is switched off (having reached its destination) before all passengers have got off the bus. As the ECAS only works when the ignition is switched on, the level will rise as there is no corrective control.

Parameter 16 can be used to set a standby period within which ECAS responds to an increase in level and vents the bellows. Adjustments other than venting are not carried out despite parameter 16 being set.

A transverse throttle function in standby mode is only available if bit 5 = "1" is set in option parameter 2.

Parameter 17

Road speed up to which the raising/lowering commands are accepted (km/h).
This parameter can be used to set the road speed up to which specific level changes can be initiated by the driver.

The maximum speed up to which the driver can change the ride height is the speed specified in parameter 18. The maximum speed up to which kneeling can be requested is fixed at 5 km/h.

Parameter 18

Automatic normal level (km/h)
For safety reasons, it may be required driving at higher speeds is only possible at the normal levels. Parameter 18 can be used to set a speed limit above which the level is automatically adjusted to the preselected normal level.

The value for parameter 18 must be greater than the value of parameter 17 and greater than 0 km/h!

Parameter 19

Control delay when stationary (in 250 ms)
A sensible value for control delay when stationary is generally considered to be one second (4 counts). This control delay allows for a stabilising phase after each adjustment, providing time for the final level position to be reached before another (corrective) adjustment is initiated.

Parameter 20

During dynamic level changes, i.e. at v > 0 km/h, the height is only corrected if the distance sensor signals differ continuously from the nominal level including tolerances (parameters 7, 8, 9) for a period defined in parameter 20 (control delay when driving, e.g. 60 sec). Each distance sensor is dealt with separately. If the level of a distance sensor is permanently outside the tolerance window after the valve has been switched off, a corrective adjustment is made at the corresponding distance sensor. Further level corrections do not take place until the period preselected with parameter 20 has expired. By selecting an appropriate value for parameter 20, the air consumption is kept to a minimum and an adjustment due to dynamic body movements is avoided as far as possible.

Parameter 21

Buffer recognition time (in 250 ms).
The buffer recognition time should be < 30 sec (< 120 counts) in order to prevent plausibility faults, see parameter 14.

Parameter 22

Kneeling level 1-distance sensor axle (counts)
This parameter is used to define the level for the 1-distance sensor axle up to which the vehicle lowers during automatic kneeling.

During manual kneeling, the driver must keep the pushbutton pressed until at least this level (more precisely: Kneeling level + 2 x nominal level tolerance) has been reached, otherwise the lowering process is cancelled. Provided this is set via parameter 24, the vehicle may even need to be lifted again after such an event.
A corresponding indication can appear in the driver's display.

Parameter 23

Kneeling level 2-distance sensor axle (counts)
Corresponds to parameter 22 for the 2-distance sensor axle.

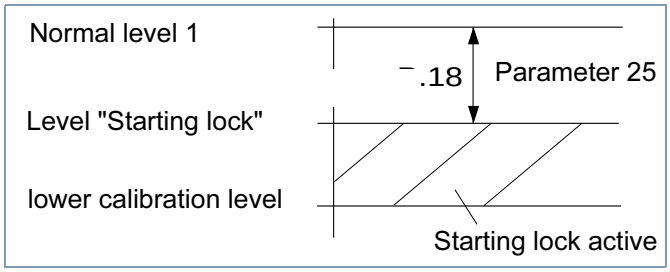
Parameter 24

Reversing after kneeling has been cancelled (counts)
If the pushbutton is released during manual kneeling before the kneeling level is reached, the lowering movement is immediately cancelled, followed by an upwards movement through the height specified by parameter 24. A reverse process beyond normal level 1 is only carried out up to normal level 1.

Parameter 25

Level for switching on the starting lock (counts)
After the vehicle has been lowered by means of kneeling, the starting lock is activated via the CAN-BUS once the level drops below normal level. The starting lock is disabled again after kneeling has been completed and the level specified by parameter 25 is exceeded.

This level is set as a differential to normal level 1 (calibration level) (> 2x tolerance):



Description of functions for parameters 26 – 31
Tyre impression compensation (only for bit 7 = 1 of optional parameter 1)

The electronic control unit can only adjust the level between the vehicle body and the vehicle axle on the basis of height information obtained from the distance sensors. As the number of passenger increases, the total weight of the vehicle also increases and with it the tyre impression. This may reduce the ground clearance of the vehicle too much. On the other hand, it may also cause the legally permitted maximum vehicle height to be exceeded when the vehicle is empty and the tyres are only slightly impressed. The entrance level - important for buses - varies relative to the load status.

In order to compensate varying tyre impressions, it is possible to correct the required nominal level by a pressure-dependent level adjustment relative to the bellows pressure, thereby maintaining a constant distance between road and body. For this purpose, a **pressure sensor is connected to a bellows via a separate air connection** (preferably on a kneeling side so that a constant entrance height is guaranteed even if the load differs).

Six parameters are available for the tyre impression compensation:

Parameter 26

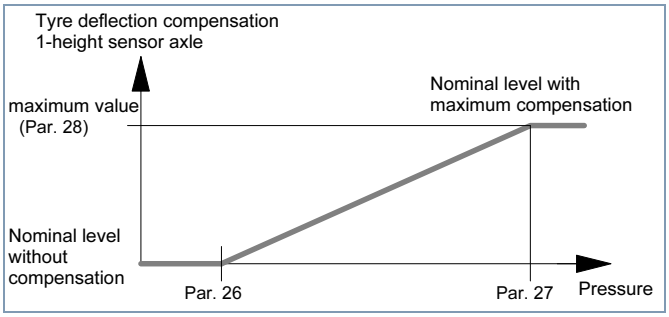
"Pressure at which, when exceeded, the tyre impression compensation at the 1 height sensor axle becomes effective“. This value usually corresponds to the bellows pressure at the 1-distance sensor axle when the vehicle is unladen.

Parameter 27

"Pressure at which the tyre impression is compensated with the maximum value on the 1-distance sensor axle". This value usually corresponds to the bellows pressure at the 1-distance sensor axle when the vehicle fully loaded.

Parameter 28

Maximum value for compensating the tyre impression on the 1-distance sensor axle". This value generally corresponds to the differential laden vehicle / unladen vehicle tyre impression at the 1-distance sensor axle . Between these extreme values, the tyre impression compensation changes linearly with the load:



Parameters 29 - 31 also apply (as described above) for the 2-distance sensor axle.
Further properties of the tyre impression compensation:

- It is performed at every level.
- During an adjustment, the tyre impression compensation is constantly updated, even when the brakes are applied.
- The pressure sensor value is filtered to a large extent.
- The tyre impression compensation is only updated at v = 0 km/h. This value is retained for the remainder of the drive.
- The upper height limits are not exceeded by the tyre deflection compensation.

Parameters 32 – 36

Limitation of the raising/lowering speed while the door is open.
If parameters 32 to 36 are selected accordingly, the raising and lowering speed with the door open can be limited. Level corrections, required as passengers get

on/off the bus for example, can therefore be carried out much more smoothly, almost unnoticed by passengers.

Within a parameterisable tolerance range around the nominal level (parameter 32), the raising and lowering speed of the body is limited to an equally parameterisable maximum value (parameter 33). In order to adequately take into account the system's dead time, the valves are controlled by pulses for a period that can be set in the parameters, as soon as the current level enters the tolerance range or a level correction starts within the tolerance range. The result is a "soft" start of the control process. Pulse pause and period time of the PWM signal can be by parameters 34 and 35. Parameter 36 determines the max period of the pulsing valve activation.

Parameter 37

During detected cornering, automatic level correction is discontinued or is not started. This prevents undesired adjustment of dynamically occurring rolling angles during cornering.

Parameter 37 can be used to specify lateral acceleration, above which automatic level correction is not carried out. The lateral acceleration is computed from the speed of the front wheels that is transmitted by the EBS.

If parameter 37 = 0, this function is switched off, i.e. the level is adjusted to nominal level regardless of the lateral acceleration.

Parameters 38 – 46

Parameters 38 - 46 have no function and are set to zero.

Remark:
Where parameters do not have any meaning, e.g. in vehicles without air suspension on the front axle, the value 0 should be entered for more clarity, provided this is permitted. From parameter 38 upwards, the value zero must be entered for each of the parameters because otherwise the diagnostic unit may calculate an incorrect parameter checksum.

8.5 Examples of parameters for the ECU CAN II 400 070 042 0

8.5.1 Option parameters

Enter the total of the decimal numbers

No.	Meaning	Decimal
1	Bit 0 **1** must be entered	1
	Bit 1 **0** vehicle with lifting/trailing axle **1** vehicle without lifting/trailing axle	0 2
	Bit 2…7 without significance	
2	Bit 0 **0** Air suspension only on rear axle(s) [1)] **1** Air suspension on front and rear axle(s) [1)]	0 1
	Bit 1 **0** two distance sensors on rear axle(s) [1)] **1** one distance sensor on rear axle(s) [1)]	0 2
	Bit 2 **0** distance sensor rear left [1)] **1** distance sensor rear right (nur only permissible when parameter 3 bit 0 = 0) [1)]	0 4
	Bit 3 **0** one distance sensor on front axle[1)] **1** two distance sensor on front axle [1)]	0 8
	Bit 4 **0** must be entered	0
	Bit 5 **0** piston type sensor without temperature compensation [1) 2)] **1** angle of rotation sensor[1) 2)]	0 32
	Bit 6…7 **0** must be entered	0
3	Bit 0…3 **0** must be entered	0
	Bit 4 Selection of ECU address **0** always electronic unit at the front **1** bin pin coding	0 16
	Bit 5 Pressure sensors on driving axle (only when parameter 2, bit 1 = 0 and (parameter 1, bit 1 = 1 or parameter 5, bit 4 = 1)) **0** two pressure sensors on driving axle **1** one pressure sensor on driving axle	0 32
	Bit 6 position of the pressure sensor on driving axle (only when parameter 3, bit 5 = 1) **0** pressure sensor on left side **1** pressure sensor on right side	0 64
	Bit 7 without significance	
4	Bit 0 pressure sensor 4×2 vehicle **0** without pressure sensor **1** with pressure sensor	0 1
	Bit 1 **0** without pressure sensor on front axle **1** with pressure sensor on front axle	0 2
	Bit 2…7 without significance	

1) After this bit is changed, the distance sensors must be recalibrated.

2) After these parameters are changed, the relation of vehicle height to distance sensor value must be newly determined.

No.	Meaning	Decimal
5	Bit 0 Vehicle with lifting/trailing axle (only when parameter 1, bit 1 = 0) **0** with lifting axle (only when parameter 5, bit 4 = 1) **1** with trailing axle	 0 1
	Bit 1 Pressure sensors on lifting/trailing axle **0** two pressure sensors/solenoid valves **1** one pressure sensor / solenoid valve	 0 2
	Bit 2…3 **0** must be entered	0
	Bit 4 **0** pressure equality control in accordance with parameter 6, bit 1 **1** Pressure equality control	0 16
	Bit 5 without significance	
	Bit 6…7 **0** must be entered	0
6	Bit 0 automatic lowering of lifting axle in the case of overload on the driving axle **0** activated **1** not activated	 0 1
	Bit 1 axle load distribution (only when parameter 5, bit 4 = 0) **0** traction control **1** pressure ratio control	 0 2
	Bit 2…7 without significance	
7	Bit 0 traction help type **0** type "EU '99" (parameter 42.4 must be set to 255) or type "Germany" **1** manual traction help	 0 1
	Bit 1 manual traction help **0** Nordic **1** infinitely variable load transfer	 0 2
	Bit 2 **0** must be entered	0
	Bit 3 immediate adjustment to permissible traction help bellows pressure **0** without immediate adjustment **1** with immediate adjustment	 0 8
	Bit 4 **0** must be entered	0
	Bit 5…7 without significance	

No.	Meaning	Decimal
8	Bit 0 lower vehicle on front axle **0** down to calibrated low level **1** down onto rubber buffer	 0 1
	Bit 1 lower vehicle on rear axle **0** down to calibrated low level **1** down onto rubber buffer	 0 2
	Bit 2 activation standby mode **0** only through request Stop (ASC2_...) or request Normal level (ASC2_...) **1** automatically by ignition being switched off	 0 4
	Bit 3 send SAE-CAN identifier during standby mode **0** activated **1** not activated	 0 8
	Bit 4 **0** must be entered	0
	Bit 5 Additional level function **0** normal level 3 **1** exhausted bellows	 0 32
	Bit 6 without significance	
	Bit 7 **0** smooth level controller not activated **1** smooth level controller activated	0 128
9	Bit 0 Reference level for normal level 2 **0** normal level 1 **1** calibrated low level	 0 1
	Bit 1 Reference level for normal level 3 **0** normal level 1 **1** calibrated low level	 0 2
	Bit 2 Activation normal level 3 **0** through ASC2_... **1** through speed	 0 4
	Bit 3 Implausible behaviour of the vehicle level controller **0** maintain nominal levels **1** new nominal levels = measured actual levels	 0 8
	Bit 4 Automatic activation of the normal level after ignition is switched on **0** not activated **1** activated	 0 16
	Bit 5 Tyre impression compensation **0** not activated **1** activated	 0 32
	Bit 6 Residual pressure maintenance when bellows are exhausted **0** not activated **1** activated	 0 64
	Bit 7 **0** must be entered	0
10	Bit 0…1 **0** must be entered	0
	Bit 2 Axle load information upon SAE-CAN identifier Vehicle Weight **0** not activated **1** activated	 0 4
	Bit 3…7 without significance	

No.	Meaning	Decimal
11	Bit 0 Fault detection of the valve outputs **0** without measured value output **1** with measured value output	 0 1
	Bit 1 without significance	
	Bit 2 **0** component check activated **1** component check not activated	0 4
	Bit 3…7 without significance	
12	Bit 0 measured value output in identifiers Measured Values 1, 2, 3 **0** not activated **1** activated	 0 1
	Bit 1…7 without significance	
13 … 16	Bit 0…7 without significance	

8.5.2 Value parameters

No.	Meaning	Unit
Level control		
20.1	Tolerance for nominal level front axle	0.1 mm
20.2	Tolerance for nominal level rear axle	0.1 mm
21.1	Permissible right/left deviation of nominal levels.	0.1 mm
21.2	Permissible right/left deviation outside the nominal levels	0.1 mm
21.3	permissible front/rear deviation outside the nominal levels	0.1 mm
21.4	permissible level increase 7 sec after starting	0.1 mm
21.5	permissible front/rear deviation front axle > rear axle in the case of manual lifting lowering of an axle	0.1 mm
21.6	permissible front/rear deviation front axle < rear axle in the case of manual lifting lowering of an axle	0.1 mm
22.1	Control delay when stationary	250 ms
22.2	Control delay for lifting adjustments when status is "driving"	sec
22.3	Control delay for lowering adjustments when status is "driving"	sec
22.4	Buffer recognition time (should be < parameter 35.1)	250 ms
22.5	Vehicle speed up to which targeted height changes can be made.(must be < parameter 29.1)	km/h
23.1	Road speed up to which "Control delay when stationary" (parameter 22.1) is valid	km/h
Normal levels		
24.1	Level changes for normal level 1 on the front axle dependent on vehicle speed v_2 (offset = –32000)	0.1 mm
24.2	Level changes for normal level 1 on the rear axle dependent on vehicle speed v_2 (offset = –32000)	0.1 mm
25.1	Vehicle speed v_1 at which the level is automatically adjusted to normal level 1 when the vehicle is in normal level 1 ± parameter 24.1/24.2	km/h
25.2	Vehicle speed v_2 at which the level is automatically adjusted to normal level 1 ± parameter 24.1/24.2 when the vehicle is in normal level 1	km/h
25.3	Duration for which the vehicle speed must be the higher value of v_1 or v_2 to adjust the level to normal level 1 + parameter 24.1/24.2 or normal level 1.	sec
26.1	Differential normal level 2 front to (offset = –32000) – normal level 1 (parameter 9.0 = 0) – lower calibrated low level (parameter 9.0 = 1)	0.1 mm
26.2	Differential normal level 2 front to (offset = –32000) – normal level 1 (parameter 9.0 = 0) – lower calibrated low level (parameter 9.0 = 1)	0.1 mm
27.1	Differential normal level 3 front to (offset = –32000) – normal level 1 (parameter 9.1 = 0) – lower calibrated low level (parameter 9.1 = 1)	0.1 mm
27.2	Differential normal level 3 front to (offset = –32000) – normal level 1 (parameter 9.1 = 0) – lower calibrated low level (parameter 9.1 = 1)	0.1 mm
28.1	Vehicle speed at which, when exceeded, the level is automatically adjusted to normal level 3 if the vehicle is in normal level 1 (only when parameter 9.2 = 1)	km/h
28.2	Vehicle speed at which, when the speed drops below this speed, the level is automatically adjusted to the corresponding normal level 1 or 2 (only when parameter 9.2 = 1, parameter 28.2 must be < parameter 28.1)	km/h
29.1	Vehicle speed at which, when the speed drops below this level, the level is automatically adjusted to the corresponding normal level 1, 2 or 3	km/h
upper levels		
30.1	Offset to the upper nominal level increase on the front axle	0.1 mm
30.2	Offset to the upper nominal level increase on the rear axle	0.1 mm
Customer levels		
31.1	without significance	
31.2	Differential of customer level front axle to normal level 1 (offset = –32000)	0.1 mm
31.3	Differential of customer level rear axle to normal level 1 (offset = –32000)	0.1 mm
31.4	Differential of customer level rear axle right to normal level 1 (offset = –32000)	0.1 mm

No.	Meaning	Unit
Standby		
32.1	increased tolerance in standby-mode (front/ rear, only effective if the value is > 0)	0.1 mm
33.1	Control delay in standby-mode	sec
33.2	Standby period after the ignition is switched off (terminal 15) hours (0 ... 254)	hrs.
33.3	Standby period after the ignition is switched off (terminal 15) minutes (0 ... 59)	min
Plausibility:		
34.1	Limit for plausibility test at front when lowering	0.1 mm
34.2	Limit for plausibility test at rear when lowering.	0.1 mm
35.1	Period for plausibility check	sec
35.2	Delay for plausibility test after "ignition on" (terminal 15)	10 sec
Pressure check		
36.1	Residual pressure in the lifting axle / trailing axle bellows and the driving axle bellows	0.1 kPa
36.2	Pressure hysteresis	0.1 kPa
36.3	permissible average overload pressure on the driving axle	0.1 kPa
37.1	Pressure ratio between driving axle and lifting axle / trailing axle, normal axle load (value≤ 255)	0,01
37.2	Pressure ratio between driving axle and lifting axle / trailing axle, increased axle load (value≤ 255)	0,01
38.1	permissible pressure ratio deviation	0.1 kPa
Lifting axle/trailing axle		
39.1	without significance	
39.2	without significance	
40.1	Height increase normal level 1, 2, 3 with lifted lifting axle / relieved trailing axle	0.1 mm
41.1	Vehicle speed up to which manual lifting/trailing axle control is possible (value≤ 255)	km/h
Traction help		
42.1	only in the case of traction help: Portion of the load/pressure limit at which the decision to lift or lower the lifting axle is taken (value ≤ 255)	%
42.2	Driving speed up to which traction help can be switched on (value≤ 255)	km/h
42.3	Driving speed at which traction help is automatically switched off again (value ≤ 255)	km/h
42.4	Duration of traction help (new EU directive: set parameter to 255)	5 sec
42.5	Forced pause after traction help	5 sec
43.1	Level increase with activated traction help	0.1 mm
43.2	temporary level increase while the driving axle pressure is adjusted to the permissible level during traction help	0.1 mm

No.	Meaning	Unit
Pressure changes lifting axle		
44.1	Pressure increase in the driving axle bellows by means of lifting the lifting axle with 0 kPa in the pressure bellows of the lifting axle prior to lifting	0.1 kPa
44.2	Pressure increase in the driving axle bellows by means of lifting the lifting axle with 300 kPa in the pressure bellows of the lifting axle prior to lifting	0.1 kPa
Tyre impression compensation		
45.1	Mean pressure on the driving axle at which tyre impression compensation begins	0.1 kPa
45.2	Mean pressure on the driving axle at which the tyre impression is compensated with the maximum value	0.1 kPa
45.3	Maximum value with which the tyre impression on the driving axle is compensated	0.1 mm
45.4	Mean pressure on the front axle at which tyre impression compensation begins	0.1 kPa
45.5	Mean pressure on the front axle at which the tyre impression is compensated with the maximum value	0.1 kPa
45.6	Maximum value with which the tyre impression on the front axle is compensated	0.1 mm
Critical levels		
46.1	Upper limit of the critical level on the front axle relative to normal level 1(offset = –32000)	0.1 mm
46.2	Lower limit of the critical level on the front axle relative to normal level 1 (offset = –32000)	0.1 mm
46.3	Upper limit of the critical level on the rear axle relative to normal level 1(offset = –32000)	0.1 mm
46.4	Lower limit of the critical level on the rear axle relative to normal level 1 (offset = –32000)	0.1 mm
Supply pressure request		
APR	requested supply pressure when lifting lifting/ trailing axle and during traction help control processes	0.1 kPa

8.5.3 Option parameter bus

Enter the total of the decimal numbers

No.	Meaning	Decimal
1	Bit 0 Control of the side that is not kneeled **0** The side that is not kneeled is not adjusted **1** The side that is not kneeled is adjusted	 0 1
	Bit 1 Door monitoring for kneeling **0** door status is monitored **1** door status is ignored	 0 2
	Bit 2 Door status during manual kneeling **0** only permitted with closed doors **1** also permitted with doors open	 0 4
	Bit 3 additional processes during kneeling **0** not possible **1** possible	 0 8
	Bit 4 Stop when normal level 1 is reached **0** not activated **1** activated	 0 16
	Bit 5 Adjusting back to normal level 1 when the last door is closed during kneeling **0** not activated **1** activated	 0 32
	Bit 6 Automatic level correction during braking **0** no correction during braking action **1** correction only when door is open	 0 64
	Bit 7 Automatic level correction with door open **0** not activated **1** activated	 0 128

No.	Meaning	Decimal
2	Bit 0 CAN requirement with ASC2_... and ASC6_... for an articulated bus **0** identical messages for front and rear section **1** different messages	 0 1
	Bit 1 Transverse throttle active (pressure compensation right / left) **0** always when driving **1** in accordance with bus par. 2.5 and 2.6	 0 2
	Bit 2 manual height changes **0** possible when supply pressure sufficient OR engine running **1** possible when supply pressure sufficient AND engine running	 0 4
	Bit 3 automatic traction help in the event of an active anti-slip control process **0** not activated **1** activated	 0 8
	Bit 4 Suppression of automatic level correction when engine is at standstill **0** not activated **1** activated	 0 16
	Bit 5 Activate transverse throttle when driving prior to automatic level correction **0** not activated **1** activated	 0 32
	Bit 6 Activate transverse throttle when there is little lateral acceleration **0** not activated **1** activated	 0 64
	Bit 7 Suppression of automatic level corrections when there is intense lateral acceleration **0** not activated **1** activated	 0 128
3	Bit 0 Switchable transverse throttle **0** not installed **1** installed	 0 1
	Bit 1 **0** must be entered	0
	Bit 2 Take joint angle between front section and rear section into account for kneeling **0** ignore angle **1** take angle into account	 0 4
	Bit 3 Supply pressure information **0** via SAE-CAN message ECAM **1** via pressure switch	 0 8
	Bit 4 **0** sidewalk detector as make contact **1** sidewalk detector installed as break contact	0 16
	Bit 5 Valve configuration on the front axle **0** with separate lifting / lowering valve **1** without separate lifting / lowering valve	 0 32
	Bit 6 Reception of the SAE-CAN message door control **0** not activated **1** activated	 0 64
	Bit 7 Sidewalk detector **0** not installed **1** installed	 0 128

No.	Meaning	Decimal
4	Bit 0 **0** anti-tilt function not activated **1** anti-tilt function activated	0 1
	Bit 1 anti-tilt function detection **0** Lateral acceleration sensor **1** software algorithm	 0 2
	Bit 2 lowering after detection of anti-tilt function **0** without monitoring right / left deviation **1** with monitoring of right / left deviation	 0 4
	Bit 3…7 without significance	
5	Bit 0 Adjustment to normal level when speed in parameter 22.5 is reached, provided no predefined nominal level is active **0** not activated **1** activated	 0 1
	Bit 1 no control process when ramp is extended **0** not activated **1** activated	 0 2
	Bit 2…7 without significance	

8.5.4 Value parameter bus

No.	Meaning	Unit
Level control		
6	Maximum permissible joint angle between front section and rear section for kneeling	1 °
7	Speed threshold up to which starting lock during kneeling is transmitted	1 km/h
8	Reversing path in the event of kneeling as portion of the distance from kneeling level to normal level 1	1 %
9	Kneeling level limit as portion of the distance from kneeling level to normal level 1	1 %
10 A.1	Value 0 must be entered	
10 A.2	without significance	
10 B.1 … B.3	without significance	
Anti-tilt function		
11.1	Angle at which the anti-tilt function is activated	0,5 °
11.2	Angle at which the anti-tilt function is deactivated	0,5 °
11.3	Buffer recognition time during an active anti-tilt function process	250 ms
11.4	Speed up to which an ant-tilt function process can be started	1 km/h
11.5	Delay time for starting the anti-tilt function	1 sec
12.1	Deviation from nominal level at which the anti-tilt function is activated, level above nominal level	0.1 mm
12.2	Deviation from nominal level at which the anti-tilt function is activated, level below nominal level	0.1 mm
12.3	Right / Left deviation at which the anti-tilt function is terminated	0.1 mm
Acceleration limit for activation of the transverse throttle		
13	Acceleration up to which activation of the transverse throttle is possible	0,01 m/s^2
Customer levels		
14.1	Delay time for starting the automatic traction help	250 ms
14.2	Delay time for terminating the automatic traction help	250 ms

A detailed description of the parameters is not included here because during servicing all parameters are meant to be transferred to ensure that the characteristics are also transferred.

When an ECU is replaced, the parameters are read out and transferred using the Diagnostic Software. You will find the buttons "Read out parameters" and "Transfer parameters" under the "System" menu in the menu item "ECU replacement".

Many parameters have a similar meaning to those of the ECU without CAN and ECU CAN I.

9 Calibration

When commissioning the new system, the sensors need to calibrated after all parameters have been set. The sensors are calibrated using the Diagnostic Software. There are two types of calibration: the calibration of distance sensors and the calibration of pressure sensors.

The calibration process must also be carried out when the electronic unit needs to communicate with a newly installed sensor. This is the case when a sensor or the electronic unit is replaced.

Authorisation (PIN) is generally required for calibration. This may be the PIN that is used to for changing parameters or calibration PIN 2, which is granted after having been accordingly instructed by WABCO sales representatives.

9.1 Distance sensor calibration

The process of calibrating the distance sensor aligns the sensor with the electronic control unit. The vehicle body is here moved to normal level I, to the upper and lower level (stops beyond which movement is not possible when raising and lowering), and the respective level is then saved to the electronic control unit. The distance sensor values are specified in counts or timer ticks.

9.1.1 Preparing the distance sensor calibration

– Place vehicle on a surface which is horizontal and even.

– Use brake wedges to secure the vehicle against rolling and release both the parking brake and the halt brake.

– Ensure that the vehicle has a sufficient supply of compressed air and sufficient voltage supply.

– Make sure that the distance sensor was properly installed and that its lever moves freely over the entire raising/lowering range.

9.1.2 Carrying out the distance sensor calibration

The distance sensors are calibrated using the Diagnostic Software. There various calibration options. These depend on the selected parameter settings:

- Calibrate 3 levels
- Only calibrate normal level
- Direct input of the distance sensor values



Abb. Menu "Calibrate the distance sensors" in the Diagnostic Software

Calibrate 3 levels

The 3 levels must be calibrated, and the body moved to the corresponding level, adhering to the following sequence: Normal level 1, upper level and lower level.

– Select the menu item "Calibrate the distance sensors" in the Diagnostic Software and click "Start calibration".
You are then prompted to enter the PIN.

– Use the "Left" or "Right" buttons to select the respective vehicle page.

– Click "Air-intake" or "Exhaust" and move the vehicle to the normal level 1 specified by the vehicle manufacturer.

– Fix the distance sensor in centre position and adjust the linkage of the distance sensor, if necessary.

– Click "Save normal level".
This saves the actual levels to which the body was moved as normal levels.

– Click "Air-intake" and move the body to the upper stop level.

! Charge the air-suspension bellows only until the upper stop level is reached. Further air-intake results in an excessive pressure increase and may cause damage.

– Press "Save upper level".
This saves the actual levels to which the body was moved as upper stop levels. To protect the stops, the ECU will automatically reduce the value for the upper stop level by 7 counts.

– Click "Exhaust" and move the body to the lower stop level.

– Ensure that the pressure in the air suspension bellows has been completely relieved. Use a pressure gauge for this purpose.

– Press the button "Save lower level".
This saves the actual levels to which the body was moved as lower stop levels.

After the individual calibration phases have been completed, the Diagnostic Software will check the fault memory and display whether calibration was performed correctly.

Only calibrate normal level

This type of calibration is a good idea if the positions of the upper and lower stops are known and it is only necessary to calibrate the distance sensor to the normal level. The values for the upper and the lower level are entered manually into the Diagnostic Software.

– Select the menu item "Calibrate the distance sensors" in the Diagnostic Software.

– Use the "Left" or "Right" buttons to select the respective vehicle page.

– Click "Air-intake" or "Exhaust" and move the vehicle to the normal level 1 specified by the vehicle manufacturer.

– Fix the distance sensor in centre position and adjust the linkage of the distance sensor, if necessary.

– Click the button "Start calibration".
You are then prompted to enter the PIN.

– Enter the count or timer tick values for the upper and lower level in the corresponding fields.

– Click "Save normal level".
This saves the values for the normal level 1 to which the body was moved and the values entered for the upper and the lower level.

Direct input of the distance sensor values

With this type of calibration, all distance sensor values are entered into the Diagnostic Software. To be able to do so, the distance sensor values must be known.

9.1.3 Notes on the distance sensor calibration

For a successful performance of the calibration, the following principles for the distance sensor values DSV must be observed: Because the numerical values may vary from case to case, they only serve as a guideline:

- The entered distance sensor values (DSW) must be greater than 4 counts and less than 250 counts.
4 counts < DSV < 250 counts
- The upper level (UL) must be larger than the total of the normal level (NL) plus 3 counts and 3 times the nominal level tolerance (ΔDSV) set in the parameters. The front/rear assignment of the distance sensor depends on its slot in the control unit.
DSV_{UL} > DSV_{NL} + 3 counts + 3 x ΔDSV
- The lower level (LL) must be less than the normal level (NL) less twice the nominal level tolerance ΔDSV .
DSV_{LL} < DSV_{NL} - 2 x ΔDSV

! Increasing the normal level when the lifting axle is raised and compensating for tyre impression have to be taken into account when calibrating sensors.

If values are entered for these parameters, it may be that calibration will not lead to the desired result. If a vehicle is now calibrated with a raised lifting axle and a bellows pressure just under the lifting axle lowering pressure, and the normal level command is issued at the end of diagnosis, then the normal level increases (offsets) relative to the calibrated normal level are added to the loading condition accordingly and may lead to problems with regard to the overall vehicle height.

9.2 Pressure sensor calibration

The process of pressure-sensor calibration aligns the pressure sensor with the ECU and is necessary for the equalisation with atmospheric pressure. The pressure sensor values are given in counts.

Pressure-sensor calibration is in fact an offset allocation. At ambient pressure, the pressure sensor transmits a certain signal to the control unit which, depending on the type of sensor used, is somewhere around 16 and 20 counts. This value has a pressure of 0 bar assigned to it.

Proper calibration requires that the supporting bellow on which the pressure sensor is located are pressureless.

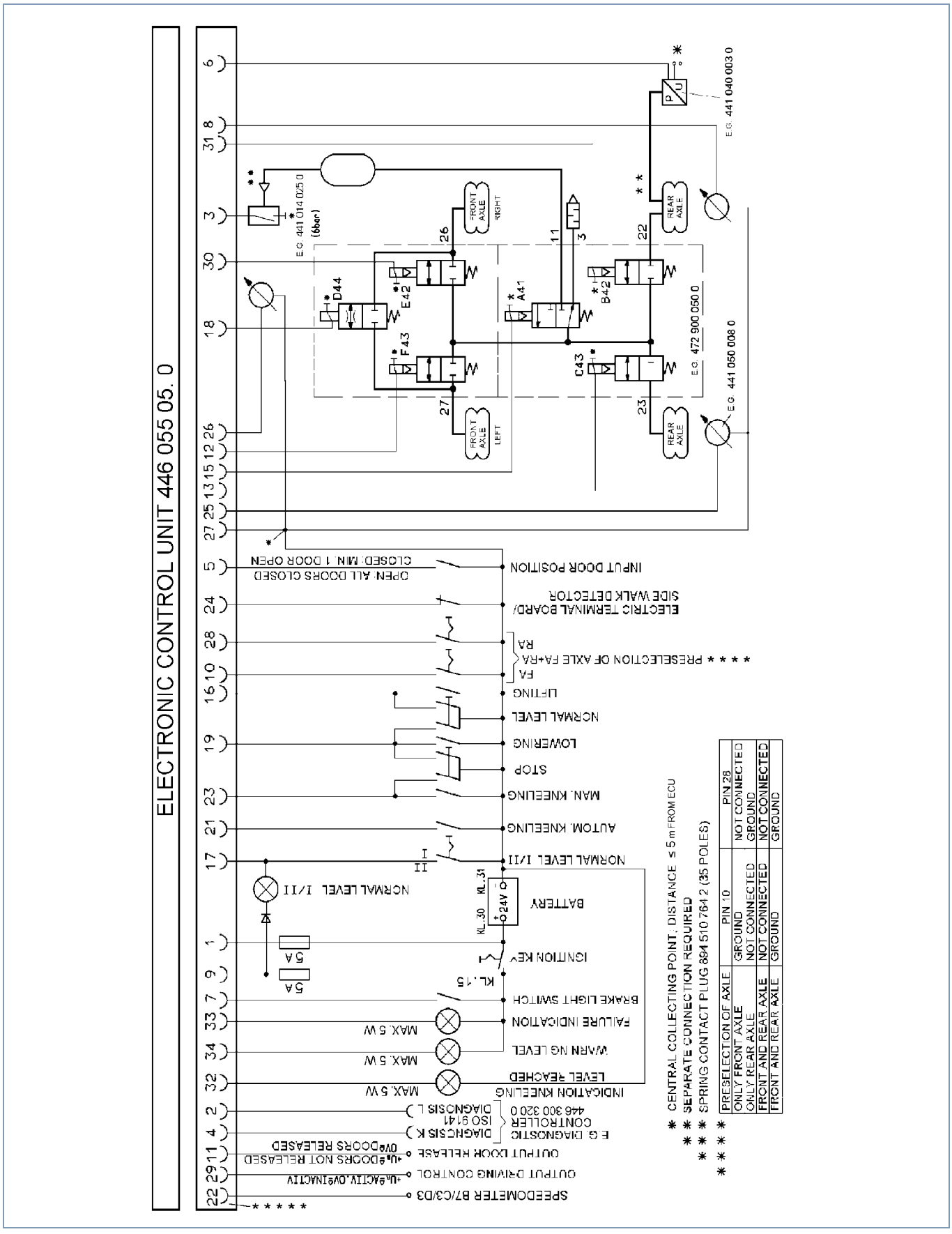
– Connect a pressure gauge to ensure that the air suspension bellows are pressureless or remove the pressure sensor from the air suspension bellows.

The pressure sensor is calibrated via the menu item "Calibrate pressure sensor" in the Diagnostic Software.

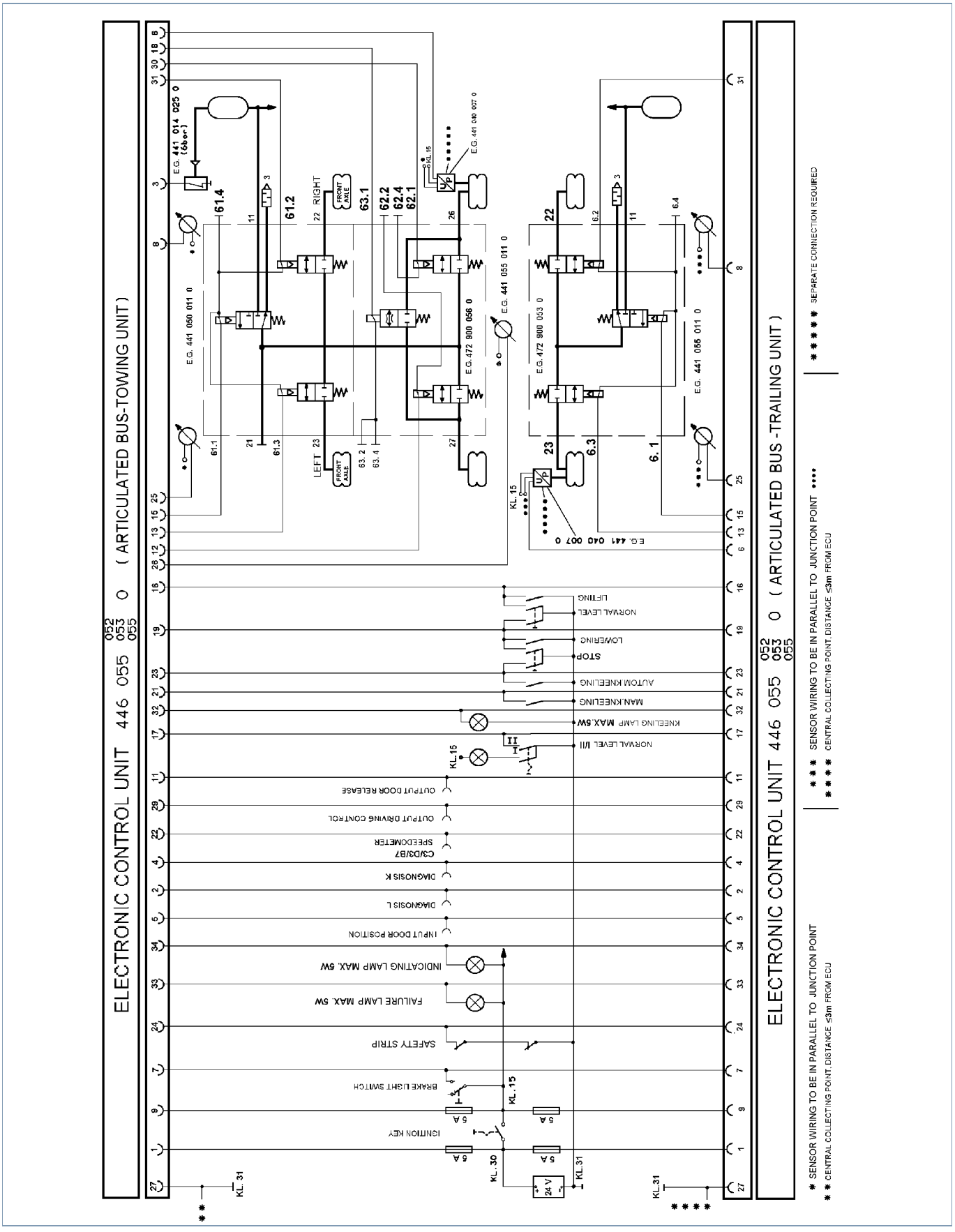


Abb. Menu "Calibrate the pressure sensor" in the Diagnostic Software

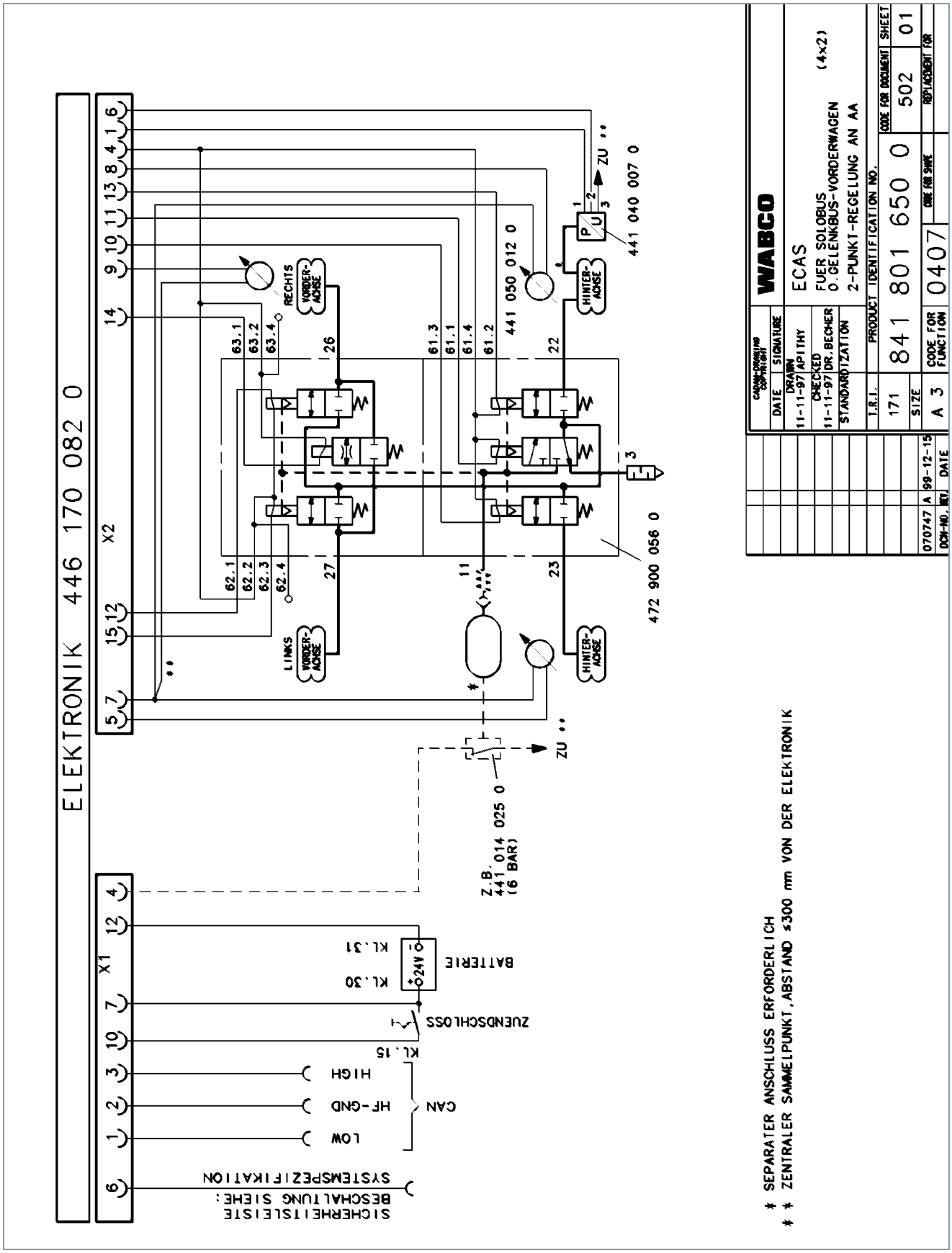
10.1 Circuit diagram solo bus



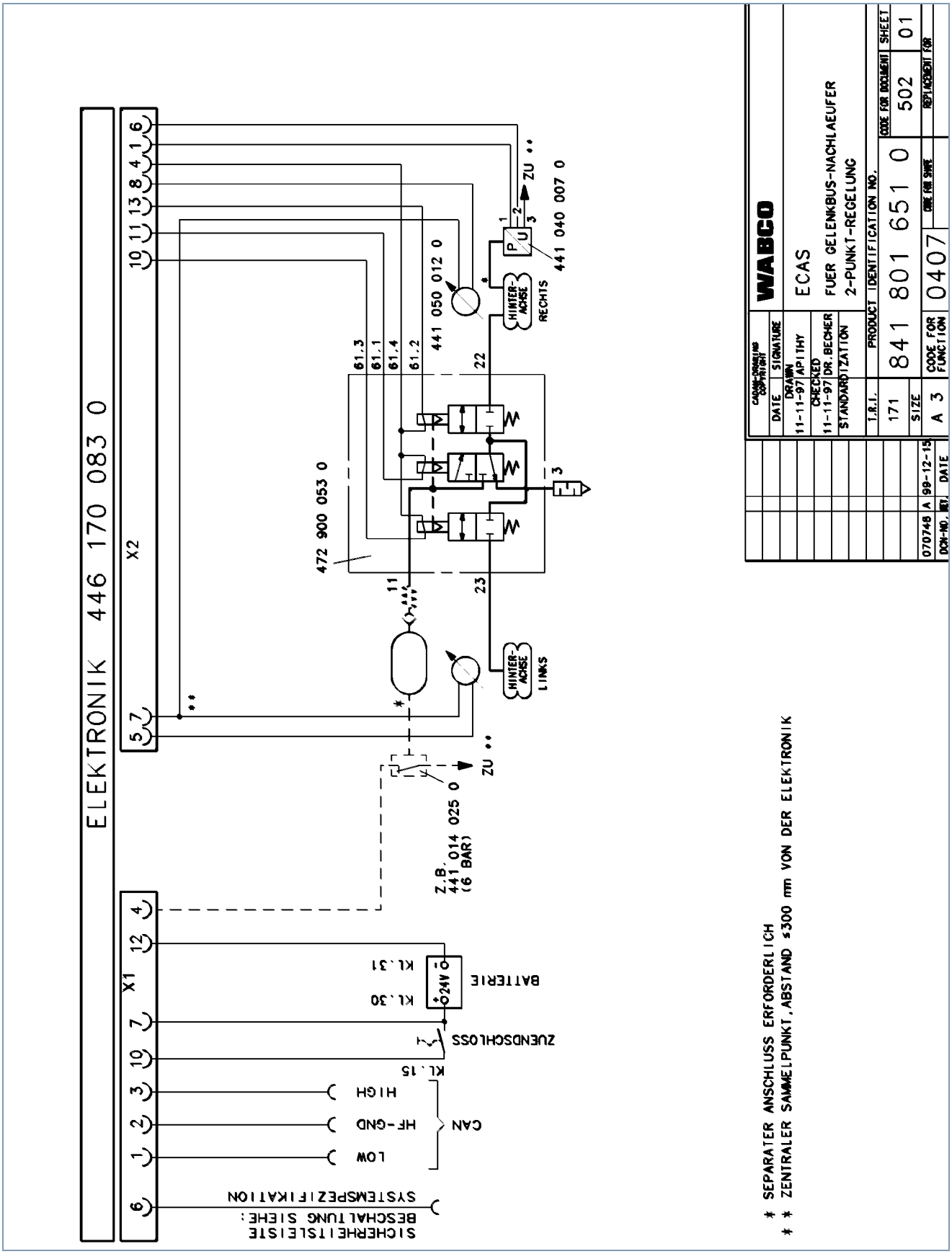
10.2 Circuit diagram articulated bus



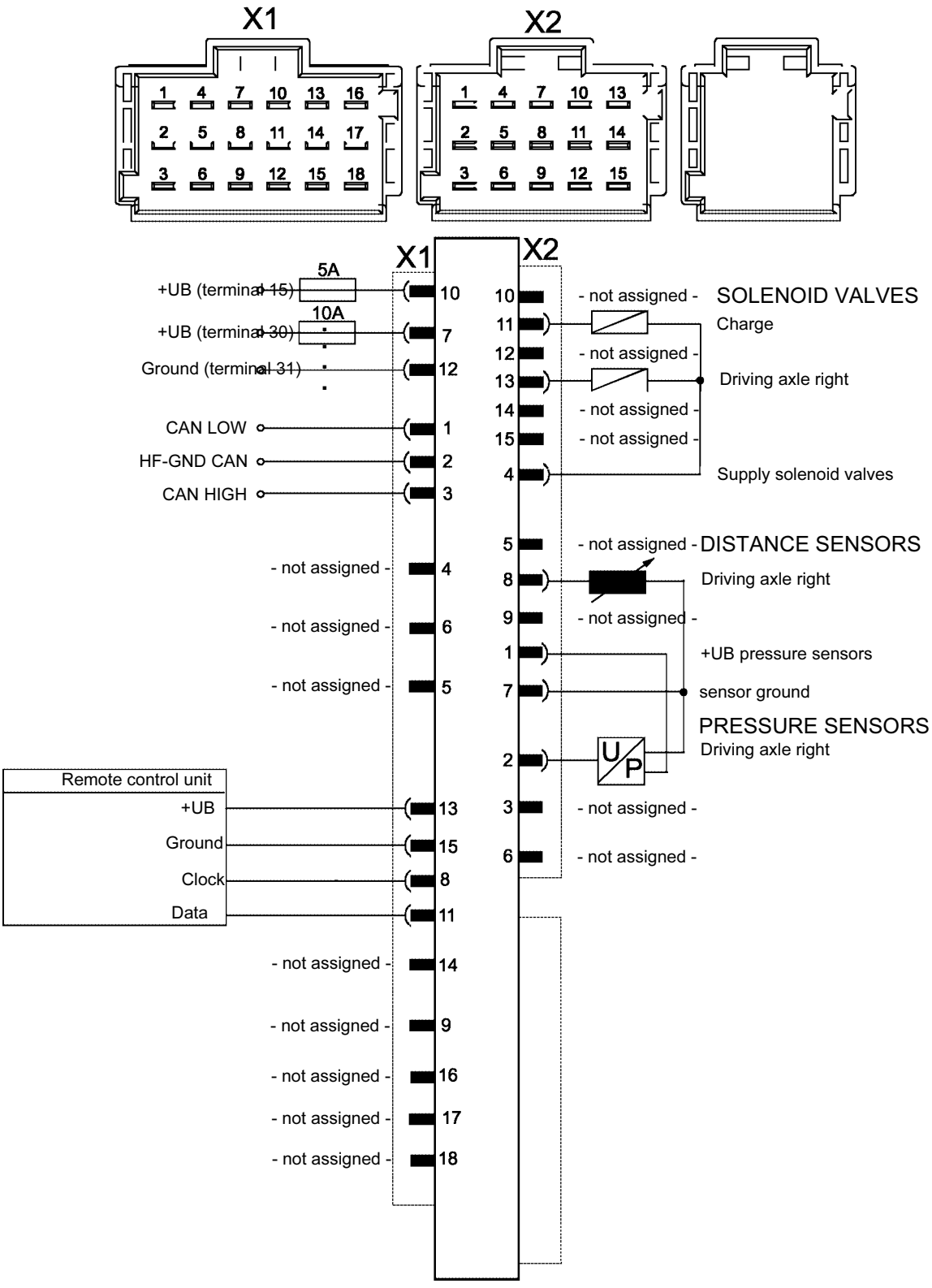
10.3 Circuit diagram solo bus



10.4 Circuit diagram articulated bus



10.5 Pin assignment ECU 446 170 209 0 / 4 × 2 CAN II



ISUZU

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CITIPORT



WORKSHOP MANUAL
FRONT AXLE

REPAIR MANUAL
for ZF Independent Wheel Suspension
RL-75 E/EC/A
RL-82 EC

IMPORTANT INFORMATION:

Due to the great variety of ZF units it is necessary to limit disassembly and reassembly manuals to a current ZF production unit. Continuous technical upgrading of the ZF units and extensions concerning design options may require differing steps, which can be carried out by qualified specialists without greater difficulties by means of the perspective views included in the corresponding spare parts lists.

This disassembly and reassembly manual is based on the design level of a ZF production unit at the time of issue of the manual.

ZF Friedrichshafen AG reserves the right to replace this disassembly and reassembly manual by a successive edition at any time without advance notice. Upon request, ZF Friedrichshafen AG will advise which edition is the latest one.

Any maintenance work is to be done in accordance with ZF's Operating Instructions (ZF Order No.: 5871 197 902) and ZF's List of Lubricants TE-ML 12!

The ZF list of lubricants is being continuously updated and can be obtained or viewed as follows:
- in all ZF plants
- in all ZF service organizations
- Internet http://www.zf.com

ATTENTION:

Observe the vehicle manufacturer's instructions and specifications for the installation and commissioning of the unit!

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PREFACE

This documentation has been developed for specialized staff trained by ZF Friedrichsahafen AG for repair and maintenance work to be made on ZF units.

Due to the continuous technical upgrading of the product, however, the repair of the unit at your disposal may require both deviating work steps and differing setting and testing data.

We would therefore recommend you to entrust masters and servicemen with the work on your ZF product whose practical and theoretical training is constantly updated in our training school.

The Service Stations established by ZF Friedrichshafen all over the world offer you:

1. Permanently trained staff
2. Specified equipment, e.g. special tools
3. State-of-the-art genuine ZF spare parts

All work is done there with utmost care and reliability.

In addition, repair work carried out by ZF Service Stations is covered by the ZF warranty within the terms of the currently applicable contractual conditions.

Any damage resulting from work which is done in an improper and unprofessional manner by third parties and any consequential costs incurred shall be excluded from this contractual liability. This shall also be applicable if other than genuine ZF spare parts are used.

This manual is based on the state-of-the-art at the time of printing.
It was prepared with utmost care in order to avoid errors.
However, we shall not be liable for any possible errors in figures or descriptions.

ZF Friedrichshafen AG

GENERAL

The Service Manual covers all work required for disassembly and the relating reassembly.

When repairing the unit, ensure utmost cleanliness and that the work is done in a professional manner.

Dismantle the unit only if any damaged parts must be replaced. After removing screws or nuts, loosen lids and housing parts which were installed with seals by slight blows with a plastic hammer. Use suitable pulling devices for removing parts being tightly installed on the shafts, such as bearings, bearing rings and similar.

Carry out disassembly and reassembly work on a clean working place. Use special tools which have been developed for this purpose. Prior to reinstallation of the parts, clean contact faces of housings and lids from residues of seals. Remove any burrs or similar irregularities with an oil stone. Clean housings and end covers, in particular corners and angles, with a suitable detergent. Damaged or heavily worn parts must be replaced, with an expert assessing whether parts subject to normal wear during operation, such as bearings, thrust washers etc. will be reinstalled.

Parts such as seal rings, locking plates, split pins etc. must generally be replaced. Radial seal rings with worn or broken sealing lip must also be renewed. In particular, ensure that no chips or other foreign bodies remain in the housing. Check the lube oil holes and grooves regarding unhindered passage.

Oil according to the relating List of Lubricants shall be applied to all bearings prior to their installation:

Only a heating furnace or an electric drier is permitted to be used for heating up parts such as bearings, housings, etc.!
Parts fitted in heated state must be readjusted after cooling down to ensure a perfect contact.

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When assembling the unit, exactly observe the tightening torques and setting data indicated in the manual. Tighten screws and nuts according to the enclosed standard table, unless otherwise specified.

When fitting snap rings and retaining rings, pay attention to an exact contact in the grooves!

The use of fluid sealing agents or Molykote is not permitted for the control part in transmissions – due to a possible malfunction.

Never wash disks having organic friction linings (e.g. paper disks) - adverse effect on lining adhesion.

Only dry cleaning is permitted (leather cloth).



A

Structure of the Service Manual

The structure of this repair manual reflects the sequence of work steps for completely dismantling the removed unit.

Tools required for carrying out the repair work are listed in the current text as well as in chapters “WS” (List of Special Tools) and “WH” (Commercial Tools).

Important information on labor safety

As a basic principle, the workshop carrying out the repair or maintenance of ZF units shall be fully responsible for labor safety.

A suitably trained and skilled staff is required for a proper repair of these ZF products.

The repair workshop shall be responsible for the training.

 ***CAUTION***	This symbol serves as a to special working procedures, methods, information, use of auxiliaries etc... indicated in this repair manual.

 ***DANGER***	This symbol identifies situations in which lacking care may lead to .

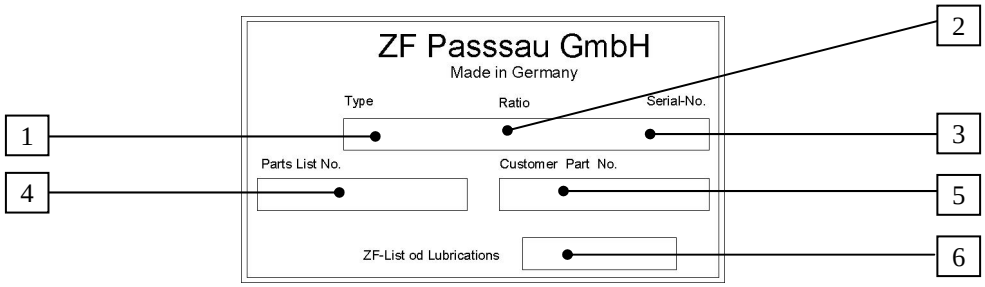
NOTE:	Thoroughly study this manual before starting any tests or repair work.

NOTE:	Figures, drawings and parts in this manual do not always represent the original; they show the working procedure. Since the figures, drawings and parts are not shown to scale, do not draw any conclusions on size and weight (not even within one and the same illustration). Carry out work according to the legend.

NOTE:	After repair work and tests, the expert staff must verify that the product is perfectly functioning again.

A A A

1 = Axle type
2 = Ratio
3 = Unit-No.: (Serial-No.)
4 = ZF-Parts List-No.
5 = Customer part no. (Vehicle - Ident-No.)
6 = ZF- List of lubrications



A A A

1. = Axle type
2. = Serial-No.
3. = ZF-Parts List-No.

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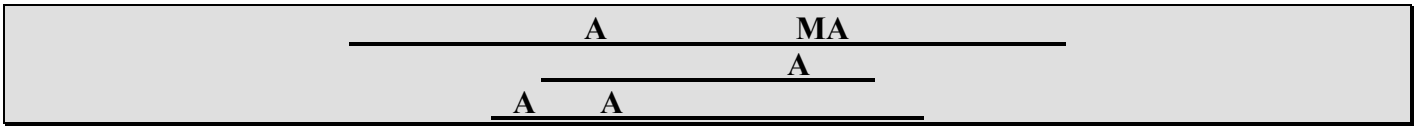
4. = Mark and type of vehicle
5. = Denomination of the spare part
6. = Spare parts-No.
7. = Way of transport



25.40 mm	=	1 in (inch)
1 kg (Kilogramm)	=	2.205 lb (pounds)
9.81 Nm (1 kpm)	=	7.233 lbf x ft (pound force foot)
1.356 Nm (0.138 kpm)	=	1 lbf x ft (pound force foot)
1 kg / cm	=	5.560 lb / in (pound per inch)
1 bar (1.02 kp/cm^2)	=	14.5 psi (pound force per square inch lbf/in^2)
0.070 bar (0.071 kp/cm^2)	=	1 psi (lbf/in^2)
1 Liter	=	0.264 Gallon (Imp.)
4.456 Liter	=	1 Gallon (Imp.)
1 Liter	=	0.220 Gallon (US)
3.785 Liter	=	1 Gallon (US)
1609.344 m	=	1 Mile (land mile)
0° C (Celsius)	=	+ 32° F (Fahrenheit)
0 ° C (Celsius)	=	273.15 Kelvin

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M A M A A

_____	längenbezogene Masse in kg/m;	flächenbezogene Masse in t/m^2
_____	linear density in kg/m;	areal density in t/m^2
_____	Densité linéaire en kg/m;	Densité superficielle en t/m^2

			A		
Masse Density Masse	m	kg (Kilogramm)	kg		
Kraft Force Force	F	N (Newton)	kp	1 kp = 9.81 N	
Arbeit Work Travail	A	J (Joule)	kpm	0.102kpm = 1J = 1Nm	
Leistung Power Puissance	P	KW (Kilowatt)	HP (DIN)	1 HP = 0.7355 KW 1 KW = 1.36 HP	
Drehmoment Torque Couple	T	Nm (Newtonmeter)	kpm	1 kpm = 9.81 Nm	T (Nm) = F (N) · r (m)
Kraftmoment Moment (Force) Moment (Force)	M	Nm (Newtonmeter)	kpm	1 kpm = 9.81 Nm	M (Nm) = F (N) · r (m)
Druck (Über-) Pressure (Over-) Pression (Sur-)	pü	bar	atü	1.02 atü = 1.02 kp/cm^2 = 1 bar = 750 torr	
Drehzahl Speed Nombre de Tours	n	min -1 rpm tr/min			

M

M4	2.8		4.1		4.8
M5	5.5		8.1		9.5
M6	9.5		14		16.5
M7	15		23		28
M8	23		34		40
M10	46		68		79
M12	79		115		135
M14	125		185		215
M16	195		280		330
M18	280		390		460
M20	390		560		650
M22	530		750		880
M24	670		960		1100
M27	1000		1400		1650
M30	1350		1900		2250
M33	1850		2600		3000
M36	2350		3300		3900
M39	3000		4300		5100

M

M 8 x 1	24		36		43
M 9 x 1	36		53		62
M 10 x 1	52		76		89
M 10 x 1.25	49		72		84
M 12 x 1.25	87		125		150
M 12 x 1.5	83		120		145
M 14 x 1.5	135		200		235
M 16 x 1.5	205		300		360
M 18 x 1.5	310		440		520
M 18 x 2	290		420		490
M 20 x 1.5	430		620		720
M 22 x 1.5	580		820		960
M 24 x 1.5	760		1100		1250
M 24 x 2	730		1050		1200
M 27 x 1.5	1100		1600		1850
M 27 x 2	1050		1500		1800
M 30 x 1.5	1550		2200		2550
M 30 x 2	1500		2100		2500
M33 x 1.5	2050		2900		3400
M 33 x 2	2000		2800		3300
M 36 x 1.5	2700		3800		4450
M 36 x 3	2500		3500		4100
M 39 x 1.5	3450		4900		5700
M 39 x 3	3200		4600		5300

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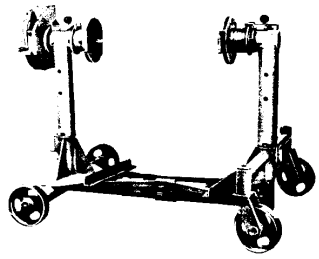
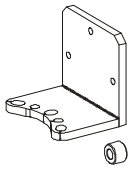
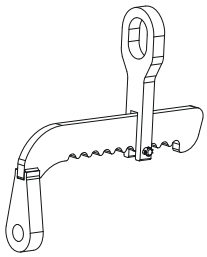
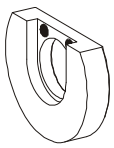
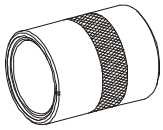
1		**A** with tilting device	1	1/3 2/2 3/1 3/3
2			1	1/3 2/2
3			1	1/3 2/2 3/8 4/10 5/32
4			1	1/5 2/4 2/7
5			1	1/6 1/9 2/5 2/8 6/2 7/2 7/16

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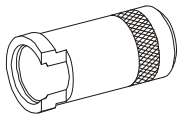
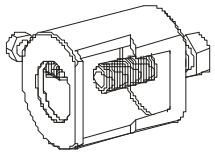
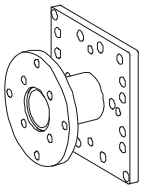
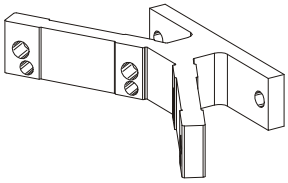
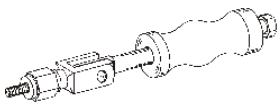
6			1	1/6 1/9 2/5 2/8 6/2 7/2 7/16
7			1	1/8
8			1	3/1 3/3
9			1	3/1 3/3
10			1	3/5 4/19

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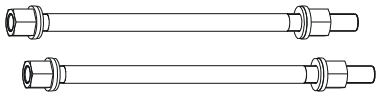
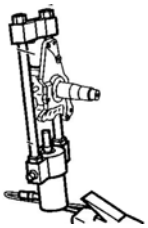
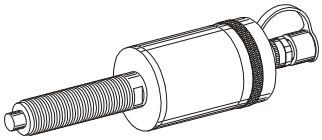
11			1	3/6 3/8 4/20
12			1	3/6 3/8 4/20
13			1	3/6 3/8 4/20
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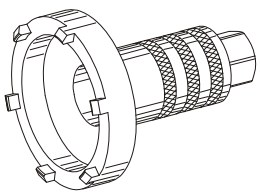
15			1	4/9 5/33

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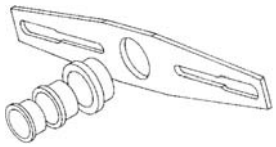
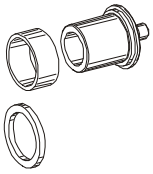
16				4/9 5/33
17			1	5/2
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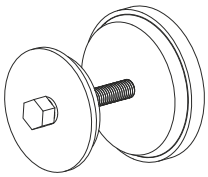
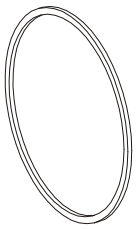
19		**A** **AA**	1	5/5
20		**A**	1	5/6

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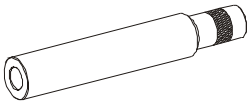
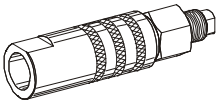
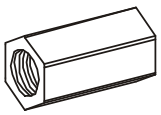
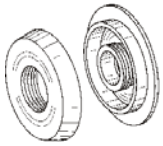
22			1	5/11
23			1	5/17
24		**M**	1	5/17
25			1	5/20

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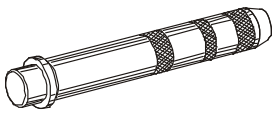
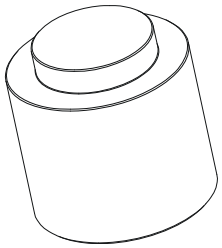
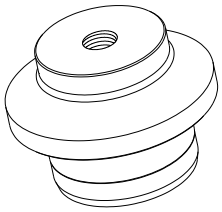
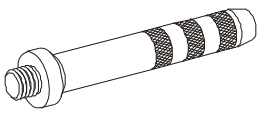
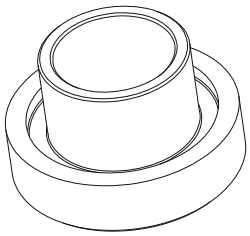
26			1	5/20
27			1	5/22 5/23 5/26 5/27 5/28 5/29 5/30
28			1	5/26
29				5/26
30				5/27

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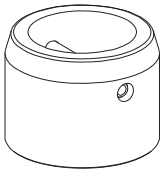
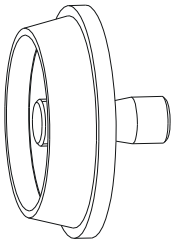
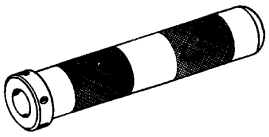
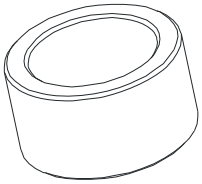
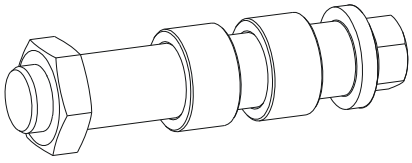
31				5/31
32			1	6/3 7/3 8/3
33			1	6/3 7/3 8/3
34			1	8/4
35		**A**		6/4 7/4 7/16 8/4

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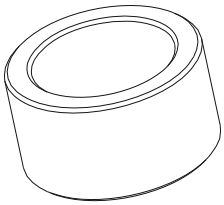
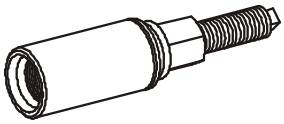
36			1	6/4 7/4 7/16
37		**M**	1	6/12 6/14 7/12 7/14 8/12 8/13
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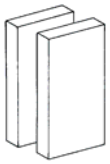
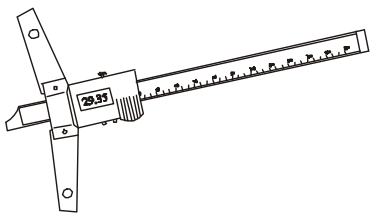
3		70 mm 100 mm	1	Universal
4		200 mm 300 mm	1	Universal
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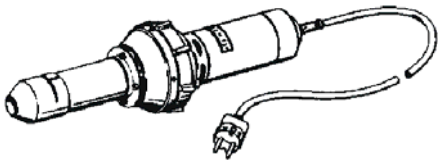
7		230 V 115 V	1	Universal
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10		_____	1	Universal
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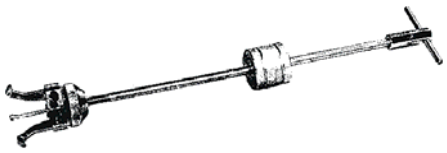
12		_____	1	Universal
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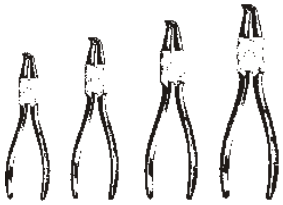
14		_____ I11-I21-I31-I41 90°	1	Universal

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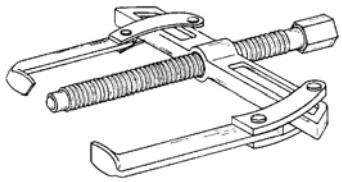
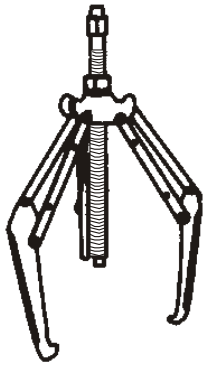
17		Jaw width 80 mm Throat depth 100 mm Jaw width 120 mm Throat depth 125 mm Jaw width 170 mm Throat depth 125 mm Jaw width 200 mm Throat depth 175 mm Jaw width 350 mm Throat depth 250 mm Jaw width 520 mm Throat depth 300 - 500 mm Jaw width 250 mm Throat depth 200 mm Jaw width 380 mm Throat depth 200 mm	1	Universal

MM A A M A A M

18		Jaw width 85 mm Throat depth 65 mm Jaw width 130 mm Throat depth 105 mm Jaw width 230 mm Throat depth 150 mm Jaw width 295 mm Throat depth 235 mm Jaw width 390 mm Throat depth 230 mm Jaw width 640 mm Throat depth 290 mm	1	Universal

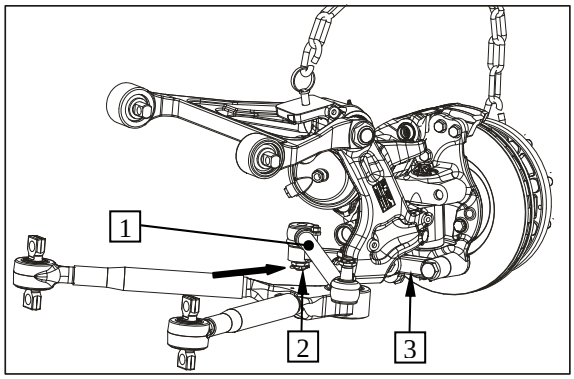


Figure 1

Lift independent wheel suspension RL-75 E by means of lifting device and prepare it for attachment to the assembly truck.

Remove split pin (see arrow) from the tie rod (1), loosen castle nut (2) and separate tie rod from tie rod arm (3).

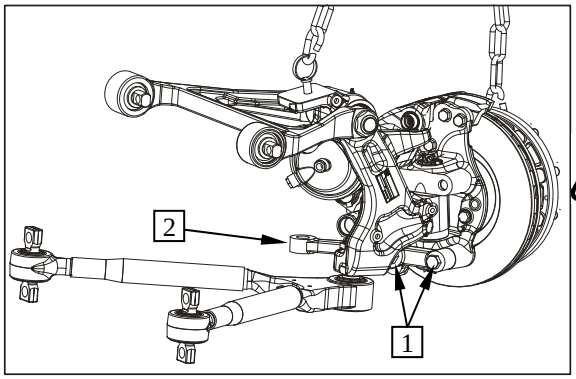


Figure 2

Separate tie rod arm (2) from steering knuckle by loosening the hexagon screws (1).

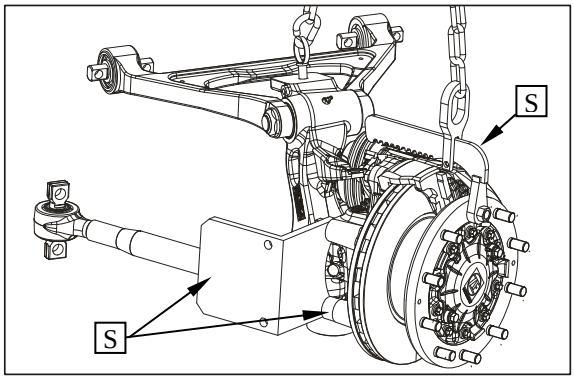


Figure 3

Attach RL-75 E independent wheel suspension to the assembly truck.

(S)	Assembly truck	5870 350 000
(S)	Clamping angle with spacer bush	5870 350 101
(S)	Bracket	5870 281 043

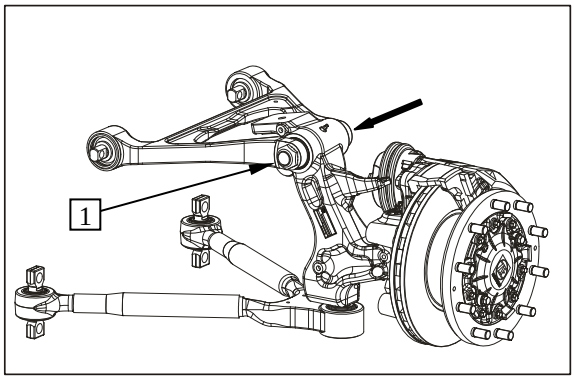


Figure 4

Disassemble upper control arm (Figures 4 to 6).

Loosen hexagon nut (1).

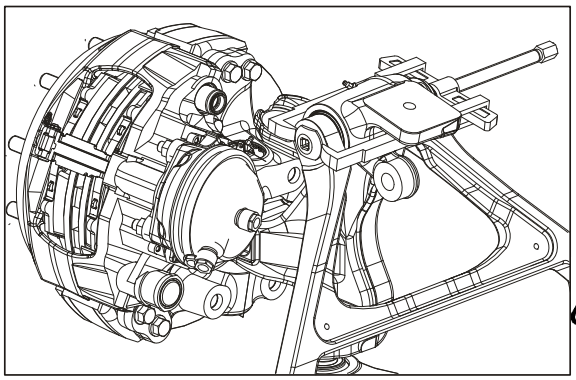


Figure 5

Press out the bolt, using a two-armed puller.

Now remove components of the control arm bearing.

(S) Pressure piece 5870 100 059

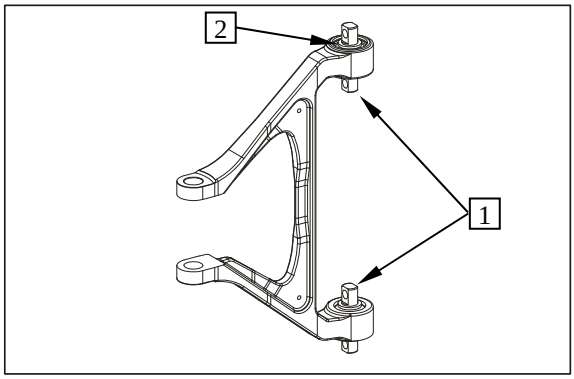


Figure 6

Preload joint assy (1) with a press and remove retaining rings (2). Remove spacer ring.

Use a plastic hammer to force the joint out of the control arm hole.

(S) Pressing bush 5870 506 134
(S) Pressure piece 5870 100 056

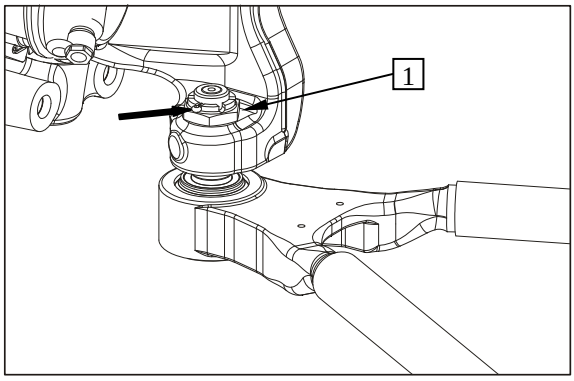


Figure 7

Disassemble lower control arm (Figures 7 to 9).

Remove split pin (see arrow) and loosen hexagon nut (1).

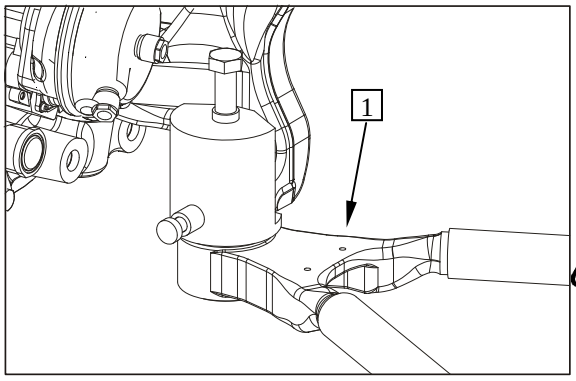


Figure 8

Use forcing device to force control arm (1) out of the steering knuckle carrier hole.

(S) Forcing device 5870 080 052

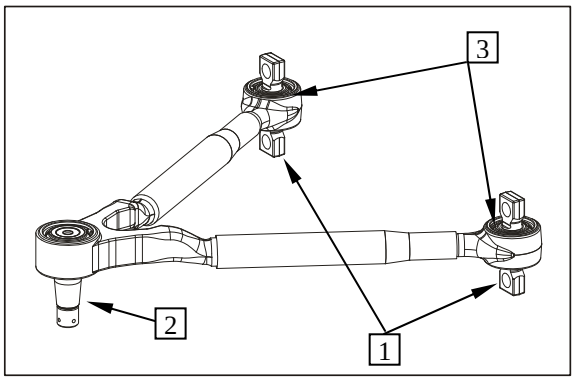


Figure 9

Preload joints (1) and ball stud (2) with a press and remove retaining ring (3).
Remove spacer ring.

Use a plastic hammer to force the joints (1) and ball stud (2) out of the control arm hole.

(S) Pressing bush	5870 506 134
(S) Pressure piece	5870 100 056

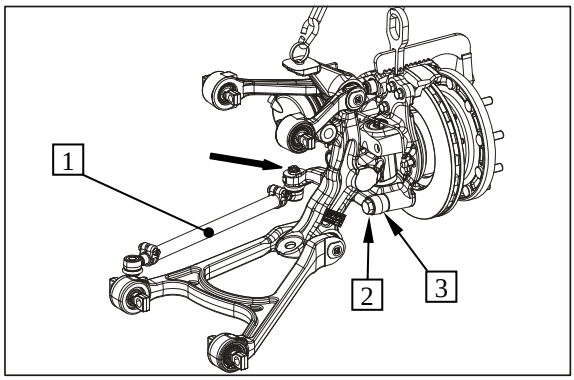


Figure 1

Lift independent wheel suspension RL-75 EC / RL-82 EC by means of lifting device and prepare it for attachment to the assembly truck.

Remove split pin (see arrow) from the tie rod (1), loosen castle nut (2) and separate tie rod from tie rod arm (3).

Separate tie rod arm (3) from steering knuckle by loosening the hexagon screws (2).

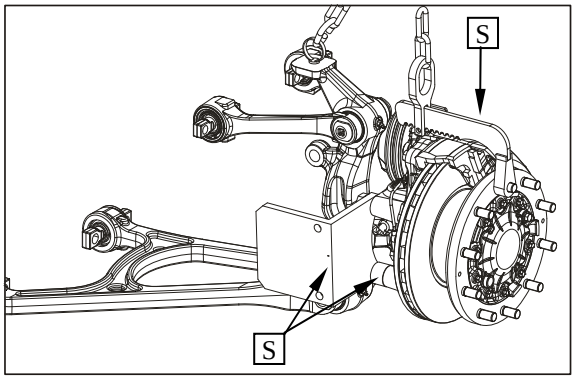


Figure 2

Attach RL-75 EC / RL-82 EC independent wheel suspension to the assembly truck.

(S)	Assembly truck	5870 350 000
(S)	Clamping angle with spacer bush	5870 350 101
(S)	Bracket	5870 281 043

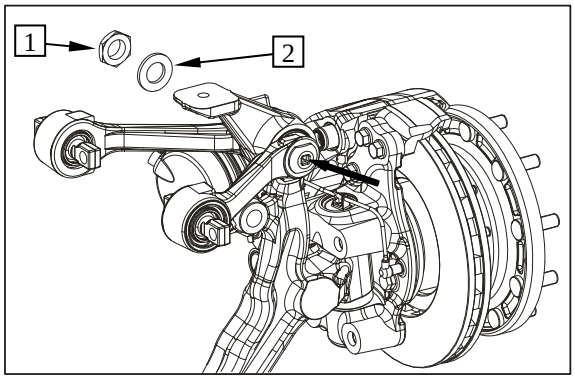


Figure 3

Disassemble upper control arm (Figures 3 to 5).

Loosen hexagon nut (1) and remove shim (2).

Heat up hexagon nut with hot-air blower!

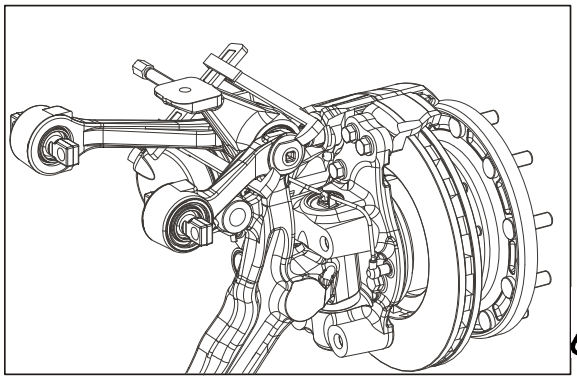


Figure 4

Press out the bolt, using a two-armed puller.

Now remove components of the control arm bearing.

(S)	Pressure piece	5870 100 059

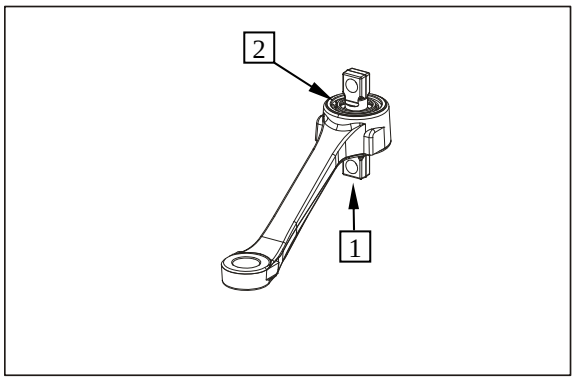


Figure 5

Preload joint assy (1) with a press and remove retaining ring (2).
Remove spacer ring.
Use a plastic hammer to force the joint out of the control arm hole.

(S) Pressing bush	5870 506 134
(S) Pressure piece	5870 100 056

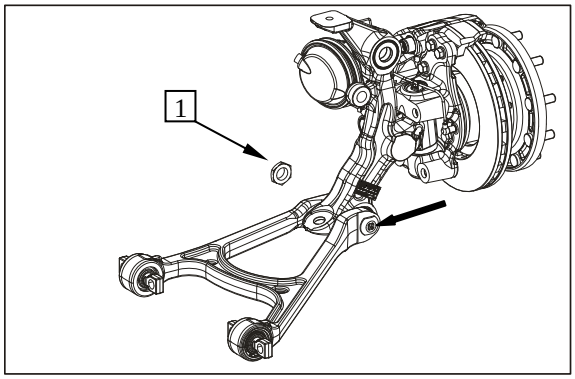


Figure 6

Disassemble lower control arm (Figures 6 to 8).

Loosen hexagon nut (1) and remove shim.

Heat up hexagon nut with hot-air blower!

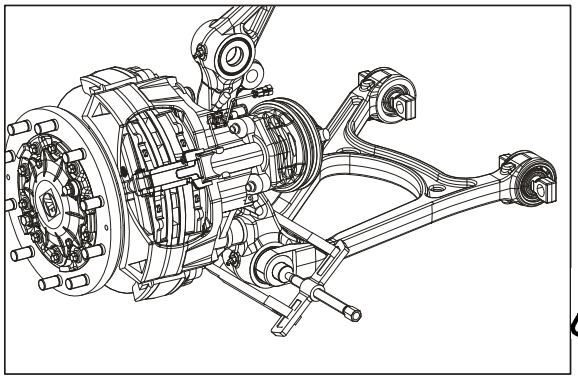


Figure 7

Press out the bolt, using a two-armed puller.

Now remove components of the control arm bearing.

(S)	Two-armed puller	5870 970 007
(S)	Pressure piece	5870 100 059

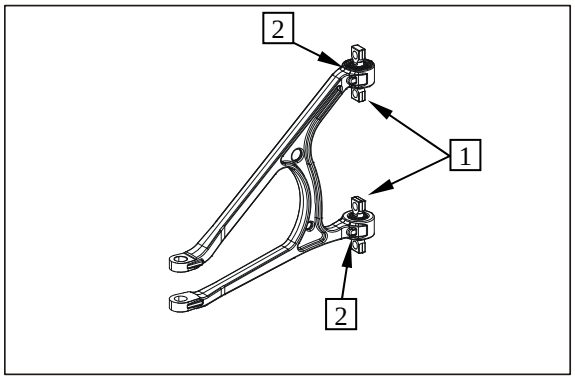


Figure 8

Preload joint assies (1) with a press and remove retaining ring (2).
Remove spacer ring.
Use a plastic hammer to force the joint out of the control arm hole.

(S) Pressing bush	5870 506 134
(S) Pressure piece	5870 100 056

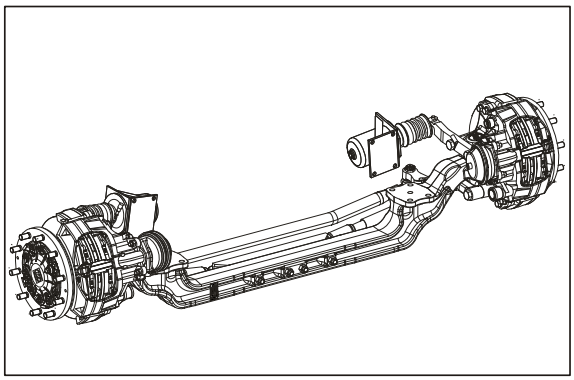


Figure 1

A

A

Attach RL-75 A, ZF front/tag axle to the assembly truck.

(S) Assembly truck	5870 350 000
(S) Fixing plate	5870 350 119
(S) Clamping angle	5870 350 093

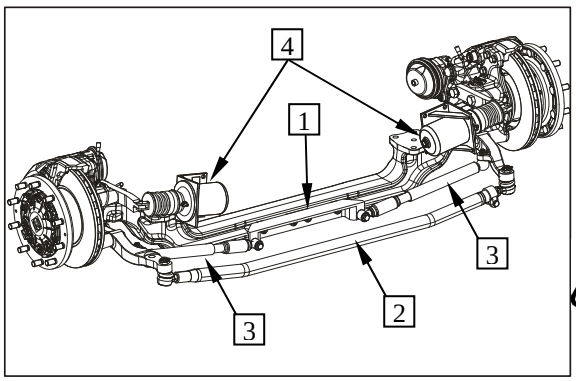


Figure 2

Remove components:

1 = Fixture
2 = Tie rod
3 = Absorber
4 = Cylinder

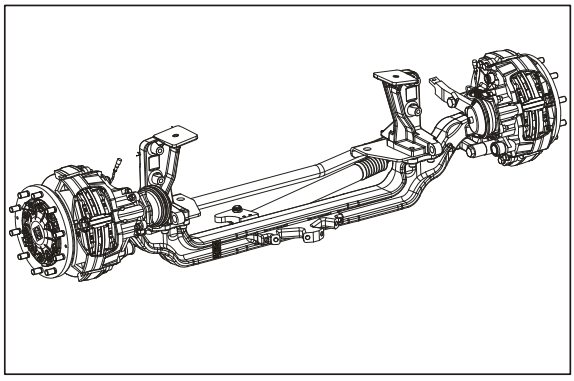


Figure 3

Attach RL-75 A, ZF front/tag axle to the assembly truck.

(S) Assembly truck	5870 350 000
(S) Fixing plate	5870 350 119
(S) Clamping angle	5870 350 093

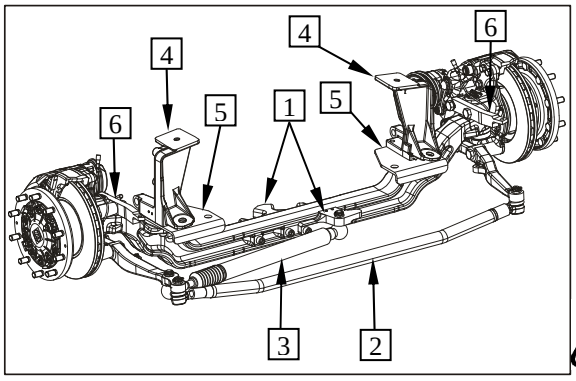


Figure 4

Remove components:

1 = Fixture
2 = Tie rod
3 = Absorber
4 = Spring carrier
5 = Console
6 = Lever

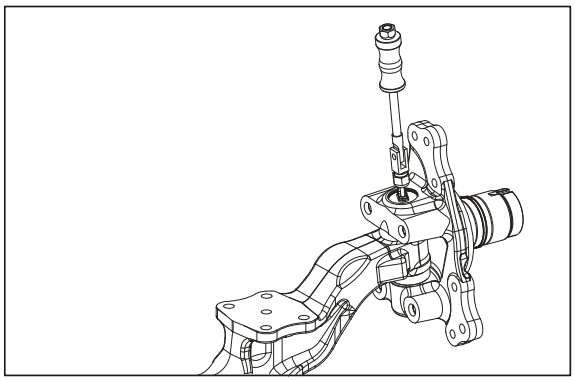


Figure 5

Remove grease nipple and snap out retaining ring.

Use striker to force closing cover out of the steering knuckle hole.

(S) Striker	5870 650 001

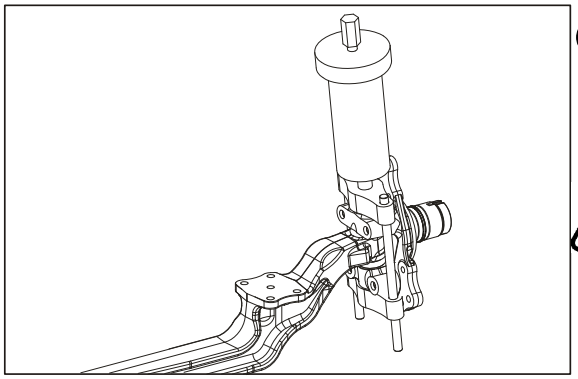


Figure 6

A

Attach forcing device to the steering knuckle. Use a hydraulic cylinder to press out the axle bolt.

(S) Pull rods	5870 285 028
(S) Pressure plates	5870 285 027
(S) Hydraulic spindle	5873 003 007
(S) Hydraulic pump	5870 287 010

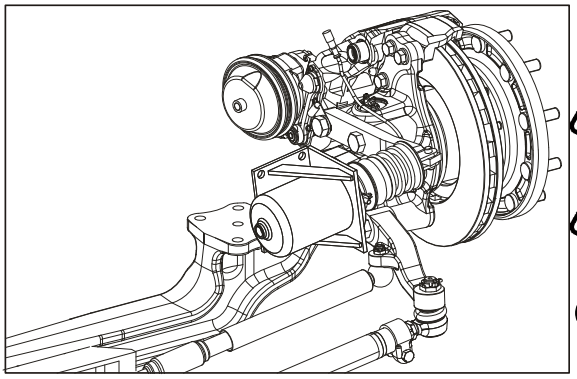


Figure 7

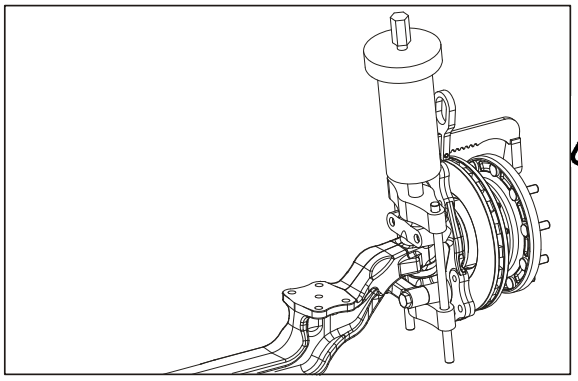


Figure 8

Attach forcing device to the steering knuckle. Use a hydraulic cylinder to press out the axle bolt.

(S) Pull rods	5870 285 028
(S) Pressure plates	5870 285 027
(S) Hydraulic spindle	5873 003 007
(S) Hydraulic pump	5870 287 010
(S) Bracket	5870 281 043

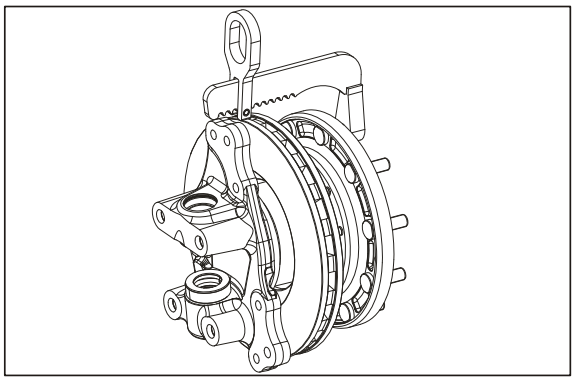


Figure 9

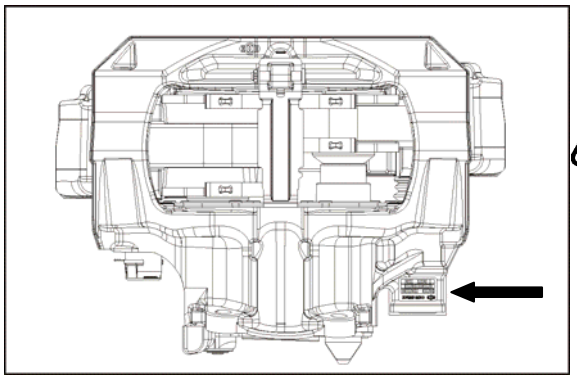


Figure 1

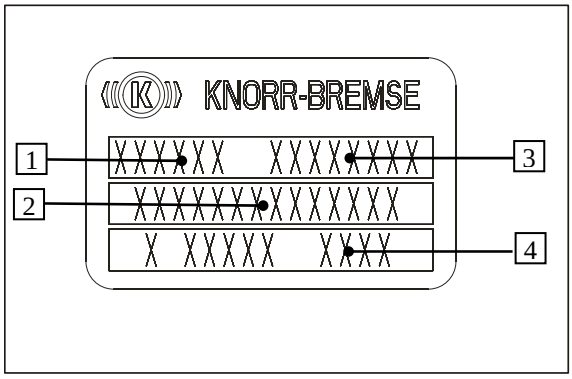


Figure 2

1 = Brake type
2 = ZF Order No.
3 + 4 = Brake manufacturer's indications

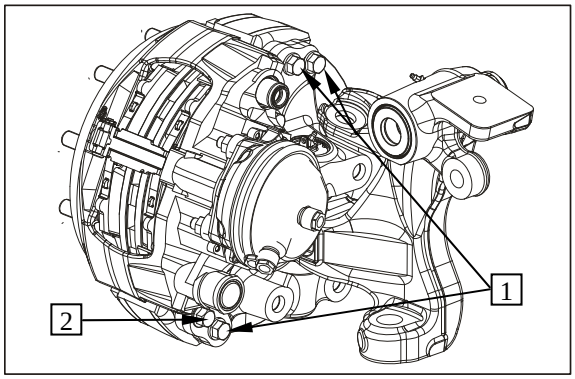


Figure 3

Loosen hexagon screws (1) and tight-fit screw (2) and separate brake caliper from steering knuckle.

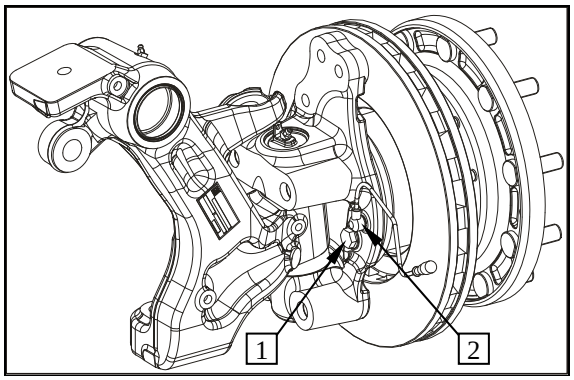


Figure 4

Remove stop screw with hexagon nut (1) and tachometer with clamping bush (2).

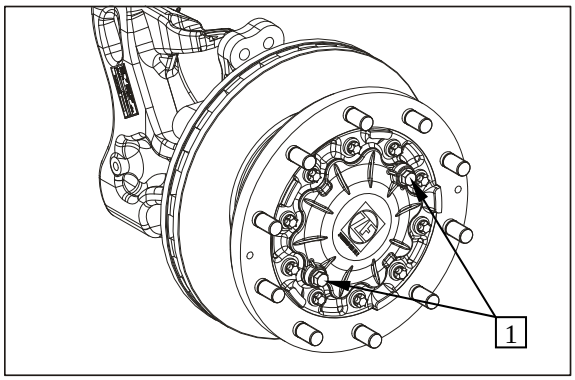


Figure 5

Loosen hexagon screws (1).

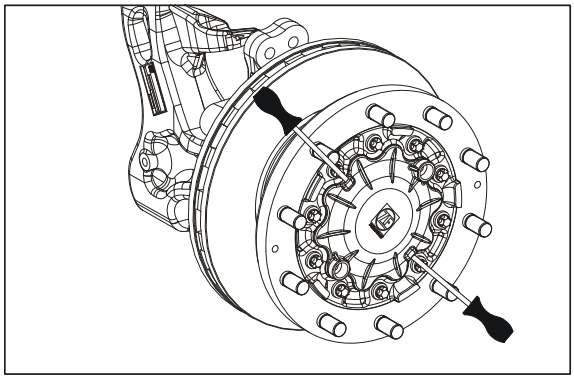


Figure 6

Separate cover from hub.

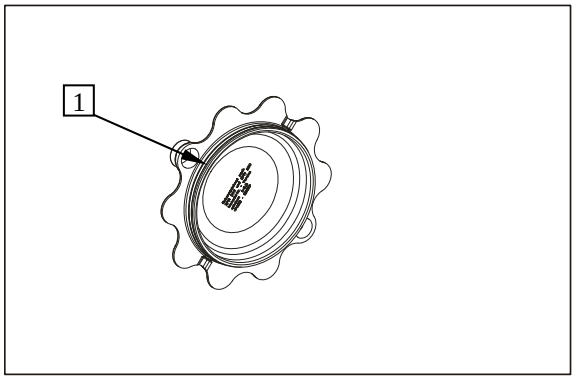


Figure 7

Remove O-ring (1).

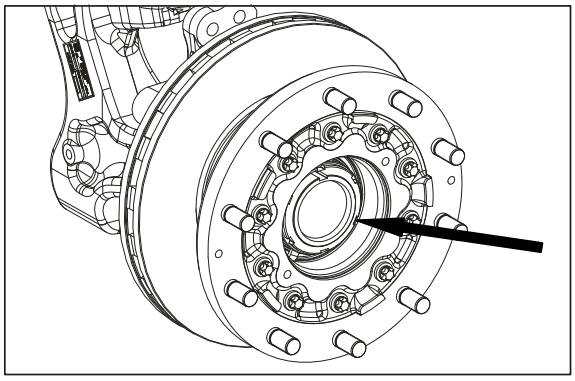


Figure 8

Unlock outer slotted nut (see arrow).

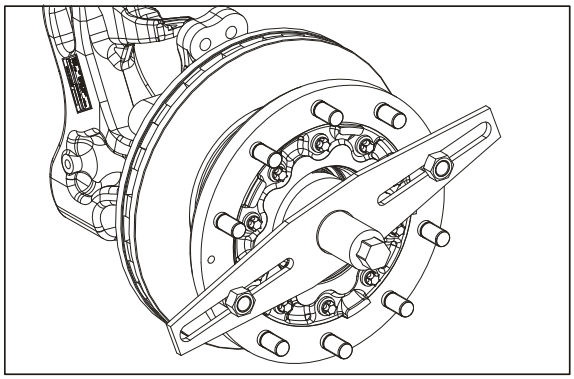


Figure 9

Loosen outer slotted nut, remove locking plate and loosen inner slotted nut.

(S) Slotted nut wrench 5870 401 136
(S) Centering bracket 5870 912 012

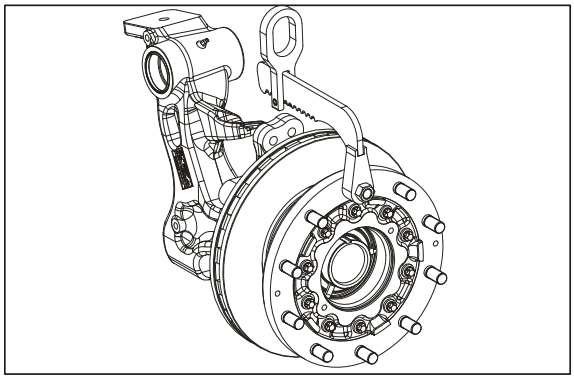


Figure 10

Separate hub/brake disk from steering knuckle.

(S) Lifting bracket 5870 281 043

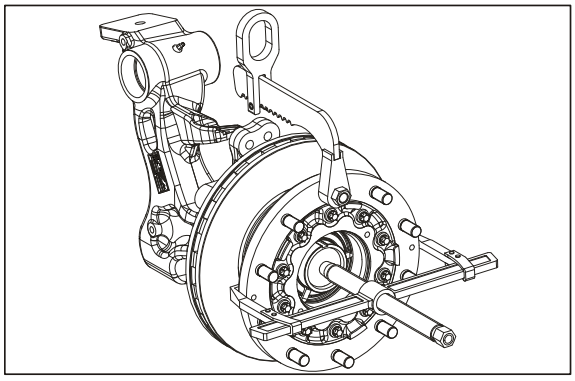


Figure 11

Place a pressure piece into the steering knuckle hole and pull hub/brake disk off the steering knuckle.

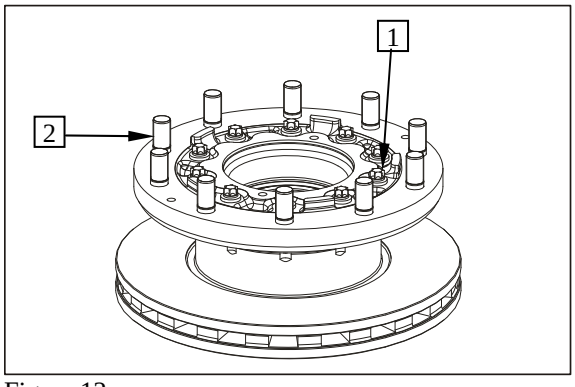


Figure 12

Loosen bolted connection (1) and separate brake disk/hub.

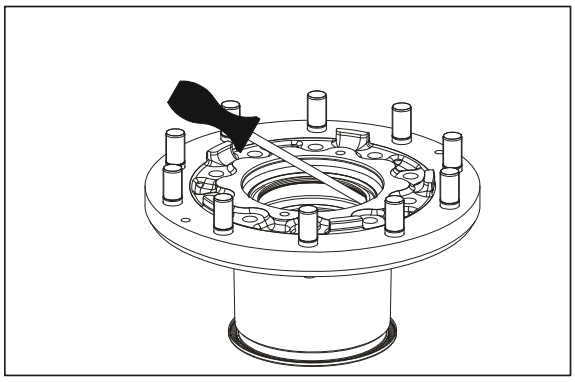


Figure 13

Remove shaft seal on side of wheel stud from the hub hole.

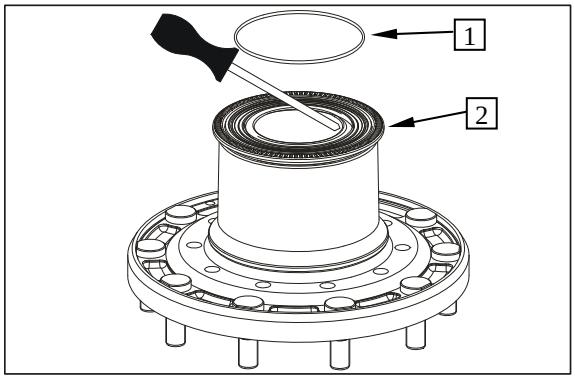


Figure 14

Remove O-ring (1).

Remove cassette-type seal on side of brake disk from the hub hole.

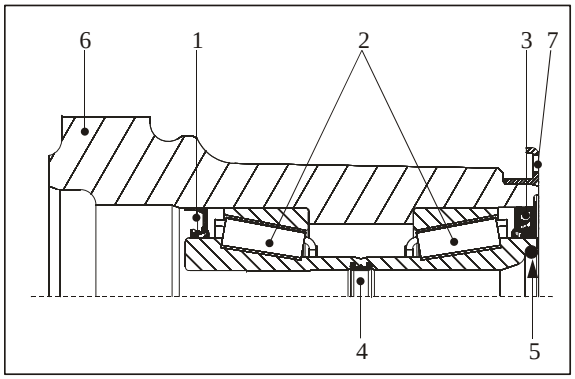


Figure 15

- **M**

Legend to Figure 15:

1 = Shaft seal (on side of wheel stud) *
2 = Bearing inner and outer ring
3 = Cassette-type seal (on side of brake disk)*
4 = Retaining ring
5 = O-ring*
6 = Hub
7 = Impulse disk

Bearing unit

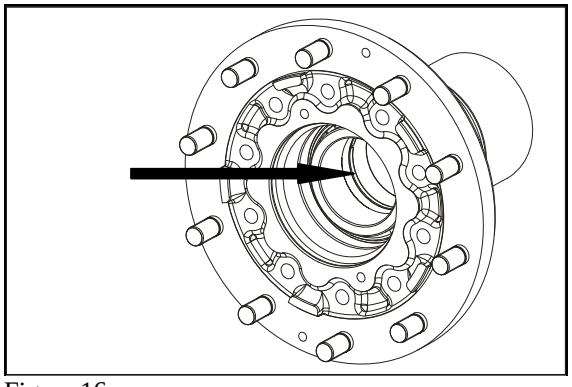


Figure 16

Remove retaining ring (see arrow – legend item 4).

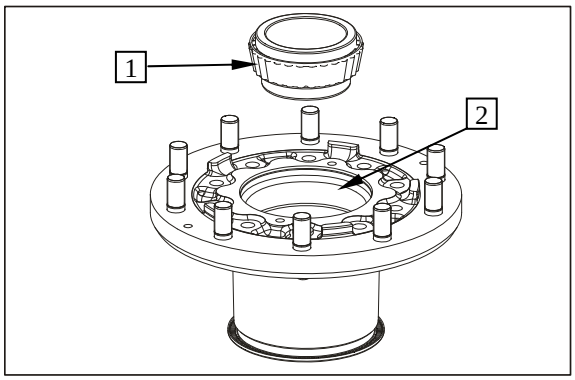


Figure 17

Remove both bearing inner rings (1).

If required, remove both bearing outer rings (2).

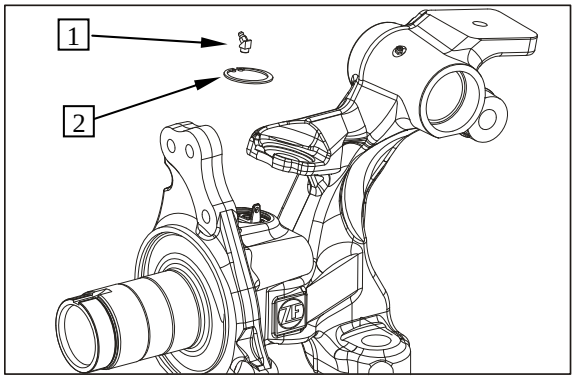


Figure 18

Remove grease nipple (1).

Snap out retaining ring (2).

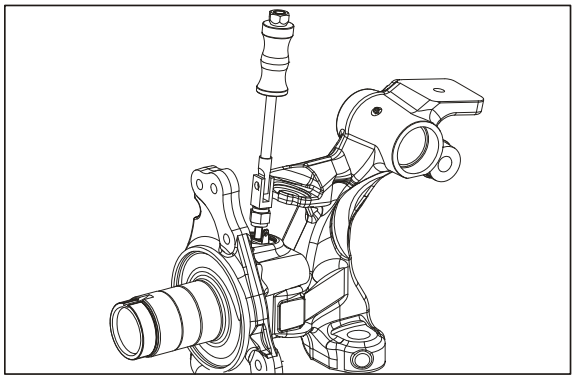


Figure 19

Use a striker to force closing cover out of the steering knuckle hole.

(S) Striker	5870 650 001

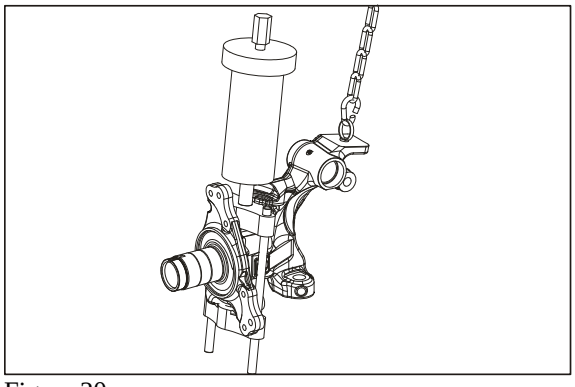


Figure 20

Attach forcing device to the steering knuckle. Use hydraulic cylinder to press out the axle bolt.

(S) Pull rods	5870 285 028
(S) Pressure plates	5870 285 027
(S) Hydraulic spindle	5873 003 007
(S) Hydraulic pump	5870 287 010

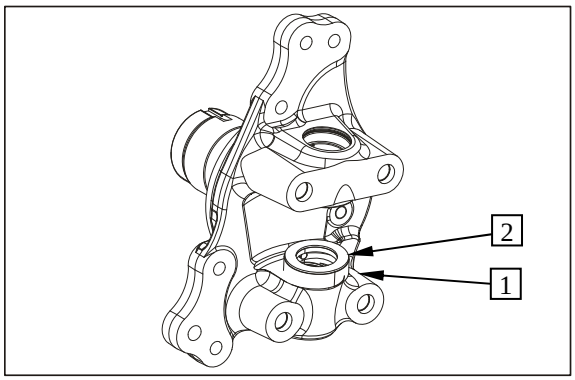


Figure 21

Remove axial roller bearing (1) and shim (2).

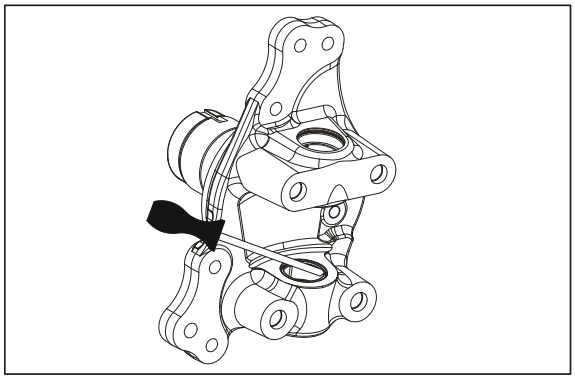


Figure 22

Remove upper and lower sealing rings from the steering knuckle hole (there might be no lower ones, depending on the version).

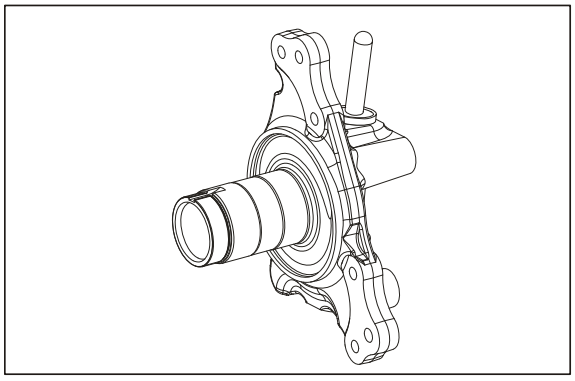


Figure 23

Force upper needle sleeves and lower needle sleeves/sliding bearing bush (depending on the version) out of the steering knuckle.

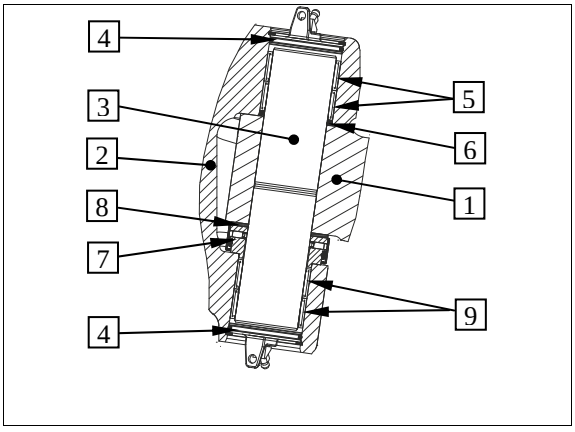


Figure 1

A

The figure shows the assembled axle bolt.

1 = Steering knuckle carrier
2 = Steering knuckle
3 = Axle bolt
4 = Seal holder with grease nipple and retaining ring
5 = Needle sleeves
6 = Seal ring
7 = Axial roller bearing
8 = Shim (adjusting shim for axial play)
9 = Needle sleeves/sliding bearing bush (depending on the version)

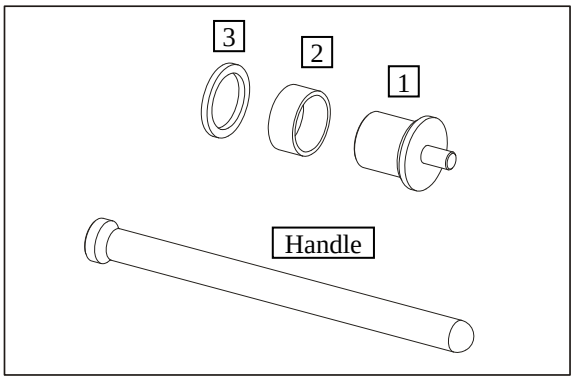


Figure 2

The figure shows the required special tool for assembling the needle sleeve/sliding bearing bush and the seal rings (see figure 4)

(S) Driver tool set (part 1 to 3)	5870 055 107
(S) Handle	5870 260 003

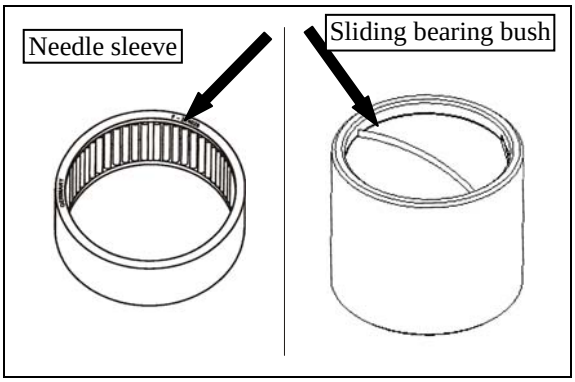


Figure 3

Fit lower and upper needle sleeve/sliding bearing bush to the steering knuckle (see figure 4).

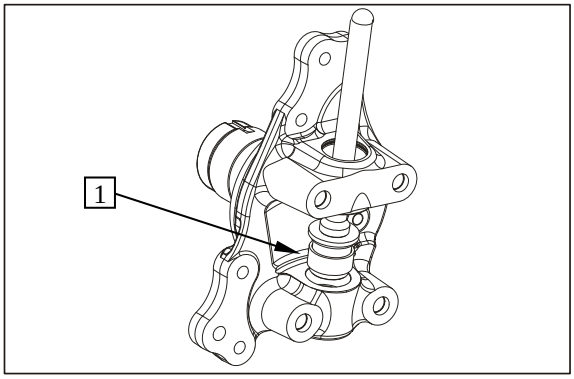


Figure 4

As an initial step, press in the first needle sleeve (1) with special tool (part 1) until contact is obtained.
Then use special tool (part 1 and part 2) to bring the needle sleeve into the final position.

Now press in the second needle sleeve with special tool (part 1) until contact is obtained.

M

Press in seal ring (1) with special tool (part 1 and part 3) until contact is obtained (look at figure 1).

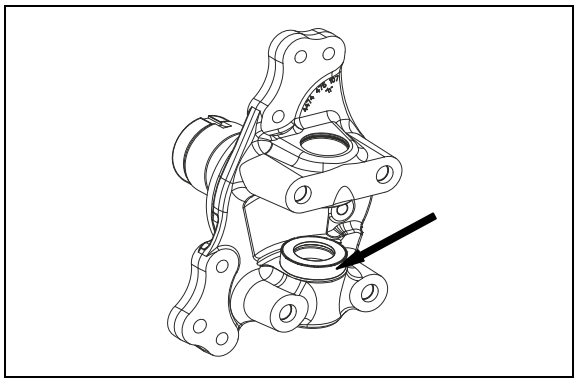


Figure 5

Bring axial roller bearing into contact position with steering knuckle, with the carrier facing downwards.

(S) Assembly fixture AA01 046 851

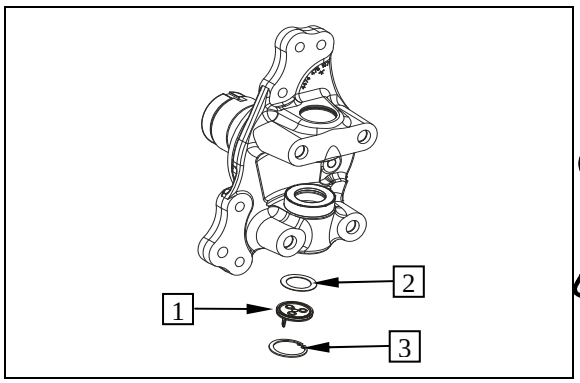


Figure 6

Place seal holder (1) with assembly disk (2) into the lower steering knuckle hole, preliminarily without O-ring, and fix them with retaining ring 58x2 (3).

Adjusting disc 0630 000 197

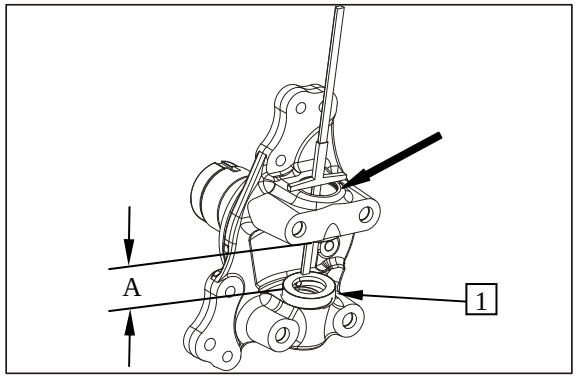


Figure 7

Determine dimension „A“.

A

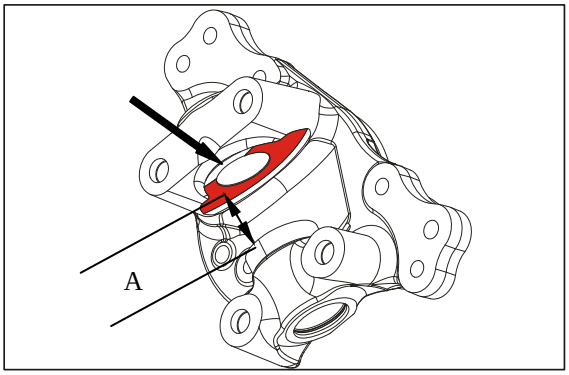


Figure 8

A

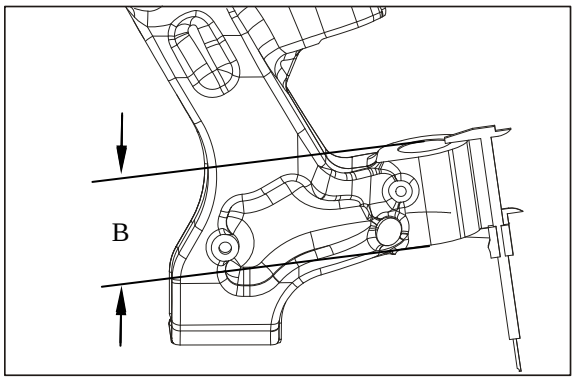


Figure 9

Determine dim. „B“.

Dim.	„A“……	90.4 mm
Dim.	„B“ ……....	- 87.5 mm
Difference		= 2.9 mm
Required axial play 0.05-0.15 e.g.		- 0.1 mm
Shim (adjusting shim)	thickness	= 2.8 mm

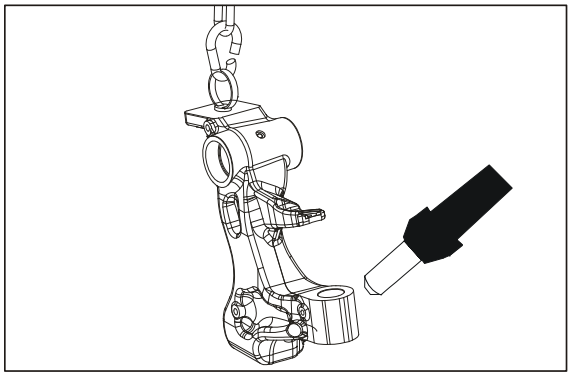


Figure 10

(S) Thermometer 5870 220 011

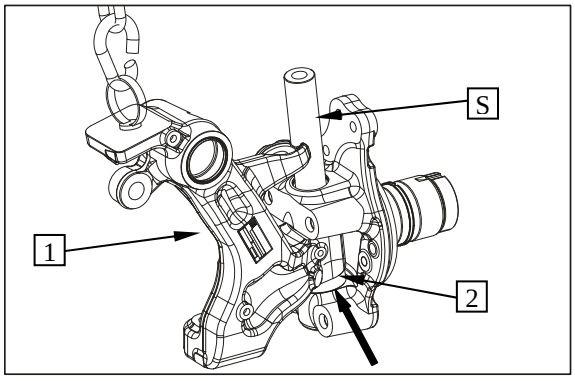


Figure 11

Position the steering knuckle carrier (1) with the lifting device, fit shim (2) and align them with the centering pin (S).

M

(S) Centering pin 5870 912 018

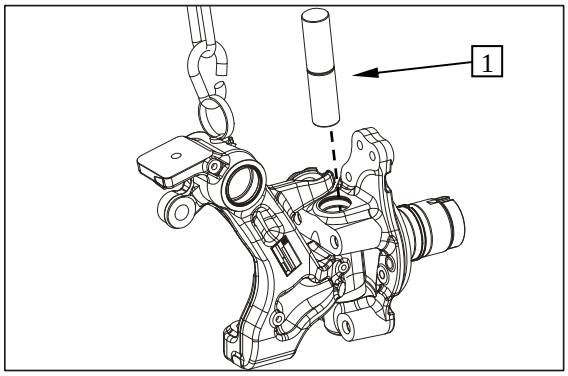


Figure 12

Mount undercooled axle bolt (1) until contact is obtained.

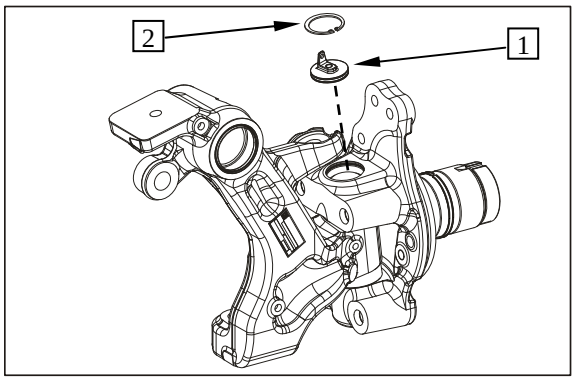


Figure 13

Place O-ring 55x3 into the groove of the seal holder (1) and grease it.

Place seal holder (1) into the steering knuckle hole and fix it with a retaining ring (2).

A

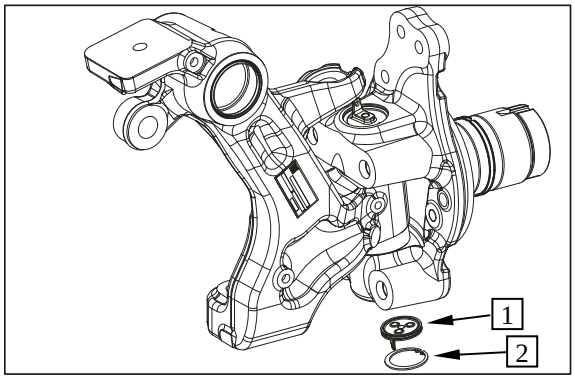


Figure 14

Place O-ring 55x3 into the groove of the seal holder (1) and grease it.

Place seal holder into the steering knuckle hole and fix it with retaining ring 58x2 (2).

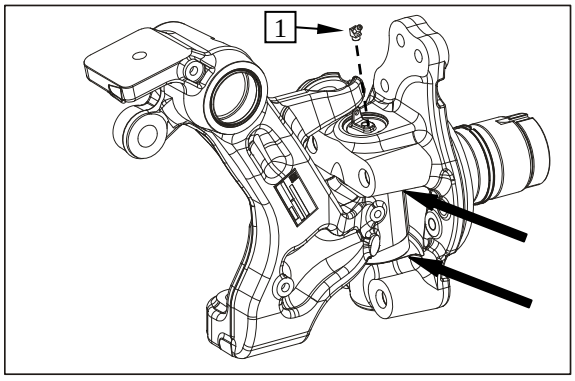


Figure 15

Fit upper and lower grease nipple M10x1 (1).

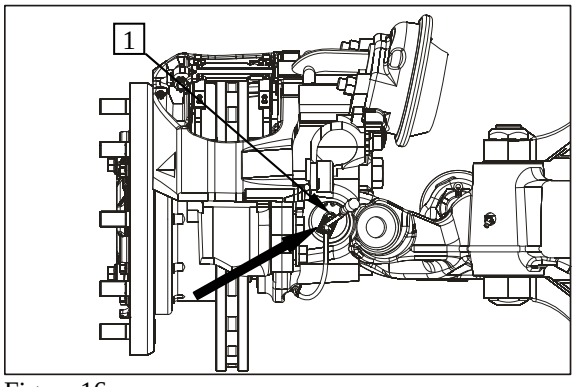


Figure 16

Installation position of seal holder's tab see arrow.

Use a grease gun to lubricate the steering knuckle bearing at the lower and upper grease nipple (1) until grease comes out at the seal ring.

M

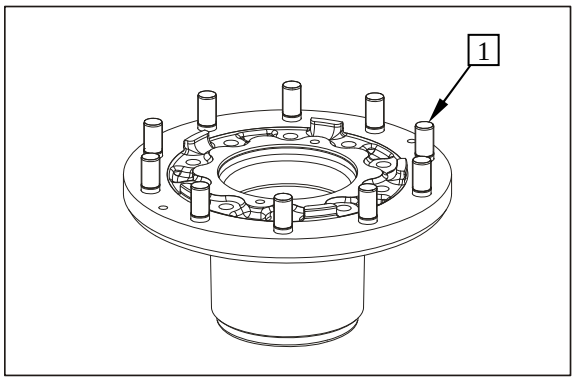


Figure 17

If wheel studs (1) need to be replaced, use the proper special tool for fitting.

(S) Wheel stud puller - basic tool	5870 610 010
(S) Insert M22x1.5	5870 610 002

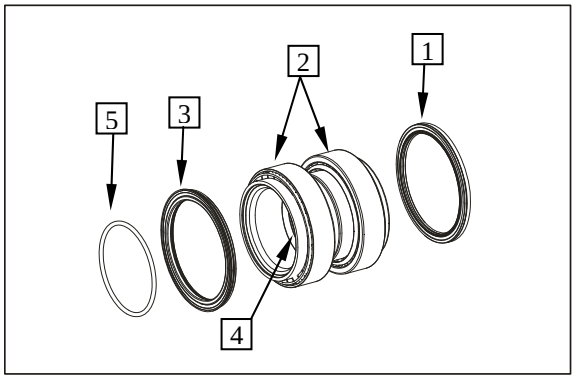


Figure 18

Figures 18 and 19 show the single parts of the compact bearing and their installation position.

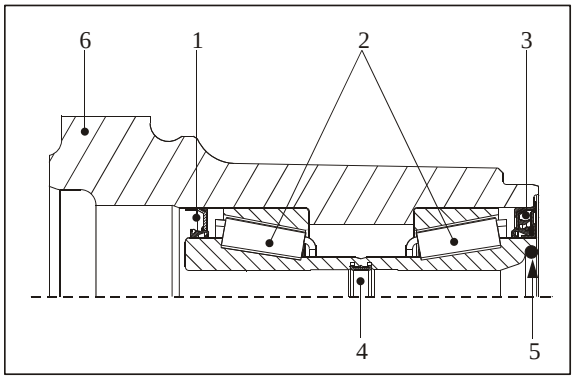


Figure 19

1 = Shaft seal (on side of wheel studs) *
2 = Bearing inner and outer ring
3 = Cassette-type seal (on side of brake disk)* } bearing unit
4 = Retaining ring
5 = O-ring*
6 = Hub

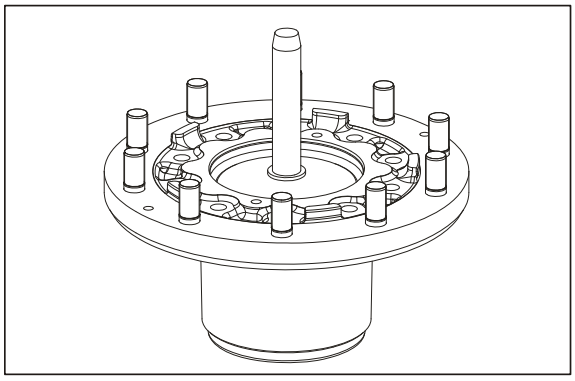


Figure 20

Press in both bearing outer rings until contact is obtained.

(S) Driver tool	5870 050 003
(S) Handle	5870 260 004

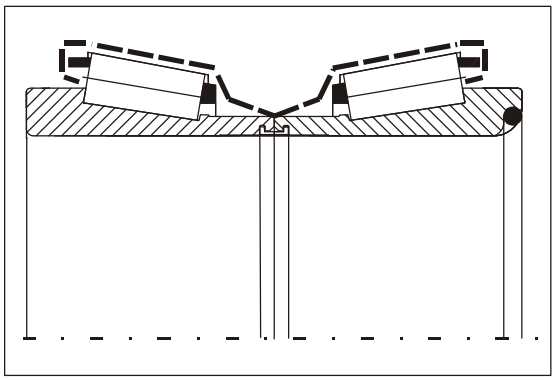


Figure 21

Grease compact bearing in the marked area - - - .

M

Service/Techn. Information

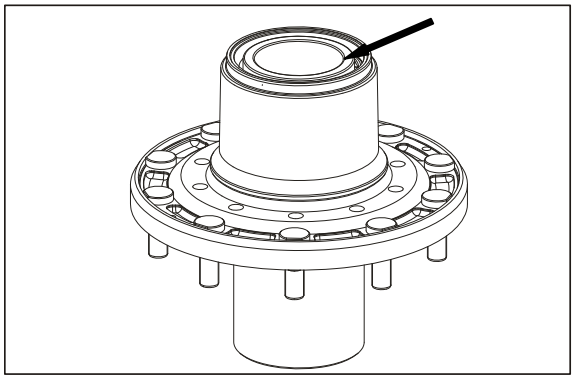


Figure 22

Place hub onto the support and fit bearing inner ring on brake disk side.

(S) Support 5870 345 121

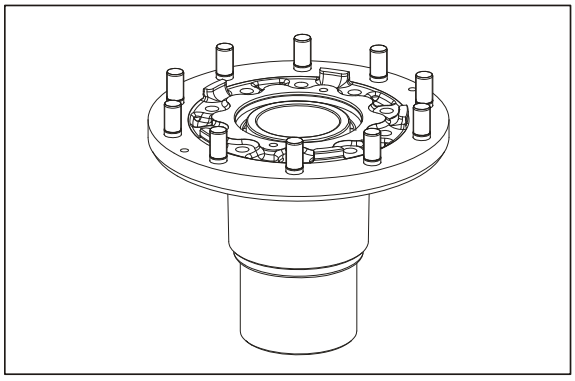


Figure 23

Turn hub upside down, place it onto the support and fit outer bearing inner ring.

(S) Support 5870 345 121

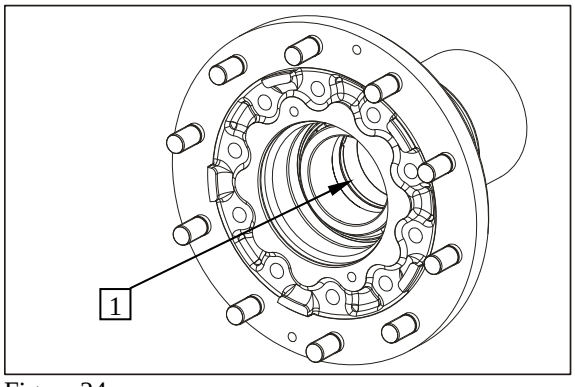


Figure 24

Fix both bearing inner rings with a retaining ring (Figures 24 and 25).

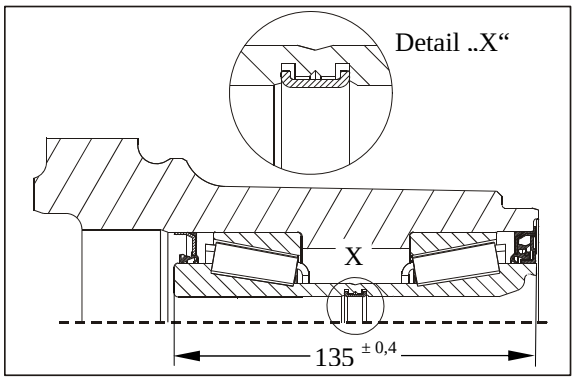


Figure 25

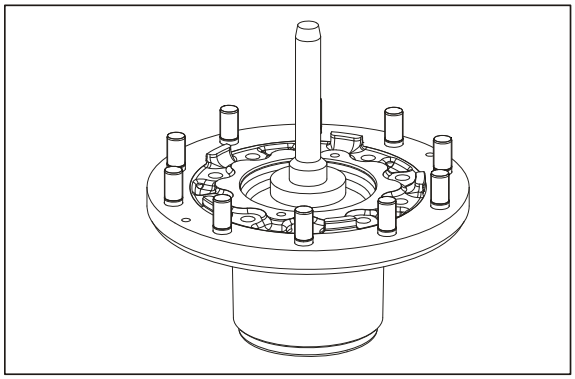


Figure 26

Fitting of shaft seal on side of wheel studs.

(S) Driver tool	5870 053 026
(S) Handle	5870 260 011
(S) Support	5870 345 121

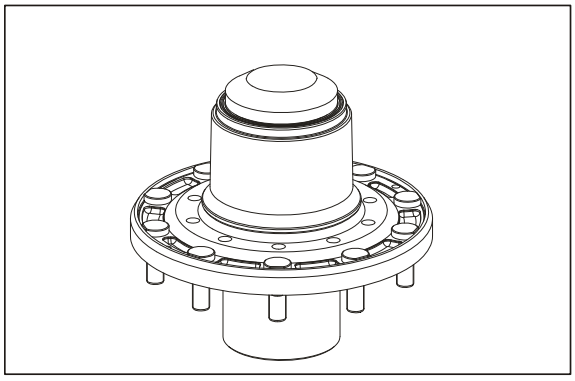


Figure 27

Fit cassette-type seal on side of brake disk.

(S) Driver tool	5870 048 317
(S) Support	5870 345 121

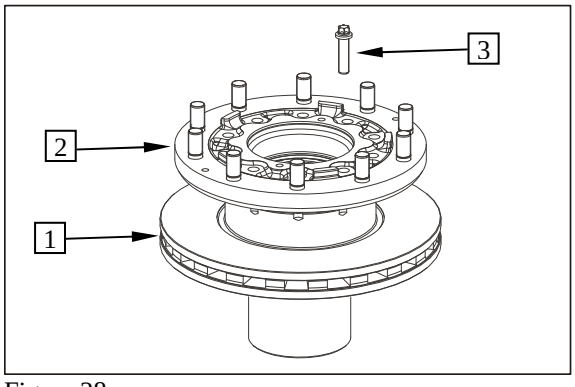


Figure 28

Bring brake disk (1) into contact position on the hub (2) and tighten it with Torx screws M16x1.5x60 (3).

Tightening torque (M16/10.9x1.5x60)….. M_A = 240 Nm

(S) Support	5870 345 121

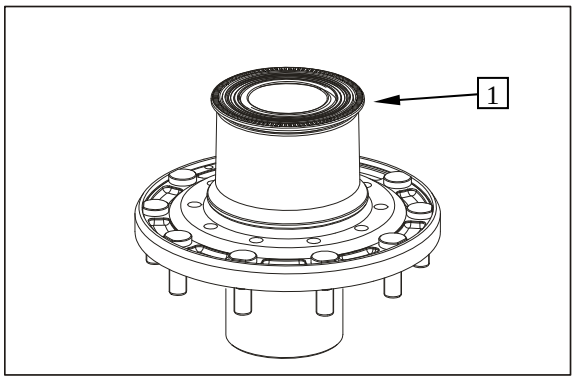


Figure 29

Press impulse disk (1) onto the hub evenly.

(S) Support 5870 345 121

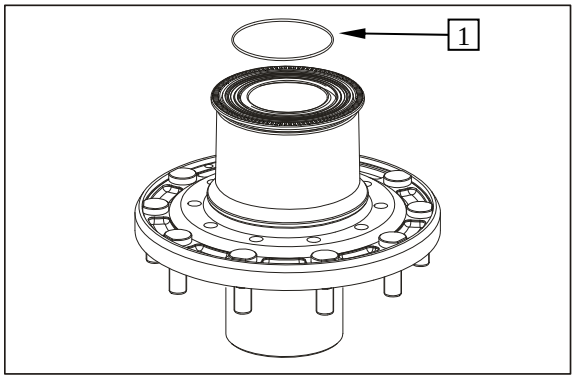


Figure 30

Place O-ring 109x5 (1) into the annular groove of the bearing inner ring and grease it.

(S) Support 5870 345 121

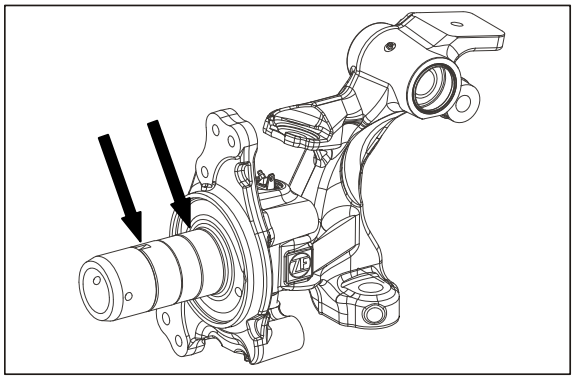


Figure 31

Grease bearing seat (see arrows) with lubricant „MOLYKOTE DX“.

Mount inner installer onto the steering knuckle.

(S) Inner installer 5870 651 099

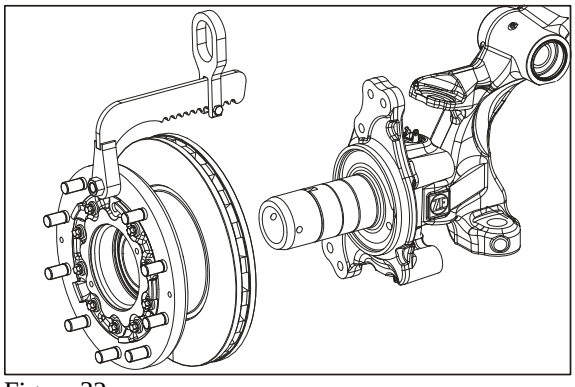


Figure 32

Use the lifting device to carefully bring the preassembled hub into contact position.

Now remove inner installer.

(S) Lifting bracket 5870 281 043

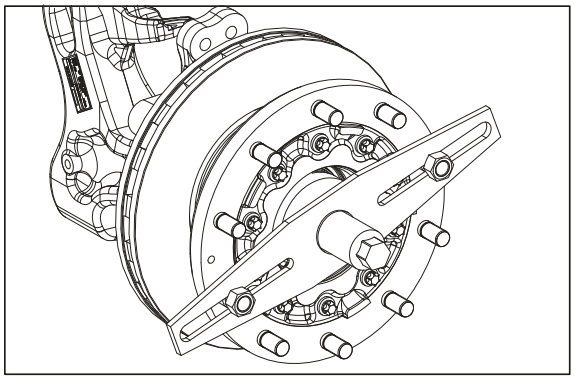


Figure 33

Fit internal slotted nut M95x1.5.

First step: Tighten slotted nut with 100 Nm.

Second step: Tighten slotted nut to torque.

Tightening torque (inner slotted nut) ….. M_A = 850 Nm

(S) Slotted nut wrench	5870 401 136
(S) Centering bracket	5870 912 012

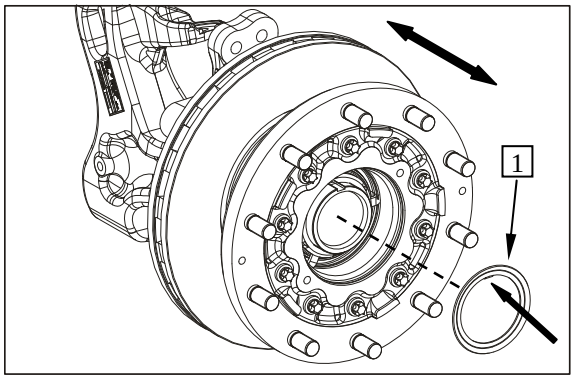


Figure 34

Mount locking plate (1) and fit outer slotted nut.

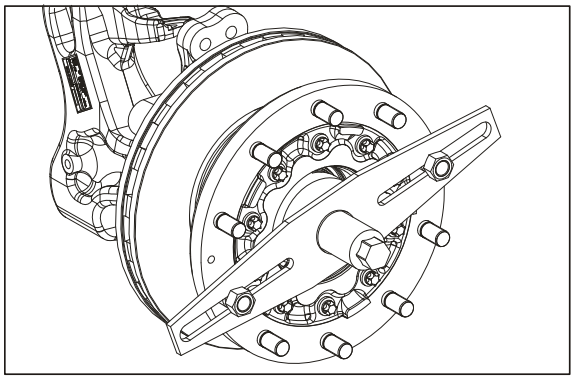


Figure 35

Tightening torque (outer slotted nut) …….. M_A = 1200 Nm

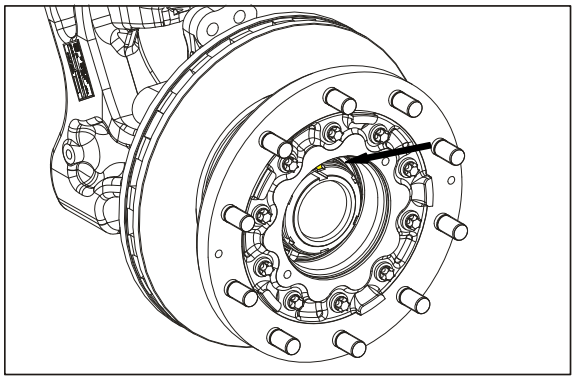


Figure 36

Secure slotted nut by deforming the locking plate, i.e. by indenting the locking plate into a groove of the outer slotted nut.

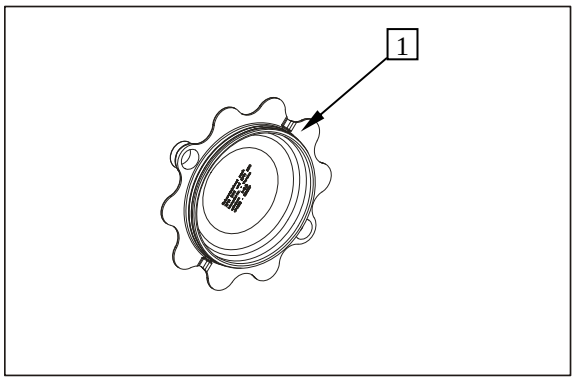


Figure 37

Insert O-ring 155x3 (1) into the annular groove of the cover and grease it.

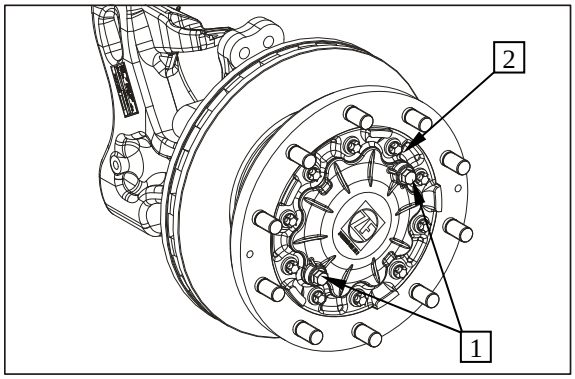


Figure 38

Mount cover and fix it with hexagon screws M12x25 (1).

Tightening torque (M12/10.9x25……M_A = 100 Nm)

Tighten the Torx screws M16x1.5x60 (2) of the bolted connection -brake disk/hub- to torque.

Tightening torque (M16/10.9x1.5x60)….. M_A = 240 Nm

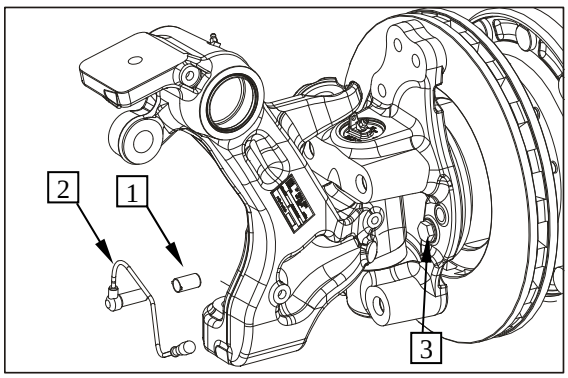


Figure 39

Insert bushing (1) and press tachometer (2) into the bushing until contact is obtained, without using striking tools.

The distance between tachometer and measuring ring is automatically adjusted by the wheel play.

Tightening torque without lock nut (M16/10.9x1.5x30)
MA = 300 Nm
Tightening torque with lock nut (M16/10.9x1.5x30)
MA = 130 Nm

A **M**

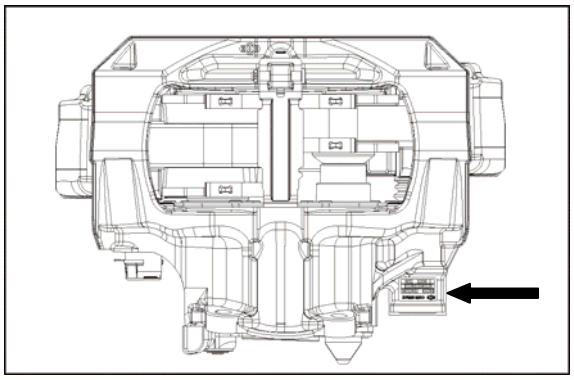


Figure 40

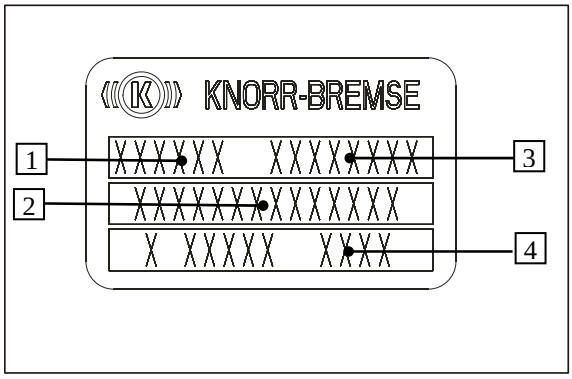


Figure 41

1 = Brake type
2 = ZF order No.
3 + 4 = Brake manufacturer's indications

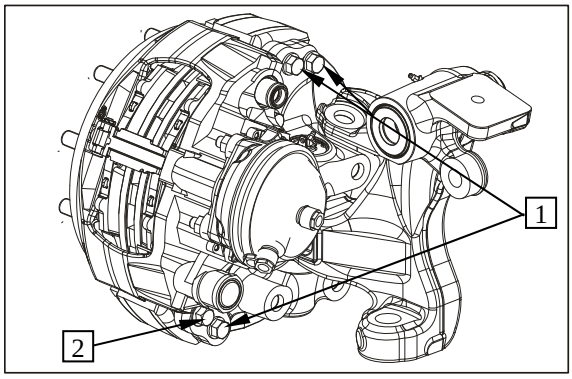


Figure 42

Fix brake to the steering knuckle using hexagon screws M16x1.5x60 (1) and tight-fit screw Ø19 mm (2).

Tightening torque (M16/10.9x1.5x60) ..... MA = 270 Nm
Tightening torque (M16/10.9x1.5x60) ..... MA = 270 Nm
(tight-fit screw)

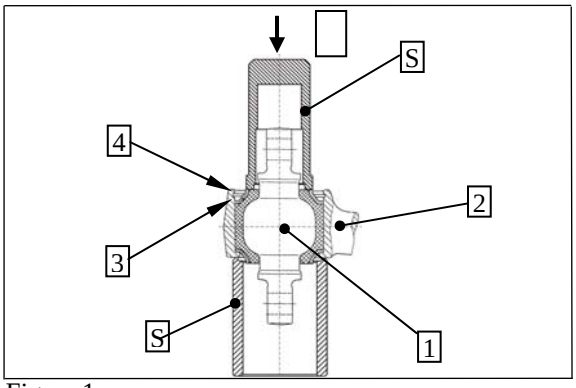


Figure 1

Place joint (1) into the control arm (2). Press spacer ring (3) and retaining ring (4) with the pressure piece (S) under axial pressure until the retaining ring has snapped in.

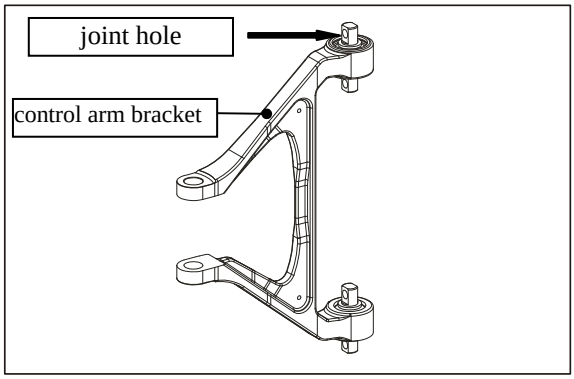


Figure 2

(S) Pressure piece 5870 100 056
(S) Pressure sleeve 5870 506 134

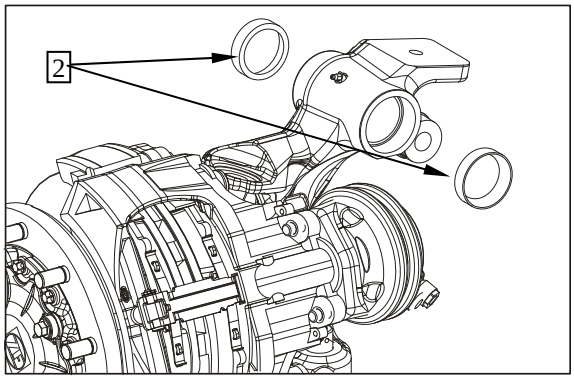


Figure 3

Press both bearing outer rings (1) into the steering knuckle carrier (2) until contact is obtained.

(S) Driver tool 5870 058 084
(S) Handle 5870 260 002

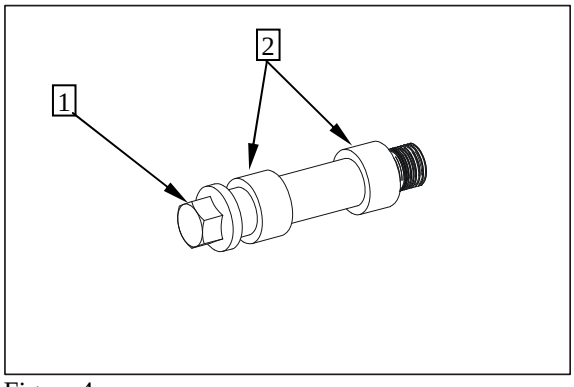


Figure 4

A

The figure shows the required special tool for adjusting the rolling torque.

1 = Assembly mandrel
2 = Assembly bushing (2x)

(S) = Assembly mandrel (assy) 5870 345 091
(S) = Pressure sleeve 5870 100 060

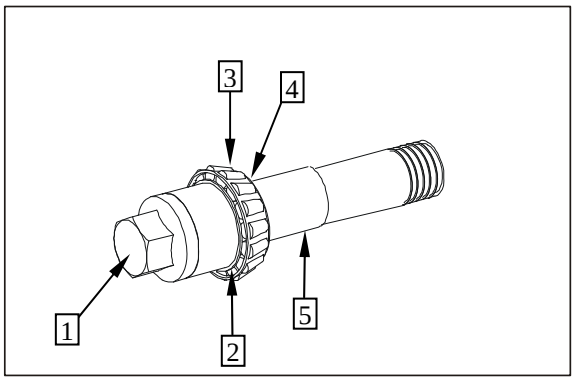


Figure 5

Mount single parts onto the assembly mandrel according to Figure 5.

1 = Assembly mandrel
2 = Ring
3 = Bearing inner ring
4 = Shim
5 = Bushing

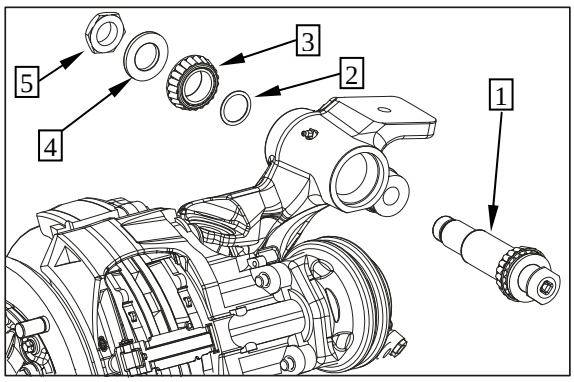


Figure 6

Insert preassembled assembly mandrel (1) into the steering knuckle carrier, mount shim (2), bearing inner ring (3) and ring (4) from the other side and fit hexagon nut (5).

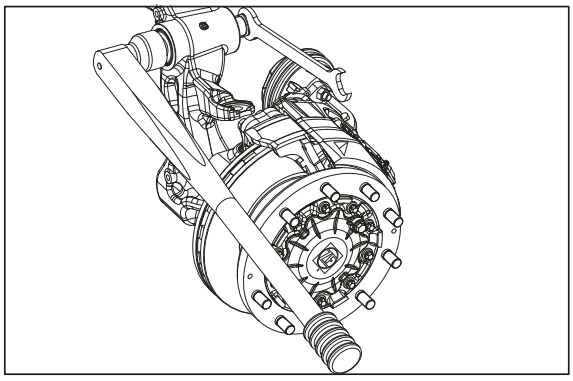


Figure 7

Tighten hexagon nut M36x1.5.

Tightening torque ..... M_A = 500 Nm

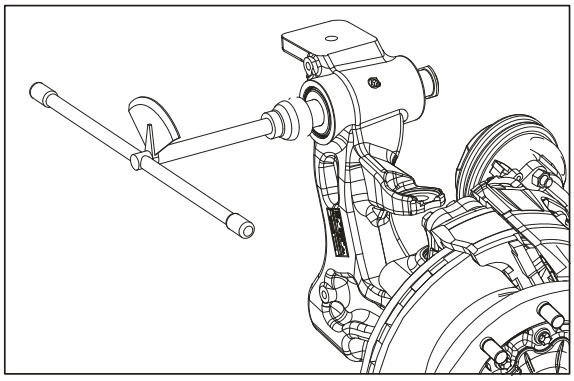


Figure 8

Check rolling torque 8 to 15 Nm.

A

Loosen hexagon nut and remove single parts.

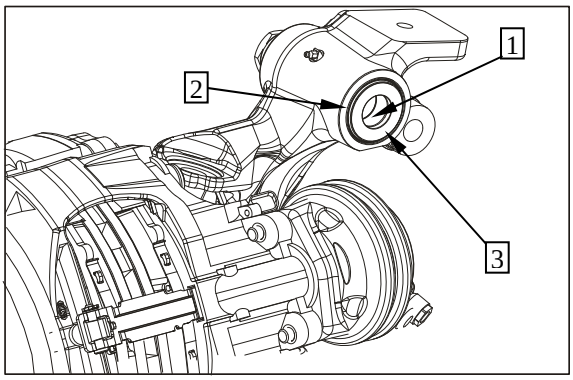


Figure 9

Install bearing inner ring (1), scraper (2) and ring (3) in this order.

A

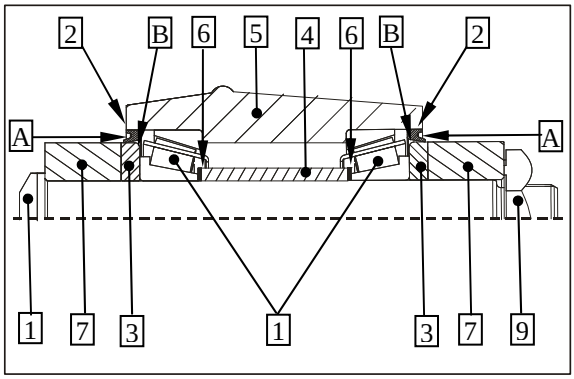


Figure 10

Legend to Figure 10:

1 = Roller bearing assy
2 = Scraper
3 = Ring
4 = Bushing
5 = Steering knuckle carrier
6 = Shim
7 = Control arm
8 = Bolt
9 = Hexagon nut

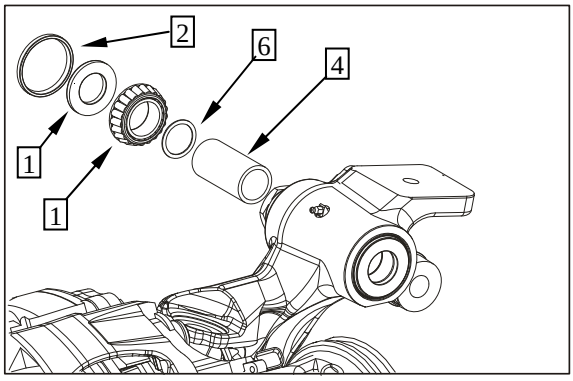


Figure 11

Fit bushing (4) and determined shim (6) to the opposite side of the steering knuckle carrier.

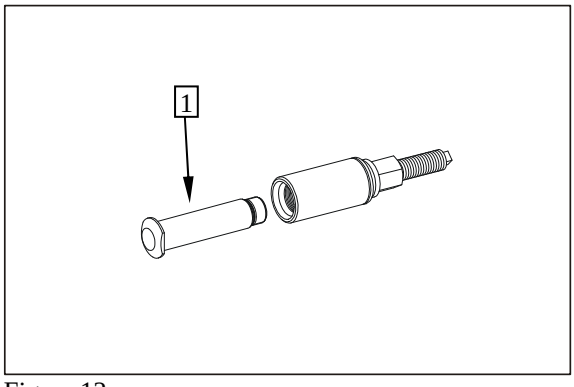


Figure 12

Fit control arm bolt (Figures 12 to 15).

Figure 12 shows the required special tool for fitting the control arm bolt (1).

(S) Mounting fixture 5870 000 097

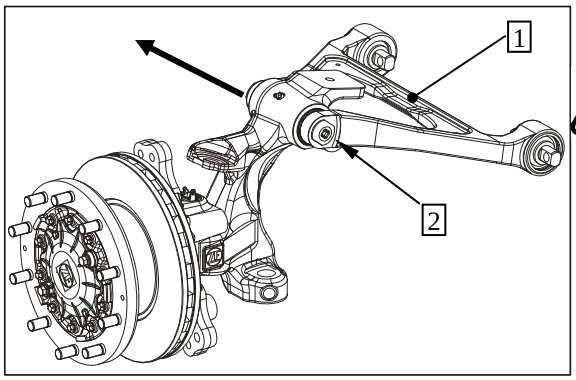


Figure 13

Position control arm (1) and install it with mounting fixture.

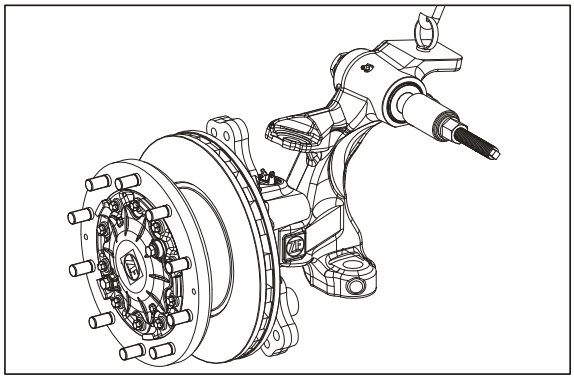


Figure 14

Use the mounting fixture to press in the control arm bolt until contact is obtained.

Now remove mounting fixture.

(S) Mounting fixture 5870 000 097

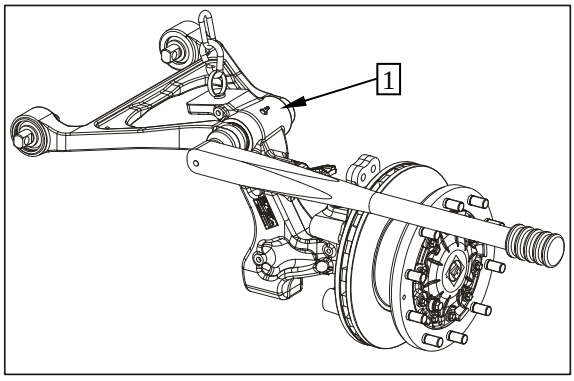


Figure 15

Wet thread of hexagon nut with Loctite type No. 262!

Tighten hexagon nut.

Tightening torque ..... M_A = 1000 Nm

Fit grease nipple (1) and lubricate control arm bearing until grease comes out at the seals.

Industrial EP multi-purpose grease, type Glissando 283 EP 2 LF
ZF Order No. 0671 190 079!

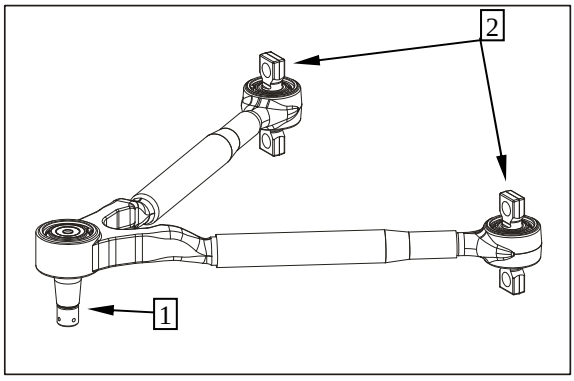


Figure 16

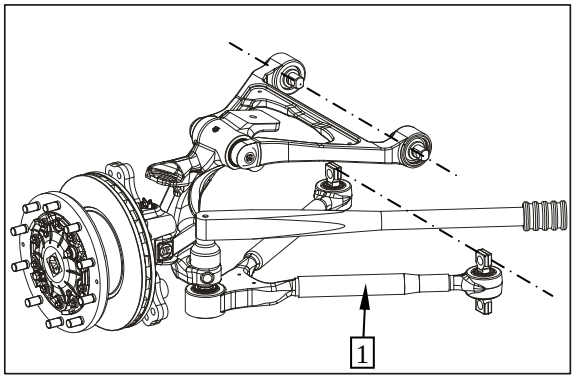


Figure 17

Place lower control arm (1) into the steering knuckle carrier hole and tighten it with castle nut.

Tightening torque .....approx. M_A = 600 Nm

Secure castle nut with split pin!

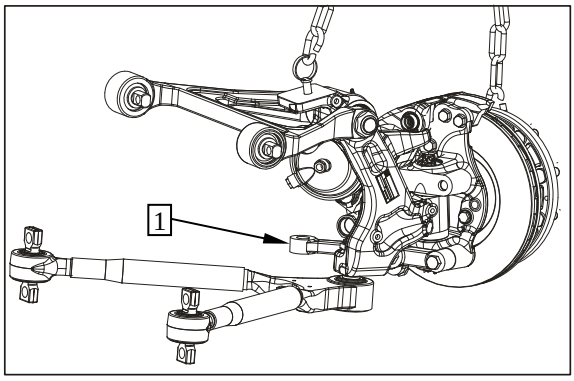


Figure 18

Fix tie rod arm (1) to the steering knuckle using hexagon screws.

Tightening torque (M24/10.9x1.5x90)..... M_A = 1 100 Nm

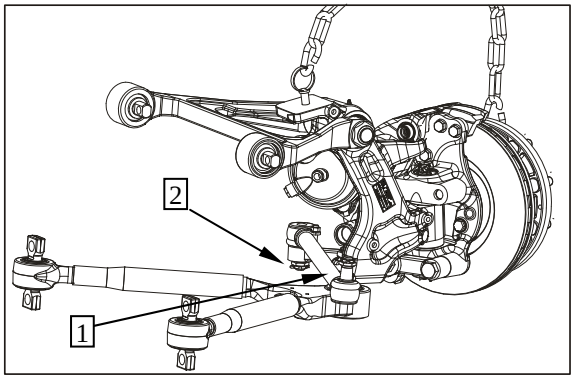


Figure 19

Fix tie rod (1) to the tie rod arm by means of castle nut (2).

Tightening torque (M24x1.5) ..... M_A = 250 - 280 Nm

Secure castle nut (3) with split pin!

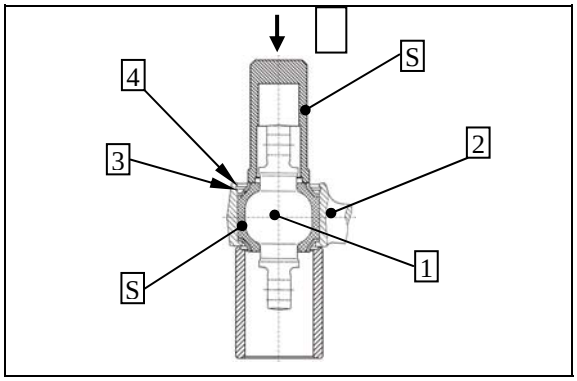


Figure 1

Place joint (1) into the control arm (2). Press spacer ring (3) and retaining ring (4) with the pressure piece (S) under axial pressure until the retaining ring has snapped in.

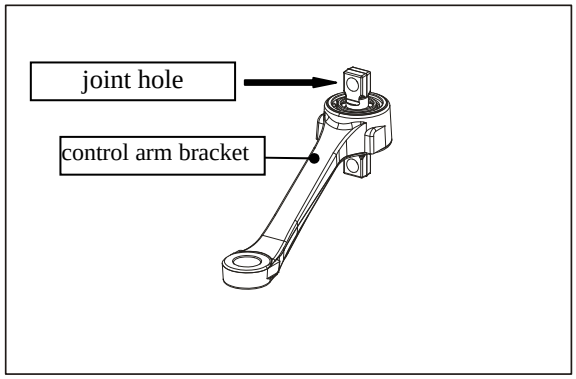


Figure 2

(S) Pressure piece 5870 100 056
(S) Pressure sleeve 5870 506 134

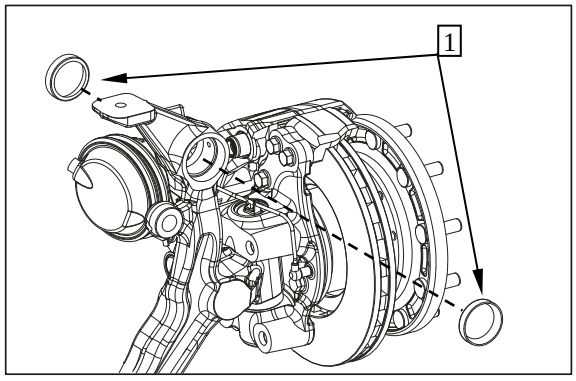


Figure 3

Press both bearing outer rings (1) into the steering knuckle carrier (2) until contact is obtained.

(S) Driver tool 5870 058 084
(S) Handle 5870 260 002

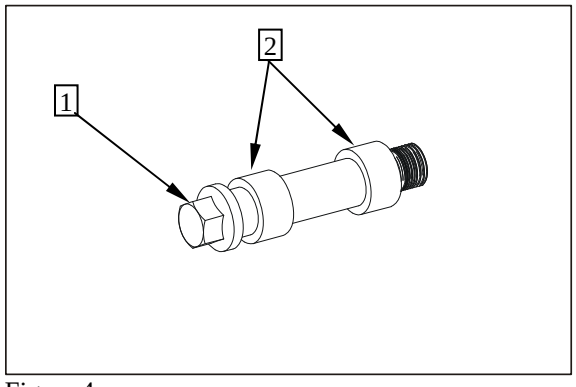


Figure 4

A

The figure shows the required special tool for adjusting the rolling torque.

1 = Assembly mandrel
2 = Assembly bushing (2x)

(S) = Assembly mandrel (assy) 5870 345 091
(S) = Pressure sleeve 5870 100 060

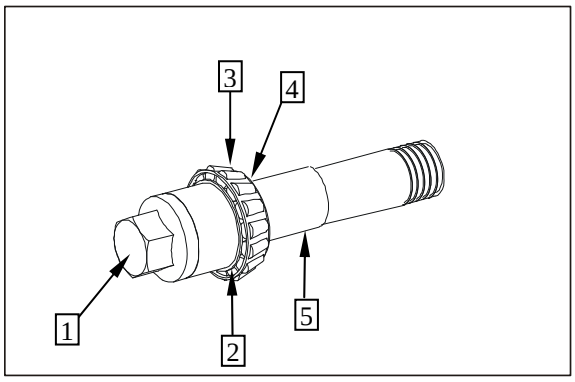


Figure 5

Mount single parts onto the assembly mandrel according to Figure 5.

1 = Assembly mandrel
2 = Ring
3 = Bearing inner ring
4 = Shim
5 = Bushing

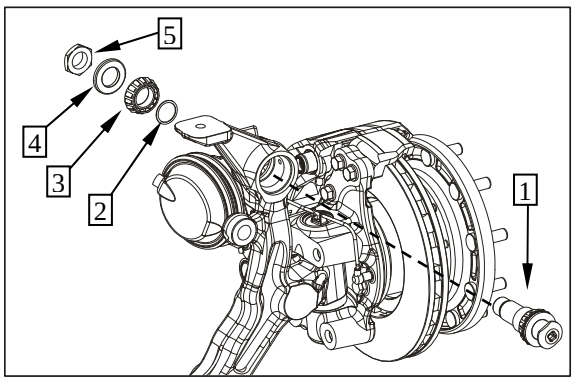


Figure 6

Insert preassembled assembly mandrel (S) into the steering knuckle carrier, mount shim (2), bearing inner ring (3) and shim (4) from the other side and fit hexagon nut (5).

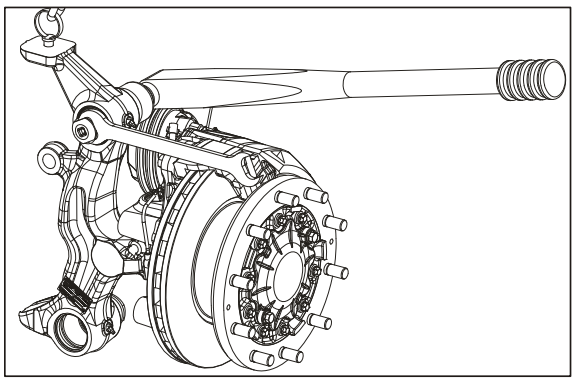


Figure 7

Tighten hexagon nut M36x1.5.

Tightening torque..... M_A = 500 Nm

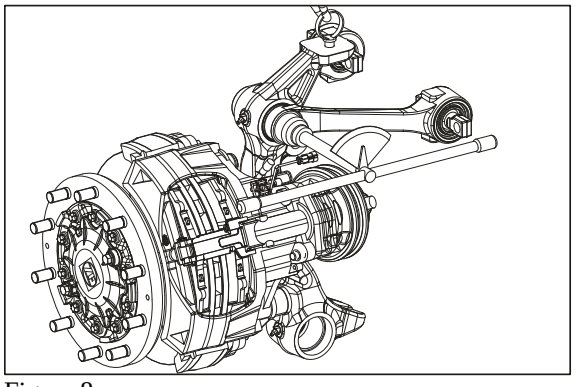


Figure 8

Check rolling torque 8 to 15 Nm.

A

Loosen hexagon nut and remove single parts.

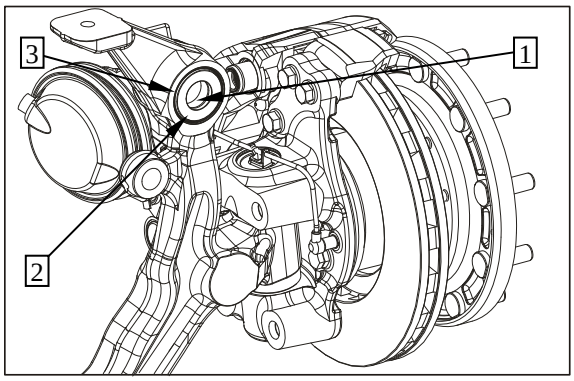
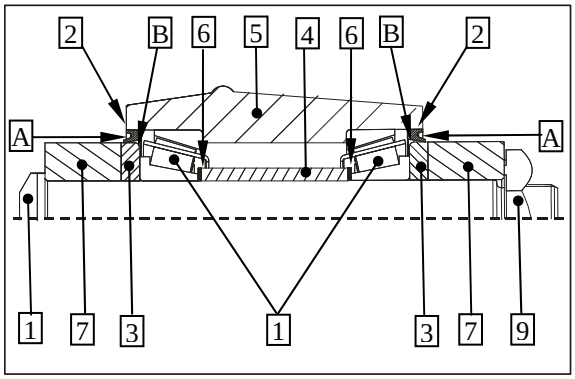


Figure 9

Install bearing inner ring (1), scraper (2) and ring (3) in this order.

A



Legend to Figure 10:

1 = Roller bearing assy
2 = Scraper
3 = Ring
4 = Bushing
5 = Steering knuckle carrier
6 = Shim
7 = Control arm
8 = Bolt
9 = Hexagon nut

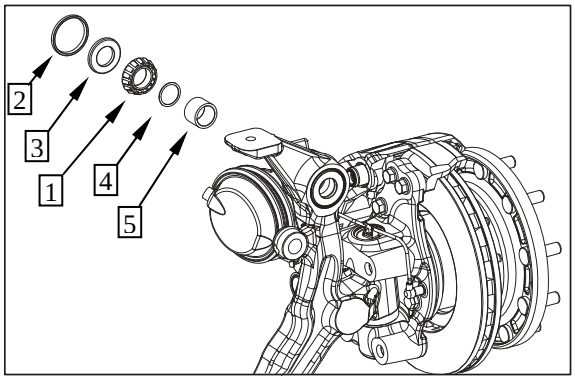


Figure 11

Fit bushing (5) and determined shim (4) to the opposite side of the steering knuckle carrier.

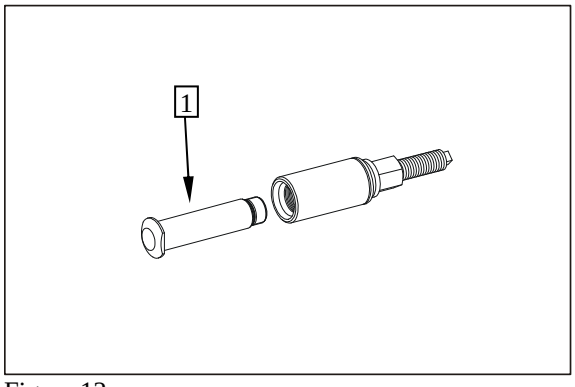


Figure 12

Fit control arm bolt (Figures 12 to 15).

Figure 12 shows the required special tool for fitting the control arm bolt (1).

(S) Mounting fixture 5870 000 097

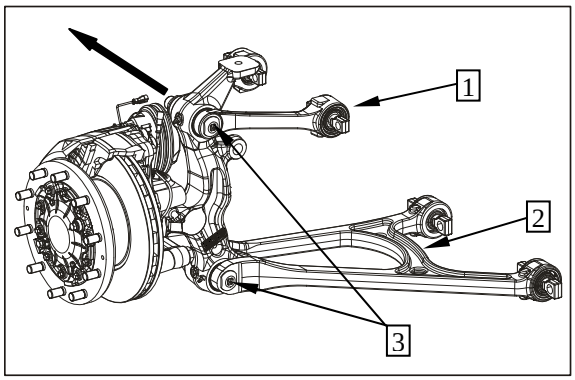


Figure 13

Position upper control arm (1) and lower control arm (2) and install them with mounting fixture.



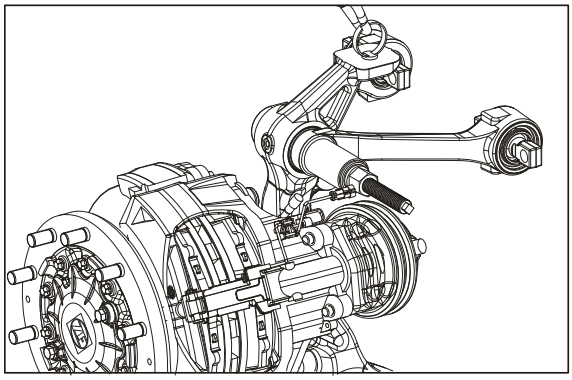


Figure 14

Use the mounting fixture to press in the control arm bolt until contact is obtained.



(S) Mounting fixture 5870 000 097

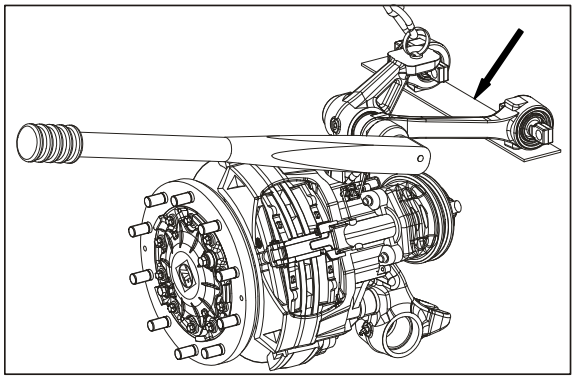


Figure 15



Tighten hexagon nut.

Tightening torque..... M_A = 1000 Nm



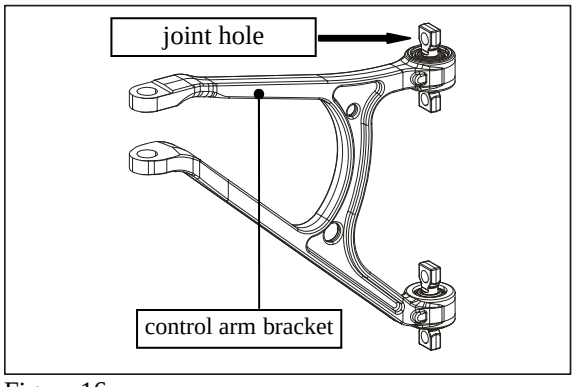


Figure 16

_____:

Assemble lower control arm according to Figures 1 – 2.



(S) Pressure piece 5870 100 056
(S) Pressure sleeve 5870 506 134

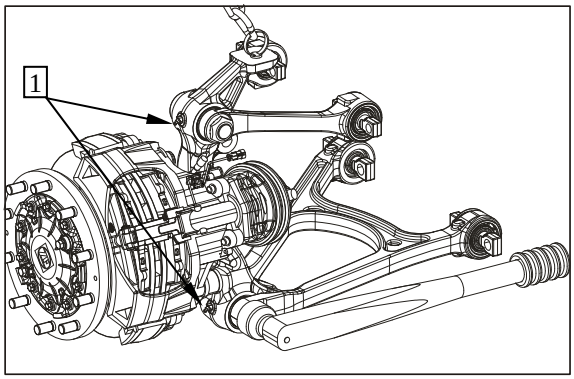


Figure 17

Tighten hexagon nut.

Tightening torque ..... M_A = 1000 Nm

Fit grease nipple (1) and lubricate upper and lower control arm bearing until grease comes out at the seals.

Industrial EP multi-purpose grease, type Glissando 283 EP 2 LF
ZF Order No. 0671 190 079!

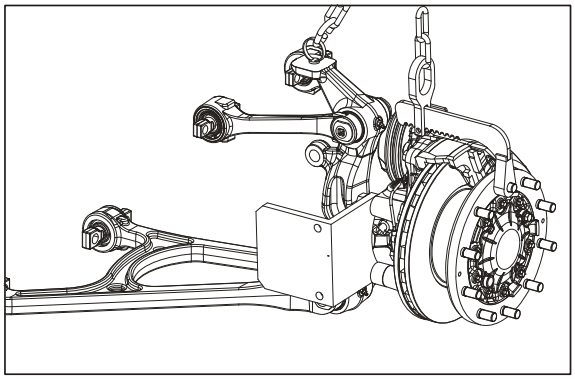


Figure 18

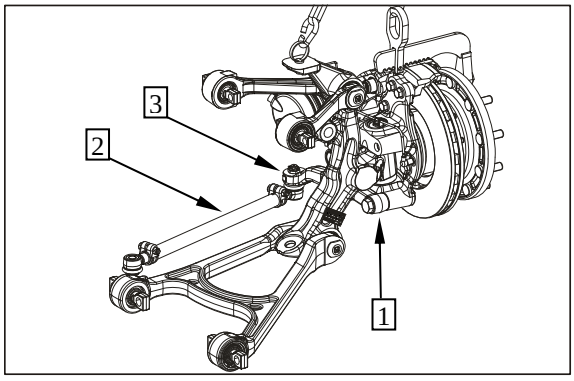


Figure 19

Fix tie rod arm (1) to the steering knuckle using hexagon screws.

Tightening torque (M24/10.9x1.5x90)..... M_A = 1100 Nm

Fix tie rod (2) to the steering lever (3) by means of castle nut.

Tightening torque (M24x1.5) ..... M_A = 210 - 230 Nm

Secure castle (3) nut with split pin!

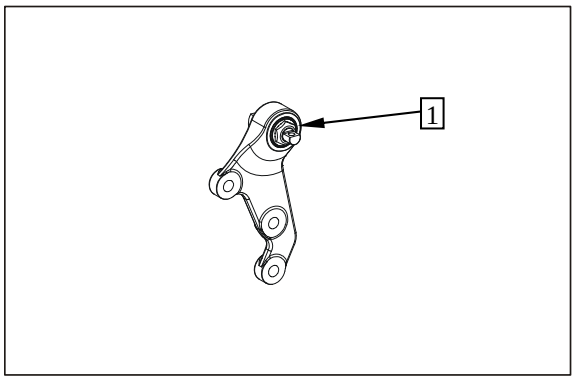


Figure 1

Disassemble relay lever (Figures 1 and 2).

Loosen hexagon nut (1).

Heat up hexagon nut with hot-air blower.

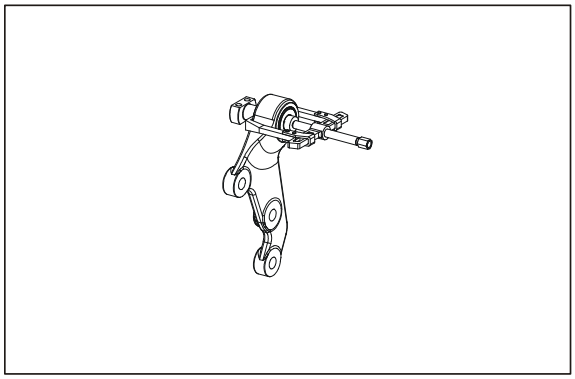


Figure 2

Press out bearing bolt (1) with two-armed puller.

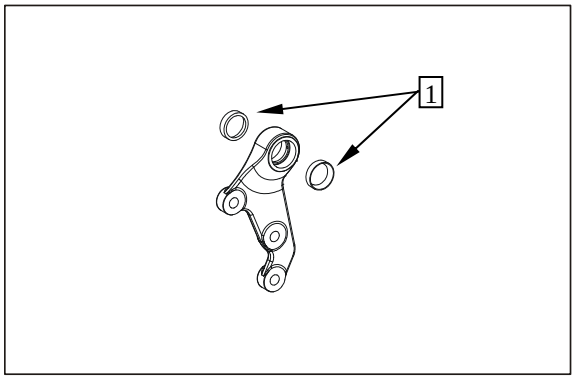


Figure 3

Press both bearing outer rings (1) into the relay lever until contact is obtained.

(S) Driver tool	5870 058 084
(S) Handle	5870 260 002

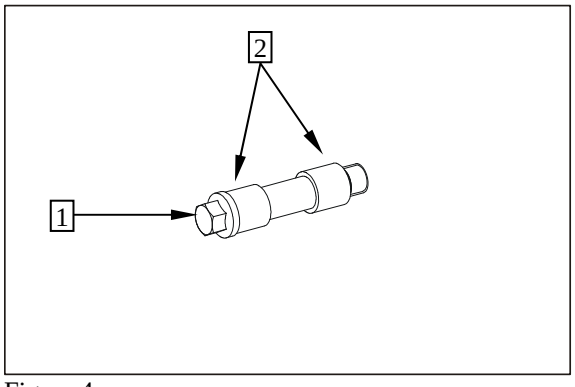


Figure 4

A

The figure shows the required special tool for adjusting the rolling torque.

1 = Assembly mandrel
2 = Assembly bushing (2x)

(S) = Assembly mandrel (assy)	5870 345 091
(S) = Pressure sleeve	5870 100 064

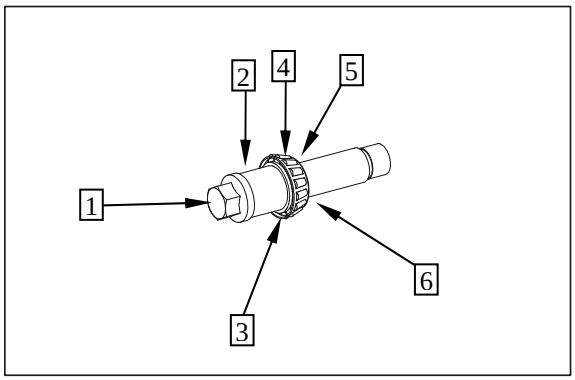


Figure 5

Mount single parts onto the assembly mandrel according to Figure 5.

1 = Assembly mandrel
2 = Pressure sleeve
3 = Ring
4 = Bearing inner ring
5 = Shim
6 = Bushing

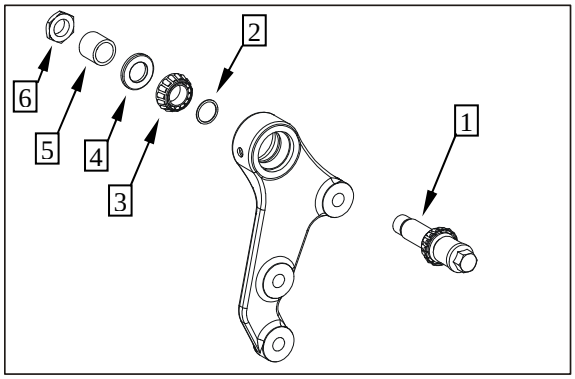


Figure 6

Insert preassembled assembly mandrel (1) into the relay lever, mount shim (2), bearing inner ring (3), ring (4) and pressure sleeve (5) from the other side and fit hexagon nut (6).

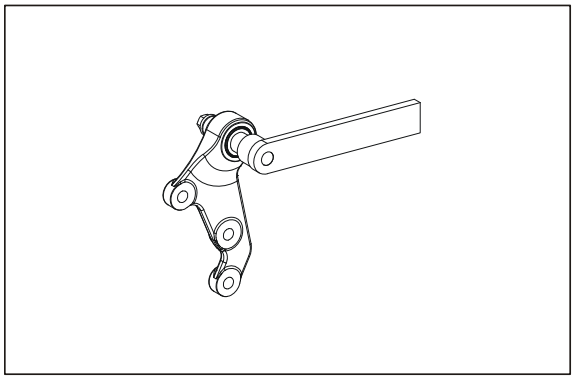


Figure 7

Tighten hexagon nut.

Tightening torque ..... M_A = 500 Nm

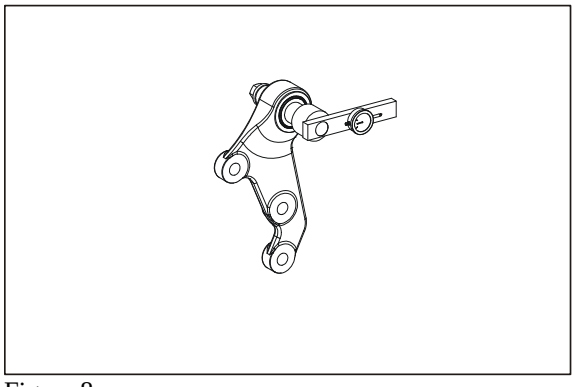


Figure 8

Check rolling torque 5 to 12 Nm.

A

Loosen hexagon nut and remove single parts.

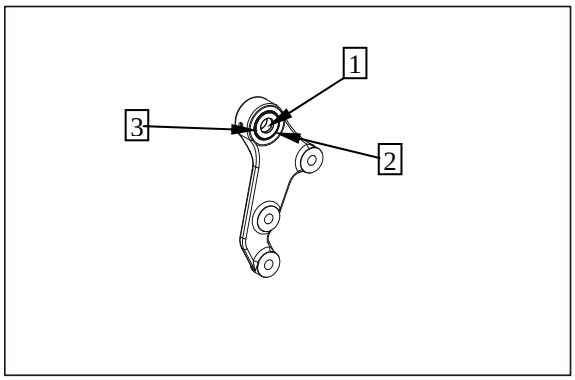


Figure 9

Install bearing inner ring (1), scraper (2) and ring (3) in this order.

A

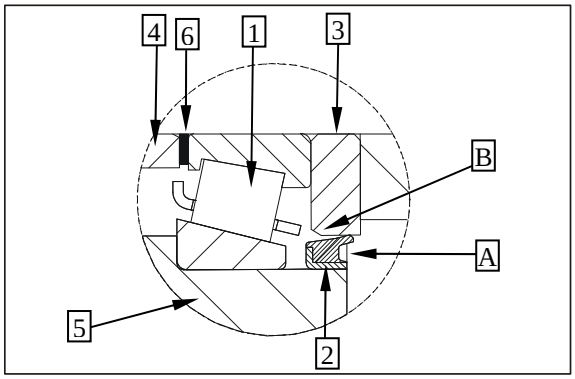


Figure 10

Legend to Figure 10:

1 = Roller bearing assy
2 = Scraper
3 = Ring
4 = Bushing
5 = Relay lever
6 = Shim
7 = Hexagon nut

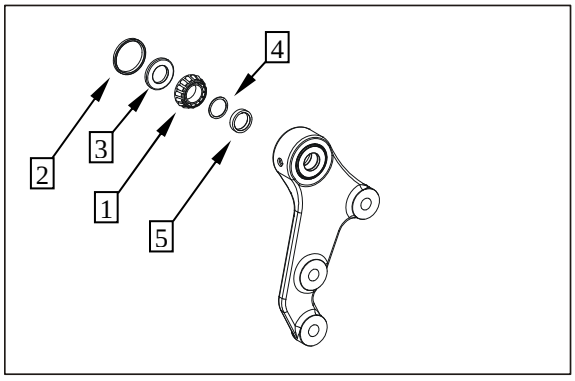


Figure 11

Fit bushing (5) and determined shim (4) to the opposite side of the relay lever.

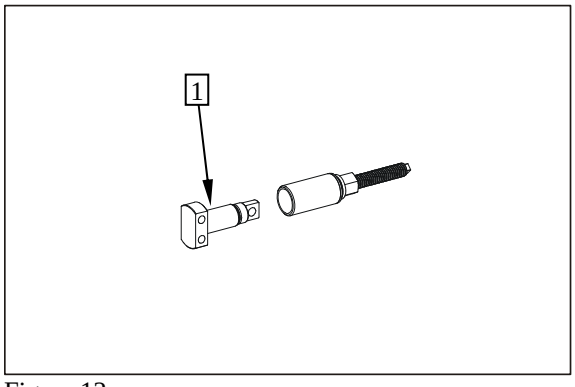


Figure 12

Install relay lever support (Figures 12 to 14).

Figure 12 shows the required special tool for fitting the bearing bolt (1).

(S) Mounting fixture	5870 000 097
(S) Thread insert	5870 000 104

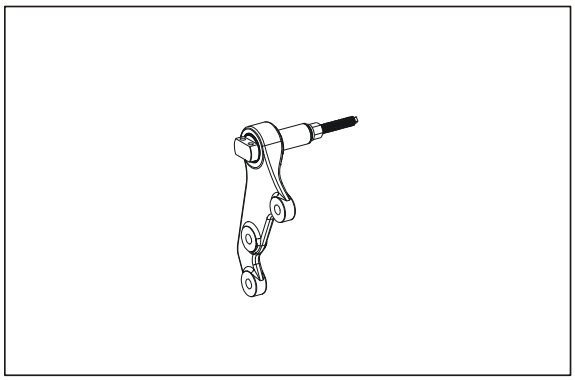


Figure 13

Use the mounting fixture to press in the bearing bolt until contact is obtained.

Now remove mounting fixture.

(S) Mounting fixture	5870 000 097
(S) Thread insert	5870 000 104

M

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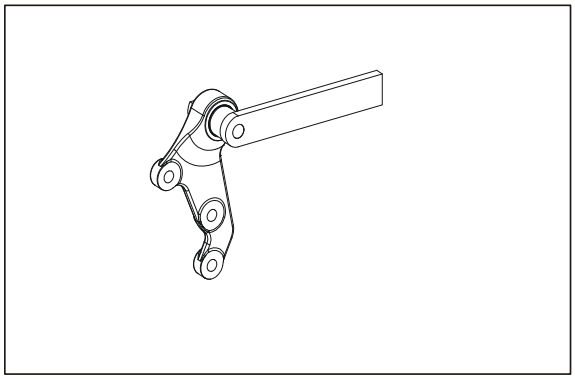


Figure 14

Fit hexagon nut with the collar facing the ring.

Tighten hexagon nut.

Tightening torque..... M_A = 1000 Nm

Fit grease nipple (1) and lubricate control arm bearing until grease comes out at the seals.

Industrial EP multi-purpose grease, type Glissando 283 EP 2 LF ZF Order No. 0671 190 079!

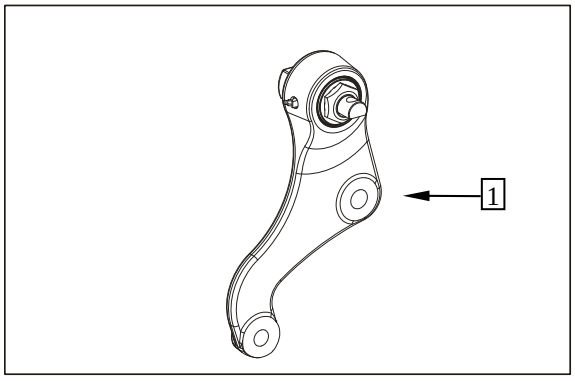


Figure 15

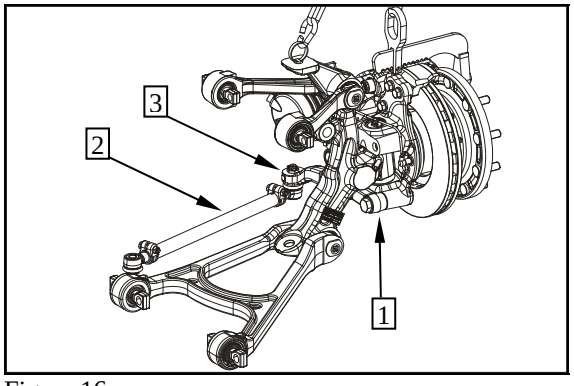


Figure 16

Fix tie rod arm (1) to the steering knuckle using hexagon screws.

Tightening torque (M24/10.9x1.5x90)..... M_A = 1 100 Nm

Fix tie rod (2) to tie rod arm by means of castle nut (3).

Tightening torque (M20x1.5) ..... M_A = 210 - 230 Nm

Secure castle nut (3) with split pin!

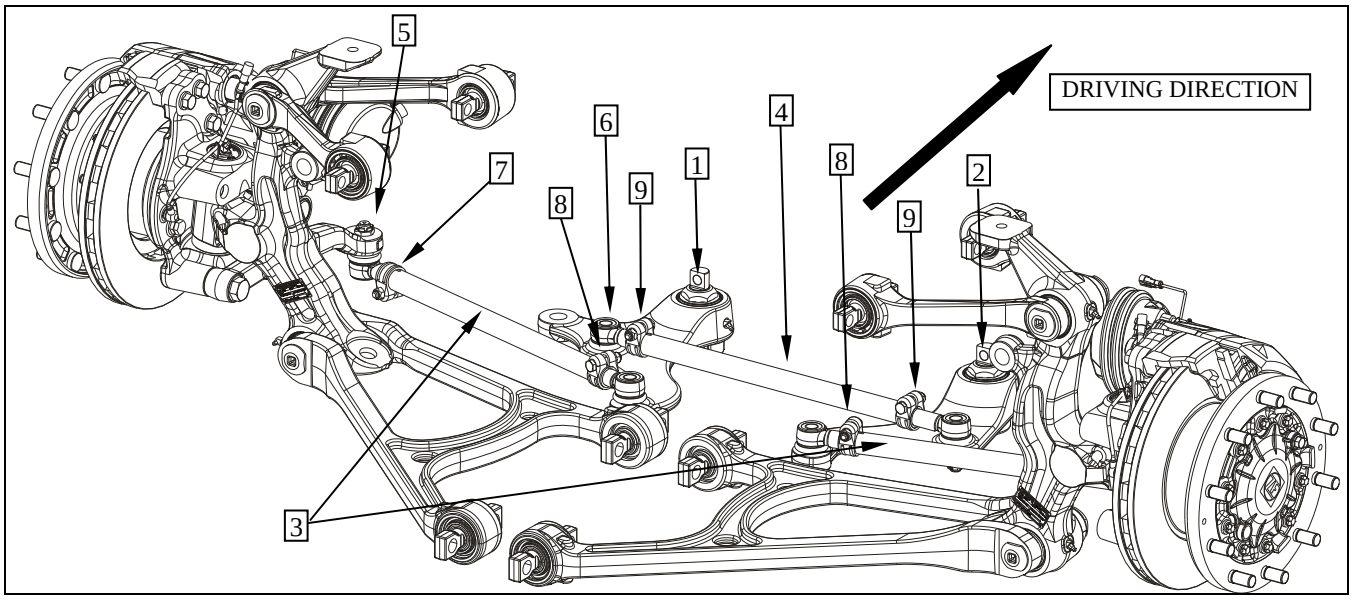


Figure 17

Use castle nuts (5) to fix tie rods (3) to the tie rod arm and steering lever or relay lever.

Tightening torque (M20x1.5) ..... M_A = 210 - 230 Nm

Secure castle nuts with split pin!

Fix tie rod (4) to the steering lever and relay lever.

Tightening torque (M24x1.5) ..... M_A = 250 - 280 Nm

Secure castle nuts with split pin!

1 = Relay lever
2 = Steering lever
3 = Tie rod (2x)
4 = Tie rod
5 = Castle nut M20x1.5 (4x)
6 = Castle nut M24x1.5 (2x)
7 = Clamp
8 = Clamp
9 = Clamp

A

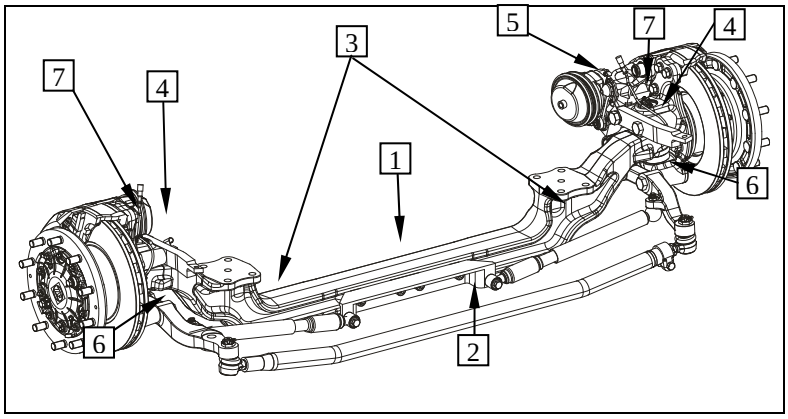
Tie rod (3) ➔ vertically downwards (Figure No. 7)
(fit opposite side analogously)
➔ vertically upwards (Figure No. 8)

Tie rod (4) ➔ vertically upwards (Figure No. 9)

Tightening torque (M12x1.5) ..... M_A = 80 - 90 Nm

A

A



1 = Fixture (absorber)
2 = Tie rod
3 = Absorber
4 = Lever
5 = Fixture (tachometer cable)
6 = Tie rod arm
7 = Steering knuckle

Figure 1

Attach fixture (1) to the axle housing using cylindrical screws M20x1.5x155 and hexagon nuts M20x1.5.

☞

Tightening torque (hexagon nut M20x1.5)..... M_A = 620 Nm

Attach absorber (3) to the fixture (1) by means of hexagon screw M14x1.5x70 and hexagon nut M14x1.5, and to the tie rod arm (6) using castle nuts M14x1.5.

Secure castle nuts with split pin!

Tightening torque (hexagon nut M14x1.5) ..... M_A = 90 Nm
Tightening torque (castle nut M14x1.5) ..... M_A = 80 Nm

Attach tie rods (2) to the tie rod arm (6) by means of castle nuts M24x1.5.

Secure castle nuts with split pin!

Tightening torque (castle nut M24x1.5) ..... M_A = 250 - 280 Nm

Attach lever and fixture (4) to the steering knuckle (7) using hexagon screws M24x1.5x75.

Tightening torque (M24/10.9x1.5x75)..... M_A = 1100 Nm

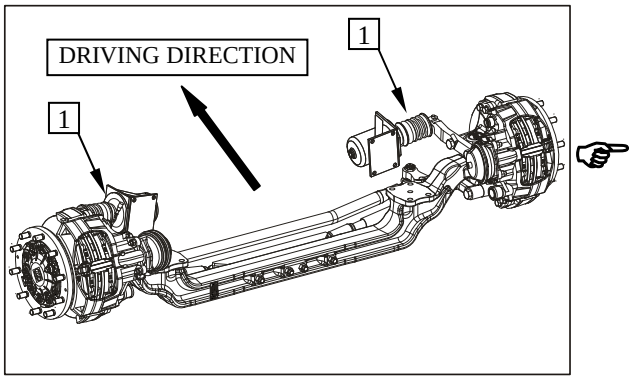
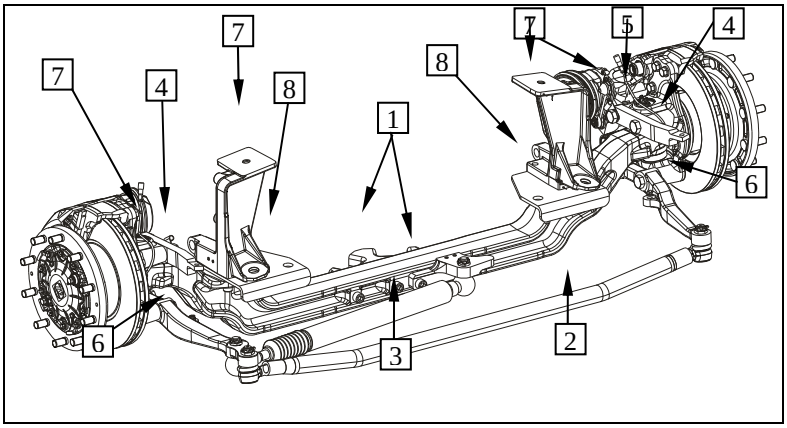


Figure 2

Use bolt to fix cylinder (1) to the lever and secure it with split pin.



1 = Fixture (absorber)
2 = Tie rod
3 = Absorber
4 = Lever
5 = Fixture (tachometer cable)
6 = Tie rod arm
7 = Spring carrier
8 = Bracket

Figure 3

Attach fixture (1) to the axle housing using cylindrical screws M20x1.5x175 and M20x1.5x155.

☞

Tightening torque (M20/10.9x155)..... M_A = 620 Nm
Tightening torque (M20/10.9x175)..... M_A = 620 Nm

Attach tie rods (2) and absorber (3) to the tie rod arm (6) using castle nuts M24x1.5.

Secure castle nuts with split pin!

Tightening torque (castle nut M24x1.5) ..... M_A = 250 - 280 Nm

Attach lever and fixture (4) to the steering knuckle (7) using hexagon screws M24x1.5x75.

Tightening torque (M24/10.9x1.5x75)..... M_A = 1100 Nm

Fix spring carrier (7) and bracket (8) to the axle housing.
- Force cylindrical pin 20x32 into the axle housing
- Fix spring carrier and bracket to the axle housing using 4 cylindrical screws M20x1.5x60.

Tightening torque (M20/10.9x1.5x60) ..... M_A = 620 Nm

☞

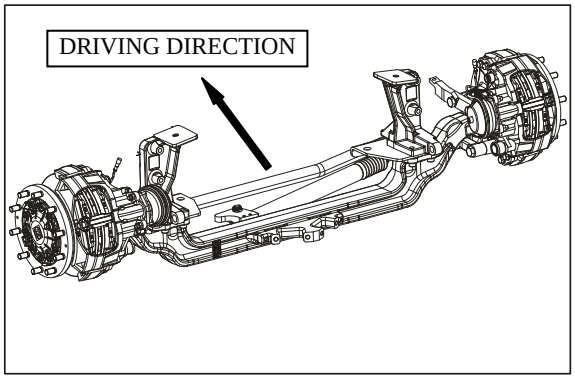


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Figure 4

ISUZU

ISUZU ACADEMY TECH CENTER

CITIPORT



WORKSHOP MANUAL

OPERATING

INSTRUCTIONS

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1 Preface

Please read the operating instructions carefully. The operating instructions contain important information about safety, operation, and maintenance of the ZF product. Also observe the special information provided by the vehicle manufacturer or the body manufacturer.

Object of documentation is a ZF product. State of design acc. to date of issue.

The figures serve to illustrate the operation or the workflow and may deviate from your ZF product. Illustrations and figures are not drawn to scale; therefore, no conclusions about size and weight can be drawn.

As a result of type diversity, the figures contained in these operating instructions may deviate from your ZF product as, in some instances, only the standard versions are presented as an example.

ZF Friedrichshafen AG

1.1 Document overview

The specifications listed in these documents must be observed, because they are a prerequisite for fault-free operation of the product and for the warranty granted by ZF Friedrichshafen AG. Please get in touch with your contact if you need binding documents.

Document no.	Designation	Technical information
4472.751.002	Repair Instructions (Repair stage 2)	AV110
4472.751.003	Repair Instructions (Repair stage 3)	AV110
4472.751.001	Repair Instructions	AV 133, AV 133 T

Tab. 1

2 Safety

2.1 Signal words and symbols

This document contains particularly highlighted safety instructions which are marked with one of the following signal words depending on the severity of the danger.

⚠ DANGER

DANGER
The signal word DANGER indicates a dangerous situation that, if not prevented, will lead to a severe injury or death.
⇨ Information as to how the danger can be prevented.

⚠ WARNING

WARNING
The signal word WARNING indicates a dangerous situation that, if not prevented, can lead to a severe injury or death.
⇨ Information as to how the danger can be prevented.

⚠ CAUTION

CAUTION
The signal word CAUTION indicates a dangerous situation that, if not prevented, can lead to a slight or moderate injury.
⇨ Information as to how the danger can be prevented.

NOTICE

The signal word NOTICE indicates a situation that, if not prevented, can lead to property damage.
⇨ Information as to how the property damage can be prevented.

The following symbols are additionally used:

⚠ This symbol refers to additional, safety-relevant information.

ⓘ This symbol indicates information concerning special workflows, methods, application of aids, etc.

2.2 General safety instructions

Read all safety instructions and information. Failure to comply with safety instructions and information may lead to property damage, serious injuries or death.

Intended use

The ZF product is exclusively intended for the application as defined in the contract and as agreed on the time of delivery. Any other or extended form of use does not comply with this definition of intended use. The intended use includes compliance with this documentation and other applicable documents, in order to avoid malfunctions and damage in operation.

The ZF product is designed and produced in line with state-of-the-art technology. The ZF product in its delivery status is safe to operate. However, the ZF product may pose dangers if improperly used by unauthorized, untrained and uninstructed staff or if not used according to its intended use.

Figures might deviate from the ZF product and are not drawn to scale. No conclusions can be drawn with regard to size and weight.

Installation, commissioning, maintenance and repair

Perform assembly, commissioning, maintenance and repair work exclusively according to this documentation and other applicable documents.

Observe the following points:

- Employ authorized, trained and instructed staff.
- Observe technical provisions.
- Only use genuine ZF spare parts.
- Only use genuine ZF accessories.
- Only use genuine ZF special tools.
- Unauthorized changes and modifications lead to the expiry of the operator's license, warranty or guarantee.

In case of damage, contact ZF and have the following information on the product ready:

- Type
- Parts list [BoM] number
- Serial number
- Operating hours
- Description of damage

Observe safety instructions, valid safety regulations and legal conditions to prevent malfunctions and damage.

The country-specific safety regulations, accident prevention regulations and environmental protection provisions apply additionally.

Wear safety-relevant workwear for all work. Depending on the work, also wear personal protective equipment.

After completing the work, check correct function and functional security.

Handling of ZF product

Unauthorized changes and modifications might impair functional security. Changes, modifications and applications are only permissible upon written approval by ZF Friedrichshafen AG.

Observe the following when working on the ZF product:

- Secure workspace.
- Only carry out work at the unit when in a voltage-free state.
- Protect unit against being started accidentally. Attach instruction plate where it is clearly visible.
- Perform work when engine is switched off.
- Protect engine against being started accidentally. Attach instruction plate where it is clearly visible.
- Do not stand beneath a suspended load.
- Do not work on a suspended load.
- Only use permitted means of transport and lifting devices with sufficient load-bearing capacity.
- Close open tubings and hoses and avoid damage.
- Observe tightening torques.
- Protect cables against mechanical damage.

Noise

Noise might cause irreversible damage to hearing.

The perception of acoustic signals, warning calls or sounds warning of impending danger is impaired by noise.

Observe the following when working on the ZF product:

- Avoid noise.
- Wear ear protection.

Operating supplies and aids

Operating supplies and aids might cause permanent damage to health and environmental damage.

Observe the following when selecting operating supplies and aids:

- Health risks
- Environmental compatibility
- Material safety data sheets

Observe the following when handling operating supplies and aids:

- Store operating supplies and aids in suitable and correctly labeled containers.
- Seek medical help in case of injuries due to hot, cold or caustic operating supplies or aids.

Observe the following to protect the environment:

- Collect leaking operating supplies and aids in sufficiently large containers.
- Observe disposal regulations.
- Observe material safety data sheets.

3 Technical Data

3.1 Oil

3.1.1 Oil grade

NOTICE
Damage to ZF product due to incorrect oil possible. ⇨ Only use oils listed in the valid ZF List of Lubricants.

Observe the information on the type plate.

Oils approved and listed in the ZF List of Lubricants TE-ML 12 are binding.

The latest ZF List of Lubricants can be obtained from all ZF Service Centers and viewed at www.zf.com.

3.1.2 Oil purity

The oil must not contain any visible solid impurities.

3.1.3 Oil Quantity

The quantities specified are reference values. The oil quantity after the oil level check is decisive. Observe the information on the type plate.

Axle	Comment	Oil quantity in liters (approx.)	
		after an oil change	for initial fill after repair
AV 110, AV 133, AV 133 T		17.5	17.5

Tab. 2 Oil quantity

3.2 Grease

Hub		
Axle	Assembly	Grease quantity in g (approx.)
AV110	Hub	On each hub 90 up until 102
AV 133, AV 133 T		On each hub 125 up until 150

Tab. 3 Grease quantity

Hub
Hubs are supplied filled with lubricant. Only use lubricants according to manufacturer's instructions. The specified lubricating greases are listed in the ZF List of Lubricants: TE-ML 12.

3.3 Type plate

Position of the type plate

The type plate is on the axle housing.

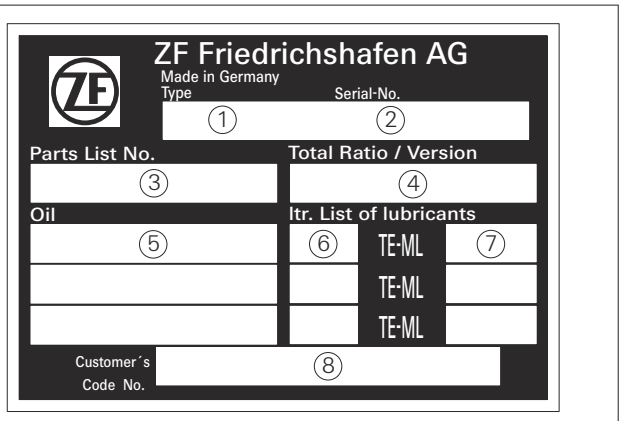

Fig. 1 Type plate

1 Product designation
2 Serial number
3 Parts list number
4 Transmission ratio
5 Oil specification
6 Approx. oil quantity for initial filling
7 Number of List of Lubricants
8 Customer spec. number, if known to ZF

The following data should be quoted when making inquiries or undertaking repairs: 1, 2, 3

4 Operation

4.1 Towing a vehicle

Before towing the vehicle, disconnect the driveline to prevent further mechanical damage. The named parts are needed on the AV 133 and AV 133 T axles to create an oil-tight seal.

The specifications in the Operating Instructions of the vehicle manufacturer are binding.

1. Loosen (1) bolted connection.
2. Pull flange shaft (2) out of the hub and remove it.
3. Grease 0634.303.940 [O-ring] and insert it into the annular groove on 4472.235.021 [Cover].
4. Insert 4472.235.021 [Cover] into the hub.
5. Fix 4472.235.021 [Cover] with two Torx screws (1).
   Tightening torque: **100 Nm**

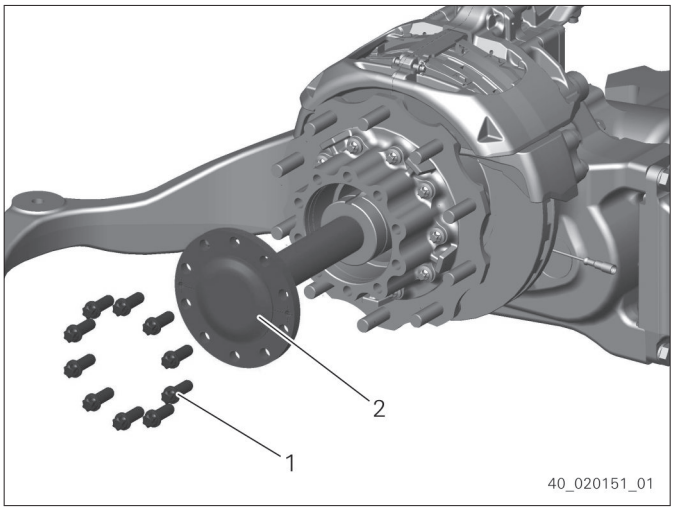

Fig. 2

4.2 Water contamination of the axle

In case of extreme influences water can penetrate into the axle. In case of normal weather and road conditions splash water does not cause any problems.

NOTICE

Possible damage to ZF product due to penetrating water.

⇨ If water is suspected in the ZF product, check oil.

If water has been detected in the axle, dismantle, clean and reassemble the compact bearing. The procedure is described in the Repair Instructions.

Observe the following points:

- In the following areas do **not** work with high pressure cleaner or steam cleaner:
  - Hubs(1)
  - Breather or breather connection (2)
  - Input flange(3)
- **Do not** use washing systems with high levels of water spraying in the areas (1), (2) and (3) e. g. intense underbody washing.
- **Do not** drive through floods or exceptional water accumulations.

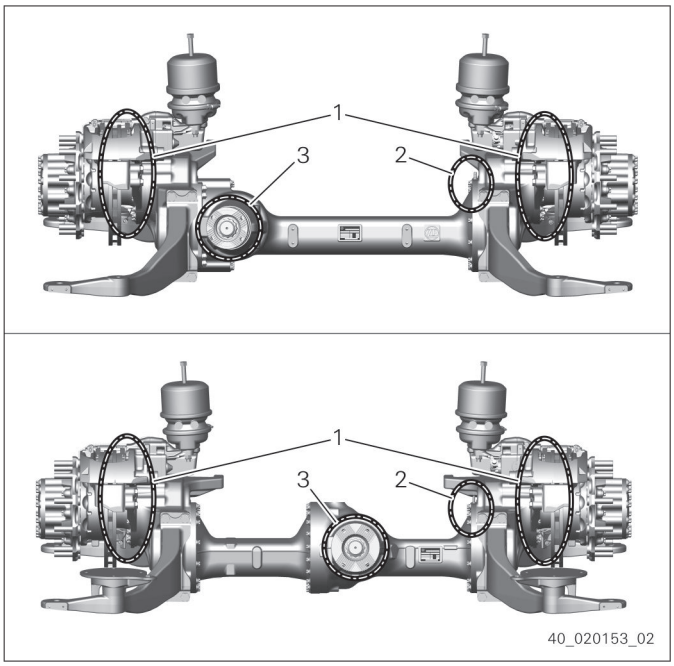

Fig. 3 AV 133, AV 133 T

Further potential reasons for penetration of water:

- Missing, wrongly installed or damaged breather hose
- Loose or damaged breather hose connections
- Blocked or damaged breather
- Damaged or worn seals
- Missing or wrongly installed cover when towing the vehicle and dismantled flange shafts
- Driving during very severe weather conditions

For further information refer to Service Information 08/09.

5 Maintenance

5.1 Checking oil level

- At least once a year
- When putting the vehicle into operation
- In case of new or repaired axles

Requirements:

- Axle is installed horizontally into the vehicle
- Vehicle is in horizontal position.
- Air pressure of all tires corresponds to the maximum value.

⚠ Observe the environmental regulations *(refer to section General safety instructions, page 6)*.

1.

⚠ CAUTION

Risk of burn injuries due to contact with hot surfaces.
Slight or moderate injury possible.
⇨ Wear protective gloves.

Thoroughly clean the screw plug oil level check.

2. Place a suitable container under the screw plug oil level check.

3.

⚠ CAUTION

Risk of burns due to contact with hot oil.
Slight or moderate injury possible.
⇨ Wear protective goggles.
⇨ Wear protective gloves.

Remove the screw plug oil level check (1) and remove the O-ring.

ℹ In case of the version with mounted breather, slight overpressure can build up in the axle.

4. Check the oil level. The oil level must correspond to the bottom edge of the oil level check hole.

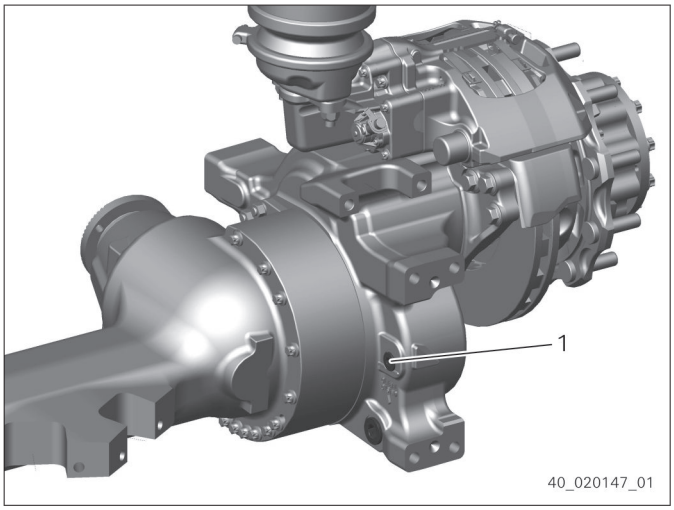

Fig. 4 Oil level check

1 Screw plug for ATF level check

If the oil level is not correct, fill or drain oil accordingly. Further information *(refer to section Oil change, page 13)*.

5. Renew O-ring on the screw plug oil level check (1).

6. Screw in screw plug oil level check (1) and tighten.
   Tightening torque: **70 Nm**

5.2 Oil change

5.2.1 Changing oil on the AV 110 and AV 133

Requirements:
- The axle is installed into the vehicle horizontally.
- Vehicle is in horizontal position.
- Axle is at operating temperature.

For intervals refer to ZF List of Lubricants TE-ML 12

Observe the environmental regulations *(refer to section General safety instructions, page 6)*.

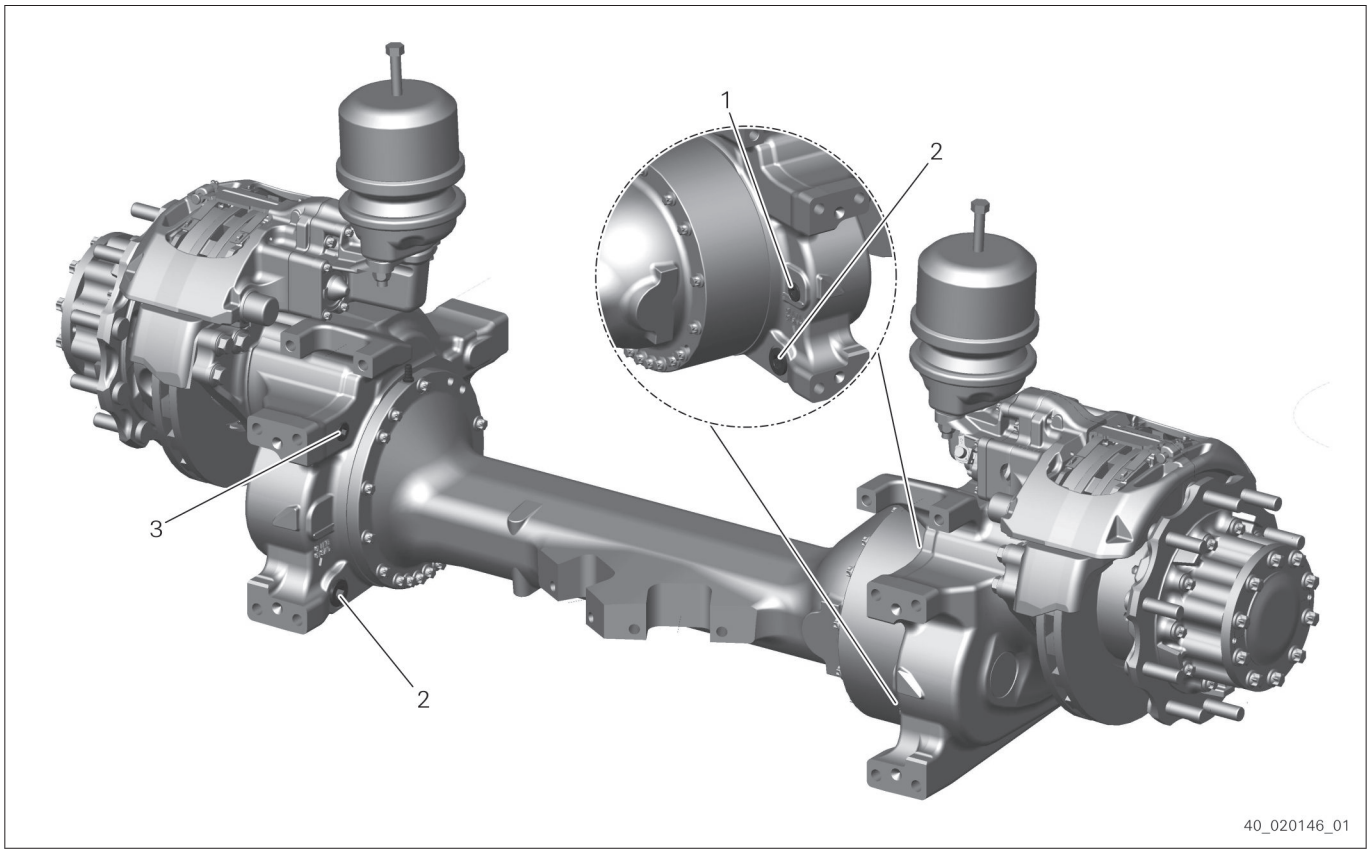

Fig. 5 AV133

1 Oil level screw plug
2 Oil drain screw plug
3 Oil fill screw plug

1.

⚠ CAUTION

Risk of burn injuries due to contact with hot surfaces.
Slight or moderate injury possible.
⇨ Wear protective gloves.

Thoroughly clean all screw plugs.

2. Place a suitable container under the oil drain screw plugs.

3.

⚠ CAUTION

Risk of burns due to contact with hot oil.
Slight or moderate injury possible.
⇨ Wear protective goggles.
⇨ Wear protective gloves.

Remove screw plug oil filling (3) and O-ring.

In case of the version with mounted breather, slight overpressure can build up in the axle.

4. Remove screw plug oil level (1) and O-ring.

5. Remove screw plugs oil drain (2) and O-ring.

6. Completely drain oil into the containers.

7. Renew O-rings on all screw plugs.

8. Screw in screw plugs oil drain (2) and tighten.
   Tightening torque: **130 Nm**

9. **NOTICE**

   The use of a non-approved lubricant can lead to property damage.
   ⇨ Only use lubricant from the currently valid ZF List of Lubricants.

   Slowly fill in oil at the oil filling hole until the bottom edge of the oil level hole (1) is reached.

10. Check oil level after some minutes and correct if necessary.

11. Screw in screw plug oil filling (3) and tighten.
    Tightening torque: **70 Nm**

12. Turn in screw plug oil level (1) and tighten.
    Tightening torque: **70 Nm**

5.2.2 Changing oil on the AV 133 T

Requirements:
- The axle is installed into the vehicle horizontally.
- Vehicle is in horizontal position.
- Axle is at operating temperature.

For intervals refer to ZF List of Lubricants TE-ML 12

Observe the environmental regulations *(refer to section General safety instructions, page 6)*.

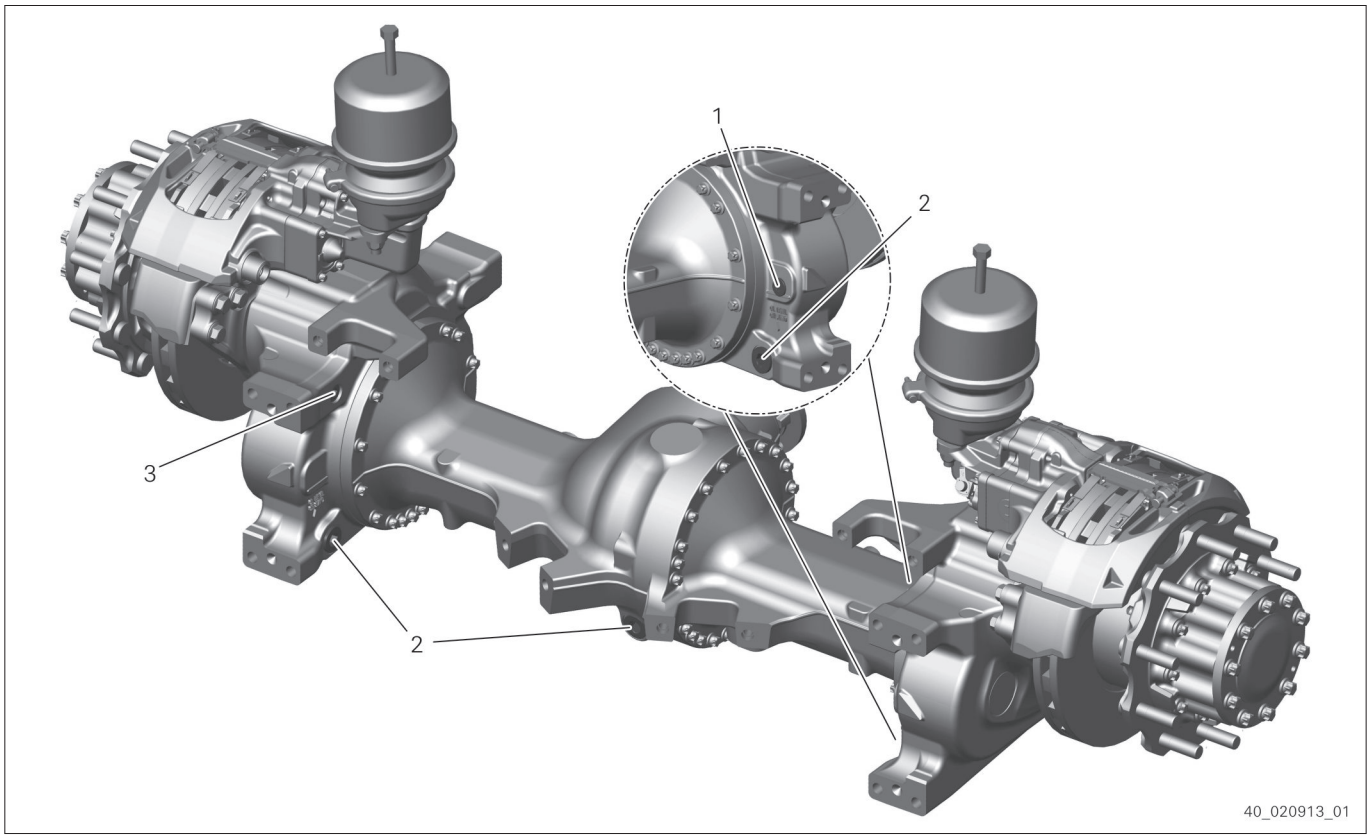

Fig. 6 AV 133 T

1 Screw plug oil level
2 Oil drain screw plug
3 Oil fill screw plug

1.

⚠ CAUTION

Risk of burn injuries due to contact with hot surfaces.
Slight or moderate injury possible.
⇨ Wear protective gloves.

Thoroughly clean all screw plugs.

2. Place a suitable container under the oil drain screw plugs.

3.

⚠ CAUTION

Risk of burns due to contact with hot oil.
Slight or moderate injury possible.
⇨ Wear protective goggles.
⇨ Wear protective gloves.

Remove screw plug oil filling (3) and O-ring.

In case of the version with mounted breather, slight overpressure can build up in the axle.

4. Remove screw plug oil level (1) and O-ring.

5. Remove screw plugs oil drain (2) and O-ring.

6. Completely drain oil into the containers.

7. Renew O-rings on all screw plugs.

8. Screw in screw plugs oil drain (2) and tighten.
   Tightening torque: **130 Nm**

9. **NOTICE**

   The use of a non-approved lubricant can lead to property damage.
   ⇨ Only use lubricant from the currently valid ZF List of Lubricants.

   Slowly fill in oil at the oil filling hole until the bottom edge of the oil level hole (1) is reached.

10. Check oil level after some minutes and correct if necessary.

11. Screw in screw plug oil filling (3) and tighten.
    Tightening torque: **70 Nm**

12. Turn in screw plug oil level (1) and tighten.
    Tightening torque: **70 Nm**

5.3 Breather

5.3.1 Checking breather

During maintenance work on the axle check breather.

1. Check breather for damage.
   Check tubes on the breather for:
   - Chafe marks
   - Kinks
   - Bottlenecks
   - Cracks and holes

2. Check to ensure that end of breather hose is in a dust-free and dry room.

Repair damage.
Change position of end of breather hose.
Check oil for water contamination.

5.3.2 Replacing filter (version with mounted breather)

During maintenance work on the axle, replace the breather filter.

1. Press fixing clamps on the bracket apart and pull the cover (1) from the bracket.
2. Remove filter.
3. Apply light coat of grease to O-ring on filter.
4. Insert new filter into the bracket with the handle pointing outwards until contact is obtained.
5. Push the cover (1) onto the bracket, until the fixing clamps engage.

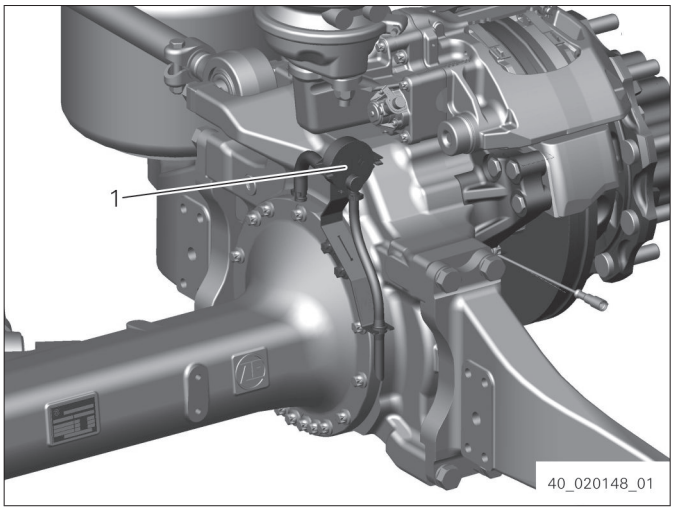

Fig. 7 AV 133 Breather

5.4 Change grease

The grease in the hub can only be changed, if the hub is removed and completely dismantled. The procedure is described in the Repair Instructions (see document overview).

Change the grease:

- If grease is leaking on the shaft seal on the brake disk side
- If the brake has overheated. This is the case, for example, with burnt pressure piece bellows.
- After the regular interval

For intervals refer to ZF List of Lubricants TE-ML 12

6 Inspection

6.1 Lifting vehicle

When the vehicle is lifted on the axle, permitted max. axle load is 10 t. Do NOT position lifting jacks on other points than those marked:

6.1.1 Lifting vehicle with axle AV 110 or AV 133

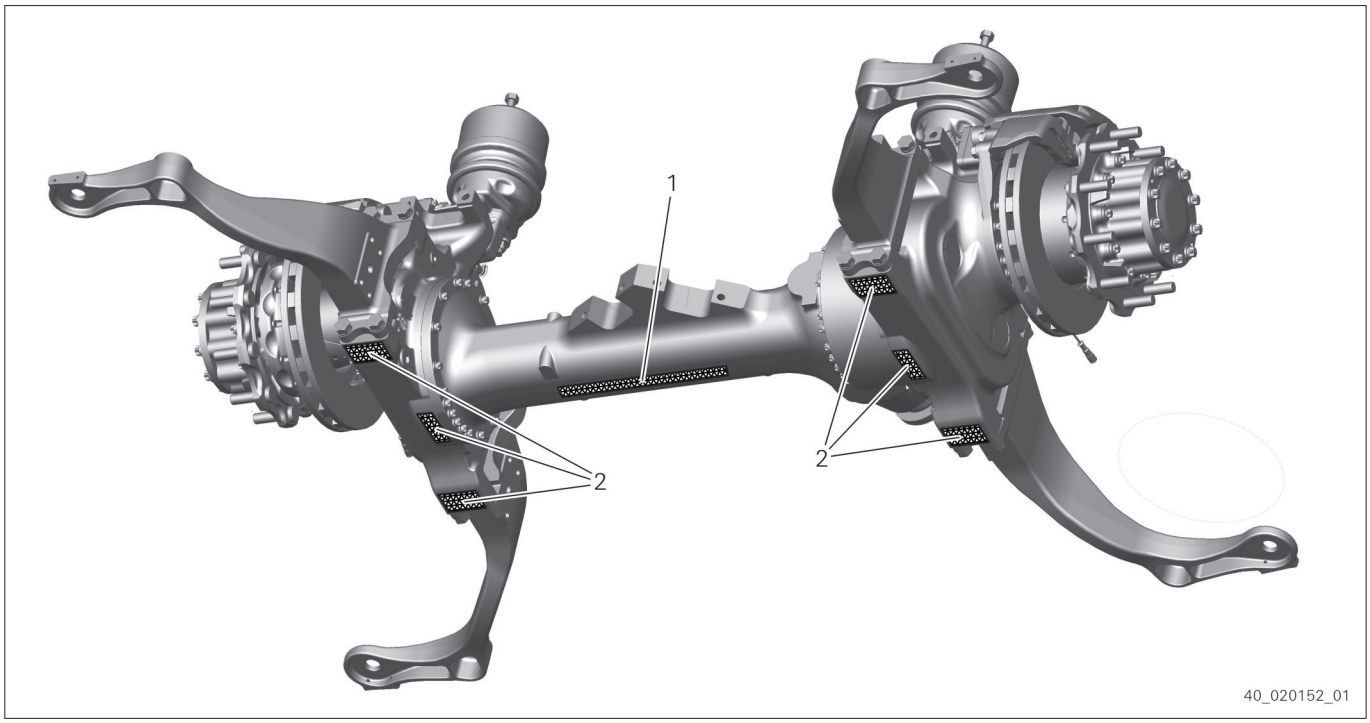

Fig. 8 AV 133

Depending on the lifting jack point, the contact surface of the lifting jacks must have the following minimum sizes:

- On the small lifting jack points (2) 35 cm², e.g. 5 cm x 7 cm or Ø 7 cm
- On the large lifting jack point (1) 160 cm², e.g. 40 cm x 4 cm

6.1.2 Lifting vehicle with axle AV 133 T

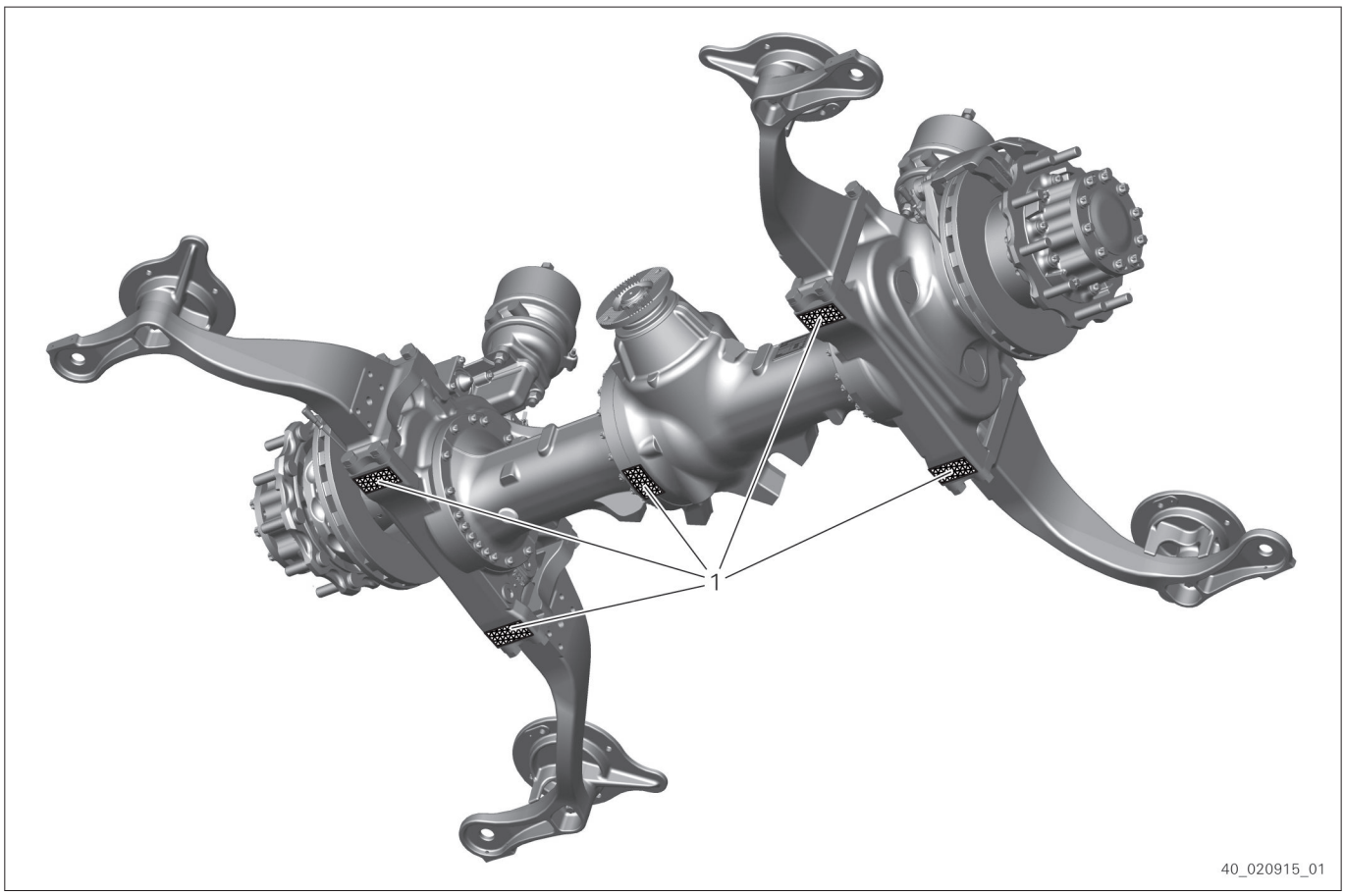

Fig. 9 AV 133 T

Ensure that the contact surface (1) of the lifting jacks is at least 35 cm², e. g. 5 cm x 7 cm or Ø 7 cm.

6.2 Check shaft seal of the hub

When exchanging the brake disk, check the shaft seal at the brake disk side.

1. A slight grease collar of approx. 1 mm is permitted.

   Check shaft seal at the brake disk side for grease leakage.
   If grease is leaking, check the compact bearing.

6.3 Checking compact bearing

Check axial play of the compact bearing in case of:

- ABS-error message
- Increasing noise development with increasing speed

- Exchange of brake disk
- Repairs on the brake

Requirements:

- The wheel is lifted.
- The brake linings do **not** make contact with the brake disk.

Observe the environmental regulations *(refer to section General safety instructions, page 6)*.

1. Loosen wheel nuts and remove the wheel.
2. Loosen screws on the flange shaft.
3. Pull flange shaft out of the hub (2) and remove it.
4. Fix magnetic stand (1) on the hub (2).
5. Place dial gauge (3) on the front side surface of the hub carrier.
6. Push hub (2) towards the axle with both hands and rotate it by approx. 20° to 30° in both directions several times.
7. Set dial gauge (3) to zero.
8. Use both hands to pull hub (2) away from the axle and rotate it approx. 20° to 30° in both directions several times.
9. Read axial play on the dial gauge (3).
10. Repeat measurement three times. Between the individual measurements rotate the hub (2) several times in both directions.
11. Calculate mean value of the four values. The result is the axial play of the compact bearing.

    In case of an axial play of more than 0.20 mm change compact bearing. For the procedure refer to the Repair Instructions *(refer to section Document overview, page 4)*.

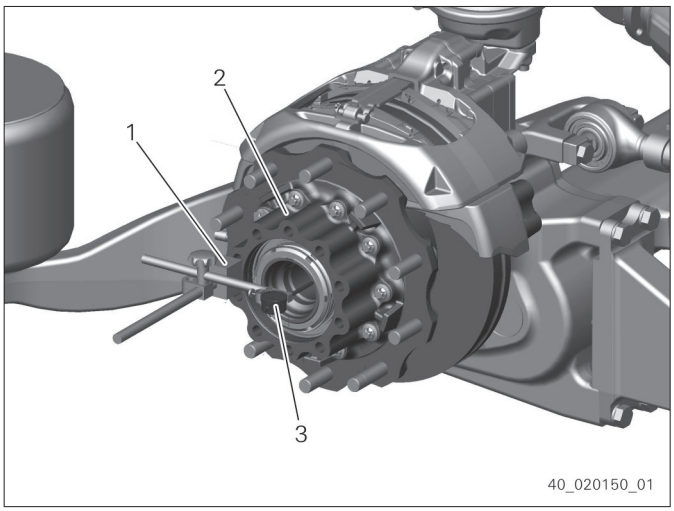

Fig. 10

6.4 Check wheel studs and wheel nuts

During maintenance work on the axle check wheel studs and wheel nuts.

Do not oil or grease wheel studs or wheel nuts.

1. Check wheel studs and wheel nuts for corrosion.
   Exchange severely corroded wheel studs and wheel nuts. For the procedure refer to the Repair Instructions.

7 Workshop Equipment

7.1 New parts

The following new parts are not listed in the spare parts catalog.

Order no.	For axle	Quantity	Designation	Chapter/Section
4472.235.021	AV 133, AV 133 T	2	Cover	*(refer to section Towing a vehicle, page 10)*
0634.303.940	AV 133, AV 133 T	2	O-ring (suitable for cover)	*(refer to section Towing a vehicle, page 10)*
0501.330.611	AV 110, AV 133, AV 133 T	1	Filter incl. O-ring	*(refer to section Replacing filter (version with mounted breather), page 18)*

Tab. 4

8 Tightening Torques

Designation	Tightening torque	Measuring instrument	Comment Chapter/Section
Torx screws M18 x 1.5 x 45	100 Nm	Torque wrench	Securing of cover 4472.235.021 ▪ Towing a vehicle, page 10
Screw plug oil filling M24 x 1.5	70 Nm	Torque wrench	▪ Checking oil level, page 12
Oil drain screw plug M36 x 1.5	130 Nm	Torque wrench	▪ Changing oil on the AV 110 and AV 133, page 13 ▪ Changing oil on the AV 133 T, page 15
Oil fill screw plug M24x1.5	70 Nm	Torque wrench	▪ Changing oil on the AV 110 and AV 133, page 13 ▪ Changing oil on the AV 133 T, page 15
Screw plug oil level M24 x 1.5	70 Nm	Torque wrench	▪ Changing oil on the AV 110 and AV 133, page 13 ▪ Changing oil on the AV 133 T, page 15

9 Annex

9.1 Overview of revisions

index	Date of issue	Initiator	Chapter/Section	Comment
a	09.2015	—	—	First issue
b	09.2016	—	All	Document no. corrected in footer and on cover page.
			Oil change	Editorial adaptations implemented.
			Oil grade	Editorial adaptations implemented.
c	03.2017	—	—	AV 133 T added.
			All	Editorial adaptations implemented.

Tab. 5

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ISUZU

ISUZU ACADEMY TECH CENTER

CITIPORT



WORKSHOP MANUAL

REAR AXLE AND

SUSPENSION

REPAIR MANUAL

ZF – DROP CENTER AXLE AV-132/AV-132 T

Version: wheel head with compact bearing

Information:

Due to the great variety of ZF units it is necessary to limit disassembly and reassembly manuals to a current ZF production unit.
This documentation has been developed for specialized staff trained by ZF for repair work to be done on ZF units.
Continuous technical upgrading of the ZF units and extensions concerning design options may require both deviating work steps and differing setting and testing data.

This disassembly and reassembly manual is based on the design level of a ZF production unit at the time of issue of the manual**.**

ZF Friedrichshafen AG reserves the right to replace this disassembly and reassembly manual by a successive edition at any time without advance notice. Upon request, ZF Friedrichshafen AG will advise which edition is the latest one.

Any maintenance work is to be done in accordance with ZF's Operating Instructions
(ZF order no. 5871 214 901) and **ZF List of Lubricants TE-ML 12**.

The ZF list of lubricants is being continuously updated and can be obtained or viewed as follows:
- at all ZF plants
- at all ZF Service Organizations
- Internet **www.zf.com**

For service and maintenance work on the brake system, always observe the specifications of the brake manufacturer as well as of the vehicle manufacturer.

ATTENTION:

Observe the vehicle manufacturer's instructions and specifications for the installation and commissioning of the unit!

ZF Friedrichshafen AG
ZF Services
Donaustr. 71
D - 94034 Passau

Section.: MAIP21

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PREFACE

This documentation has been developed for specialized staff trained by ZF Passau for repair and maintenance work to be done on ZF units.

This manual describes a ZF series product with a design level valid at the date of edition

Due to the continuous technical upgrading of the product, however, the repair of the unit at your disposal may require both deviating work steps and differing setting and testing data.

We would therefore recommend you to entrust masters and servicemen with the work on your ZF product whose practical and theoretical training is constantly updated in our training school.

The Service Stations established by ZF Friedrichshafen all over the world offer you:

1. Permanently trained staff
2. Specified equipment, e.g. special tools
3. Stat-of-the-art genuine ZF spare parts

All work is done there with utmost care and reliability.

In addition, repair work carried out by ZF Service Stations is covered by the ZF warranty within the terms of the currently applicable contractual conditions.

Any damage resulting from work which is done in an improper and unprofessional manner by third parties and any consequential costs incurred are excluded from this contractual liability.
This shall also be applicable if other than genuine ZF spare parts are used.

ZF Passau GmbH

Service Department

GENERAL

The Service Manual covers all work required for disassembly and the relating reassembly.

When repairing the unit, ensure utmost cleanliness and excellent workmanship. Dismantle the unit only if any damaged parts must be replaced. After removing screws or nuts, loosen lids and housing parts which were installed with seals by slight blows with a plastic hammer. Use suitable pulling devices for removing parts being tightly installed on the shafts, such as bearings, bearing rings and similar.

Carry out disassembly and reassembly work on a clean working place. Use special tools which have been developed for this purpose. Prior to reinstallation of the parts, clean contact faces of housings and lids from residues of seals. Remove any burrs or similar irregularities with an oil stone. Clean housings and end covers, in particular corners and angles, with a suitable detergent. Damaged or heavily worn parts must be replaced, with an expert assessing whether parts subject to normal wear during operation, such as bearings, thrust washers etc. will be reinstalled.

Parts such as seal rings, locking plates, split pins etc. must generally be replaced. Radial seal rings with worn or broken sealing lip must also be renewed. In particular, ensure that no chips or other foreign bodies remain in the housing. Check the lube oil holes and grooves regarding unhindered passage.
Oil according to the relating List of Lubricants shall be applied to all bearings prior to their installation:

NOTE: Only a heating furnace or an electric drier is permitted for heating parts such as bearings, housings, etc!
Parts fitted in heated state must be readjusted after cooling down to ensure a perfect contact.

CAUTION:
When assembling the unit, exactly observe the tightening torques and setting data indicated in the manual. Tighten screws and nuts according to the enclosed standard table, unless otherwise specified.
The use of fluid seals or Molykote is not permitted for the control part in the transmissions due to a possible malfunction.

Never wash clutch plates having organic friction linings (e.g. paper linings) (adverse effect on lining adhesion).
Only dry-cleaning is permitted (leather cloth).



DANGER
When using detergents, observe the manufacturer's instructions regarding their handling.

Structure of the Repair Manual

The structure of this repair manual reflects the sequence of work steps for completely dismantling the removed unit.

Special tools required for carrying out the repair work are listed in the current text as well as in chapters "W" (List of Special Tools) and "WB" (Commercial Tools).

Important information on labor safety

As a basic principle, the workshop carrying out the repair or maintenance of ZF units shall be fully responsible for labor safety.
The observance of all valid safety regulations and legal requirements is a prerequisite for avoiding any damage to persons and products during maintenance and repair work.
Repair workshops must familiarize themselves with these regulations prior to starting any work.

A suitably trained and skilled staff is required for a proper repair of these ZF products.
The repair workshop shall be responsible for the training.

The following safety references are used in this manual:

☞ ***CAUTION***	This symbol serves as a **reference** to special working procedures, methods, information, use of auxiliaries etc... indicated in this repair manual.

⚠ ***DANGER***	This symbol identifies situations in which lacking care may lead to **personal injury or damage to the product**.

NOTE:	Thoroughly study this manual before starting any inspections or repair work.

NOTE:	Figures, drawings and parts in this manual do not always represent the original; they show the working procedure. Since the figures, drawings and parts are not shown to scale, do not draw any conclusions on size and weight (not even within one and the same illustration). Carry out work according to the legend.

NOTE:	After repair work and tests, the expert staff must verify that the product is perfectly functioning again.

TRAGBILDBEISPIELE ZUR GLEASONVERZAHNUNG

CONTACT PATTERN EXAMPLES OF GLEASON GEAR-TOOTH SYSTEM

EXEMPLES POUR LA DENTURE GLEASON

Ideales Tragbild d.h. die Ritzeldistanz stimmt

Ideal tooth-contact pattern i.e. pinion distance is correct

Portée idéale, c'est-à-dire la distance du pignon est correcte

Bild / Figure 1/3/5

Schubflanke (Konkav)

Coast side (concave)

Côté poussé (concave)

Bild / Figure 1



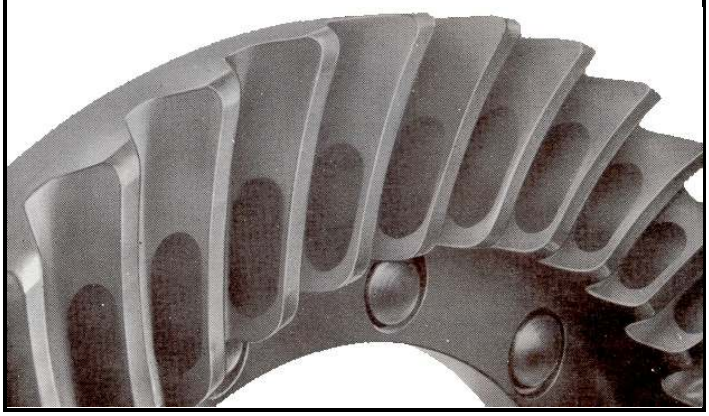
Bild / Figure 2/4/6

Zugflanke (Konvex)

Drive side (convex)

Côté entraîné (convexe)

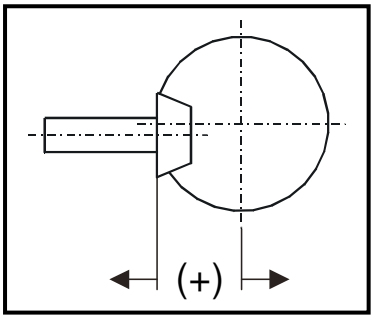
Bild / Figure 2



Ritzeldistanz muß größer werden

Pinion distance must be increased

La distance du pignon doit être augmentée



Ritzeldistanz muß kleiner werden

Pinion distance must be decreased

La distance du pignon doit être diminuée

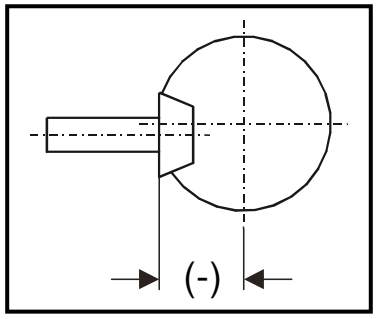


Bild / Figure 3



Bild / Figure 5



Bild / Figure 4

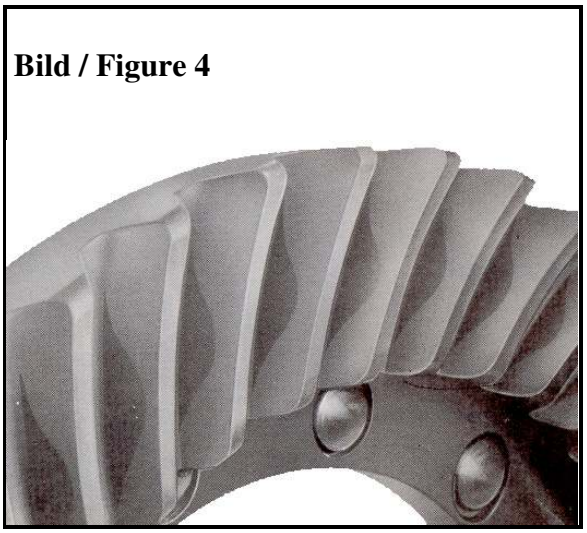
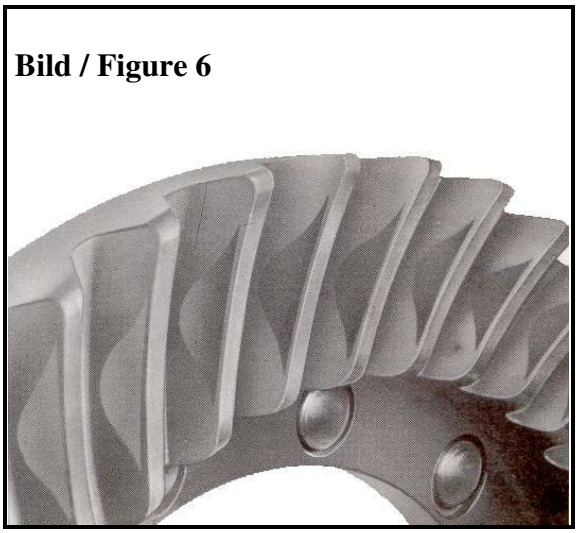


Bild / Figure 6



VERGLEICHSTABELLE FÜR MASSEINHEITEN
CONVERSION TABLE
TABLEAU DE CONVERSION

25.40 mm	=	1 in (inch)
1 kg (kilogram)	=	2.205 lb (pounds)
9.81 Nm (1 kpm)	=	7.233 lbf x ft (pound force foot)
1.356 Nm (0.138 kpm)	=	1 lbf x ft (pound force foot)
1 kg / cm	=	5.560 lb / in (pound per inch)
1 bar (1.02 kp/cm^2)	=	14.5 psi (pound force per square inch lbf/in^2)
0.070 bar (0.071 kp/cm^2)	=	1 psi (lbf/in^2)
1 liter	=	0.264 gallons (Imp.)
4.456 liters	=	1 gallon (Imp.)
1 liter	=	0.220 gallons (US)
3.785 liter	=	1 gallon (US)
1609.344 m	=	1 mile (land mile)
0° C (Celsius)	=	+ 32° F (Fahrenheit)
0 ° C (Celsius)	=	273.15 Kelvin

BEZEICHNUNG DER GESETZLICHEN EINHEITEN
DENOMINATION OF STANDARD DIMENSIONS
DENOMINATION DES DIMENSIONS STANDARDISEES

Hinweis : längenbezogene Maße in kg/m; flächenbezogene Maße in t/m^2

Note : linear density in kg/m; areal density in t/m^2

Nota : Densité linéaire en kg/m; Densité superficielle en t/m^2

Begriff **Unit** **Unité**	**Formelzeichen** **Formula Sign** **Symbole**	**neu** **New** **Nouveau**	**alt** **old** **Vieux**	**Umrechnung** **Conversion** **Conversion**	**Bemerkungen** **Note** **Nota**
Masse Density Densité	m	kg (Kilogramm)	kg		
Kraft Force Force	F	N (Newton)	kp	1 kp = 9.81 N	
Arbeit Work Travail	A	J (Joule)	kpm	0.102 kpm = 1J = 1 Nm	
Leistung Power Puissance	P	KW (Kilowatt)	PS (DIN)	1 PS = 0.7355 KW 1 KW = 1.36 PS	
Drehmoment Torque Couple	T	Nm (Newtonmeter)	kpm	1 kpm = 9.81 Nm	T (Nm) = F (N) . r (m)
Kraftmoment Moment (Force) Moment (Force)	M	Nm (Newtonmeter)	kpm	1 kpm = 9.81 Nm	M (Nm) = F (N) . r (m)
Druck (Über-) Pressure (Over-) Pression (Sur-)	pü	bar	atü	1.02 atü = 1.02 kp/cm^2 = 1 bar = 750 torr	
Drehzahl Speed Nombre de Tours	n	min^{-1}			

TIGHTENING TORQUES FOR SCREWS (in Nm) ACC. TO ZF-STANDARD 148

Friction coefficient: μ tot.= 0.12 for screws and nuts without subsequent treatment. as well as phosphated nuts. Tighten manually!

Unless otherwise specified, the tightening torques can be taken from the following chart:

Metric ISO-standard thread DIN 13. page 13

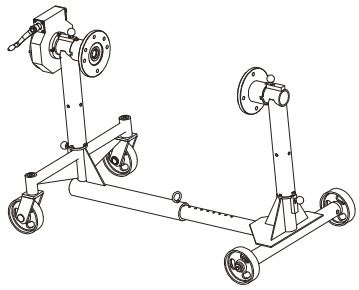
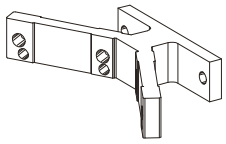
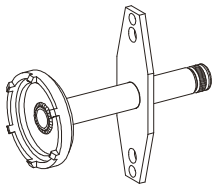
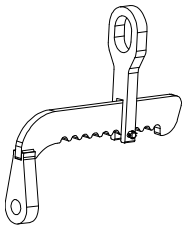
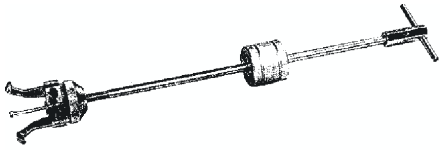
Size	8.8		10.9		12.9
M4	2.8		4.1		4.8
M5	5.5		8.1		9.5
M6	9.5		14		16.5
M7	15		23		28
M8	23		34		40
M10	46		68		79
M12	79		115		135
M14	125		185		215
M16	195		280		330
M18	280		390		460
M20	390		560		650
M22	530		750		880
M24	670		960		1100
M27	1000		1400		1650
M30	1350		1900		2250
M33	1850		2600		3000
M36	2350		3300		3900
M39	3000		4300		5100

Metric ISO- fine thread DIN 13. page 13

Size	8.8		10.9		12.9
M 8 x 1	24		36		43
M 9 x 1	36		53		62
M 10 x 1	52		76		89
M 10 x 1.25	49		72		84
M 12 x 1.25	87		125		150
M 12 x 1.5	83		120		145
M 14 x 1.5	135		200		235
M 16 x 1.5	205		300		360
M 18 x 1.5	310		440		520
M 18 x 2	290		420		490
M 20 x 1.5	430		620		720
M 22 x 1.5	580		820		960
M 24 x 1.5	760		1100		1250
M 24 x 2	730		1050		1200
M 27 x 1.5	1100		1600		1850
M 27 x 2	1050		1500		1800
M 30 x 1.5	1550		2200		2550
M 30 x 2	1500		2100		2500
M33 x 1.5	2050		2900		3400
M 33 x 2	2000		2800		3300
M 36 x 1.5	2700		3800		4450
M 36 x 3	2500		3500		4100
M 39 x 1.5	3450		4900		5700
M 39 x 3	3200		4600		5300

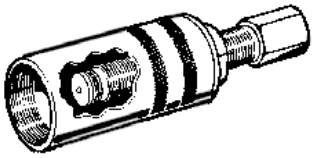
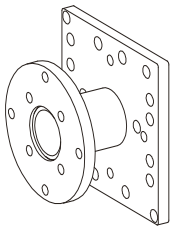
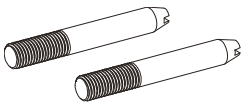
SPECIAL TOOLS FOR DISASSEMBLY AND REASSEMBLY

AV-132/AV-132 T
4472 036 072/4472 036 577

Cons. No.	Figure	Designation Order no.	Qty.	Chapter/Fig
1		**Assembly truck assy** With tilting device **5870 350 000**	1	1/1 1/20
2		**Support** **5870 350 093**	1	1/1
3		**Slotted nut wrench** **5870 401 146**	1	1/6 2/93
4		**Lifting bracket** **5870 281 043**	1	1/7 2/92
5		**Striker** **5870 650 004**	1	1/16 1/29

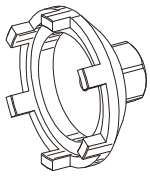
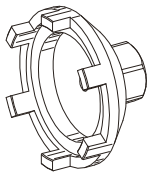
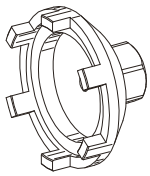
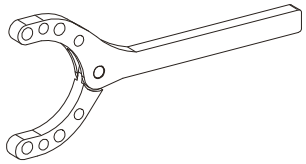
SPECIAL TOOLS FOR DISASSEMBLY AND REASSEMBLY

AV-132/AV-132 T
4472 036 072/4472 036 577

Cons. No.	Figure	Designation Order no.	Qty.	Chapter/Fig
6		**Rapid grip** **5873 012 013**	1	1/18
7		**Basic tool** **5873 002 001**	1	1/18 1/26 1/35 4/1
8		**Clamping plate** **5870 350 119**	1	1/20
9		**Locating pins** M14 **5870 204 022**	1	1/20 2/56
10		**Rapid grip** **5873 002 052**	1	1/26 4/1

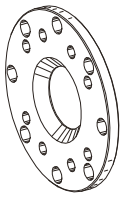
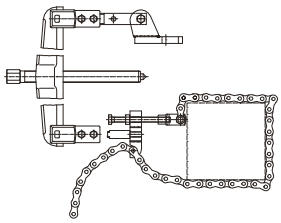
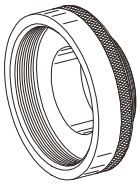
SPECIAL TOOLS FOR DISASSEMBLY AND REASSEMBLY

AV-132/AV-132 T
4472 036 072/4472 036 577

Cons. No.	Figure	Designation Order no.	Qty.	Chapter/Fig
11		**Rapid grip** **5873 002 025**	1	1/26 4/1
12		**Slotted nut wrench** Ø 86 **5870 401 093**	1	1/30 2/12 2/43
13		**Slotted nut wrench** Ø 84 **5870 401 173**	1	1/30 2/12 2/43
14		**Slotted nut wrench** Ø 81 **5870 401 139**	1	1/30 2/12 2/43
15		**Clamping fork** **5870 240 002**	1	1/30 2/12 2/43

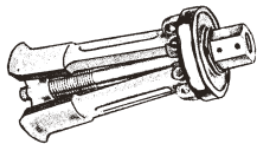
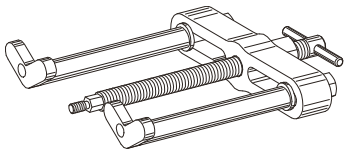
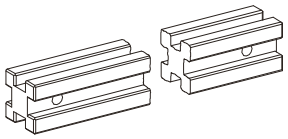
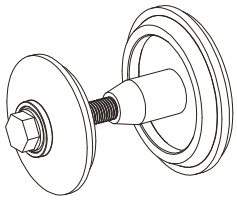
SPECIAL TOOLS FOR DISASSEMBLY AND REASSEMBLY

AV-132/AV-132 T
4472 036 072/4472 036 577

Cons. No.	Figure	Designation Order no.	Qty.	Chapter/Fig
16		**Centering disk** **5870 912 015**	1	1/30 2/12 2/43
17		**Forcing device** **5870 080 044**	1	1/33
18		**Grab sleeve** For bearing 0735 371 894 **5873 003 022**	1	1/35
19		**Reducing adapter** For grab sleeve 5873 003 022 **5873 003 011**	1	1/35
20		**Grab sleeve** for bearing 0750 117 860 **5873 002 051**	1	1/35

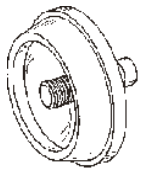
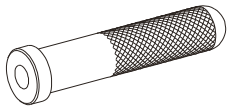
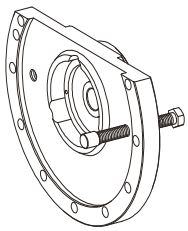
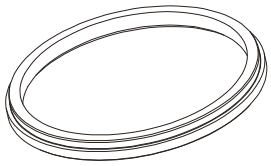
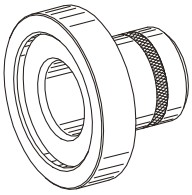
SPECIAL TOOLS FOR DISASSEMBLY AND REASSEMBLY

AV-132/AV-132 T
4472 036 072/4472 036 577

Cons. No.	Figure	Designation Order no.	Qty.	Chapter/Fig
21		**Internal extractor** **5870 300 019**	1	1/36
22		**Counter support** **5870 300 020**	1	1/36
23		**Straightedge** L = 580 mm **5870 200 022**	1	2/4 2/64 2/73
24		**Assembly fixture** **5870 345 080**	1	2/7
25		**Reducing adapter** 1/2 ″ - 1/4 ″ **5870 656 056**	1	2/13 2/40

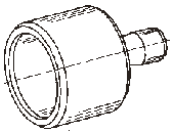
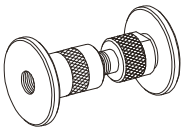
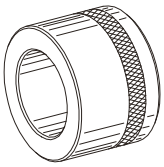
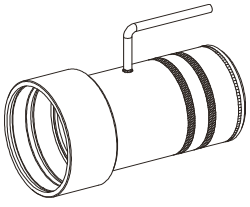
SPECIAL TOOLS FOR DISASSEMBLY AND REASSEMBLY

AV-132/AV-132 T
4472 036 072/4472 036 577

Cons. No.	Figure	Designation Order no.	Qty.	Chapter/Fig
26		**Driver tool** **5870 058 078**	1	2/25
27		**Handle** **5870 260 002**	1	2/25 2/42
28		**Test equipment** **5870 200 121**	1	2/28 2/30 2/31
29		**Adapter ring** (just for AV-132 T) **AA00 692 068**	1	2/28
30		**Driver tool** **5870 048 216**	1	2/41

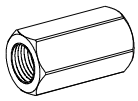
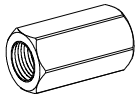
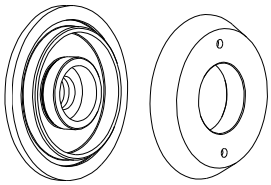
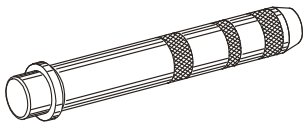
SPECIAL TOOLS FOR DISASSEMBLY AND REASSEMBLY

AV-132/AV-132 T
4472 036 072/4472 036 577

Cons. No.	Figure	Designation Order no.	Qty.	Chapter/Fig
31		**Driver tool** **5870 056 008**	1	2/42
32		**Assembly fixture** **5870 345 103**	1	2/47
33		**Plug gauge** **5870 200 094**	1	2/52
34		**Measuring bar** **5870 200 127**	1	2/61 2/63
35		**Pressing fixture** **5870 506 162**	1	2/68

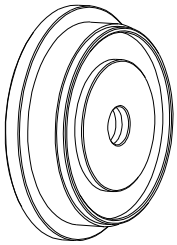
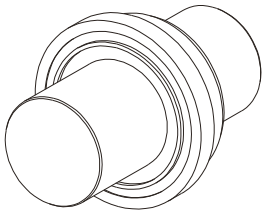
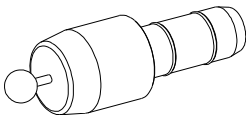
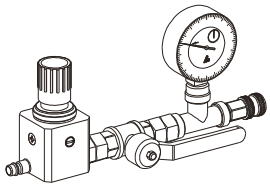
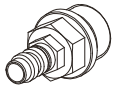
SPECIAL TOOLS FOR DISASSEMBLY AND REASSEMBLY

AV-132/AV-132 T
4472 036 072/4472 036 577

Cons. No.	Figure	Designation Order no.	Qty.	Chapter/Fig
36		**Assembly fixture** **5870 610 010**	1	2/77
37		**Insert** M22x1.5 **5870 610 002**	1	2/77
38		**Insert** 7/8 – 11 BSF **5870 610 008**	1	2/77
39		**Driver tool** **5870 050 007**	1	2/80
40		**Handle** **5870 260 004**	1	2/80

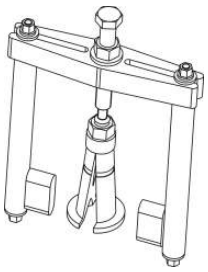
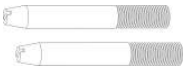
SPECIAL TOOLS FOR DISASSEMBLY AND REASSEMBLY

AV-132/AV-132 T
4472 036 072/4472 036 577

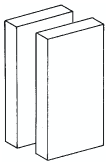
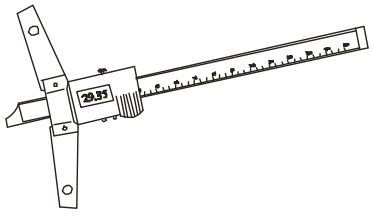
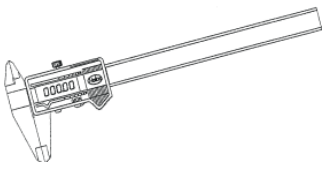
Cons. No.	Figure	Designation Order no.	Qty.	Chapter/Fig
41		**Driver tool** **5870 051 053**	1	2/87 2/88
42		**Driver tool** **AA00 607 922**	1	2/87 2/88
43		**Assembly aid** **5870 651 085**	1	2/91
44		**Air connection** **5870 286 079**	1	2/99
45		**Reducing adapter** M24x1.5 **5870 286 080**	1	2/99

SPECIAL TOOLS FOR DISASSEMBLY AND REASSEMBLY

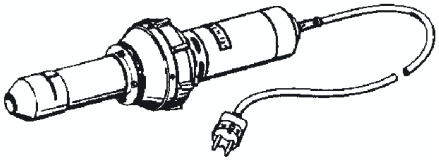
AV-132/AV-132 T
4472 036 072/4472 036 577

Cons. No.	Figure	Designation Order no.	Qty.	Chapter/Fig
46		**Pulling device** **5870 080 067**	1	4/4
47		**Locating pin** **AA00 622 210**	2	4/15
48		**Locating pins** M14x1.5 **5870 204 025**	1	4/16

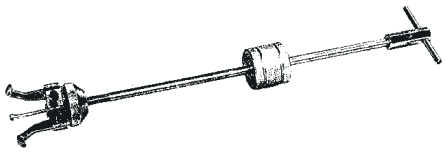
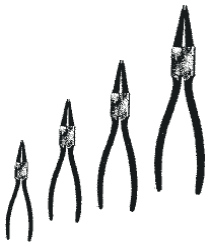
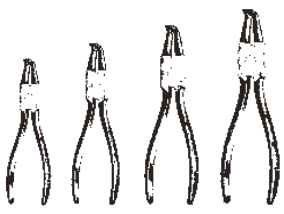
COMMERCIAL TOOLS FOR DISASSEMBLY AND REASSEMBLY

Cons. No.	Figure	Designation Order no.	Qty	Chapter/Fig.
1		**Magnetic stand** **5870 200 055**	1	Universal
2		**Dial indicator** **5870 200 057**	1	Universal
3		**Gauge blocks** **5870 200 066** 70 mm **5870 200 067** 100 mm	1	Universal
4		**Digital depth gauge** **5870 200 072** 200 mm **5870 200 114** 300 mm	1	Universal
5		**Digital caliper gauge** **5870 200 109** 150 mm	1	Universal

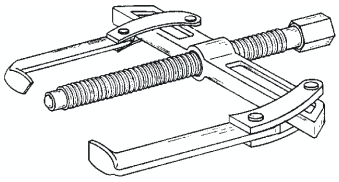
COMMERCIAL TOOLS FOR DISASSEMBLY AND REASSEMBLY

Cons. No.	Figure	Designation Order no.	Qty	Chapter/Fig.
6		**Torque wrench** **5870 203 030** 0.6 -6.0 Nm **5870 203 031** 1.0 – 12 Nm **5870 203 032** 3.0 – 23 Nm **5870 203 033** 5.0 – 45 Nm **5870 203 034** 10 – 90 Nm **5870 203 039** 80 – 400 Nm **5870 203 016** 140 – 750 Nm **5870 203 011** 750 - 2000 Nm	1	Universal
7		**Hot air blower** **5870 221 500** 230 V **5870 221 501** 115 V	1	Universal
8		**Plastic hammer** **5870 280 004** Ø 60 mm **Substitute nylon insert** **5870 280 006**	1	Universal
9		**Lifting strap** **5870 281 026**	1	Universal

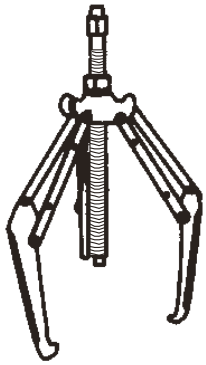
COMMERCIAL TOOLS FOR DISASSEMBLY AND REASSEMBLY

Cons. No.	Figure	Designation Order no.	Qty	Chapter/Fig.
10		**Lifting chain** **5870 281 047**	1	Universal
11		**Pry bar** **5870 345 071**	1	Universal
12		**Striker** **5870 650 004**	1	Universal
13		**Set of internal pliers** I1-I2-I3-I4 **5870 900 013**	1	Universal
14		**Set of internal pliers** I11-I21-I31-I41 90° **5870 900 014**	1	Universal

COMMERCIAL TOOLS FOR DISASSEMBLY AND REASSEMBLY

Cons. No.	Figure	Designation Order no.	Qty	Chapter/Fig.
15		**Set of external pliers** A1-A2-A3-A4 **5870 900 015**	1	Universal
16		**Set of external pliers** A01-A02-A03-A04 90° **5870 900 016**	1	Universal
17		**Two-armed puller** **5870 970 001** Jaw width 80 mm Throat depth 100 mm **5870 970 002** Jaw width 120 mm Throat depth 125 mm **5870 970 003** Jaw width 170 mm Throat depth 125 mm **5870 970 004** Jaw width 200 mm Throat depth 175 mm **5870 970 006** Jaw width 350 mm Throat depth 250 mm **5870 970 007** Jaw width 520 mm Throat depth 300 - 500 mm **5870 970 026** Jaw width 250 mm Throat depth 200 mm **5870 970 028** Jaw width 380 mm Throat depth 200 mm	1	Universal

COMMERCIAL TOOLS FOR DISASSEMBLY AND REASSEMBLY

Cons. No.	Figure	Designation Order no.	Qty	Chapter/Fig.
18		**Three armed puller** **5870 971 001** Jaw width 85 mm Throat depth 65 mm **5870 971 002** Jaw width 130 mm Throat depth 105 mm **5870 971 003** Jaw width 230 mm Throat depth 150 mm **5870 971 004** Jaw width 295 mm Throat depth 235 mm **5870 971 005** Jaw width 390 mm Throat depth 270 mm **5870 971 006** Jaw width 640 mm Throat depth 300 mm	1	Universal

1. DISASSEMBLY



Figure 1

Fix axle on the assembly truck.

(S) Assembly truck	5870 350 000
(S) Support	5870 350 093

Drain oil.

Oil to be disposed of ecologically and in accordance with the legal provisions!

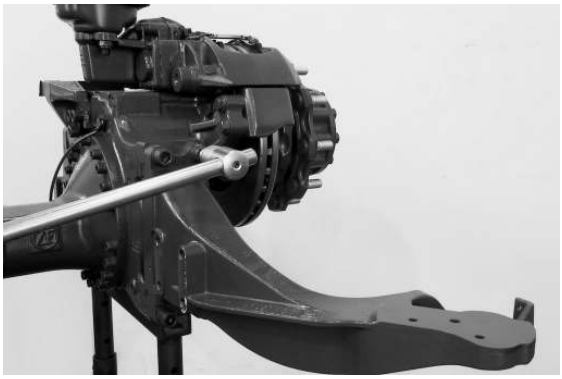


Figure 2

If necessary, separate spring carrier (4x) from the axle.

Mark the installation position of the different spring carriers!

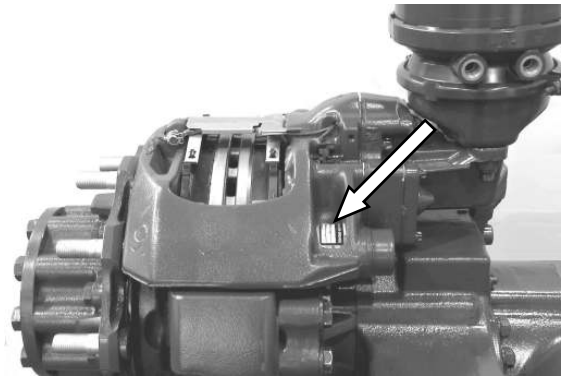


Figure 3

Separate brake from the axle (figure 3 and 4):

The brake manufacturer's instructions and specifications are mandatory for any operations done on the brake system!
The relating information is included in the repair, maintenance and service manuals of the component manufacturer!
The applicable instructions are to be requested from the brake manufacturer or can be viewed on the brake manufacturer's internet site!
Brake manufacturer and brake type are indicated on the identification plate of the brake caliper!
Figure 3 shows the position of the identification plate (arrow) using the KNORR-brake as an example!

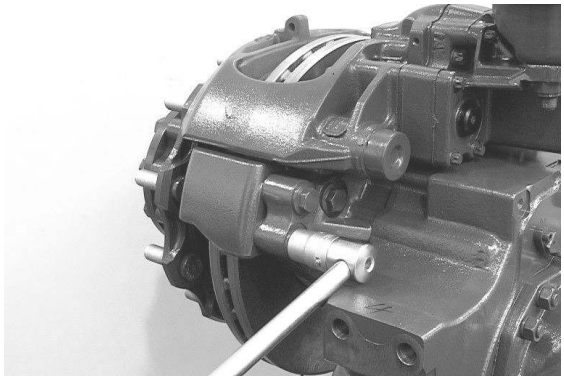


Figure 4

Loosen hexagon screws and separate brake caliper from the axle.

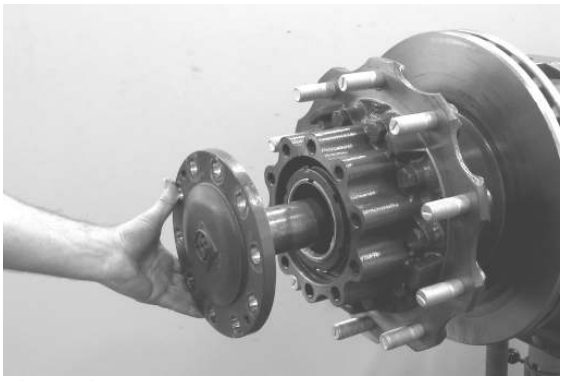


Figure 5

1.1 OUTPUT

Loosen hexagon screws and separate flange shaft from the axle.

Watch out for low quantities of residual oil!

Unlock and loosen outer slotted nut.
Remove retaining plate and loosen inner slotted nut.

(S) Slotted nut wrench 5870 401 146



Figure 6

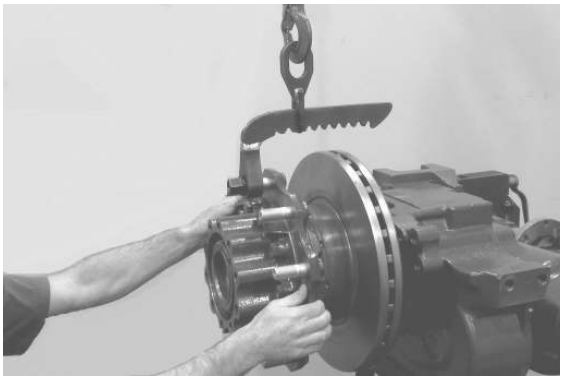


Figure 7

Separate hub/brake disk from the hub carrier.

(S) Lifting bracket 5870 281 043

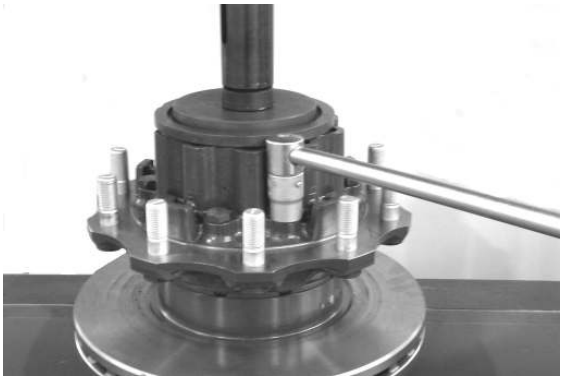


Figure 8

Fix hub/brake disk by means of press.
Loosen threaded connection and separate hub from the brake disk.

Locate press-fit mandrel at the hub mounting face.



Figure 9

Remove O-ring (arrow).



Figure 10

Use lever to remove shaft seal on the brake disk side out of hub hole.



Figure 11

Remove outer shaft seal from the hub hole.

<u>Removal of compact bearing (figures 12 to 14)</u>

☞ **Inspection of the compact bearing inside followed by a grease change is also required:**

- **within the maintenance interval, see List of Lubricants TE-ML 12.**
- **In case of grease leakage on the shaft seal at brake disk side, or when replacing the shaft seals.**
- **In case of overheated brake parts (e.g. burnt pressure piece – bellows)**

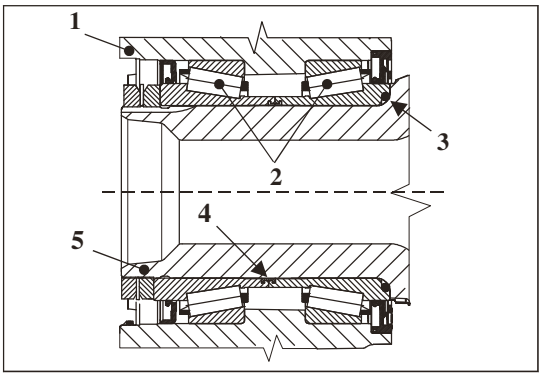


Figure 12

<u>Legend to figure 12:</u>

1 = Hub
2 = Compact bearing
3 = O-ring
4 = Retaining ring
5 = Hub carrier

} Complete component

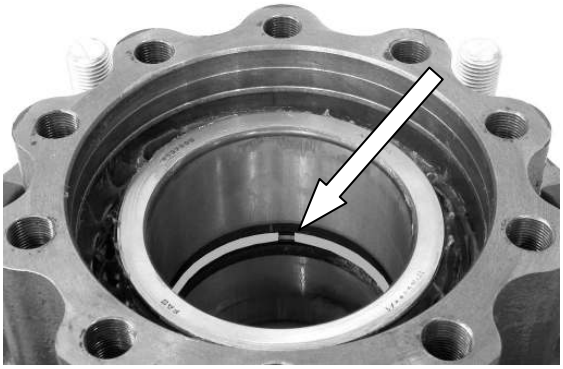


Figure 13

Unsnap retaining ring (arrow).

Remove both bearing inner rings.

If necessary, remove both bearing outer rings.



Figure 14

1.2 PORTAL DRIVE

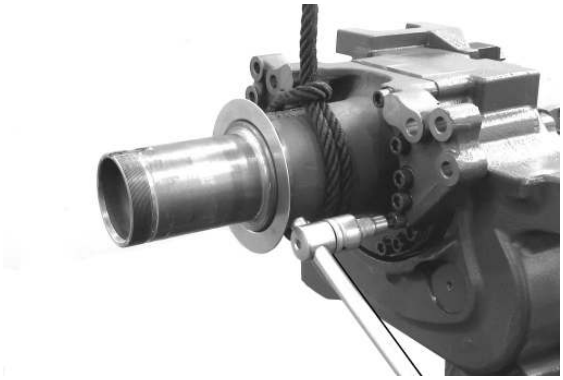


Figure 15

Locate hub carrier by means of lifting device.
Loosen threaded connection and separate hub carrier from the portal housing.



Figure 16

Pull bearing outer ring out of the hole with a striker.

☞ **Pay attention that the releasing shim does not drop!**

(S) Striker 5870 650 004

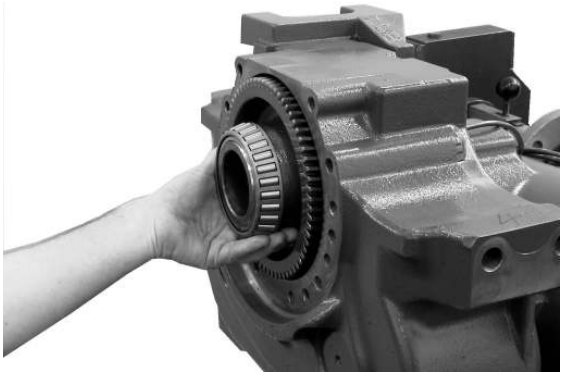


Figure 17

Remove output gear.



Figure 18

Remove both bearing inner rings from the output gear.

(S) Rapid grip 5873 012 013
(S) Basic tool 5873 002 001



Figure 19a

Use lifting device to fix portal housing.
Loosen threaded connection and separate portal drive from the axle housing.

Pay attention so that the differential and the stub shaft do not drop!
Watch out for low quantities of residual oil!

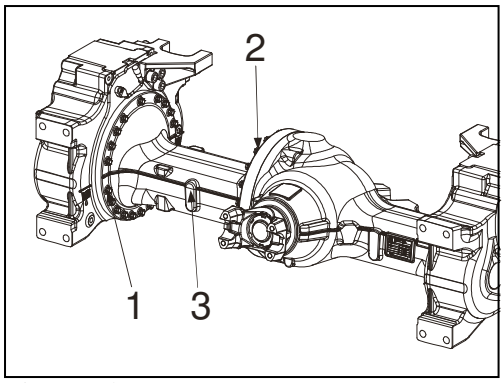


Figure 19b

Use lifting device to fix the portal housing of the AV-132 T (see previous figure). Loosen threaded connection (arrow 1) and separate portal drive from the axle housing.

Pay attention so that the stub shaft does not drop!

Then fix axle housing (arrow 3) by means of lifting device and loosen bolted connection (arrow 2). Remove axle housing.

Pay attention so that the differential does not drop!

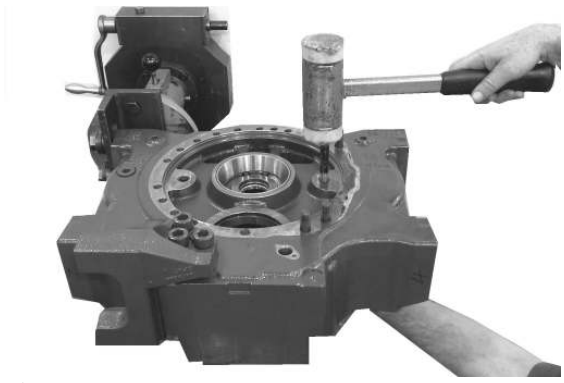


Figure 20

Fix portal drive to the assembly truck.

Mark installation position and allocation of the components during the subsequent removal of the two intermediate gears (figures 20 to 22)!

Loosen hexagon screw and install locating pin.
Drive out bearing bolt.
Remove second bearing bolt accordingly.

(S) Assembly truck	5870 350 000
(S) Clamping plate	5870 350 119
(S) Locating pins	5870 204 022

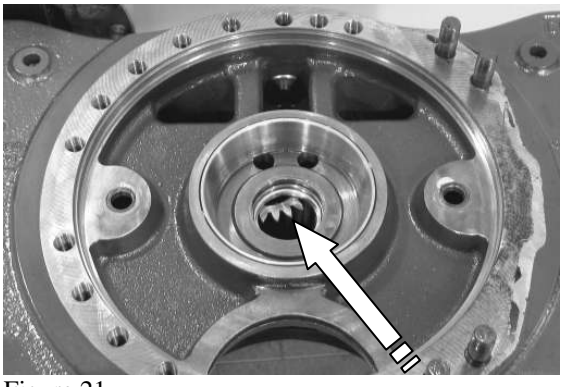


Figure 21

Shift drive gear diagonally (see arrow/figure 21) and remove releasing intermediate gear (figure 22)!

Remove second intermediate gear accordingly.

Now remove the complete drive gear.

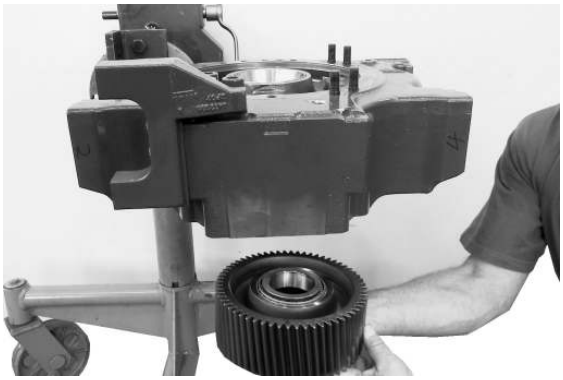


Figure 22

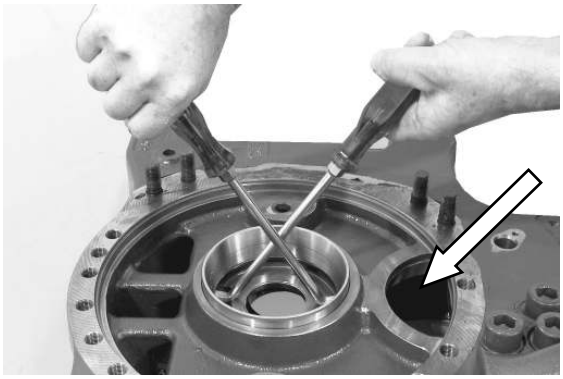


Figure 23

Use lever to pull bearing outer ring – differential bearing - out of the housing hole.

Pay attention that releasing adjusting shim does not drop!

If necessary, drive bearing outer ring - output gear bearing (arrow) - out of the housing hole.

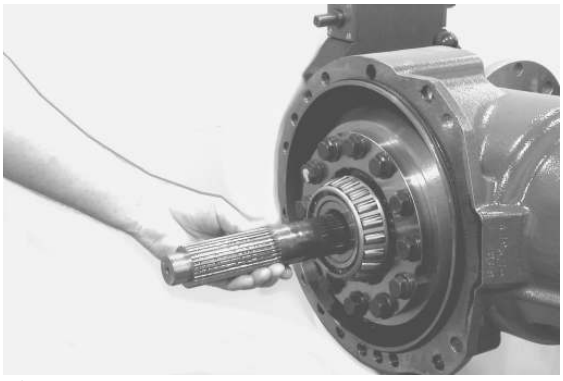


Figure 24

Pull stub shaft out of the differential.

Differential is not fixed!

1.3 DIFFERENTIAL

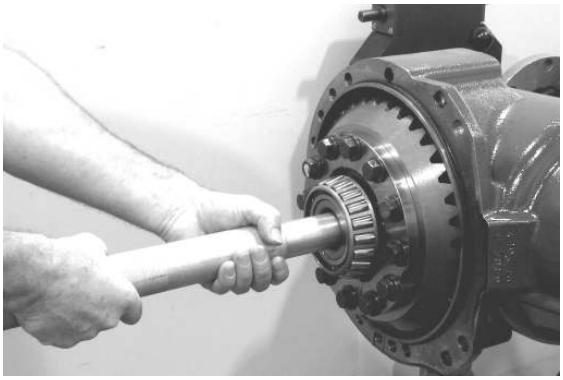


Figure 25

The following illustrations provide a description of the differential disassembly: Version I, Type "C".

Disassembly of the differential version II, type "D" see description on page 4/1 and following.

Lift differential out of the axle housing by means of an appropriate assembly mandrel.



Figure 26

Remove both bearing inner rings.

(S) Rapid grip	5873 002 052
(S) Rapid grip	5873 002 025
(S) Basic tool	5873 002 001

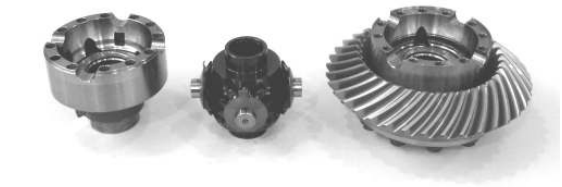


Figure 27

Loosen hexagon screws.
Separate both differential carrier halves and single components.
If necessary, loosen threaded connection and press crown wheel out of the differential carrier.

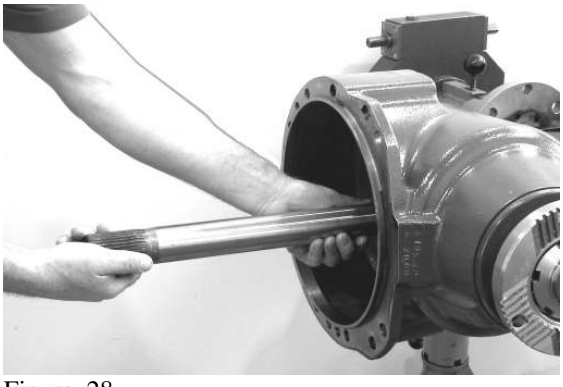


Figure 28

Pull stub shaft out of the axle.

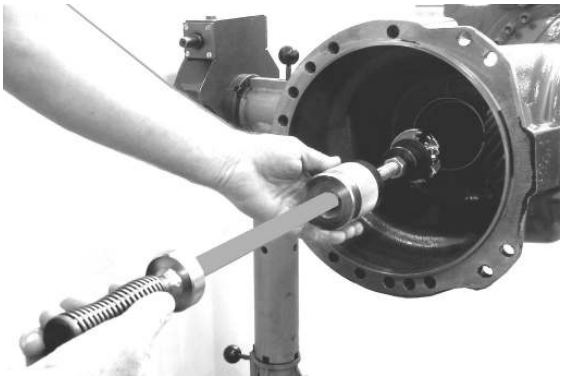


Figure 29

Drive bearing outer ring out of the housing hole by means of striker.

☞ **Pay attention that the releasing adjusting shim does not drop!**

(S) Striker 5870 650 004

1.4 INPUT

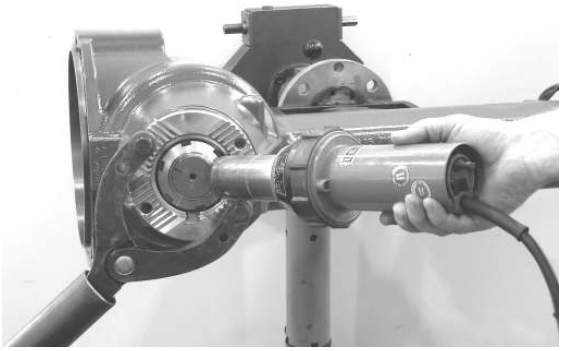


Figure 30

Loosen slotted nut (figure 30 and 31).

☞ **Heat grooved nut before loosening it (secured with Loctite)!**

(S) Clamping fork		5870 240 002
(S) Slotted nut wrench	Ø 86	5870 401 093
(S) Slotted nut wrench	Ø 84	5870 401 173
(S) Slotted nut wrench	Ø 81	5870 401 139
(S) Centering disk		5870 912 015

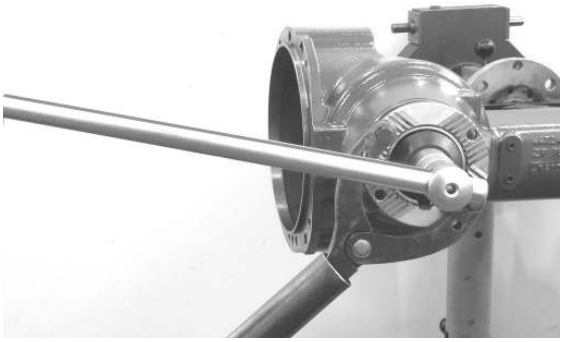


Figure 31

Pull off input flange and remove shaft seal.

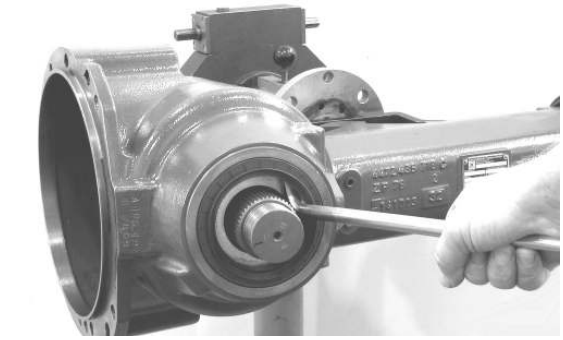


Figure 32

Press input pinion out of the bearing hole.

(S) Forcing device 5870 080 044

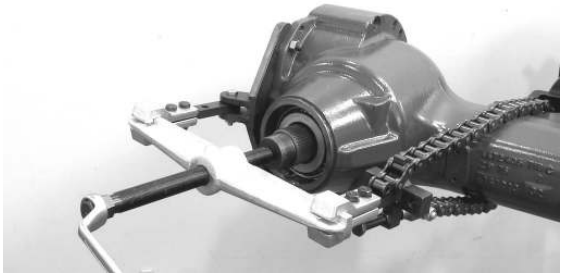


Figure 33



Figure 34

Remove adjusting ring.

Remove bearing inner ring from the input pinion.



Figure 35

☞ **Regarding special tools pay attention to the different versions of the pinion head bearing!**

Version I, bearing dimension 70 x 150 x 41 mm;
Required special tools**:**

(S) Grab sleeve	5873 003 022
(S) Reducing adapter	5873 003 011
(S) Basic tool	5873 002 001

Version II, bearing dimension 70 x 150 x 50 mm;
Required special tools:

(S) Grab sleeve	5873 002 051
(S) Basic tool	5873 002 000



Figure 36

Pull external bearing outer ring out of the hole.

(S) Internal extractor	5870 300 019
(S) Counter support	5870 300 020

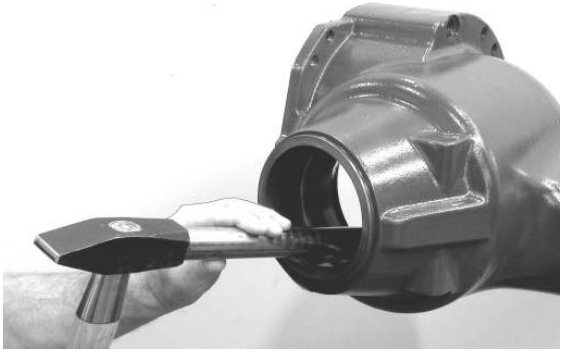


Figure 37

Drive internal bearing outer ring out of the hole.

☞ **Pay attention that the releasing adjusting shim!**

2. REASSEMBLY

2.1 INPUT - DIFFERENTIAL

General: **If either crown wheel or input pinion is damaged, both parts (bevel gear set) must be replaced!**

☞ **Make sure that mating numbers are identical!**

The following settings are described on the next pages.

- **A - Contact pattern of bevel gear set**
- **B - Backlash of bevel gear set**
- **C - Rolling torque of input pinion bearing**
- **D - Rolling torque of differential bearing**

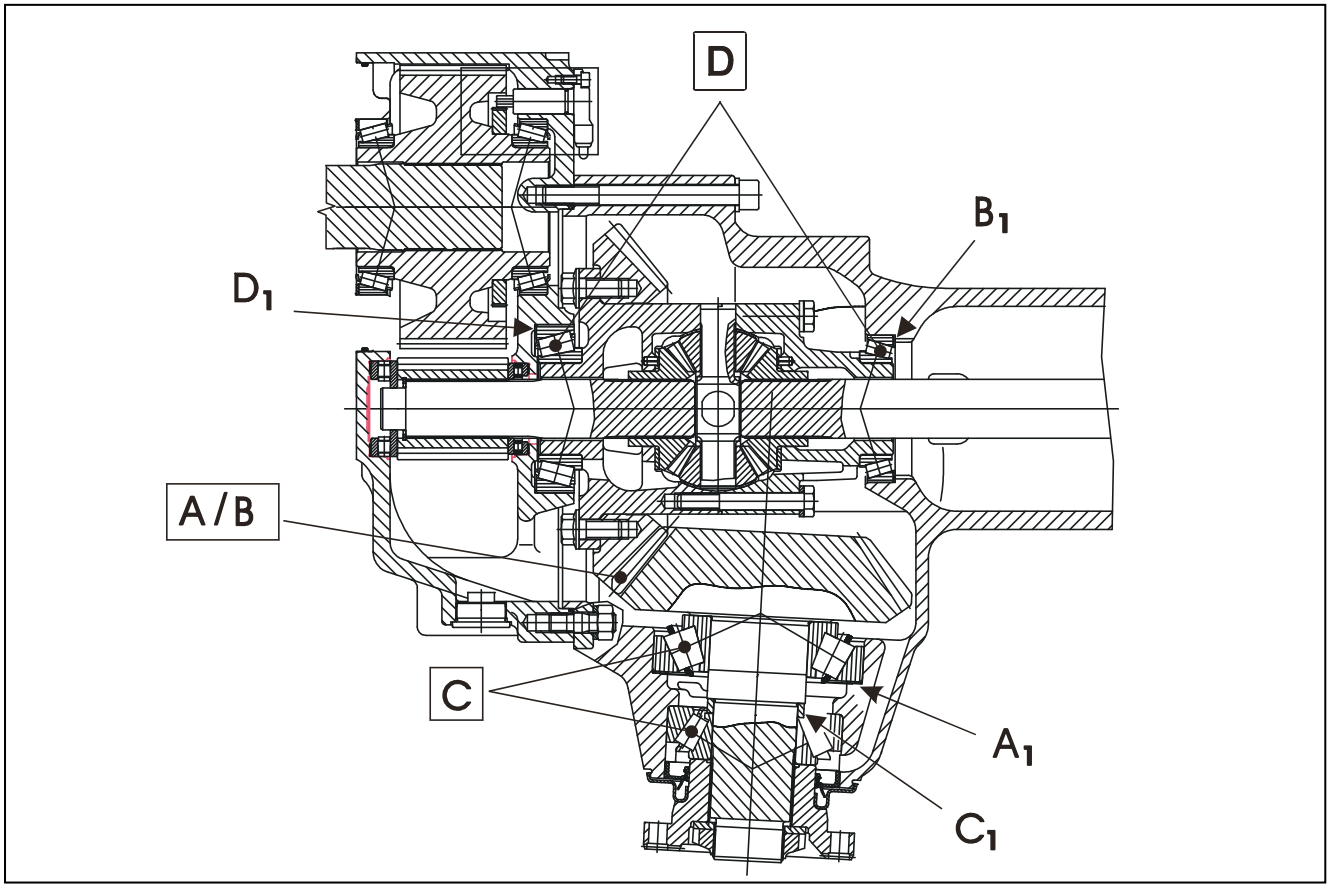


Figure 1

Legend:

A_1 - Contact pattern shim
B_1 - Shim - backlash
C_1 - Shim - input pinion bearing
D_1 - Shim - differential bearing

☞ **According to our experience, the required setting values are obtained when installing the shims removed during disassembly!**
A later check of the values, however, is absolutely necessary!

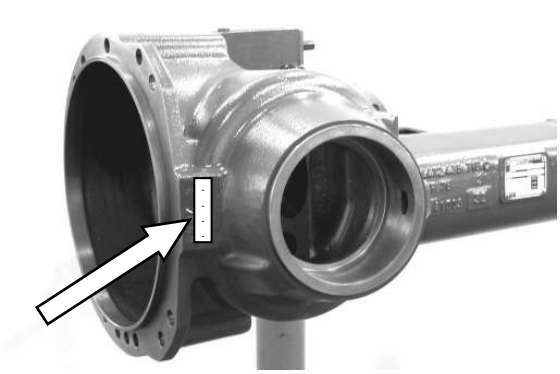


Figure 2

Setting of bevel gear set contact pattern (figure 1 … 6):

Read installation dimension A from the axle housing (arrow).

Dimension A e.g. …….. 195.42 mm

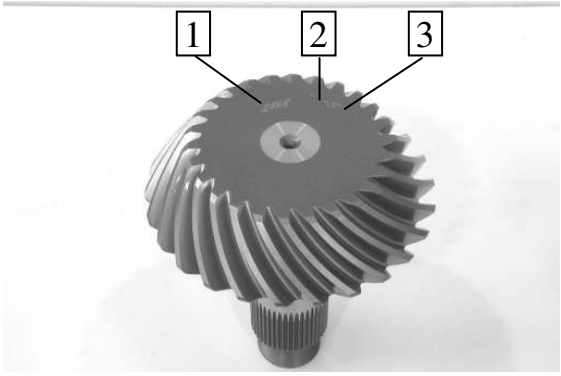


Figure 3a

Figures 3a and 3b show the input pinion.

The following technical data are stamped or marked by hand:

1 = mating number (marked by hand, on the pinion head)
2 = pinion basic dimension (stamped into the pinion head or shaft, see figure 3b)
3 = pinion distance deviation + or – (marked by hand, on the pinion head)

NOTE:
Distance deviation is indicated in $^{1}/_{100}$ mm.

Pinion dimension „X“ e.g.:

Dimension X 153 $_{-5}$ ($^{5}/_{100}$ = 0.05) = 152.95 mm

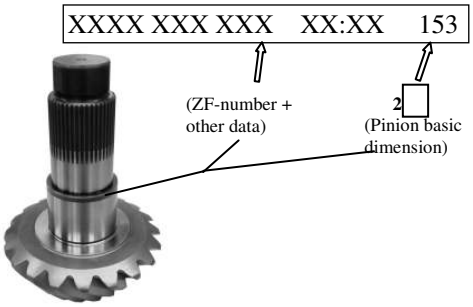


Figure 3b

If no pinion distance deviation is indicated, the pinion basic dimension corresponds with the pinion dimension „X“!

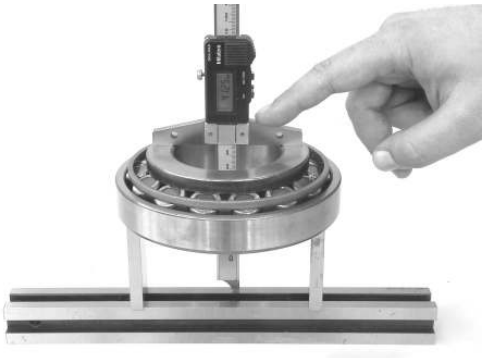


Figure 4

Determine bearing height.

Dimension Y e.g. …….. 41.25 mm

(S) Straightedge 5870 200 022

Calculation example A_1:

Dimension X (pinion dimension) e.g. …….		152.95 mm
Dimension Y (bearing height) e.g. …….	+	41.25 mm
Resulting in dimension Z	=	194.20 mm

Calculation example A_2:

Dimension A e.g. …….		195.42 mm
Dimension Z e.g. …….	-	194.20 mm
Difference = shim s	=	1.22 mm

☞ **The individual shims are available in 0.03 mm size intervals. Use the next available shim size e.g. s = 1.23!**

Supercool external bearing outer ring and insert it until contact is obtained.



Figure 5

Install shim (according to calculation example s = 1.23 mm). Supercool bearing outer ring and insert it into the bearing hole until contact is obtained using the fixture (figure 6 and 7).

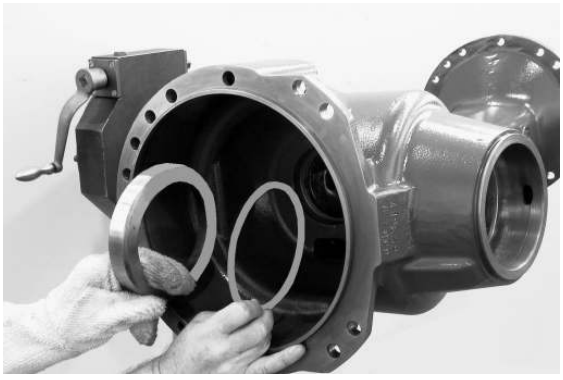


Figure 6

(S) Assembly fixture 5870 345 080

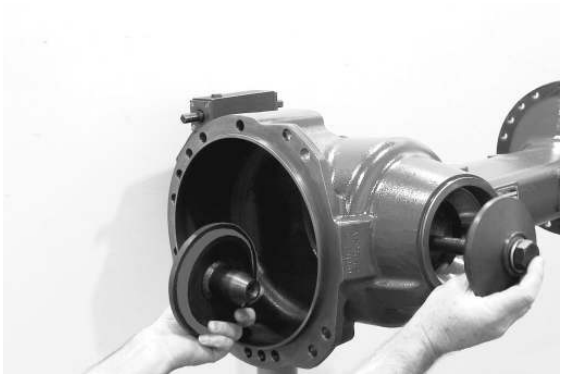


Figure 7

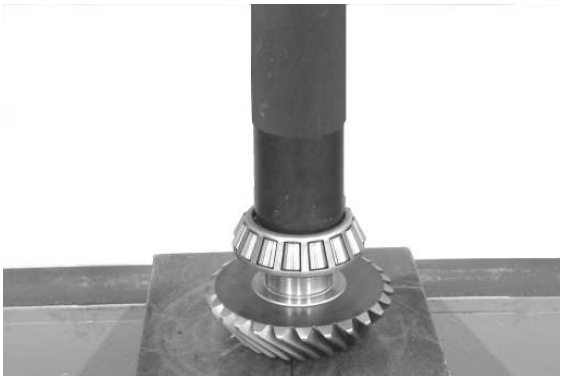
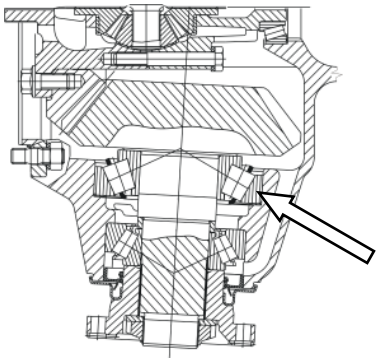


Figure 8

Force bearing inner ring to contact position.

<u>Setting of rolling torque of the input pinion bearing (Sketch … figure 13):</u>



☞ **Pay attention to different versions of pinion head bearing (arrow) regarding setting values!**

<u>Version I:</u> **Bearing dimension 70 x 150 x <u>41.27</u> mm.**
Required rolling torque 3.0 … 7.0 Nm

<u>Version II:</u> **Bearing dimension 70 x 150 x <u>50.0</u> mm.**
Required rolling torque 4.0 … 10.0 Nm

☞ **When installing new bearings, try to achieve the respective average value!**
In case of used bearings, try to achieve the lower value!

According to our experience, the necessary rolling torque is obtained when reusing the adjusting ring removed during disassembly!
A later check of the rolling torque, however, is absolutely necessary!



Figure 9

Install adjusting ring e.g. s = 10.32 mm, see figure 9!



Figure 10

Position the input pinion and mount the heated bearing inner ring until contact position is obtained.

☞ **Before mounting the input flange and tightening the slotted nut (figure 11 und 12), let bearing inner ring cool down to ambient temperature!**

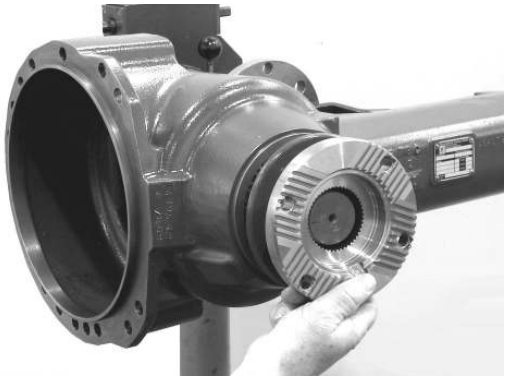


Figure 11

Mount the input flange.

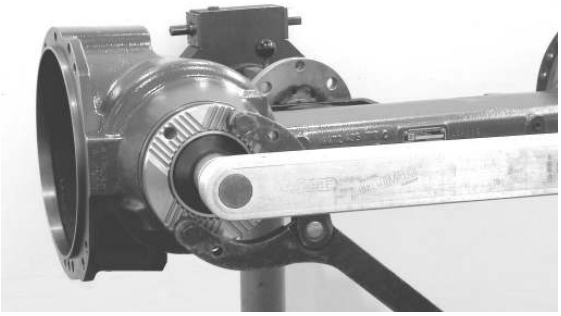


Figure 12

Mount washer and tighten slotted nut.

Tightening torque …… M_A = 1000 … 1700 Nm

☞ **Pre-tighten slotted nut with 1000 Nm and check rolling torque (figure 13)! If required, increase tightening torque step by step up to max. M_A = 1700 Nm until the required rolling torque is achieved!**
While tightening, rotate the input pinion in both directions several times.
If the required rolling torque cannot be obtained within the tolerance range of the tightening torque, use a suitable adjusting ring (figure 9) for correction as specified below:

<u>Insufficient rolling torque – fit thinner ring</u>
<u>Excessive rolling torque – fit thicker ring</u>

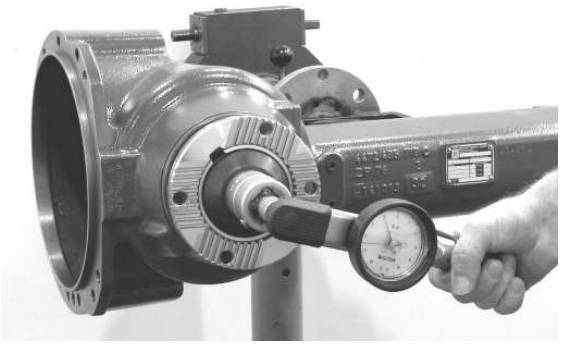


Figure 13

☞ **Note down the tightening torque of the slotted nut as well as the rolling torque of the pinion bearing after they have been set!**

Secure the slotted nut (Loctite-locking) and mount the shaft seal ring <u>after</u> contact pattern check (starting from figure 41)!

(S) Slotted nut wrench Ø 86 mm	5870 401 093
(S) Slotted nut wrench Ø 84 mm	5870 401 173
(S) Slotted nut wrench Ø 81 mm	5870 401 139
(S) Centering disk	5870 912 015
(S) Clamping fork	5870 240 002
(S) Reducing adapter ½“ – ¼““	5870 656 056



Figure 14

Differential (figure 14 … 23)

☞ **The following figures provide a description of the differential reassembly: Version I, type "C".**

Reassembly of the differential: Version II, type "D" see description on page 4/3 and following.

Heat up crown wheel and bring it into contact position with the mounting face of the differentials.

⚠ **Observe radial installation position!**
Use protective gloves!

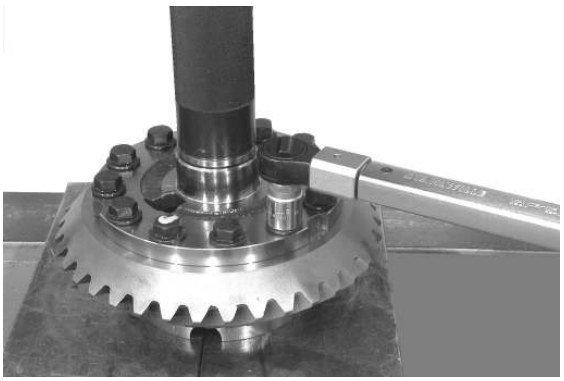


Figure 15

Fix differential carrier by means of press.
Bolt crown wheel and differential carrier.

☞ **Permitted temperature for crown wheel and differential carrier when bolting: max. + 30° C!!**

Use of new locking screws is imperative!

Tightening torque …….. M_A = 250 Nm



Figure 16

Insert thrust washer.

☞ **Pay attention to installation position – lubricating groove to show upwards (towards the axle bevel gear).**



Figure 17

Use grooved pins (2x) for radial fixation of thrust washer.

☞ **Observe installation depth of the grooved pins!**
The front face of the grooved pins must be slightly below the contact face/thrust washer (approx. 1.0 mm).

Pre-assemble second differential carrier half accordingly.



Figure 18

Install axle bevel gear.

☞ **Oil all internal components of the differential according to ZF –List of lubricants TE ML 12!**

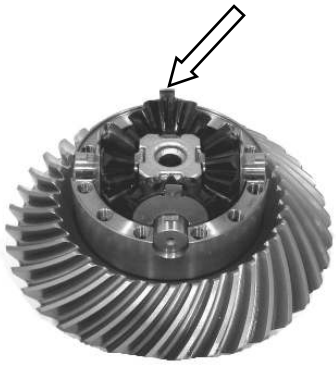


Figure 19

Mount complete differential spider.

☞ **Pay attention to radial installation position of the thrust washers – torsional stop in vertical position, see arrow!**



Figure 20

Position the second axle bevel gear.

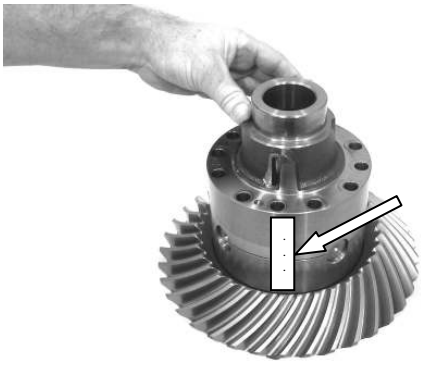


Figure 21

Mount pre-assembled differential carrier half II.

☞ Observe radial installation position, see ZF-Nr. …. … … (arrow) !

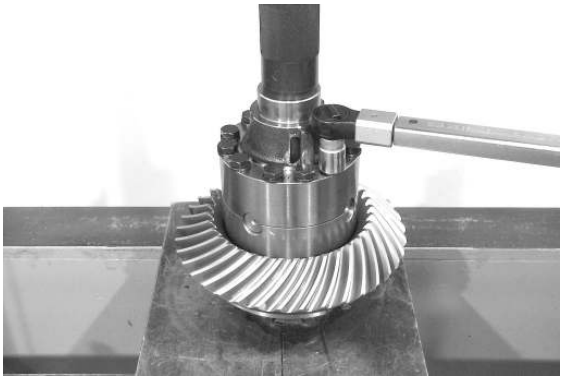


Figure 22

Fix differential carrier halves by means of hexagon screws and washers (s = 3.0 mm).

Tightening torque (M12x1.5/10.9) …… M_A = 120 Nm



Figure 23

Press both bearing outer rings until contact is obtained.

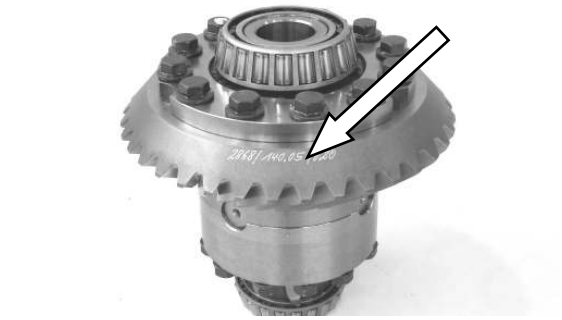


Figure 24

<u>Setting of backlash of bevel gear set</u>
and
<u>bearing rolling torque of differential 2.5 … 5.5 Nm</u>
<u>(Figure 24 … 40):</u>

☞ **For the required backlash, see crown wheel (arrow)!**



Figure 25

Insert adjusting shim and bearing outer ring into the bearing hole until contact is obtained.

(S) Driver tool	5870 058 078
(S) Handle	5870 260 002

☞ **According to our experience, the required setting values are obtained when installing the shims removed during disassembly.**
A later check of the values, however, is absolutely necessary!

Insert pre-assembled differential into the axle housing.
Then bring the axle housing into vertical position.

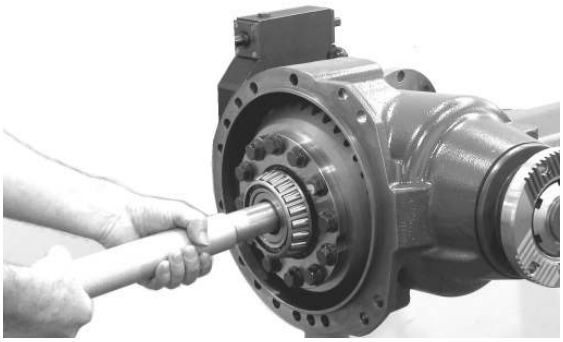


Figure 26

Install bearing outer ring.



Figure 27

Position test equipment and bring it evenly into contact position by means of hex. screws (4x).

(S) Test equipment	5870 200 121
(S) Adapter ring (just for AV-132T)	AA00 692 068



Figure 28

To ensure an exact centering of the single components, rotate bevel gear set in both directions several times.



Figure 29

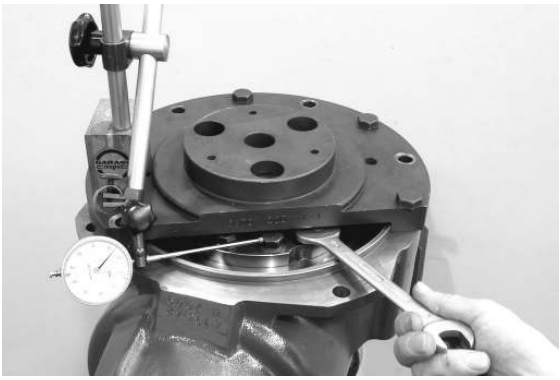


Figure 30

Check backlash!

Due to the installation conditions it is not possible to measure the backlash on the outer diameter of the crown wheel! Therefore measure the backlash on the crown wheel connection (screw head), see adjacent figure!

☞ **The required backlash is indicated on the crown wheel, see figure 24!**

Permitted tolerance deviation ± 0.04 mm

☞ **When measuring the backlash, ensure that the screw head side face is located as parallel as possible towards the center axle of the differential!**

Observe the following specifications for any necessary corrections of the backlash:

1. **Insufficient backlash ⇒ install thicker shim (figure 25).**

2. **Excessive backlash ⇒ install thinner shim (figure 25).**

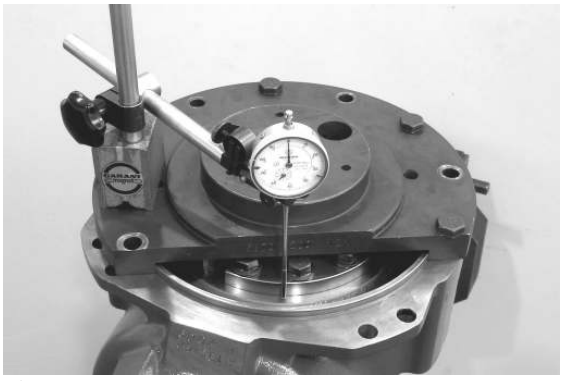


Figure 31

Position dial indicator to the crown wheel back and check max. axial run-out. 0.08 mm!

☞ **In case of deviations from the permitted axial run-out, check the exact contact between crown wheel and differential carrier and correct, if required!**



Figure 32

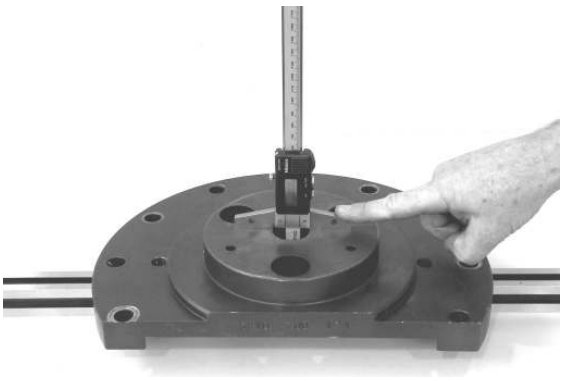


Figure 33

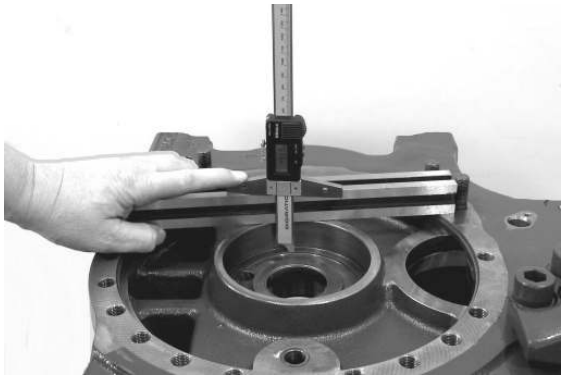


Figure 34

Setting of the rolling torque of the differential bearing 2.5 … 5.5 Nm (figure 32 … 35):

Determine dimension I, from the front face of bearing outer ring to the mounting face of the axle housing (figure 32 and 33).

☞ **Dimension I is based on the measuring operations of figure 32 and figure 33!**

Measuring operation I (figure 32):

Place digital caliper gauge in contact position with bearing outer ring and adjust to 0.00 mm.

Then separate test equipment from the axle housing.

Measuring operation II (figure 33):

Place caliper gauge to straightedge and read dimension I .

Dimension I e.g. …… 26.68 mm

(S) Straightedge 5870 200 022

Determine dimension II from mounting face of the portal housing to contact face/bearing outer ring (figure 34).

Measuring operation I:
Position digital caliper gauge between straightedge and mounting face and adjust to 0.00 mm.

Measuring operation II:
Then place caliper gauge to contact face/bearing outer ring and read dimension II.

Dimension II e.g. ……27.69 mm

Calculation example B:

Dimension II……		27.69 mm
Dimension I……	-	26.68 mm
Difference	=	1.01 mm

☞ **Difference ≙ installation dimension of the adjusting shim! The individual shims are available in 0.05 mm size intervals. The required rolling torque of the differential bearing = 2.5 … 5.5 Nm is obtained when using the next available shim size e.g. s = 1.00 mm!**



Figure 35

Insert the determined shim (e.g. s = 1.00 mm) and mount the bearing outer ring until contact is obtained.

☞ **In case of the AV-132 T, install shim and bearing outer ring on the axle housing.**



Figure 36

<u>Check of contact pattern of bevel gear set (figure 36 … 40):</u>

Cover some drive and coast flanks of the crown wheel with marking ink.

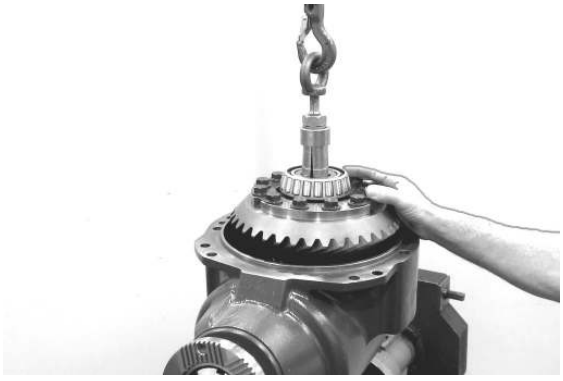


Figure 37

Insert differential into the axle housing.



Figure 38

Position the portal housing on the axle housing and fix it provisionally by hexagon nuts as well as cylindrical screws.

Tightening torque …….. M_A = 200 Nm

☞ **In case of the AV-132 T, alternatively install the axle housing (also refer to chapter 2/25 figure 74b).**

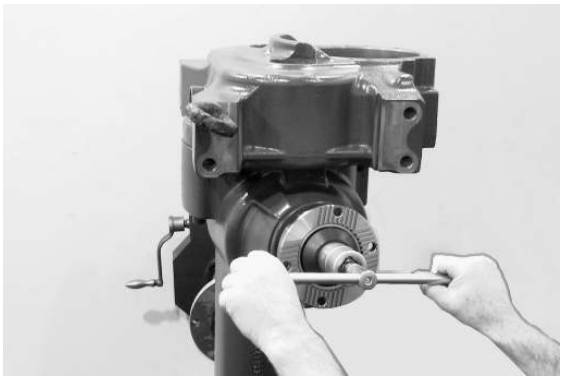


Figure 39

Roll the input pinion over the crown wheel in both directions several times.

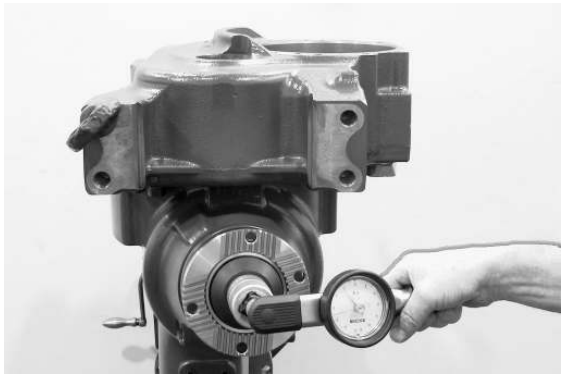


Figure 40

<u>Check of total rolling torque (pinion and differential bearing)!</u>

☞ **Total rolling torque must be approx. 2 – 3 Nm above the previously measured rolling torque of the pinion bearing (figure 13)!**
The attachment of a completely preassembled portal drive requires an increase by 3 – 4 Nm!

(S) Reducing adapter $^{1}/_{2}$ " - $^{1}/_{4}$ " 5870 656 056

Then disassemble differential and compare the contact pattern result with the contact pattern examples shown on page 0/4 and 0/5.

☞ **In case of any contact pattern deviation, a measuring error was made when determining the shim (figure 6), which must be corrected by all means!**



Figure 41

Bring axle housing into horizontal position.
Loosen slotted nut and remove input flange.

Install shaft seal with the seal lip showing to the oil chamber (figure 41).

☞ **Wet outer diameter with spirit!**
Use of the specified special tool (S) ensures the precise installation position!

(S) Driver tool	5870 048 216



Figure 42

Force the screen sheet over the collar of the input flange until contact is obtained.

(S) Driver tool	5870 056 008
(S) Handle	5870 260 002



Figure 43

☞ **Carefully clean and degrease the thread of the input pinion and the slotted nut.**
Then wet some threads of the slotted nut and of the pinion with Loctite locking compound (product no.: 262)!

Mount the input flange.
Finally fix the input flange by using a disk and a slotted nut.

☞ **The required tightening torque of the slotted nut was determined and noted down on page 2/5!**

If the pinion bearing was not dismantled, but only the shaft seal was replaced, tighten the slotted nut as follows:

- **lift the axle to allow the wheels to freely rotate.**
- **pre-tighten slotted nut to M_A = 500 Nm and rotate the input flange 10 to 15 times.**
- **finally tighten the slotted nut to M_A = 1700 Nm.**

(S) Slotted nut wrench Ø 86 mm	5870 401 093
(S) Slotted nut wrench Ø 84 mm	5870 401 173
(S) Slotted nut wrench Ø 81 mm	5870 401 139
(S) Centering disk	5870 912 015
(S) Clamping fork	5870 240 002

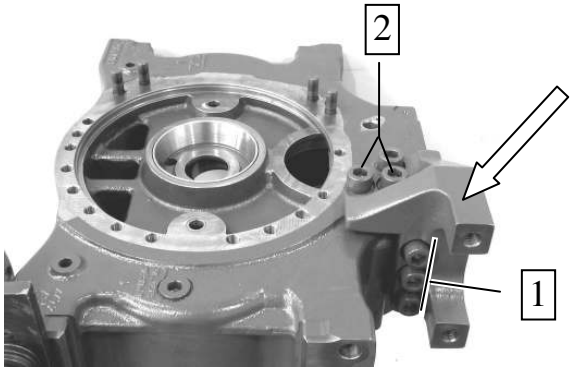


Figure 44

2.2 PORTAL DRIVE

Fix the longitudinal rod bracket (arrow) by means of cylindrical screws and washers on the portal housing as specified below:

Secure screws with Loctite 243!

1. Position the bracket on the housing.
   Provisionally hand-tighten the cylindrical screws (item 1) on rod connection side (3 … 5 Nm)!

2. Then install cylindrical screws (item 2) and tighten them with the required tightening torque M_A = 440 Nm

3. Finally tighten cylindrical screws (item 1) with the required tightening torque M_A = 440 Nm!

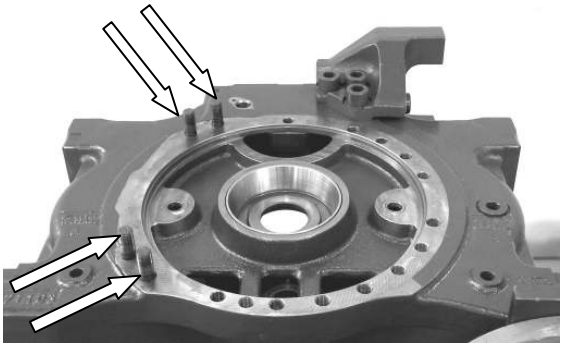


Figure 45

Mount stud bolts, see arrows!

Tightening torque …….. M_A = 33 Nm

Wet thread with Loctite 262!
Mount stud bolts only on the portal housing at differential side!

Mount drive gear (figure 46 … 50)

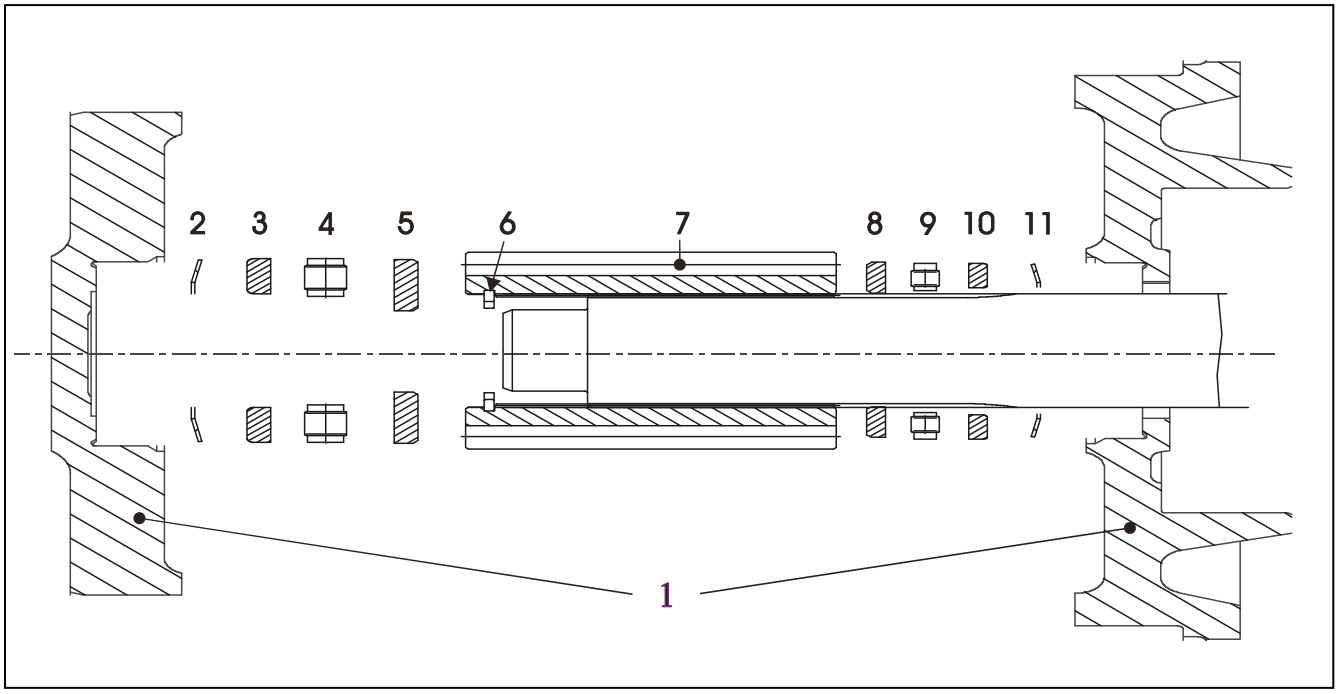


Figure 46

Legend to figure 46 :

1 = housing
2 = cup spring (67.5 x 50.5 x 0.7)
3 = Housing disk (68 x 42 x 5)
4 = axial bearing (68 x 40 x 9)
5 = Shaft disk (68 x 30 x 5)
6 = Retaining ring
7 = Drive gear
8 = Shaft disk (42 x 65 x 4)
9 = axial bearing (65 x 45 x 6)
10 = Housing disk (47 x 65 x 4)
11 = cup spring (63.8 x 50.5 x 0.7)

☞ **Observe installation position of cup springs (item 2 and item 11) see sketch!**

Install shaft disks (item 5 and item 8) with the larger chamfer or radius facing the drive gear!

Install housing disks (item 3 and item 10) with the larger chamfer or radius facing the housing!



Figure 47

Position single components item 2 … 5 and item 8 … 11 in the portal housing by using the assembly fixture (figure 47) (arrow/figure 48).

(S) Assembly fixture 5870 345 103

☞ **Use the assembly fixture to preload the cup springs until it is possible to mount the drive gear (figure 50)!**
Observe installation position of the single components, see figure 46!

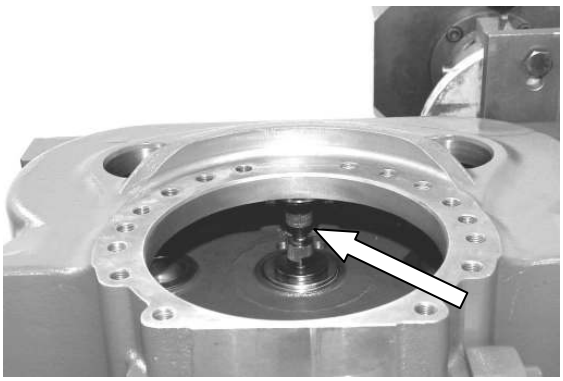


Figure 48

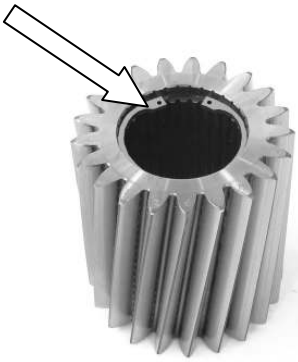


Figure 49

Engage retaining ring (arrow) into the groove of the drive gear.

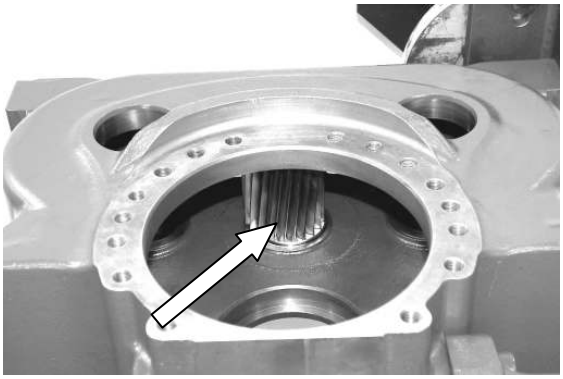


Figure 50

Position the drive gear in the housing (arrow) while removing the assembly fixture.

☞ **Observe installation position – retaining ring to show upwards, see also figure 46!**

Preassembly of intermediate gears and check of axial play 0.01 … 0.05 mm (figure 51 u. 52):

☞ **When reusing already used intermediate gears, observe allocation and installation position of single components! According to our experience, the required axial play of the intermediate gear bearing is obtained when installing the shims removed during disassembly. However, a later check is imperative!**

Install single components and insert adjusting shim.



Figure 51

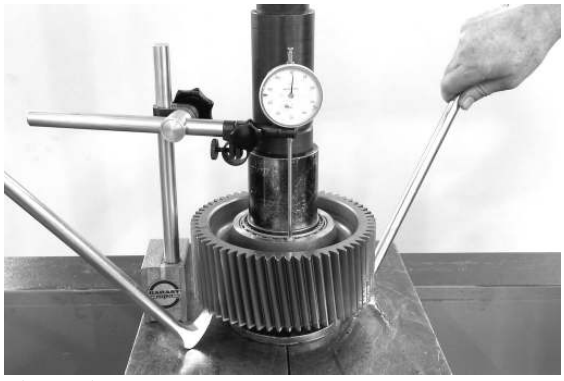


Figure 52

Insert plug gauge (S) and fix intermediate gear bearing by means of press. Contact pressure approx. 10 000 N (1 ton).

Check axial play!

☞ **In case of deviations from the necessary axial play, use suitable shim for correction (figure 51).**

(S) Plug gauge 5870 200 094

Then remove bearing bolt again.

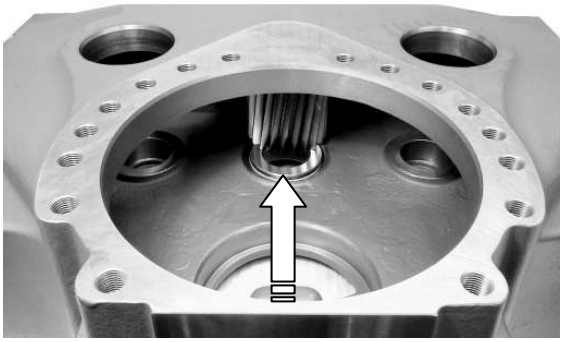


Figure 53

Installation of intermediate gears (figure 53 … 58):

In order to enable the assembly of both intermediate gears, preliminarily move drive gear in direction of arrow.

☞ **When putting back the drive gear, make sure that the installation position of the single components is maintained!**

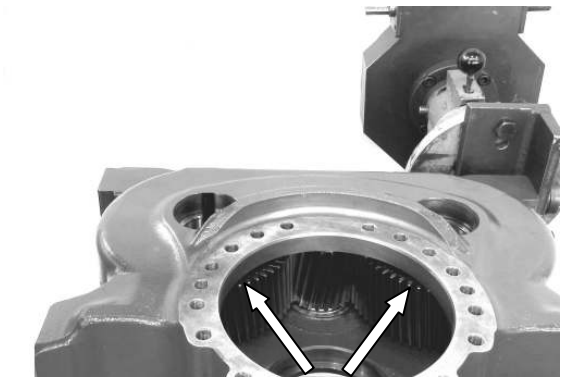


Figure 54

Position both intermediate gears (arrows) in the portal housing. Then align intermediate gears and drive gear centrally to the bearing holes.

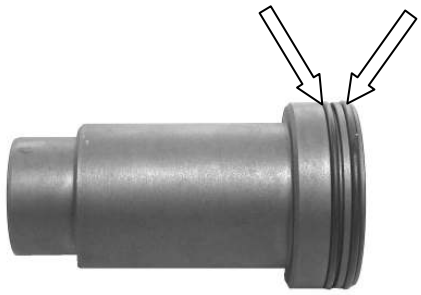


Figure 55

Insert O-rings (arrows) in both annular grooves of the bearing bolt and grease them.



Figure 56

Fix determined shim with grease (use assembly grease) and install adjusting screws.

(S) Adjusting screws 5870 204 022

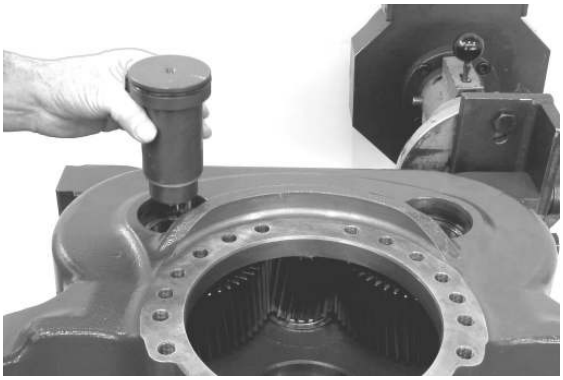


Figure 57

Locate both intermediate gears by means of bolts.

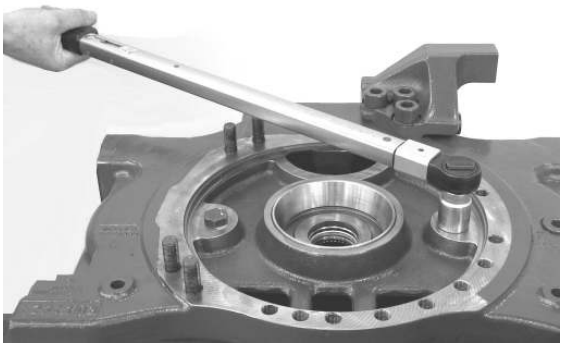


Figure 58

Rotate portal housing by 180°.

Fix both bearing bolts by means of hexagon screws.

Tightening torque (M14/10.9) …… M_A = 185 Nm

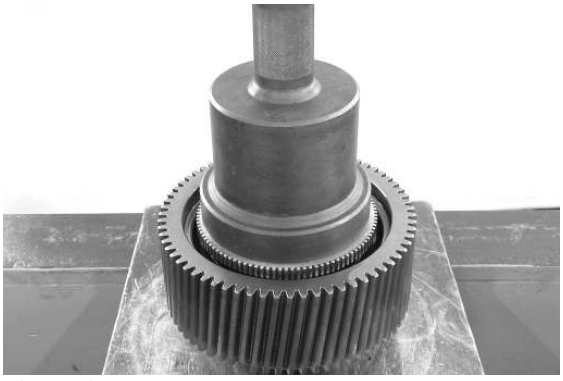


Figure 59

<u>Pre-assembly and installation of output gear (figure 59 … 71)</u>

Heat up impulse disk and force it to contact position.



Figure 60

Press both bearing inner rings until contact is obtained.

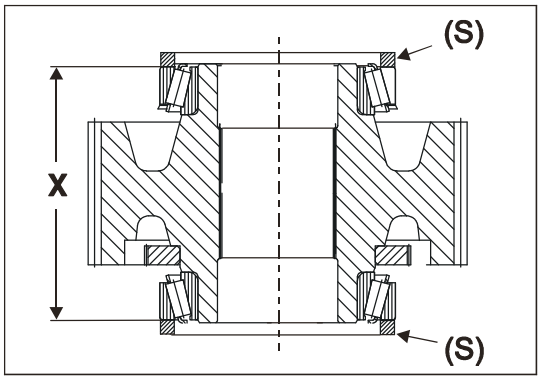


Figure 61

Setting of axial play – output bearing 0.00 … 0.03 mm (figure 61 … 65):

Determine the total height of the output gear bearing, figure 61 and 62!

(S) Measuring ring (2x)	0730 161 832
(S) Measuring bar	5870 200 127
(S) Straightedge	5870 200 022

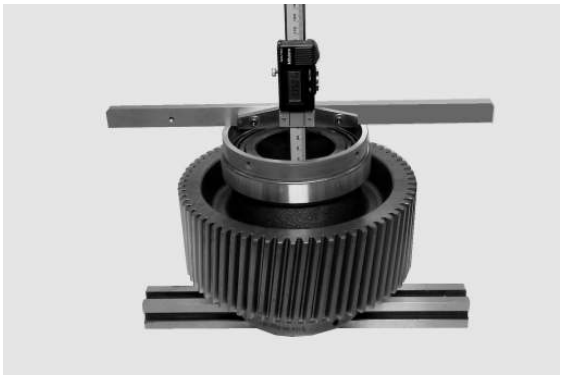


Figure 62

Dimension X e.g. ……. 135.12 mm

☞ **To ensure an exact centering of the single components, rotate bearing in both directions several times!**


Figure 63

Portal housing:

Determine dimension I, from mounting face to contact face of the bearing outer ring.

Dimension I e.g. …….. 136.48 mm

(S) Measuring bar 5870 200 127

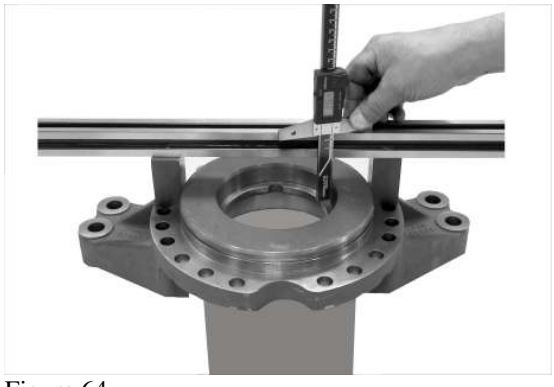


Figure 64

Hub carrier:

Measure dimension II, from the mounting face to the contact face of the bearing outer ring.

Dimension II e.g. ……... + 0.02 mm

☞ **Dimension II, can be + or – !**

(S) Straightedge 5870 200 022

Calculation example C:

Dimension I ……		136.48 mm
Dimension II ……..	+	0.02 mm
Resulting in dimension Y	=	136.50 mm

Dimension Y. ……		136.50 mm
Dimension X. ……..	-	135.12 mm
Difference	s =	1.38 mm

☞ **The individual shims are available in 0.03 mm size intervals. Use of the next thinner shim, e.g. 1.37 mm, results in an axial play of 0.01 mm!**



Figure 65

Insert the determined shim and mount bearing outer ring until contact is obtained.

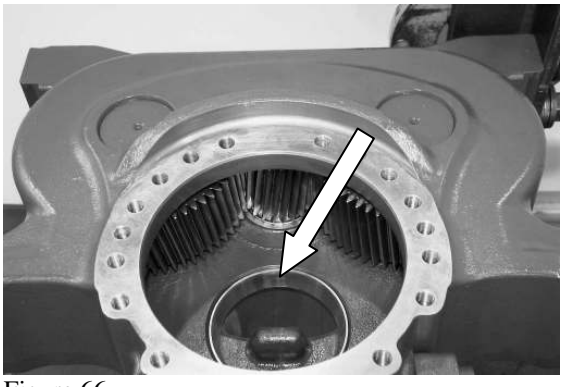


Figure 66

Insert bearing outer ring (arrow) into the bearing hole until contact is obtained.



Figure 67

Insert output gear.

☞ **Observe installation position – impulse disk to show downwards!**



Figure 68

Install screen sheet.

(S) Pressing fixture 5870 506 162

☞ **Wet the carrier seat with Loctite (type no. 574)!**
Pay attention to installation dimension 4^{+1} mm, see figure 69!
Use of the specified special tool ensures the exact installation dimension!

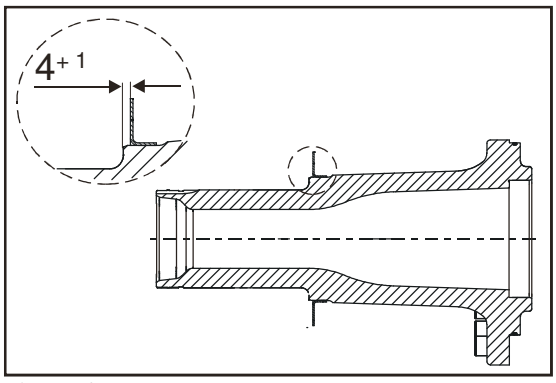


Figure 69



Figure 70

Install and grease O-ring (arrow).

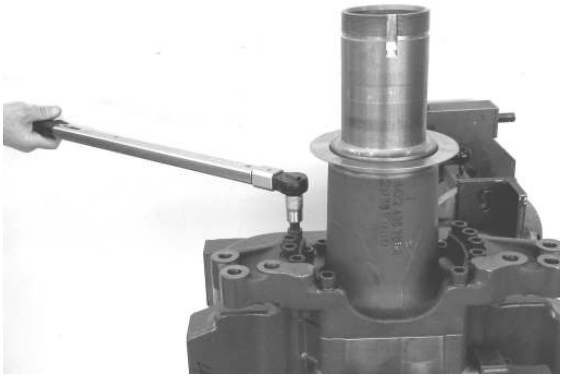


Figure 71

Fix hub carrier on portal housing.

☞ **Install washers s = 3.0 mm!**
No installation of washers is required for the version with Torx screws!
Secure with Loctite 243!

Tightening torque (cylindrical screws)	M_A = 200 Nm
or (depending on version)	
Tightening torque (Torx screws)	M_A = 185 Nm

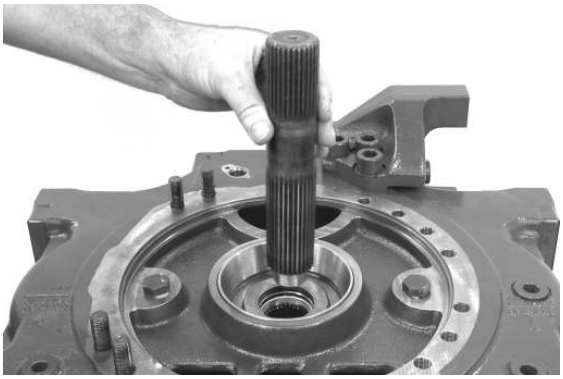


Figure 72

Insert stub shaft until contact is obtained (figure 72 and 73).

☞ **An installation dimension between 109 and 112 mm (see figure 73) ensures that all single components of the drive gear bearing are installed and centrically aligned!**

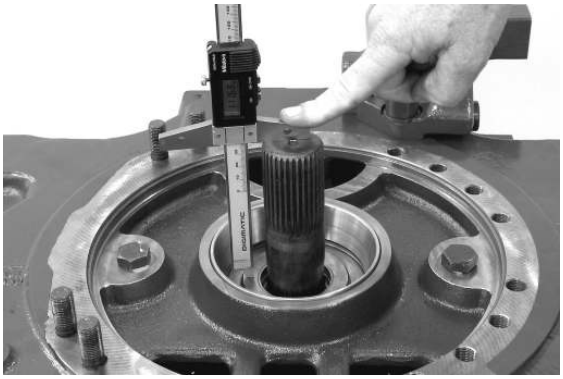


Figure 73

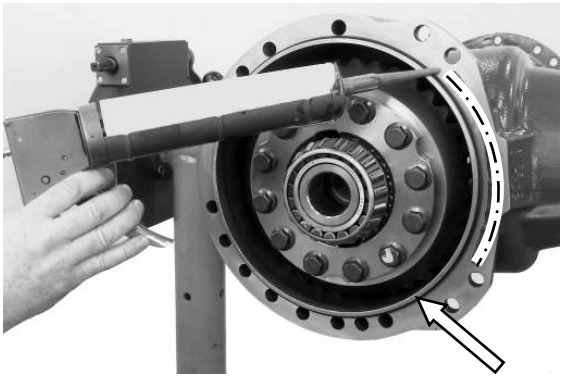


Figure 74a

Apply sealing compound, DREI-BOND SILIKON type 1207 on the area without holes of the mounting face.

Install and grease O-ring (arrow).

☞ **The sealing agent is not applicable for the AV-132 T.**

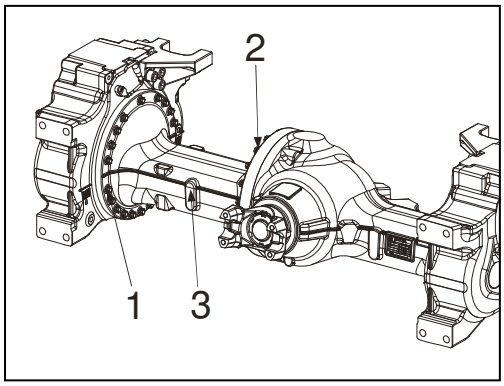


Figure 74b

Position axle housing half (arrow 3) and tighten Torx screws (arrow 2).

Mount stub shaft on portal drive. Grease O-ring and mount it on the axle housing half (arrow 3). Bring portal drive and stub shaft into contact position with axle housing half (arrow 3) and fix it by means of Torx screws (arrow 1).

Tightening torque (Torx screws) M_A = 185 Nm

☞ **This operation is not applicable for the AV-132.**

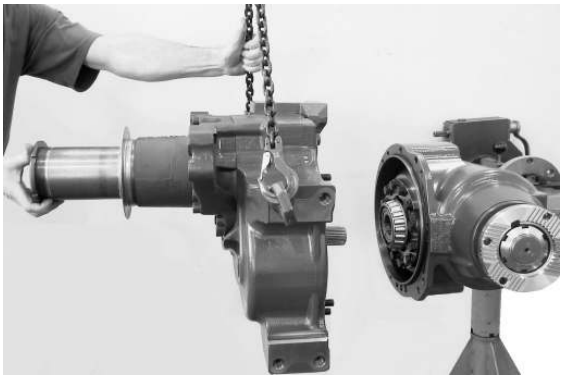


Figure 75

Use lifting device to bring portal housing into contact position with the axle housing and fix it.

☞ **Install washers s = 3.0 mm!**
No installation of washers is required for the version with Torx screws!

Tightening torque:

Hexag. nuts……	M_A = 200 Nm
Cyl-screws …..……..……	M_A = 200 Nm
or	
Torx screws ……..…	M_A = 185 Nm

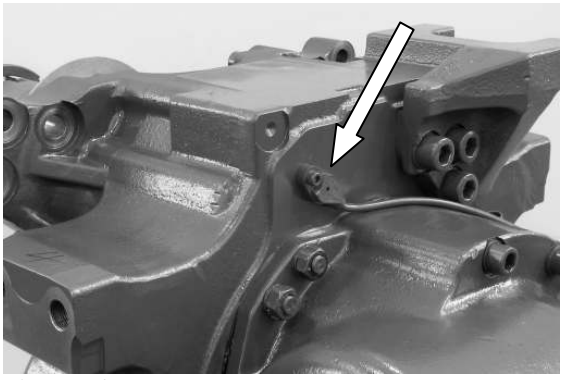


Figure 76

Mount speed sensor (arrow).

Tightening torque …… M_A = 9,5 Nm

☞ **Left and right speed sensors can vary depending on the version – observe vehicle manufacturer's specifications!**



Figure 77

2.3 OUTPUT

Mount wheel bolt.

☞ **Observe radial installation position!**

(S) Wheel bolt puller – basic tool	5870 610 010
(S) Insert 7/8 – 11	5870 610 008
(S) Insert M22x1.5	5870 610 002

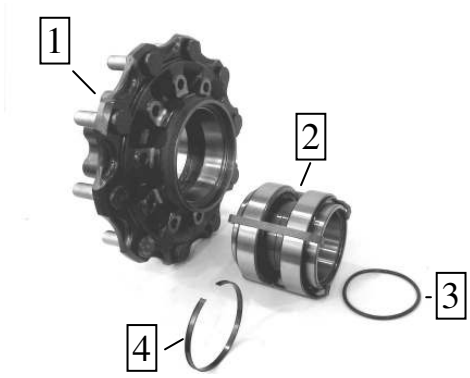


Figure 78

Mounting of compact bearing (figure 78 …86)

☞ **When replacing the compact bearing or when changing grease within the maintenance interval make sure that hub and compact bearing are cleaned thoroughly.**

Figures 78 and 79 show the single components of the compact bearing and the installation position.

Legend to figure 78 and 79:

1 = Hub
2 = Compact bearing
3 = O-ring
4 = Retaining ring
} Complete component
5 = Hub carrier

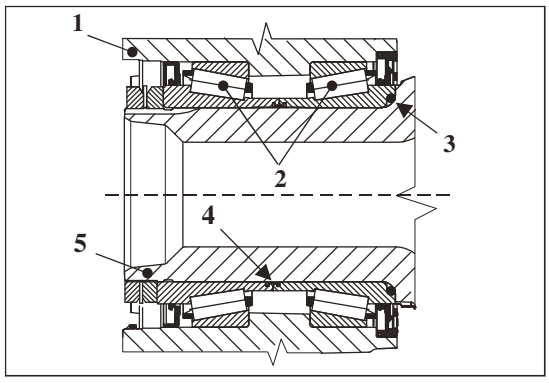


Figure 79

☞ **Item 3 and 4 are provided with the compact bearing as loose parts!**



Figure 80

Press-in both bearing outer rings until contact is obtained.

(S) Driver tool	5870 050 007
(S) Handle	5870 260 004

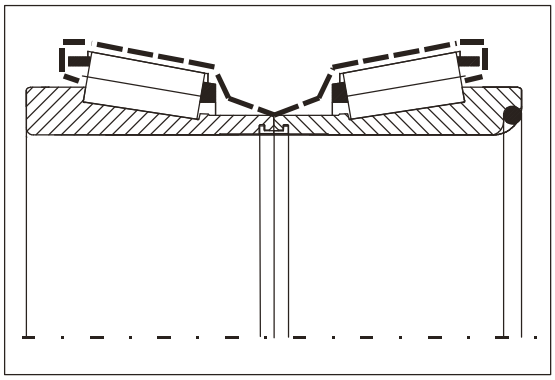


Figure 82

Apply grease on the marked area - - - of the compact bearing

Total grease quantity per output side: 130 gram (max. 150 g).

Richly grease the bearing rollers inside and outside as well as on front sides!

Do not use grease types other than those approved by ZF (e. g. Renolit LX-PEP 2, ZF-order no.: 0671 190 122).
The binding ZF List of Lubricants is TE-ML 12!
The latest update of the List of Lubricants is available at internet site www.zf.com**!**



Figure 82

Install the bearing inner ring at brake disk side.

To ensure the exact contact position of the bearing rollers in the bearing outer ring: Press bearing inner ring firmly and rotate several times (rolling in)!
The bearing inner ring at brake disk side is visible at the annular groove for the O-ring (arrow)!

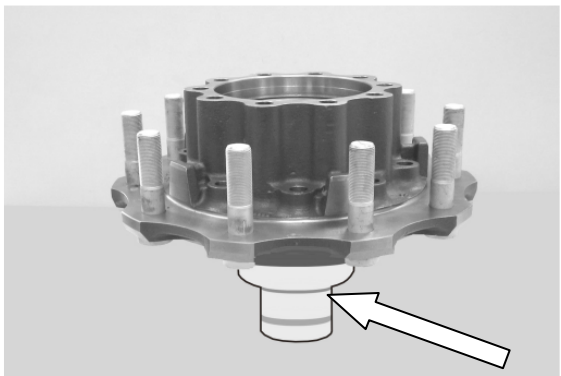


Figure 83

Turn hub.

Support the bearing inner ring at brake disk side by means of an appropriate mandrel (arrow) to maintain contact position of the bearing inner ring!



Figure 84

Install external bearing inner ring.

To ensure the exact contact position of the bearing rollers in the bearing outer ring: Press bearing inner ring firmly and rotate several times (rolling in)!
Clearance-free contact of both bearing inner rings must be ensured!



Figure 85

Fix both bearing inner rings by means of retaining ring.

☞ **Pay attention to the exact installation position of the retaining ring, see arrow / figure 86!**
A correct location results in a reference dimension of 140 $^{+/- 0.4}$ mm, see figure 86!
It is no more possible to lift the external bearing inner ring!

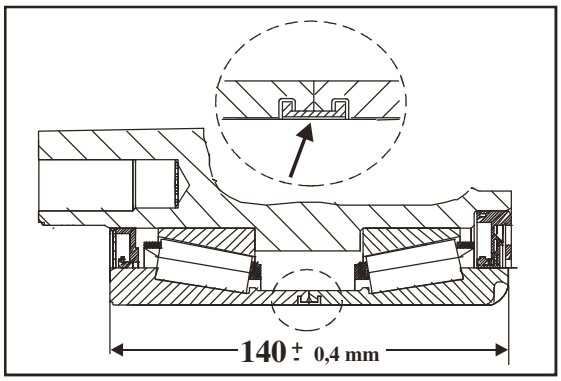


Figure 86



Figure 87

Carefully mount the outer shaft seal by means of the hand-operated press.

Shaft seal ZF-order no 0734 300 258:
(S) Driver tool AA00 607 922

Shaft seal ZF-order no 0734 319 643:
(S) Driver tool 5870 051 053

☞ **Use of the specified special tool (S) ensures the exact installation position!**
Pay attention to the installation position. Designation AUSSENSEITE/ OUTSIDE/OILSIDE“ to show upwards (outside)!

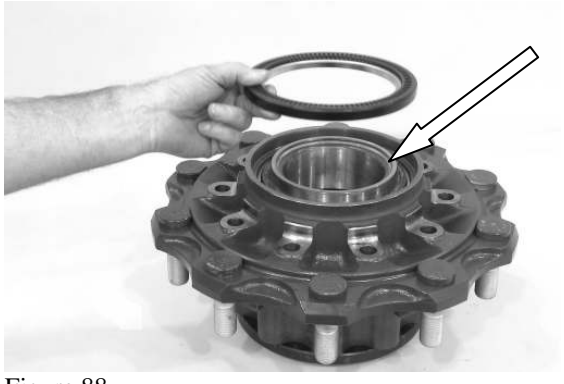


Figure 88

Carefully press-in the shaft seal at brake disk side by means of a hand-operated press. Then insert O-ring into the annular groove of the bearing inner ring.

Shaft seal ZF-order number 0734 300 257:
(S) Driver tool AA00 607 922

Shaft seal ZF-order number 0734 319 644:
(S) Driver tool 5870 051 053

☞ **Use of the specified special tool (S) ensures the exact installation position!**
Pay attention to the installation position – sensor ring to show upwards (outside) or designation „FETTSEITE / GREASE SIDE/INSIDE“ to show towards the bearing inner ring!

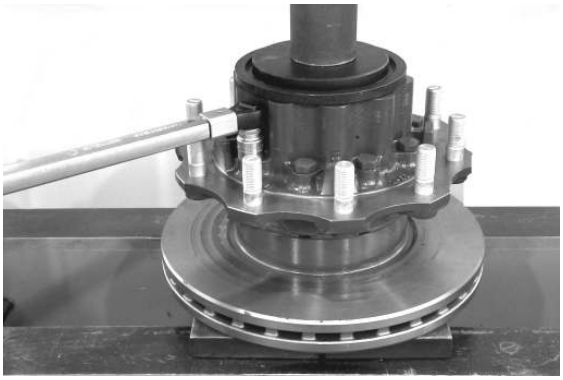


Figure 89

Bolt hub/brake disk.

Tightening torque:

Version with hex. screws M16x1.5/10.9 …... M_A = 300 Nm

Version with Torx screws M14x1.5/10.9 …. M_A = 185 Nm



Figure 90

Apply lubricant „MOLYKOTE DX“ on bearing.

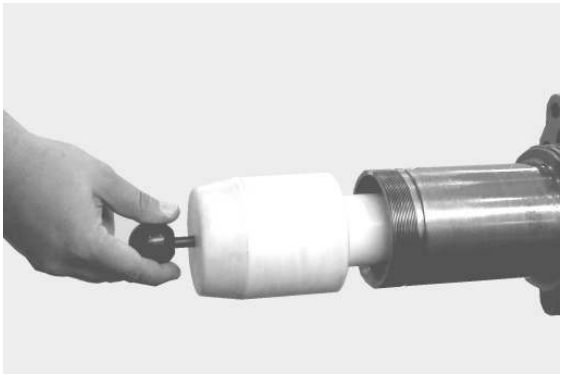


Figure 91

Mount inner installer in the hub carrier until contact is obtained.

(S) Inner installer 5870 651 085

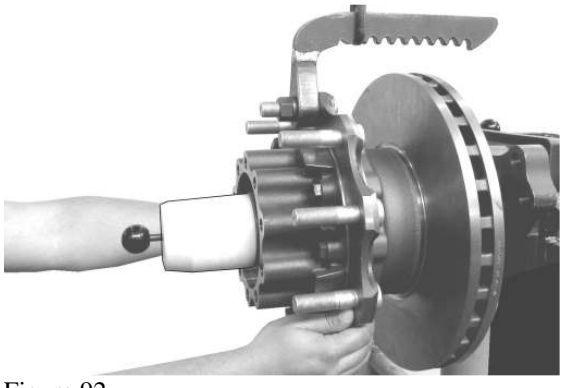


Figure 92

Carefully bring pre-assembled hub into contact position by using the lifting device.
Then remove inner installer.

(S) Lifting bracket 5870 281 043

Mount internal slotted nut.

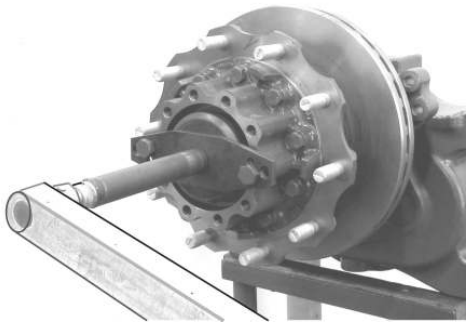


Figure 93

Pay attention to the installation position of the slotted nut – chamfer to show <u>outwards!</u>
While tightening rotate the hub in both directions several times!

Tightening torque (inner slotted nut) ….. M_A = 850 Nm

(S) Slotted nut wrench 5870 401 146

If during the tightening process of the slotted nut (figure 93) no increase of the bearing rolling torque is noticeable, or if an axial play of the wheel bearing is detected (figure 94), this may be caused by the unsnapping of the retaining ring (figure 85 u. 86).
Correct asssembly fault, if required!

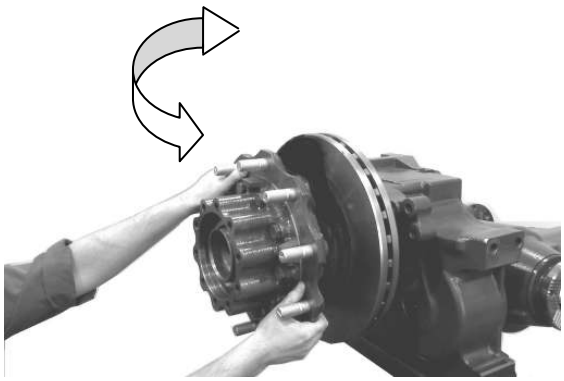


Figure 94

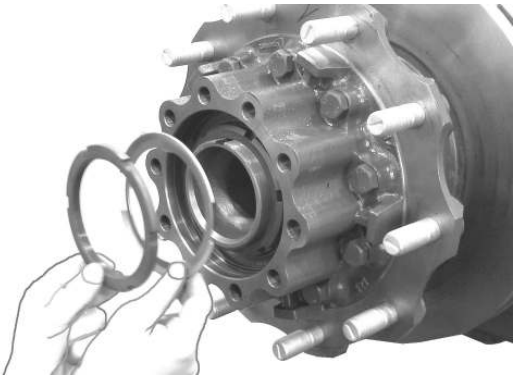


Figure 95

Install locking plate and mount outer slotted nut.

Pay attention to installation position of the locking plate – Securing clip to show inwards!
Pay attention to installation position of the slotted nut– chamfer to show <u>inwards!</u>

Tightening torque (outer slotted nut) …….. M_A = 1200 Nm

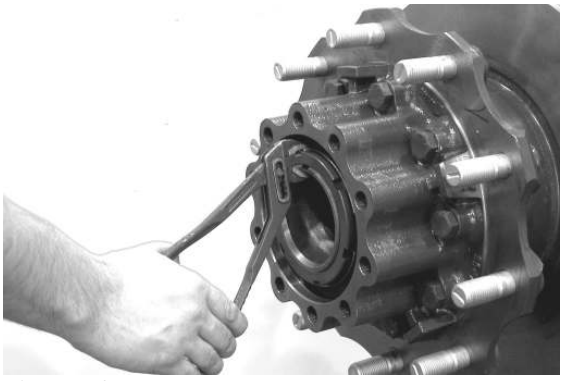


Figure 96

Secure slotted nut by deforming the locking plate into a groove of the outer slotted nut.



Figure 97

Insert the O-ring into the annular groove of the flange shaft (arrow) and grease it.

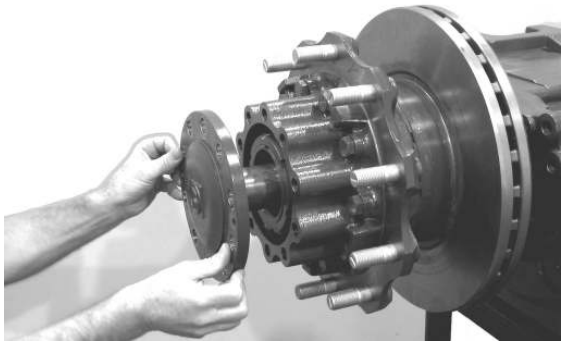


Figure 98

Mount flange shaft until contact is obtained and fix it with hexagon nuts.

Tightening torque (M18x1.5/10.9) …….. M_A = 440 Nm

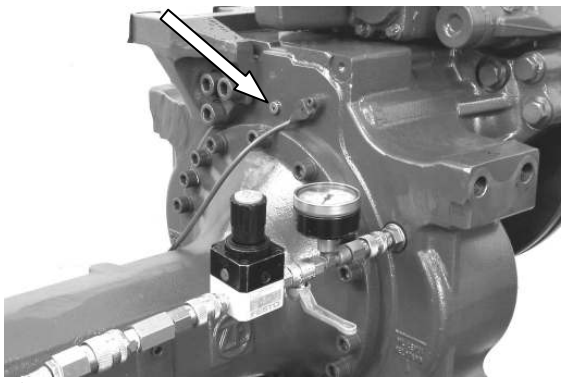


Figure 99

Check if the function of the sealing elements is correct!

Test medium: air
Test pressure : 0.5 bar
Testing time : 10 minutes

☞ **Preliminarily plug locating hole for breather valve (arrow)!**
Close the shut-off valve during the 10-minute testing time!

(S) Air connection	5870 286 079
(S) Reducing adapter	5870 286 080

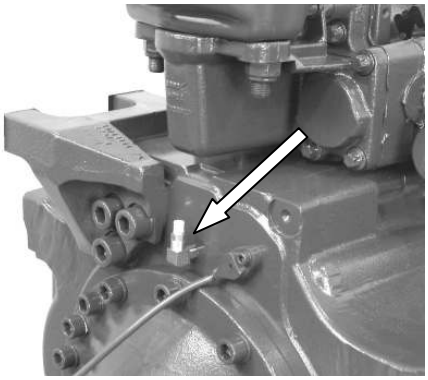


Figure 100

The following figures provide a description of the mounting of various peripheral parts and assemblies!
Different versions may require different work steps.
In this context also refer to the specifications given in the relevant spare parts list and by the vehicle manufacturer!

Mount breather valve, see arrow (Version : breather hose)!

Tightening torque …….. M_A = 6 Nm

Fitting of brake

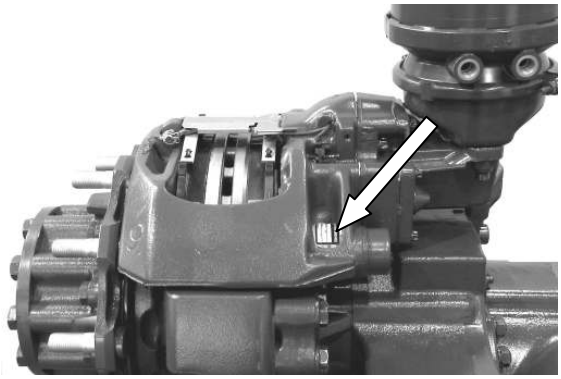


Figure 101

Tightening torque (M16x1.5 / 10.9) …….. M_A = 270 Nm
or (depending on the version)
Tightening torque (M18x1.5 /10.9) ……M_A = 440 Nm

The brake manufacturer's instructions and specifications are mandatory for any operations done on the brake system!

The relating information is included in the repair, maintenance and service manuals of the component manufacturer!

The applicable instructions are to be requested from the brake manufacturer or can be viewed on the brake manufacturer's internet site!

Brake manufacturer and brake type are indicated on the identification plate of the brake caliper.

Figure 101 shows the position of the identification plate (arrow), using the KNORR-brake as an example!
In this version pay attention to installation position of the tight-fit screw (arrow / figure 102)!.
Install the tight-fit screw on the left and right output side each at the front in driving direction!

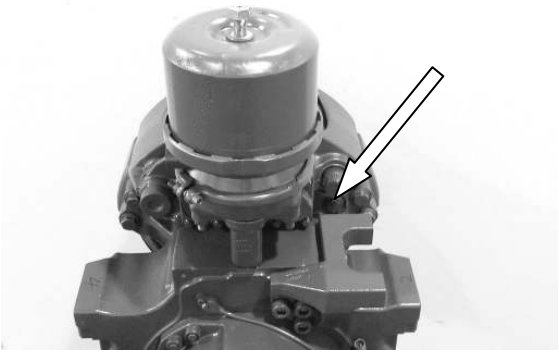


Figure 102

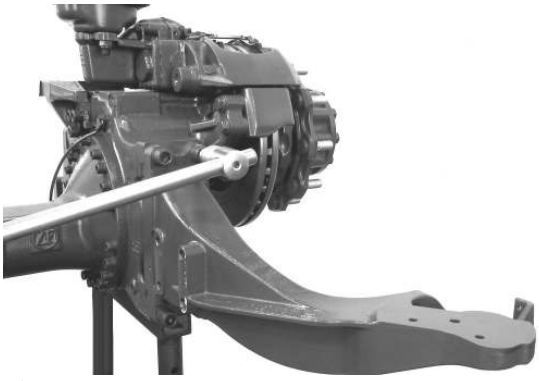


Figure 103

Fix the spring carriers (4x) with screws and washers to the axle housing.

Tightening torque (M20x1.5/10.9) …….. M_A = 620 Nm

Pay attention to the installation position – see the markings which have been applied during disassembly!

Before operating the unit, fill it with oil according to the specifications indicated in the lubrication and maintenance instructions (ZF-order no.: 5871 214 901)!

3. SUSPENSION

Version: track guidance system

Mount individual parts according to the following perspective representation and table.

Differences regarding execution are possible ! Observe the respective spare parts list !

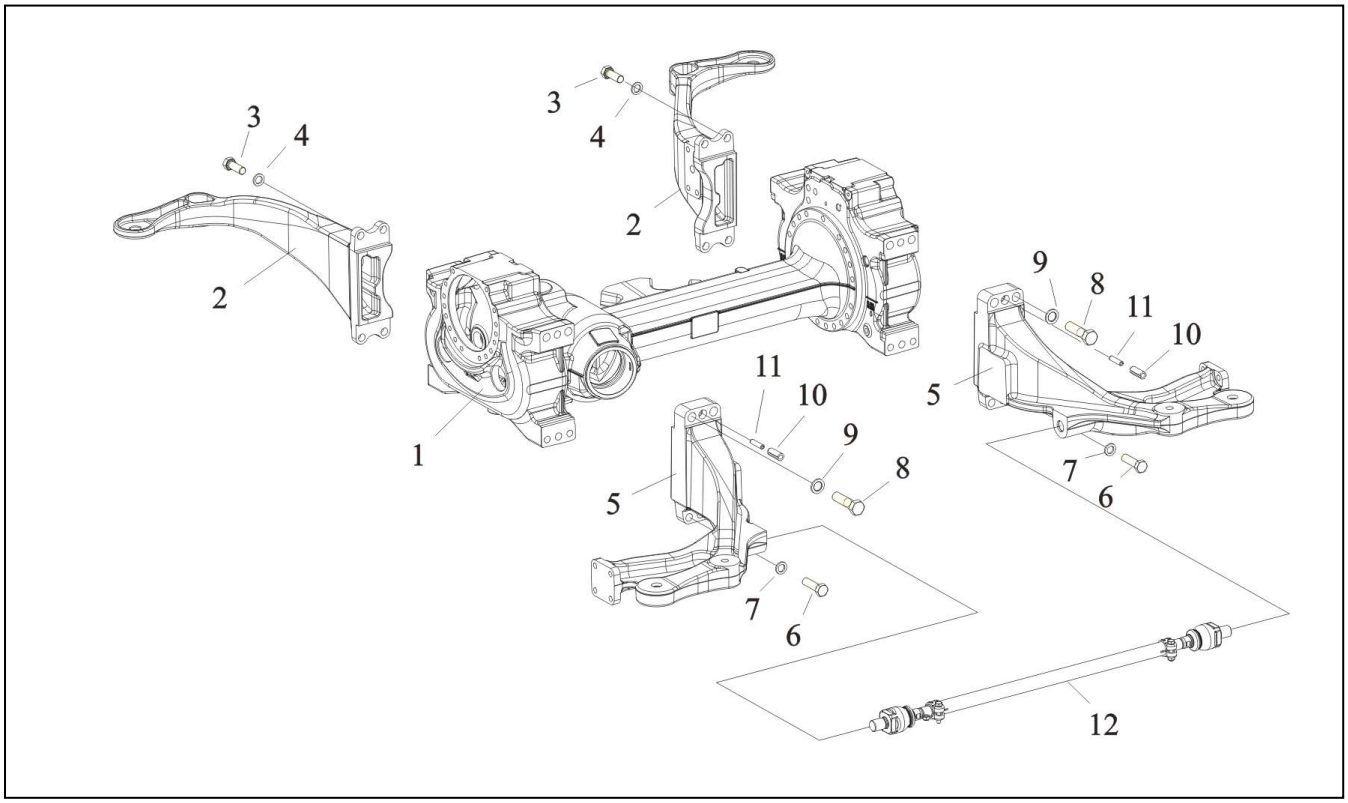


Figure 1

Legend to Figure 1:

1 = Torso axle
2 = spring carrier le. / ri.
3 = hexagon screw (M20x1,5x55/10.9) M_A = 620 Nm
4 = washer
5 = spring carrier le. / ri.
6 = hexagon screw (M20x1,5x70/10.9) M_A = 620 Nm
7 = washer
8 = hexagon screw (M24x1,5x90/10.9) …. M_A = 1100 Nm
9 = washer
10 = slot. pin
11 = slot. pin
12 = Complete stabilizer link consisting of:
Axial joint (2x) …… M_A = 600 Nm
Tube with clamps …… M_A = 50 Nm

Note on pos. 10 / 11:
Mount the slots of the slotted pins in a 180 ° offset position to each other!

Note on pos. 12:
Mount the stabilizer link clearance free!
Place the tube centrally – difference in length (le. - ri.) max. 4 mm!
Wet some threads of the axial joints (M30x1.5 / connection to the spring carrier) with Loctite locking compound (product no.: 243)!


Figure 1

4. Differential Version II / Type „D“

4.1 Disassembly

Pull off both bearing inner rings.

(S) Grab sleeve	5873 002 052
(S) Grab sleeve	5873 002 025
(S) Basic tool	5873 002 001

☞ **Due to difficult disassembly, the differential can also be obtained as a component!**

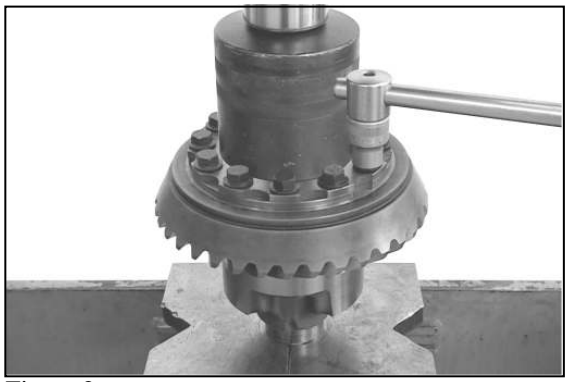


Figure 2

Fix differential by means of the press and loosen locking screws.


Figure 3

Press crown wheel out of differential carrier.

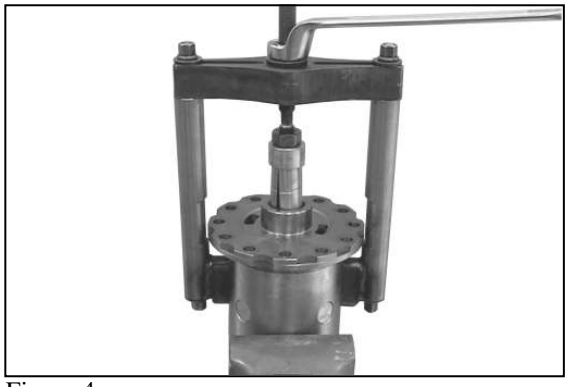


Figure 4

Pull differential cover out of differential carrier using pulling device (S).

(S) Pulling device	5870 080 067

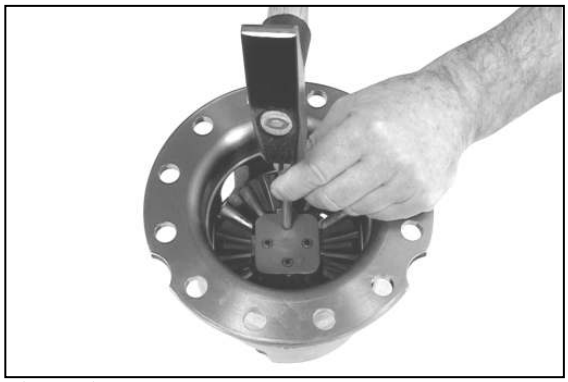


Figure 5

Take thrust washer and axle bevel gear out of the differential carrier.

Then force slotted pins out of cross joint as well as differential pin.



Figure 6

Force differential pin out of differential carrier or cross joint as far as possible.

Afterwards pull differential pin out of differential carrier (see following figure).

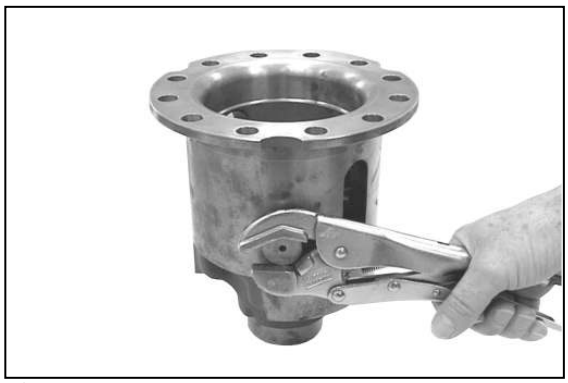


Figure 7



Figure 8

Force out opposite differential pin.

Then remove releasing single parts.

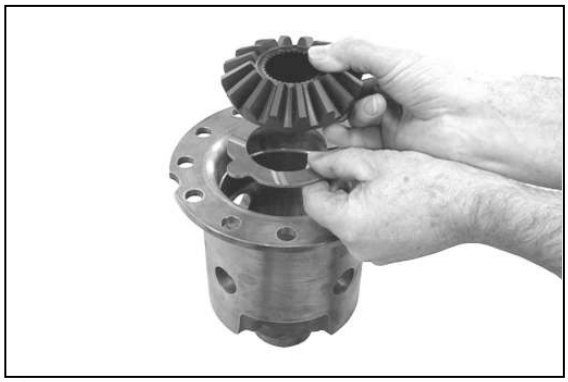


Figure 9

4.2 Reassembly

Insert thrust washer and axle bevel gear into the differential carrier.

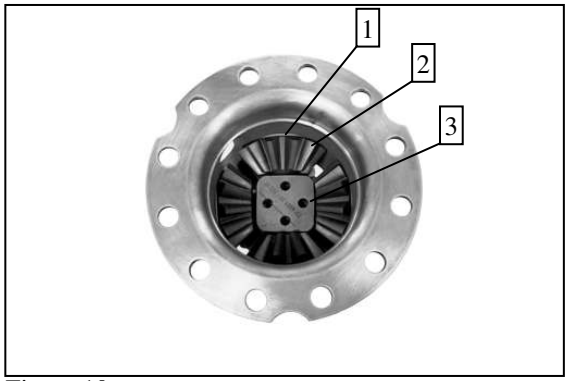


Figure 10

Insert differential bevel gears with thrust washers and cross joint into the differential carrier.

1 = Thrust washer
2 = Differential bevel gear
3 = Cross joint

☞ **Ensure radial installation position of thrust washers!**



Figure 11

Install differential pins (4x).

☞ **Ensure radial installation position, and that holes in the cross joint are aligned with holes in the planetary pin!**

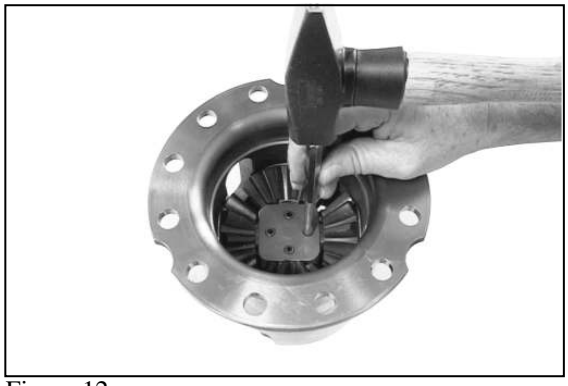


Figure 12

Force slotted pins (2 each hole) into the cross joint and into the planetary pins.

☞ **Mount slotted pins with the openings being in a 180° offset position to each other!**

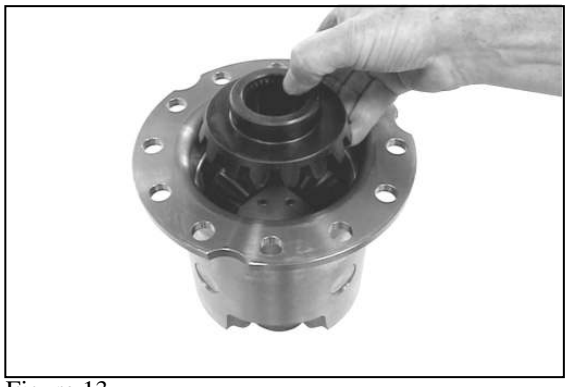


Figure 13

Insert axle bevel gear into the differential carrier.

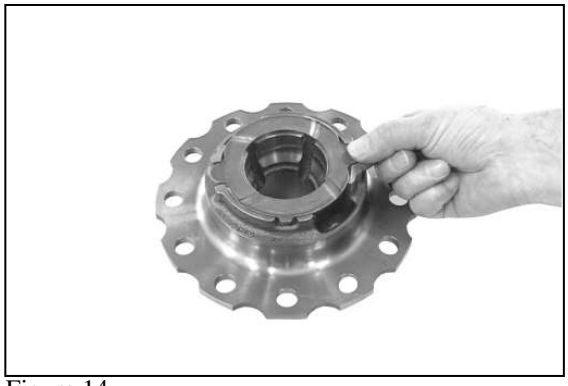


Figure 14

Fix thrust washer in differential cover using some grease.

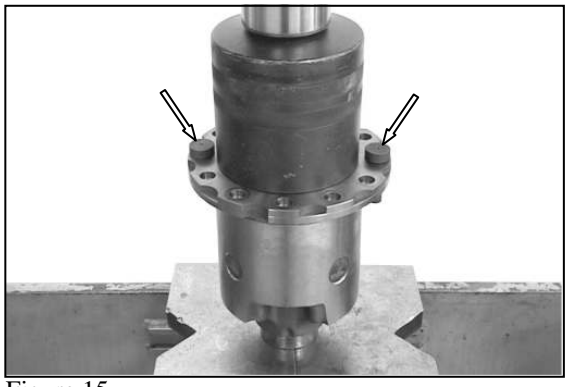


Figure 15

Radially align the differential cover by means of locating pins (2x, see arrows) and then press it into the differential carrier until contact is obtained.

(S) Locating pin AA00 622 210



Figure 16

Mount two locating pins (S), heat up crown wheel and bring into contact position with mounting face of the differential.

(S) Locating pins (M14x1.5) 5870 204 025

Wear protective gloves!

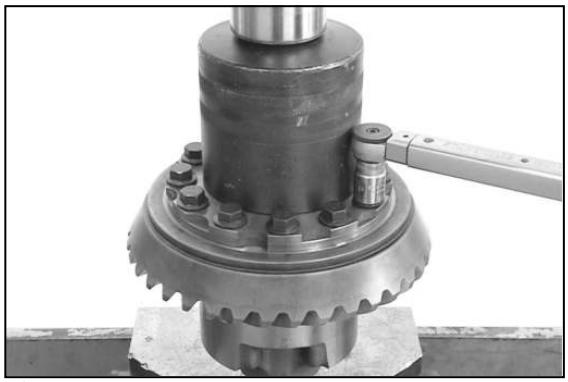


Figure 17

Fix differential carrier by means of a press.

Bolt crown wheel to differential carrier.

Tightening torque M_A = 250 Nm

Permissible crown wheel and differential carrier temperature when bolting, max. + 30° C!

Use of new locking screws is imperative!



Figure 18

Press both bearing outer rings until contact is obtained.

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WORKSHOP MANUAL

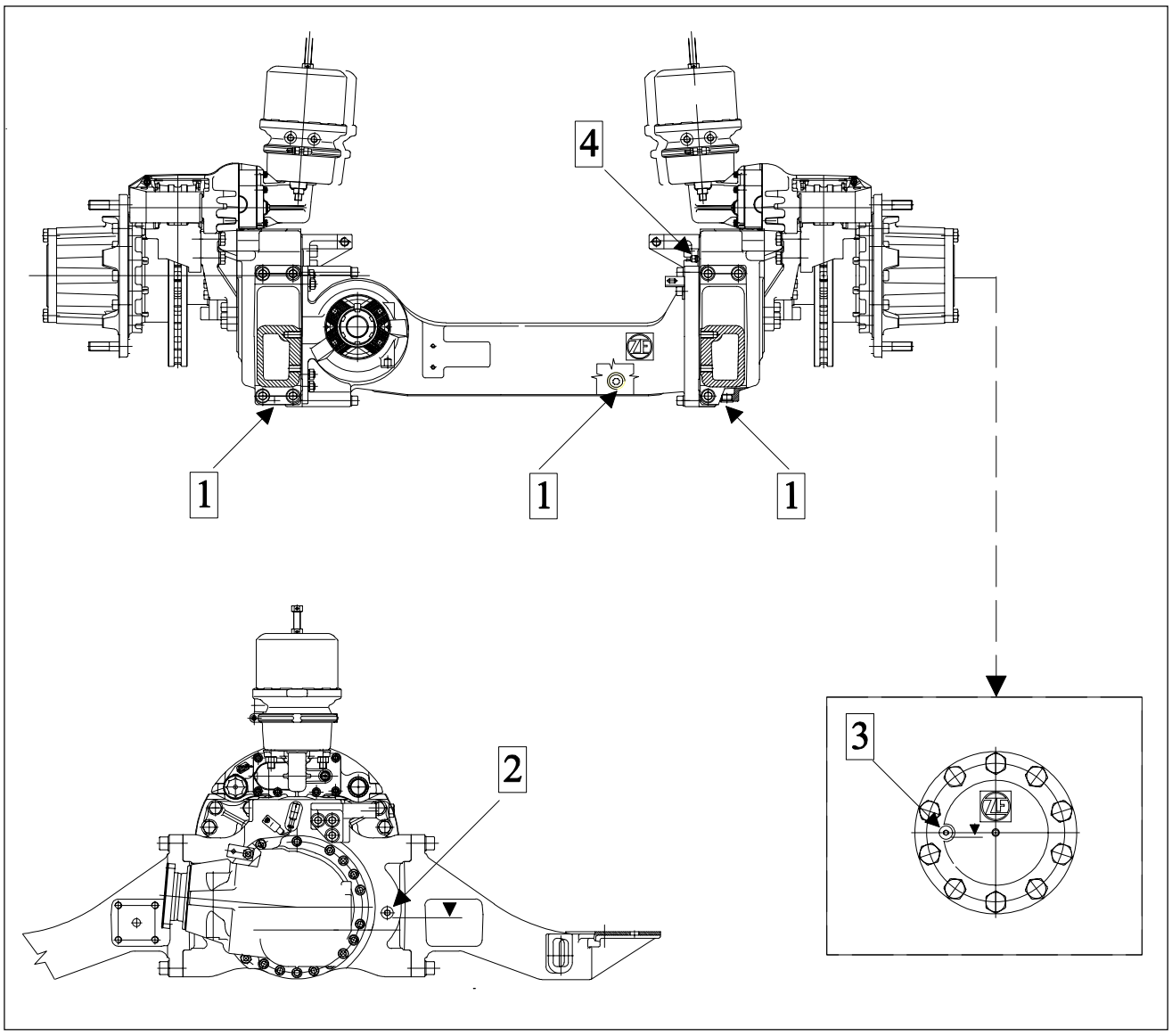
MAINTENANCE

MAINTENANCE and TOWING INSTRUCTIONS

1. Oil quality / Oil change : According to ZF List of Lubricants TE-ML 12, see pages 0.10 ... 0.13 !

Attention: The respective **updated list** can be requested in every ZF After-Sales Service Center and in the Internet under **www.zf-group.de .**

General: All drain-, filler- and level plugs must be cleaned carefully before opening!
Place vehicle in a horizontal plane!
Drain oil only immediately after a longer running time!
Observe the safety directions of the vehicle manufacturer!



Legend:

1 = Drain holes ..... Axle casing – Portal drive
2 = Filler- and level hole ..... Axle casing – Portal drive
3 = Drain-, filler and level hole ..... Output (hub)
4 = Breather

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WORKSHOP MANUAL

EBS System

Introduction

The demands made on braking systems are increasing steadily. Therefore, the development and introduction of an electronic braking system (EBS) is a logical step.

EBS increases traffic safety through reduced stopping distance and improved brake stability. The full diagnosis and surveillance functions as well as the display of brake lining wear offer an effective fleet logistics.

Advantages of EBS

EBS reduces service costs considerably.

- The electronic braking system has a lot of functions. The aim is to maximise braking safety at reduced costs, for instance by optimising wheel brake lining wear.
- Setting pressure, according to wear criteria, to the front and rear axle results in uniform lining wear. Overall wear is minimised by making the load on all wheel brakes uniform. Moreover, servicing and lining replacement are done at the same time. This reduces down-time costs.
- Depending on the vehicle utilisation profile and other factors, this also means considerable savings for the vehicle user. In terms of wheel brake service costs alone, a firsthand owner will save more money with an electronically braked bus than with a vehicle with a conventional braking system.

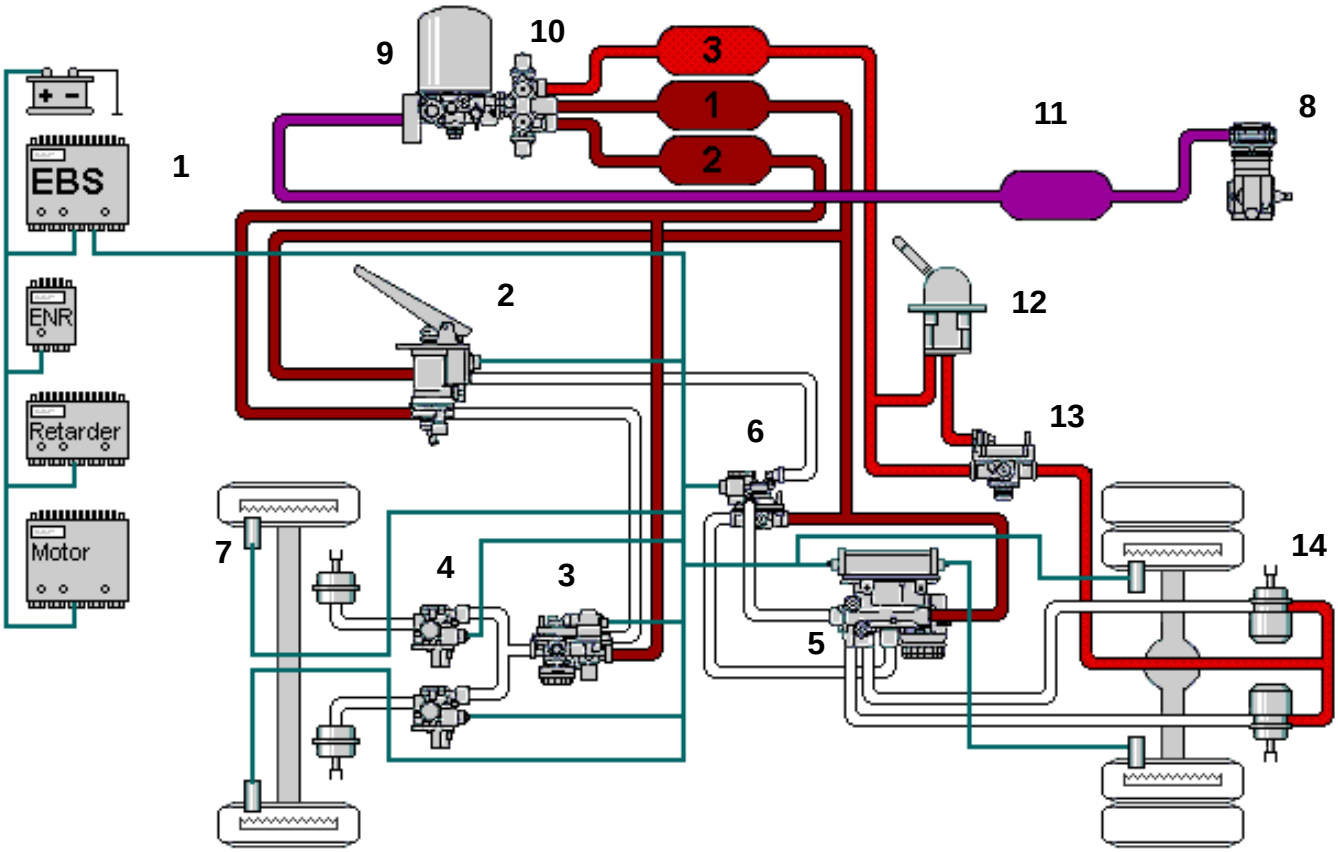
Increased brake safety

WABCO did not only take existing regulations into consideration while developing EBS. Top priority was given to safety and user advantages. This is why a vehicle with EBS can clearly do more than is required by law.

The high safety quality attributed to EBS is due to several factors:

- Braking time is reduced through shorter response time and pressure build-up time of the brakes on the front and rear axle(s).
- The improved ABS function increases vehicle stability when brakes are activated.
- The components of the front and rear axle braking system and brake lining wear are monitored permanently.
- The integrated ASR function also provides optimum vehicle stability and traction during start and acceleration.

EBS braking system for buses with no attachment (4S/4M system)



Legend:

EBS components:

1	EBS central module
2	Brake signal transmitter
3	Proportional relay valve
4	ABS solenoid valve
5	Axle modulator
6	3/2 relay valve
7	ABS sensors

Other components:

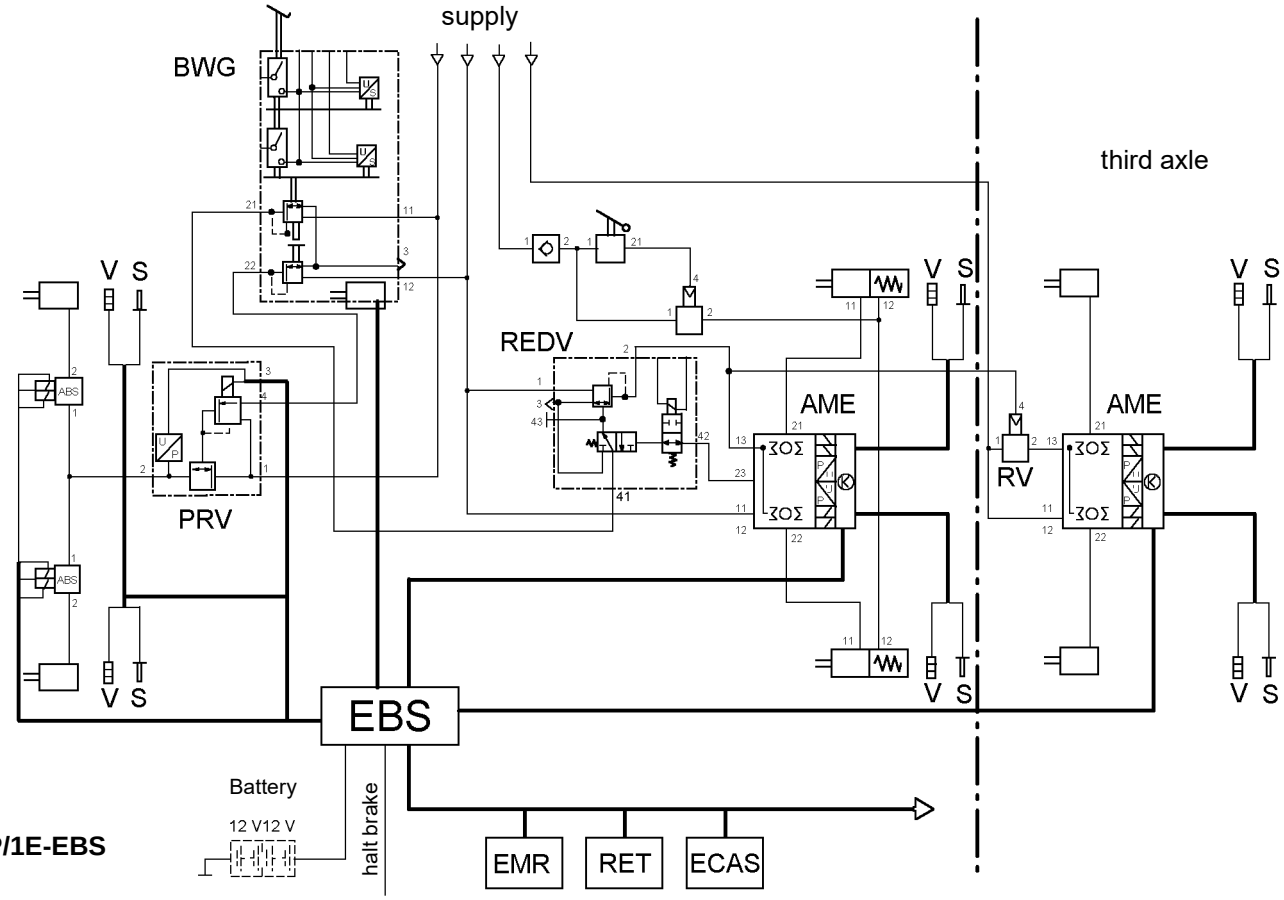
8	Compressor
9	Air dryer
10	Four-circuit protection valve
11	Air reservoir
12	Hand brake valve
13	Relay valve FBA
14	Brake cylinder

WABCO EBS construction kit

The design and structure of WABCO EBS allow high flexibility for vehicle manufacturers during system construction.
In terms of range

- ❑ subsystem or full system
- ❑ addition and cut-off redundancy
- ❑ electrical interfaces

the most complex demands can, therefore, be met. To meet the vital needs of the vehicle owner, WABCO recommends an EBS with an individual pressure control unit on the front and rear axle, and which provides for pneumatic redundancies in all brake circuits.



2P/1E-EBS

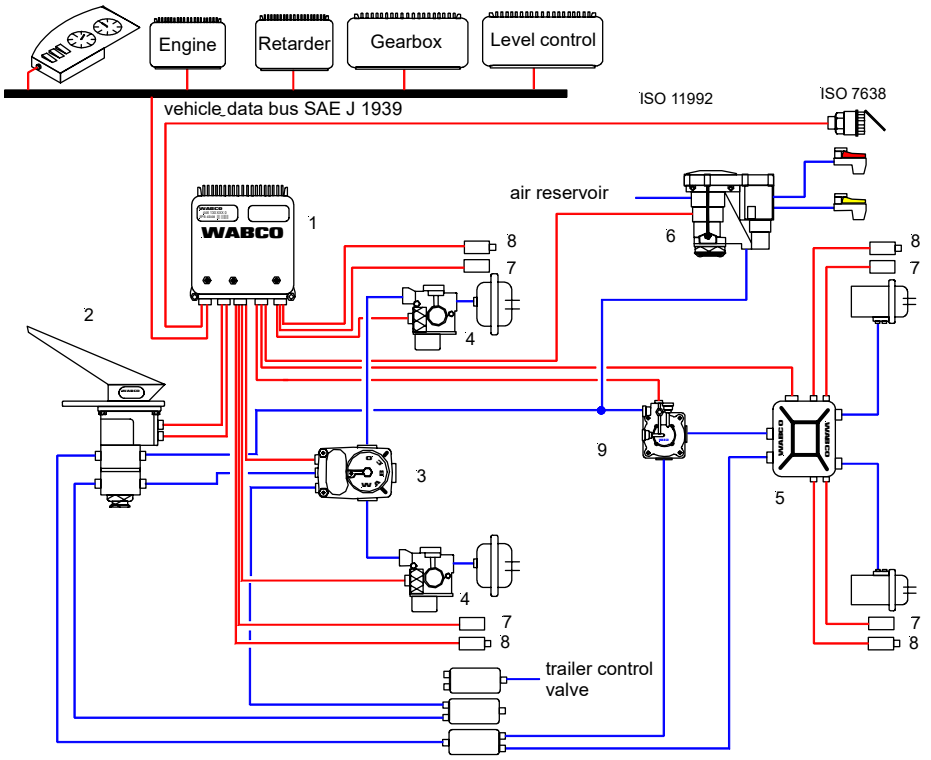
AME = Axle modulator
BWG = Brake signal transmitter
ECAS = Electronically Air Suspension System
EMR = Electronically engine control
PRV = Proportional relay valve
REDV = 3/2 relay valve (redundancy valve)
RET = Retarder
RV = Relay valve
S = Speed sensor
V = Wear indicator

The EBS described here consists of a dual-circuit, purely pneumatic unit and a superimposed single-circuit, electro-pneumatic unit. This configuration is described as 2P/1E system.

The single-circuit, electro-pneumatic unit comprises a central electronic control device (central module), the axle modulator with integrated electronic unit for the rear axle, and, if necessary, the axle modulator for the third axle, a brake signal transmitter with two integrated desired value sensors and brake switches, as well as a proportional relay valve and two ABS valves for the front axle.

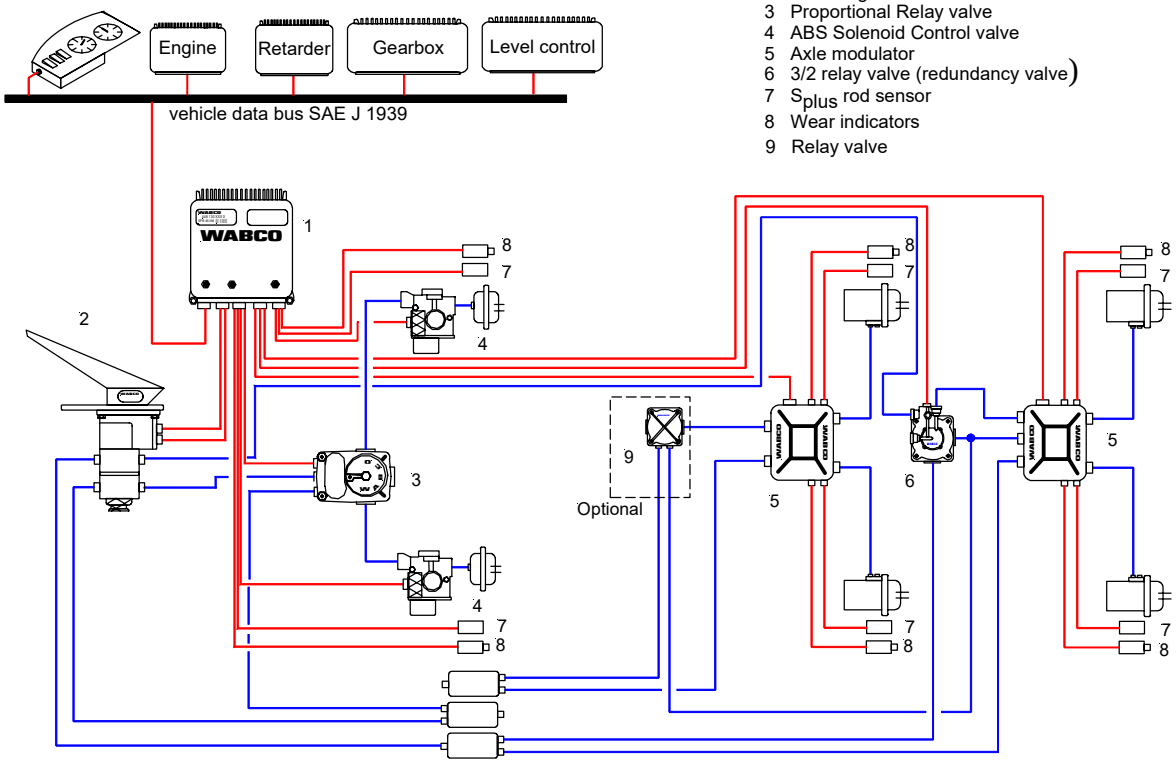
In terms of structure, the dual-circuit pneumatic unit basically corresponds to that of a conventional braking system. This unit serves as redundancy and only becomes active in case of electro-pneumatic circuit failure.

EBS 4S/4M in buses with optional trailer control

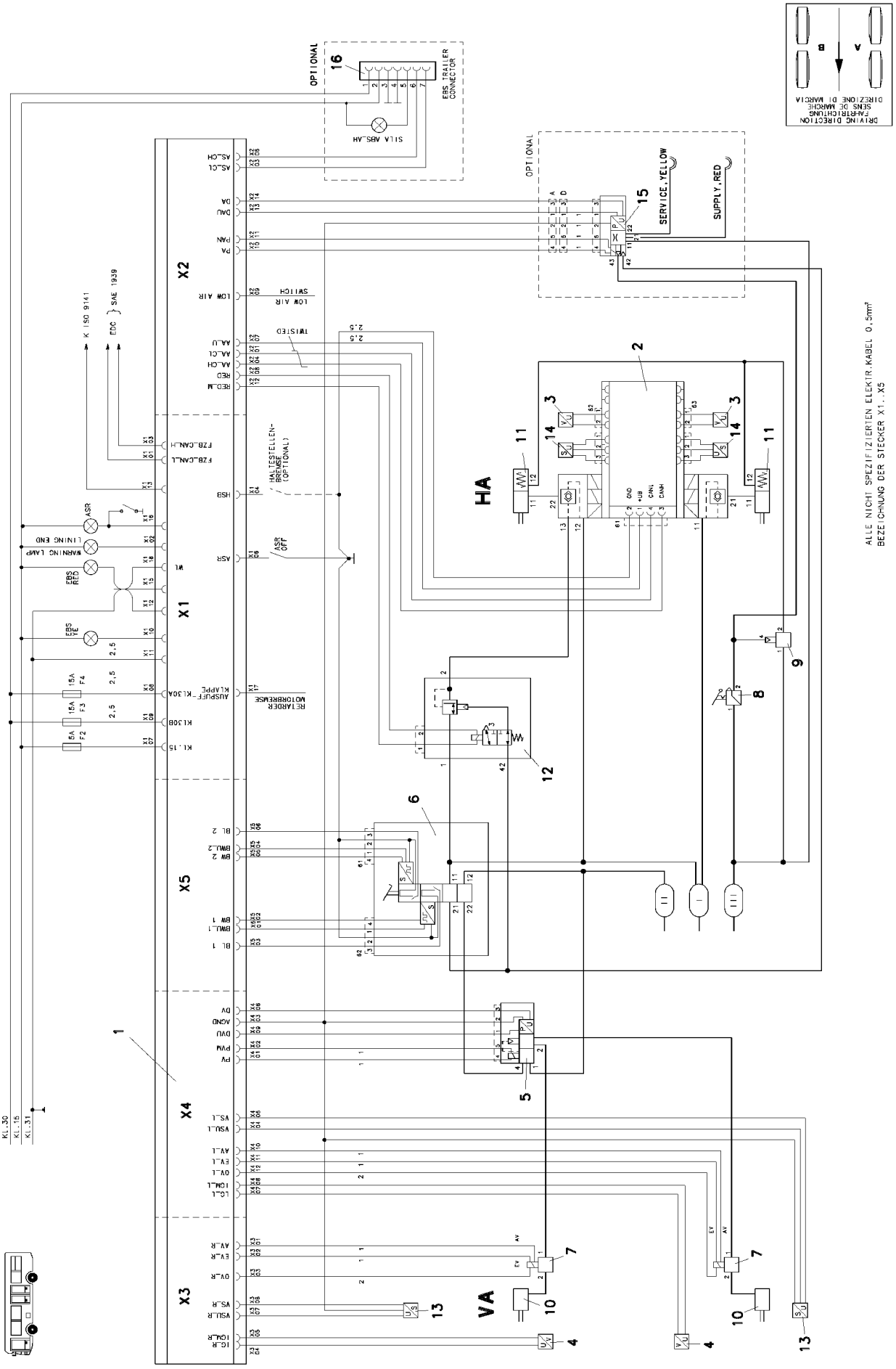


1 Central control unit EBS
2 Brake signal transmitter
3 Proportional Relay valve
4 ABS Solenoid Control valve
5 Axle modulator
6 Trailer control valve
7 S_{plus} rod sensor
8 Wear indicators
9 3/2 relay valve (redundancy valve)

EBS 6S/6M in articulated buses



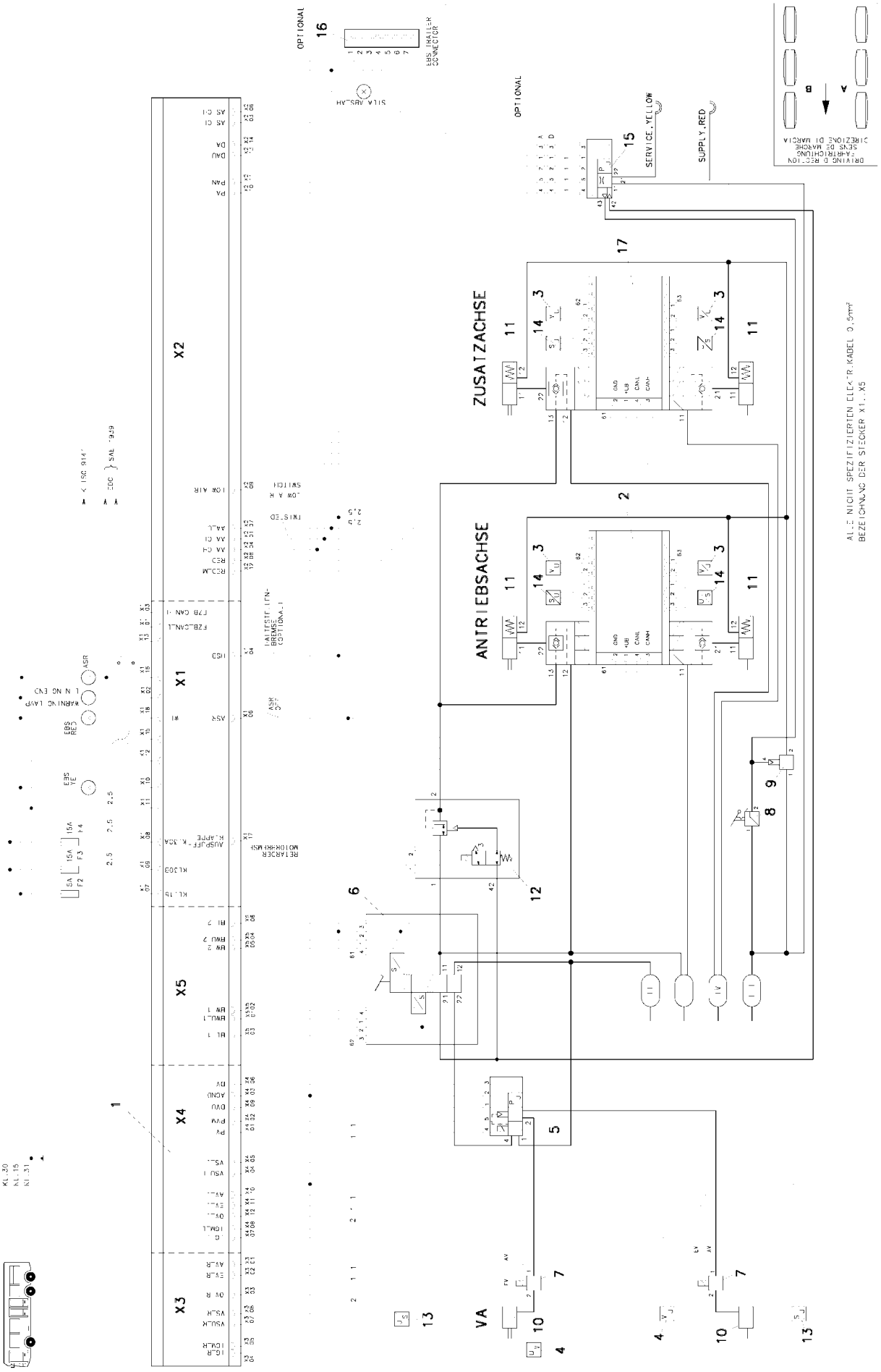
1 Central control unit EBS
2 Brake signal transmitter
3 Proportional Relay valve
4 ABS Solenoid Control valve
5 Axle modulator
6 3/2 relay valve (redundancy valve)
7 S_{plus} rod sensor
8 Wear indicators
9 Relay valve



OPTIONAL
EBS TRAILER CONNECTOR
SILA ABS_AH
SERVICE, YELLOW
SUPPLY, RED
DRIVING DIRECTION
FAHRTRICHTUNG
SENS DE MARCHE
DIREZIONE DI MARCIA
ALLE NICHT SPEZIFIZIERTEN ELEKTR.KABEL 0,5mm²
BEZEICHNUNG DER STECKER X1..X5
HA
VA
X1
X2
X3
X4
X5
LOW AIR SWITCH
TWISTED
HALTESTELLEN-BREMSE (OPTIONAL)
ASR OFF
WARNING LAMP
LINING END
EBS RED
EBS YE
AUSPUFF-KLAPPE
RETARDER MOTORBREMSE
K ISO 9141
EDC
SAE 1939

System structure in buses

Wiring diagram 841 801 702 0: Three-axle bus (6S/6M)



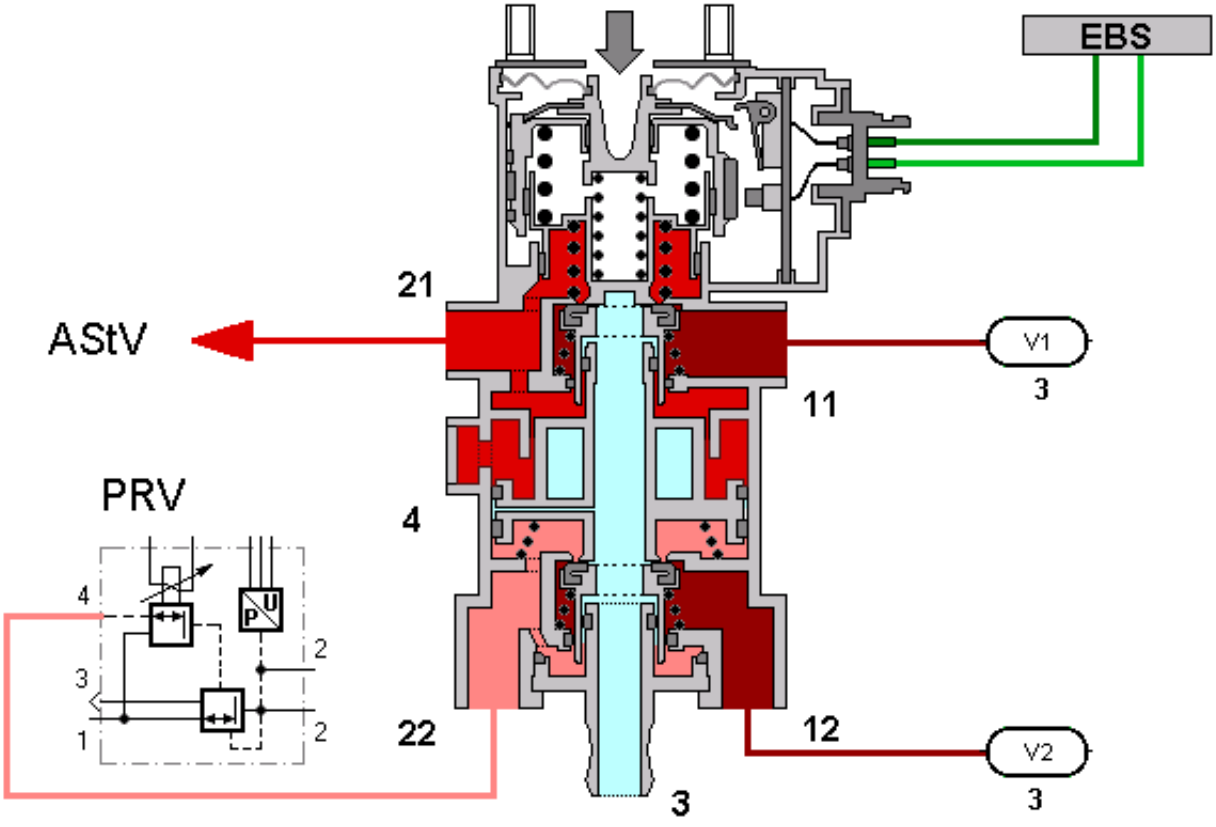
Brake signal transmitter 480 001/ 002 ... 0

The brake signal transmitter is used to produce electrical and pneumatic signals, and to increase and decrease the air pressure of the electronically controlled braking system. The device has a dual-circuit pneumatic and a dual-circuit electrical structure. Actuation start is recorded electronically by a double switch. The operating tappet's route is controlled and transmitted as pulse-width modulated electrical signal. Further pneumatic redundancy pressure is delivered in circuits 1 and 2. The pressure in the second circuit is retained slightly in the process. In case of (electrical or pneumatic) failure of a circuit, the other circuits remain functional.



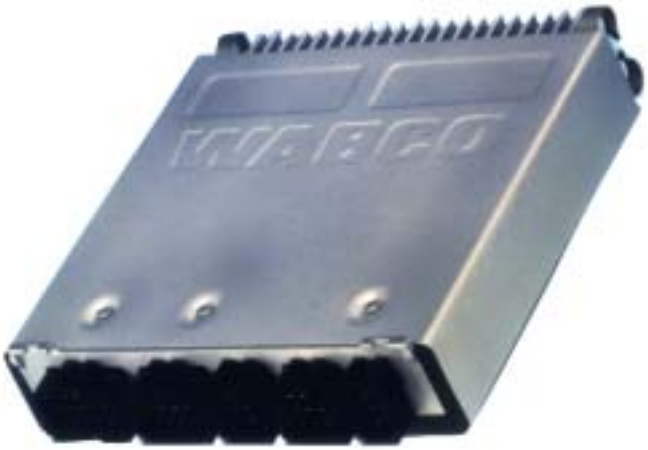
Depending on bus type, the brake signal transmitter is actuated via a running plate (480 002 ... 0) 0) or via a push pedal using the tappet (480 001 ... 0).

How it works:



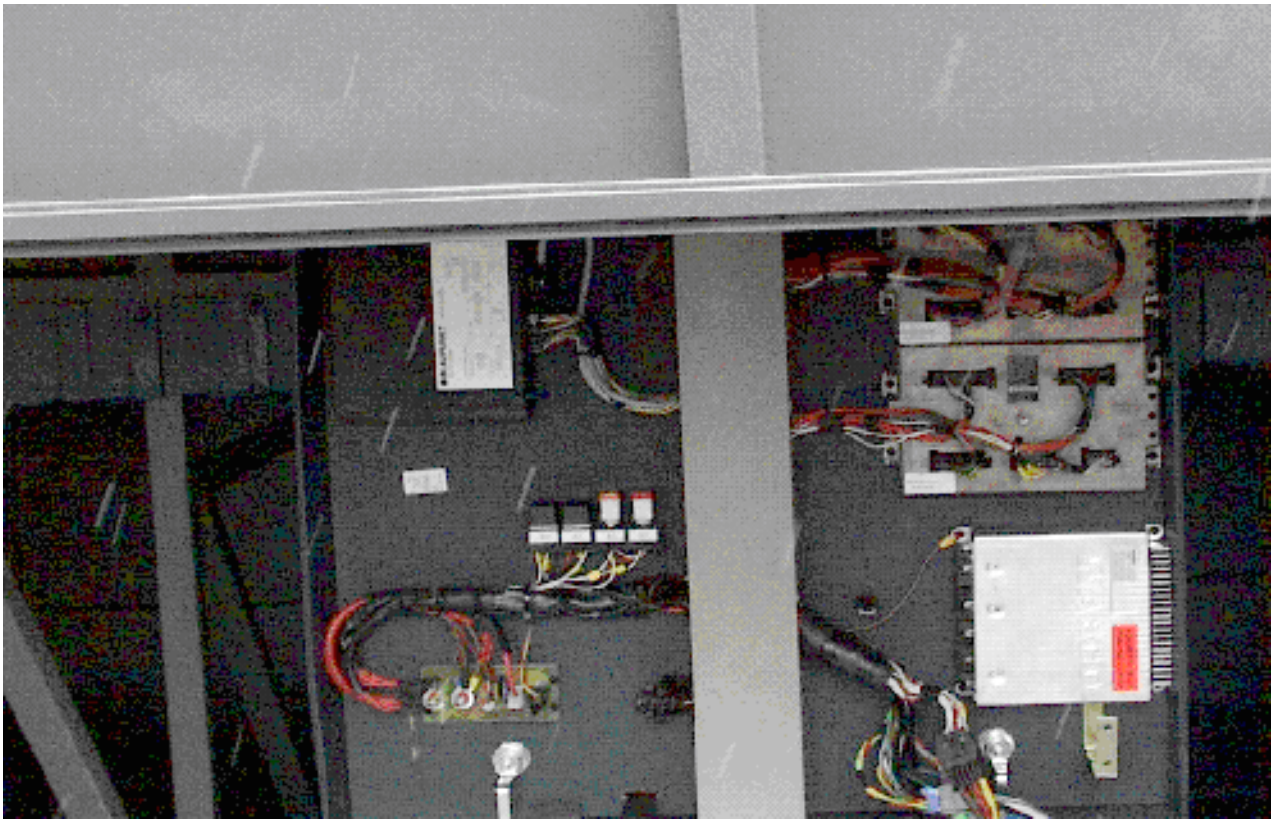
EBS central module 446 135 ... 0

The central module is used to control and monitor the electronically controlled braking system. It determines the vehicle's nominal delay from the signals received by the brake signal transmitter. The nominal delay and the wheel velocity measured by the speed sensors are input signal for the electro-pneumatic control unit, which uses it to calculate nominal pressure values for the front axle and rear axle(s). The front axle's nominal pressure value is then compared with the measured actual value, and any existing deviations corrected with the help of the proportional relay valve. Moreover, the wheel velocity is evaluated so that in case of locking, an ABS control can be carried out by modulating the braking pressure in the brake cylinders. The central module exchanges EBS system bus related data with the axle modulators.



The central module communicates with other systems (engine control unit, retarder, display unit, etc.) via the vehicle data bus in accordance with SAE J 1939.

KOM-integrated central unit:



Proportional relay valve 480 202 ... 0

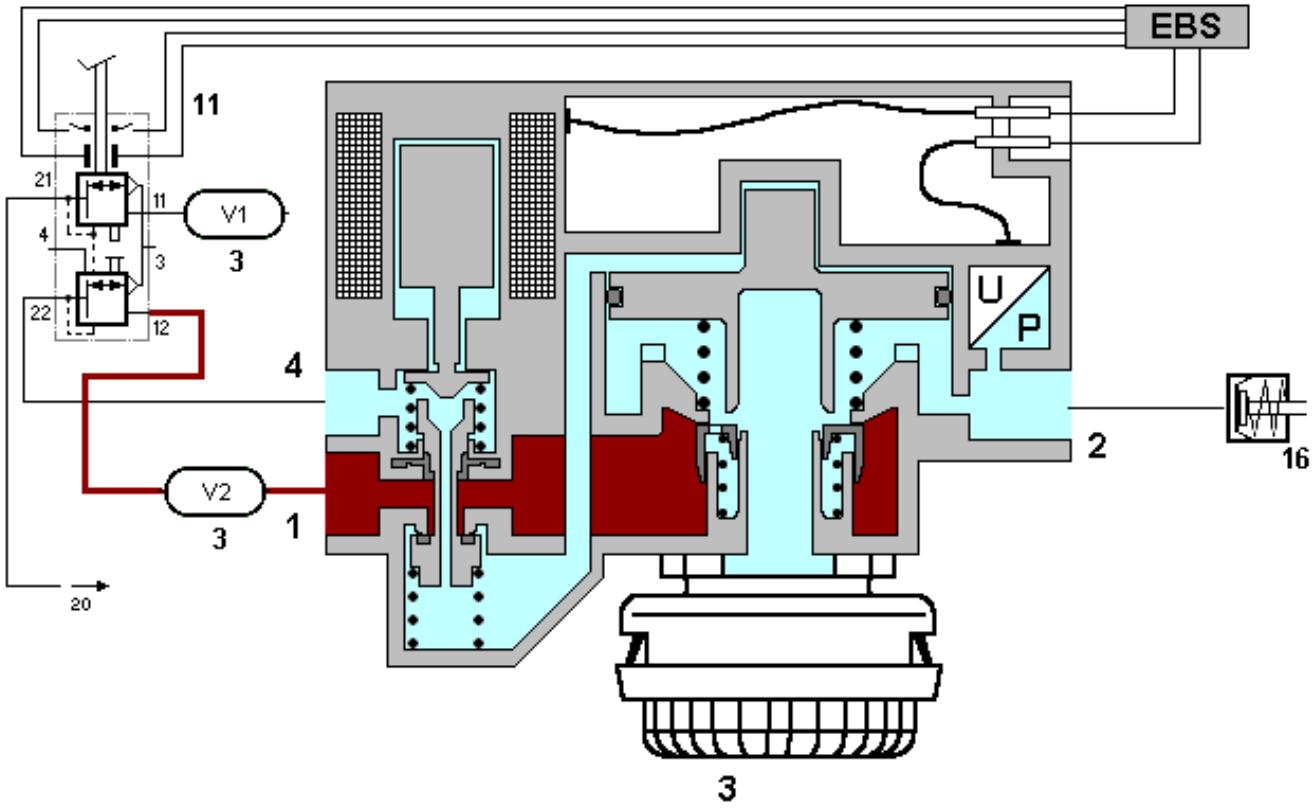
The proportional relay valve is used in the electronically controlled braking system to modulate the braking pressure on the front axle.

It comprises the proportional solenoid valve, relay valve and pressure sensor. Electrical drive and monitoring takes place via the central module of the hybrid system (electro-pneumatically / pneumatically).

The control current impressed by the electronic unit is transformed via the proportional solenoid valve into a control pressure for the relay valve. The proportional relay valve's output pressure is proportional to this pressure. The pneumatic drive on the relay valve takes place via the brake signal transmitter's redundant (back-up) pressure.



How it works:



3/2 relay valve 480 205 ... 0

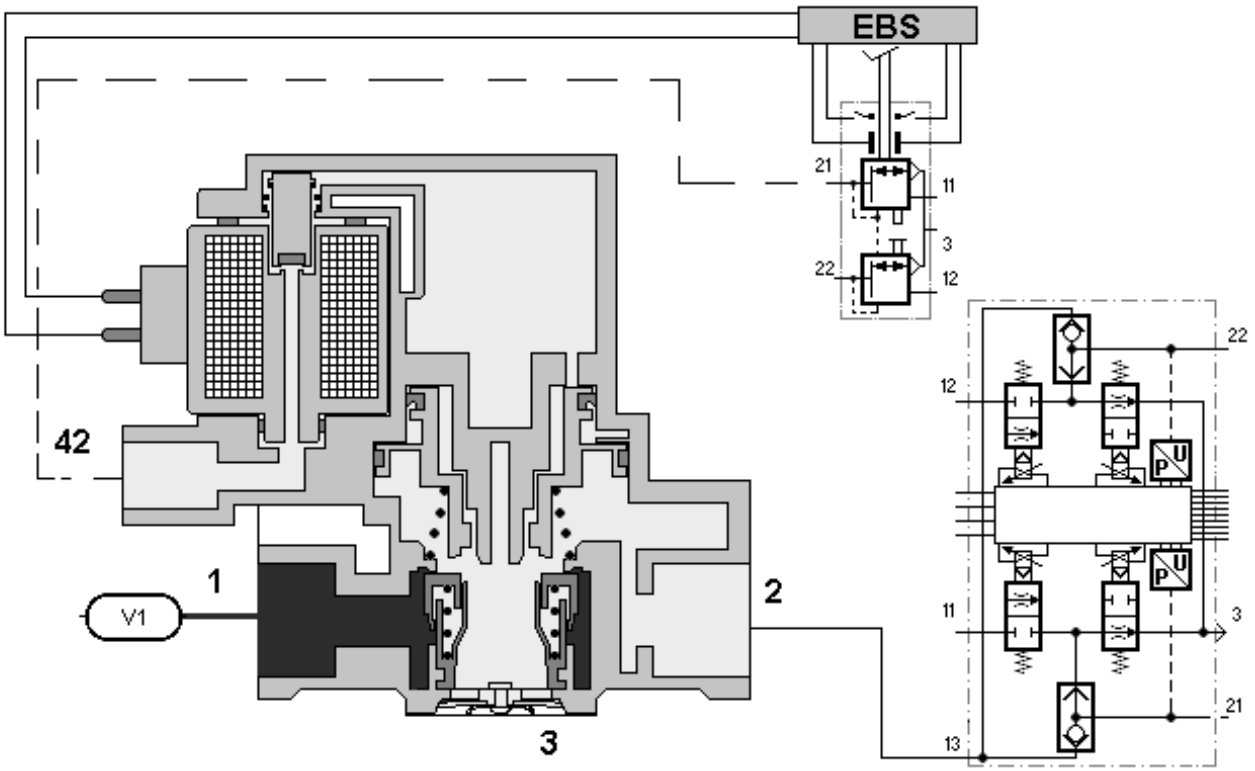


The 3/2 relay valve is used to supply air to and remove air quickly from the brake cylinder on the rear axle in case of redundancy, and comprises several valve units which must fulfil the following functions, among others:

- 2/2 solenoid valve for controlling redundancy in intact electro-pneumatic braking circuit
- Relay valve function, to improve the time behaviour of redundancy,
- Pressure retention, to synchronise the beginning of pressure level control on the front and rear axle, in case of redundancy .
- In case of redundancy, rear axle 1:1 is controlled.

The 3/2 relay valve also has a 3/2 directional control valve to which current is supplied in case of ABS and is thus meant to prevent an involuntary drive through of the rear axle redundancy pressure during ABS control.

How it works:



Axle modulator 480 103 ... 0

The axle modulator controls the brake cylinder pressure on the two sides of a single or dual axle. It has two pneumatically independent pressure control channels with an air admission and bleeder valve each, individual pressure sensors and a joint electronic control unit. Desired pressure definition and external surveillance take place via the central module.

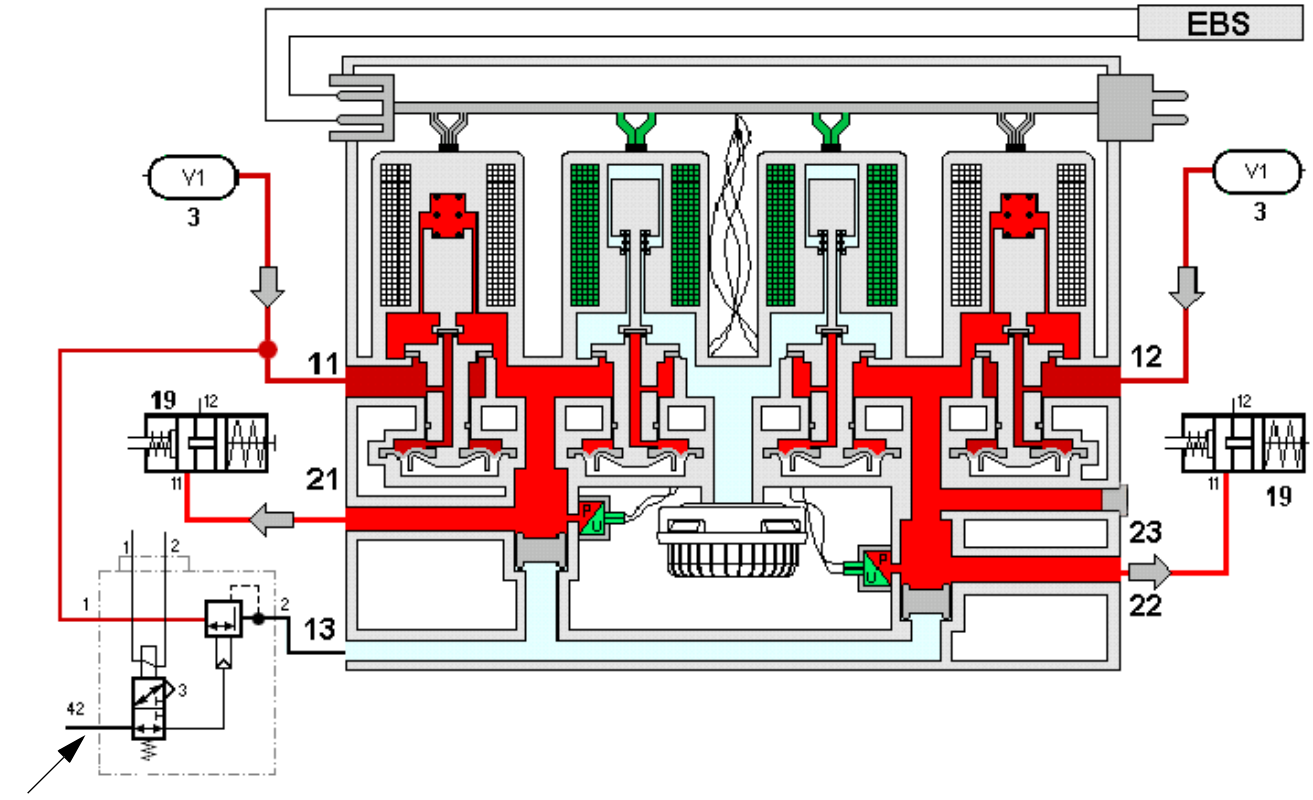


Moreover, wheel rotation speed is measured and evaluated via two speed sensors. In case of wheel-lock or wheel-spin, the set nominal value is modified. Provision has been made for the connection of two sensors to detect brake lining wear.

The axle modulator for the driving axle has an additional connection for a redundant pneumatic braking circuit. A two-way check valve on each side drives the higher pressure (electro-pneumatic or redundant) through to the brake cylinder.

The axle modulator for the additional axle does not have three two-way valve.

How it works:



Brake signal transmitter

Function of the electro-pneumatic unit

The electro-pneumatic unit of the EBS system and its signal path work via

- **Brake signal transmitter**
  two distance sensors determine the nominal value which is transmitted as pulse-width modulated signal; two integrated switches are used for nominal value confirmation, among others
- **EBS central module**
  for determining the desired pressure for each axle, and system control
- **Proportional relay valve**
  for pressure control on the front axle
- **ABS solenoid valves**
  for the quick ABS pressure control cycles on the left and right wheel brakes of the front axle
- **3/2 relay valve**
  for restraining the rear axle redundancy pressure
- **Axle modulators**
  with integrated control unit for regulating brake pressures on each side of the rear axle(s).

EBS can be activated electrically via the driving switch (pin 15) or by actuating the brake signal transmitter via the integrated brake switches.

The measured brake pedal distance is interpreted as the desired delay and converted by the central module into desired pressure standards for the rear and front axle(s), using various criteria.

The nominal value standard for the axle modulators is transmitted by the central module via a central module. The axle modulators regulate and record the braking pressures of the rear axles' left and right wheel brake. The braking pressure of the front axle is regulated by the central module via the proportional relay valve with integrated pressure sensor.

The wheel rotation speeds are recorded via the sensors known to the ABS system and serve, among others, as input quality for the pressure control algorithms, for the ABS function and for the ASR function.

Before carrying out a wear control operation, the brake lining wear sensors analyse the brake lining wear on each wheel brake.
The sensor signals from the front axle are recorded by the central module whereas those from the rear axle are recorded by the axle modulators.

Signals are processed and errors monitored for the rear axles in the axle modulators, so that the sensor values can be subsequently transmitted to the central module via the data bus.

Function of pneumatic redundancy

Front and rear axle circuits work with different redundancy methods. The front axle circuit works according to the additional redundancy principle, the rear axle circuit is equipped with a redundancy unit which can be activated with a valve.

Additional redundancy on the front axle

The front axle circuit which functions pneumatically and serves as redundancy works via

- **Brake signal transmitter**
  with 2 pneumatic circuits (front and rear axle)
- **Proportional relay valve**
  relay valve with combined pre-control via pneumatic front axle circuit and the proportional solenoid valve

on the front axle brake cylinder.

Electro-pneumatic pressure is delivered via the proportional valve when the brake signal transmitter is activated. Depending on the control force, pressure is supplied to the proportional valve by the brake signal transmitter in a delayed, pneumatically redundant manner.

This is added to the pressure delivered already electro-pneumatically. The pressure delivered by the proportional valve is adjusted to the set desired pressure by varying the electro-pneumatic pressure.

In case of electro-pneumatic unit failure, the pneumatic pressure part alone affects the proportional valve which can be raised to p_{max} by actuating the brake pedal further.

Due to the need to restrain the front axle redundant brake pressure vis-à-vis the electro-pneumatic pressure output (for instance, measures to optimise wear, or integration of endurance brake), the "electrical" nominal value predominates the pneumatic front axle pressure output on the brake signal transmitter (pneumatic dual circuit of the brake signal transmitter).

Rear axle redundancy

The pneumatic redundancy of the rear axle works via

- **Brake signal transmitter**
  with 2 pneumatic circuits (front and rear axle)
- **3/2 relay valve**
  with a 3/2 solenoid valve and a relay valve
- **Relay Valve**
  for the additional axle
- **Shuttle valves**
  integrated in the rear axle modulator

on the brake cylinder of the rear axle(s).

During hitch-free EBS operation, i.e. an electronic pressure control is possible on the rear axle, the 3/2 solenoid valve in the 3/2 relay valve is set to ”switch off redundancy”, due to the electronically controlled pressure.

Electrical / electronic structure

Power is supplied to the electronic braking system via two separate feed lines.

Clip 30a:
Power supply for the proportional relay valve and the ABS solenoid valve of the front axle and a brake signal transmitter circuit.

Clip 30b:
Power supply for the axle modulator(s), 3/2 relay valve, and the second circuit of the brake signal transmitter.

The central module has a data bus interface for communication with other vehicle systems (engine, gear system, retarder).

The axle modulator(s), ABS solenoid valve, and proportional relay valve of the front axle can be switched off individually via the short circuit-proof electronic switch in the central module.
The grounds for the external pressure and wear sensors are returned to the central module or axle modulator. Direct connection to the vehicle ground is not allowed.

Connection between the central module and the axle modulator(s) is established via an individual CAN system bus (brake bus).

The brake signal transmitter is separated electrically and has a dual circuit. The actuation process is recognised via two switches. The switches have the following functions:

- sensing the beginning of the braking process
- activating the EBS (if the driving switch is in the ”off” position)
- the offset values of the nominal value sensors are calibrated and monitored without being activated

The inactivated distance sensors transmit the electrical brake nominal value as pulse-width modulated signals to the central module. Both signals of the redundant electrical transmitter are evaluated equally.

The braking pressure on the front axle is regulated with an electrically controlled proportional valve. The actual-pressure sensors are integrated into the valve subassemblies. The actual values are transmitted as analogue signals.

Axle load sensing is not required. The braking pressure on each axle is determined by a special braking force distribution function. The valves are actuated by the central module.

The EBS system status, for instance available errors, is transmitted by the EBS to a display unit via the vehicle bus (data line). Alternatively, the display can also take place via a red and a yellow warning light, as well as via an TCS light.

Potentiometers must be provided (or possibly alternative limit switches for drum brakes) for sensing brake lining wear, and which are read in for the front axle by the central module.

The activities of each rear axle wear sensor is recorded by the axle modulator; the results are transmitted via the system bus brake to the central module. The sensors are supplied individually and per axle with short circuit-proof 5V.

Control functions

Endurance brake integration

The braking system has an integrated brake management function which always regulates the endurance brake when the brake pedal is activated based on an optimum delay of the vehicle. Optimum service brake wear is attained through the distribution of endurance and service brake. This function is an important part of delay control. The integration of endurance brake can be deactivated via the switch.

Delay control

Delay control is used to adapt the braking pressure level to the driver's desired braking rate (def. As z in %).

When the same amount of pressure is applied on the pedal, the vehicle is often braked in the same manner, irrespective of the amount of load it is carrying.

If the coefficient of friction on a wheel brake changes (for instance when the vehicle is moving downhill), the delay control unit ends every adaptation process when a predefined, fixed maximum is attained, to enable the driver to also to feel the deterioration.

Adapting to the braking system hysteresis is also part of delay control. Each time the brake is released, the releasing process is chosen in such a way that an immediate braking force modification is adjusted. This function results in quick release of the brakes, i.e. car feeling.

Braking force distribution

The distribution of braking forces on the front and rear axles depends, among others, on the comparison made in the program range "Delay control" between the actual and nominal value of vehicle delay. The pressure on the front and rear axles is set in such a way that there is optimum braking pressure output on these axles.

Brake lining wear control

When the brake is applied partially, the braking pressure distribution is adjusted, notwithstanding the available wear signals, i.e. the detected wear difference. The pressure on the wheel brakes with more lining wear is reduced slightly, whereas the pressure on the wheel brakes with less lining wear is increased adequately, so that there is no change in the overall braking rate required by the driver.

The EBS contains the following renowned functions:

Anti-lock braking system (ABS)

The control logic determines from the wheel rotation speed whether one or more wheels can be blocked and decides whether to decrease, maintain, or increase the braking pressure on it. The rear axle wheels are controlled in their optimum area in a similar manner (individual control).

On roads with extremely different adhesion levels between the right and left sides, vehicles are uncontrollable or difficult to control using the different braking forces in ABS (yawning moment development).

As a result, the braking pressure on the front axle brakes is not adjusted independent of each other, so that the driver can have a steering reaction (modified individual control).

If the driving wheels are locked when the endurance brake is applied on low adhesion levels, possibly resulting in vehicle instability, the ABS endurance brake is deactivated via the vehicle's CAN bus to maintain vehicle stability.

Traction control system (TCS)

Just like in the ABS function, while the vehicle is in motion, the electronic control system determines whether the wheels are in the stable area of the μ slip curve. In case of wheel-spin, the engine output and/or driving axle wheel braking is adjusted by the axle modulator via the CAN bus and engine control system. An activated traction control system is displayed on the functions display.

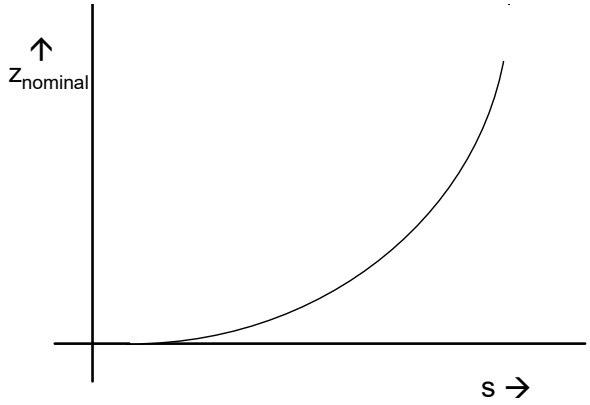
Drag torque control

Drag torque occurs in the drive train due to actuation or change of gas. The resultant braking torque can lead to driving wheel locking and thus to vehicle instability. Drag torque control prevents this situation. When a slip state is exceeded, the engine torque increases and the brake torque is reduced, irrespective of the driving wheel velocity. The function of the traction control system ends when the driving wheel values become stable again.

Backup functions

Generating brake nominal value

The brake pedal distance measured by the sensors in the brake signal transmitter is transmitted to the central module where it is ”processed”. The distance is converted into a nominal delay, based on the characteristic curve described in the chart.



Determining the brake nominal value

Pressure control on the front and rear axles

The nominal pressure derived from the brake nominal value using the higher control algorithms is controlled in the front and rear axle’s pressure control circuits. In order to improve the pressure control properties, the solenoid current in the solenoid valves are controlled.

Wheel speed sensing and wheel adjustment

Wheel speed sensing corresponds to the sensing function known to ABS. Automatic wheel adjustment makes up for the nominal wheel sizes and thus the rolling circumferences between the axles. If unacceptable wheel combinations are used, this is recognised as an error.

If the wheel sizes change, the system requires a change of parameters.

Halt brake, brake hold and release aid (Hill holder)

When the halt brake switch in the dashboard is activated, or if the door control unit so requires, the command ”Activate halt brake” is transmitted to the central module via the CAN bus or the halt brake switch. This latter sends the command to the proportional relay valve and axle modulator(s), so that 2 bar braking pressure is exerted on the brake cylinder of the front and rear axle(s).

If the halt brake command is deactivated via the switch or via the door electronic unit, and then the driving pedal activated, the ”halt brake” command is cancelled via the central module.

Failure diagnostics

Error recognition functions are used to avoid the effects of system failures and/or to inform the driver about functional problems. The error recognition principles correspond partly to those of a conventional ABS device (monitoring the ABS valves, the wheel speed sensors, the computer hardware).

On the other hand, a big part of the surveillance functions concerns EBS-specific functions (EBS-specific sensor analysis, EBS-specific solenoid control, braking pressure control, data transmission via CAN bus).

In addition to the wheel speed sensor signals, the EBS evaluates many other sensor signals and checks that these signals are error-free.

Nominal value sensing (sensors and switches)
The brake signal transmitter provides two sensor and two switch signals. The (pulse-width modulated) sensor signals are checked to see whether they conform with the authorised values, and for mutual deviations. The correctness of the (digital) switch signals are then tested.

Braking pressure sensing (on the front and rear axles)
The pressure sensor's (analogue) signals in the pressure control circuits are checked to see whether they correspond to the authorised values.

Note: The cabling for the two rear axle sensors is not accessible from outside, since it is an internal axle modulator cabling.

Wear sensing (on the front and rear axles)
The (analogue) signals from the wear sensors are checked to see whether they correspond to the admissible values.

The EBS monitors EBS-specific solenoid valve control.

Front axle proportional relay valve
The frequent solenoid (pressure proportional to the solenoid current) of the front axle proportional relay valve is checked to see whether control is carried out correctly.

Rear axle redundancy valve
The rear axle redundancy valve's solenoid switch is monitored to see that control takes place correctly.

Rear axle modulator's inlet and discharge valve
The rear axle's inlet and discharge valves are located inside the axle modulator. The solenoid cables are not accessible from outside.

The EBS monitors braking pressure control. The electrically controlled braking pressure and the pneumatically redundant pressure are also monitored.

Too low front axle braking pressure
The availability of minimum braking pressure (on the front axle at a certain solenoid current supply level) is checked.

Too high rear axle pressure deviation (from left to right)
In normal braking processes (neither ABS nor traction control system – TCS -controls) the measured braking pressure on the left and right sides of the rear axle must almost be equal. If the braking pressure deviation exceeds the admissible value, an error is reported.

Rear axle redundancy cannot be switched off
Normally, pneumatic redundancy pressure control in the rear axle is prevented by the redundancy valve. If an error makes this deactivation impossible, the rear axle braking pressure can no longer be reduced during ABS control, etc. (because there is inlet of non-ABS-compatible rear axle redundancy pressure into the rear axle brake cylinder). Error recognition takes place in this case.

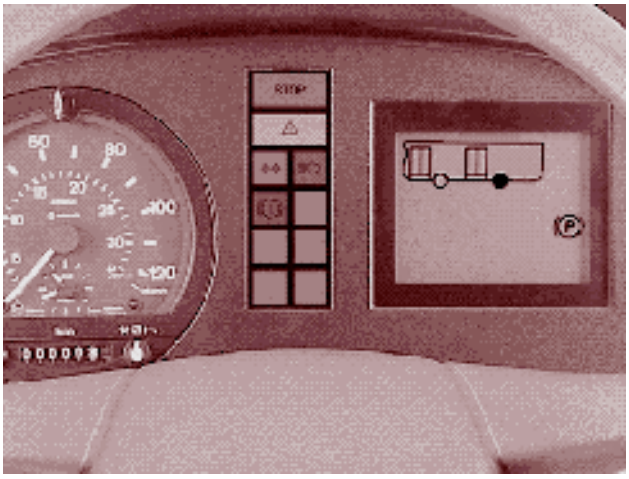
EBS monitors data transmission

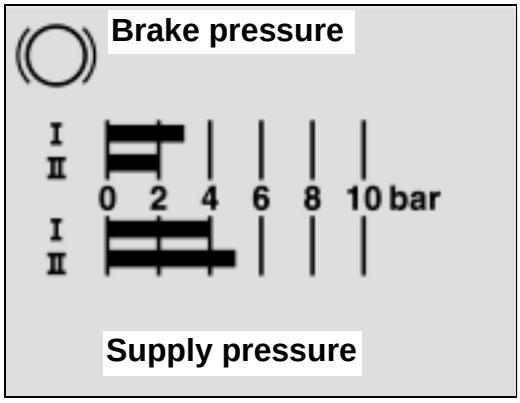
- between the EBS central module and the axle modulator (System bus)
- between the EBS and other system control devices (vehicle bus)

If communication is impossible or is suddenly cut, an error is reported.

Error display

Detected errors are transmitted by the EBS central module to the instrument panel display via the vehicle data bus, and displayed there.





Alternatively, in vehicles without such a display, errors can also be reported via a red and a yellow warning light. A separate TCS light then indicates to the driver the on-going TCS control activities.

Red Wala: ⇨ system deactivated

Yellow Wala: ⇨ slight error:
e.g. sensor failure
(emergency mode)

EBS ”emergency modes”

As a rule, certain EBS functions are deactivated when an error is detected. Functions not impaired by the failure are maintained. For the EBS-drive with limited functions, the term emergency mode is used.

The following functions can be deactivated if an error occurs:

Operation without ABS function
The ABS function can be deactivated on a wheel, an axle, or the entire vehicle. Possible causes: faulty speed sensor signal, ABS valve error, etc.

Operation without ASR function
The traction control system can be switched off completely or partially. Complete deactivation means that both the braking system and the engine control unit are deactivated.
Partial deactivation means that only the braking system is deactivated. Possible causes: (faulty speed sensor signal, etc.)

Pressure control / auxiliary pressure control
Normally, braking pressure control requires braking pressure sensor signals. When these signals are no longer available, electrical braking pressure can be produced. In this case, we talk in terms of pressure control operation or auxiliary pressure control. However, the accuracy of this pressure production is limited, compared to hitch-free pressure control. Possible causes: Pressure sensor signal failure, etc.)

Redundancy operation
If electrical pressure control becomes impossible, the corresponding axle is braked with the help of the pneumatic redundancy pressure. Possible causes: damaged solenoid, or faulty solenoid cabling, etc.)

EBS test types

The following peculiarities must be observed while testing the electronically controlled braking system:

- **Maximum pressure level control:**

  When the brake is applied > 80% of the pedal distance and ignition off, the full pressure works on the front and rear axles.

- **Roller dynanometer test:**
  (Roller dynanometer function)

  A roller dynanometer function was integrated into the EBS electronic unit so that an electronically braked KOM can be tested on a roller dynanometer. This function is used to test the braking pressure at full load (permitted total weight).

  The roller dynanometer function is activated if the EBS is not switched on via the ignition (class 15) when the vehicle is braked again, but rather through activation of the brake signal transmitter via the integrated brake switches. The front axle and/or rear axle speed must be < 3 km/h.

  Special EBS controls such as endurance brake integration, delay control and brake lining wear control are not active when the roller dynanometer function is active.

  The maximum braking pressure can now be measured. The EBS is working correctly if the measured braking pressure corresponds to the basic loaded vehicle design.

  WABCO Diagnosis equipment - see: brochure 820 001 029 3



Diagnostic Software

In addition to the familiar diagnosis equipment like WABCO Compact Tester or the Diagnostic Controller with program cards, WABCO also offers PC diagnosis.

For all newly integrated WABCO systems such as EBS, the Diagnostic Software for diagnosis with PCs is offered in addition to the program card for the Diagnostic Controller.

The software offers comprehensive and convenient diagnosis. The program and interface are compatible with **any standard PC or Laptop** with the following characteristics:

Hardware Requirements

The following hardware is required:

- notebook / laptop wherever possible
- Pentium PC and higher
- 16 MB main memory, colour display 800x600
- approx. 10 MB free hard disk memory
- 3 ½" floppy disk drive
- 1 COM interface (9-pin) for the diagnostic interface
- Win95/98/2000, WIN NT



Diagnosis Interface

For establishing diagnosis with the control unit, WABCO Diagnostic Interface Set, Part No. 446 301 021 0 is required.

The set contains the interface and a connecting cable to the PC/laptop (for the COM interface, 9-pin connection).

The vehicle connection on the interface is similar to the connection for the Diagnostic Controller, permitting the continued use of connecting cables used in the past.

Diagnostic equipment - WABCO EBS

EBS "EPB" (DaimlerChrysler)



Diagnostic cable

Diagnostic software EPB "ACTROS / ATEGO"	446 301 517 0 for PC diagnosis
Diagnostic Interface	446 301 021 0 for PC-Diagnostic
Program card EPB "ACTROS / ATEGO"	446 300 760 0 (D)
Program card EBS CITARO	446 300 766 0 (D)
Diagnostic cable	446 300 340 0

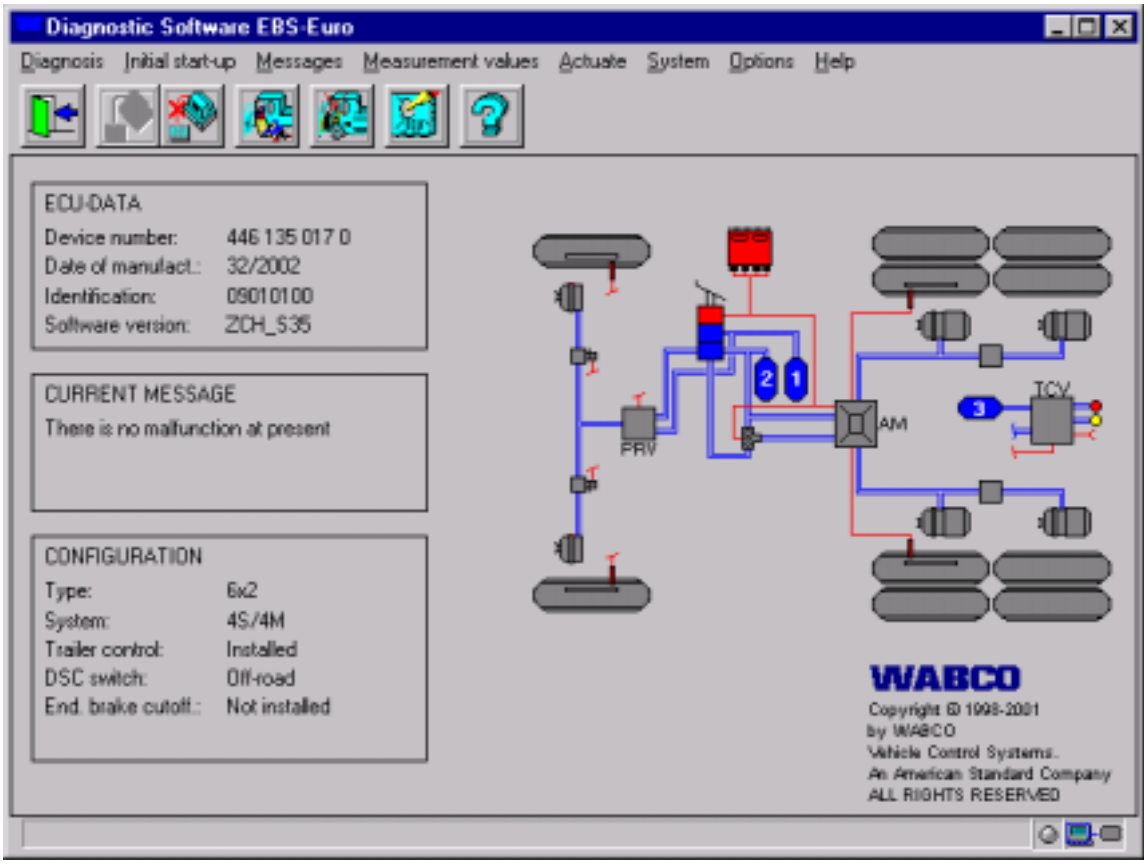
EBS Euro (Motor Vehicle)



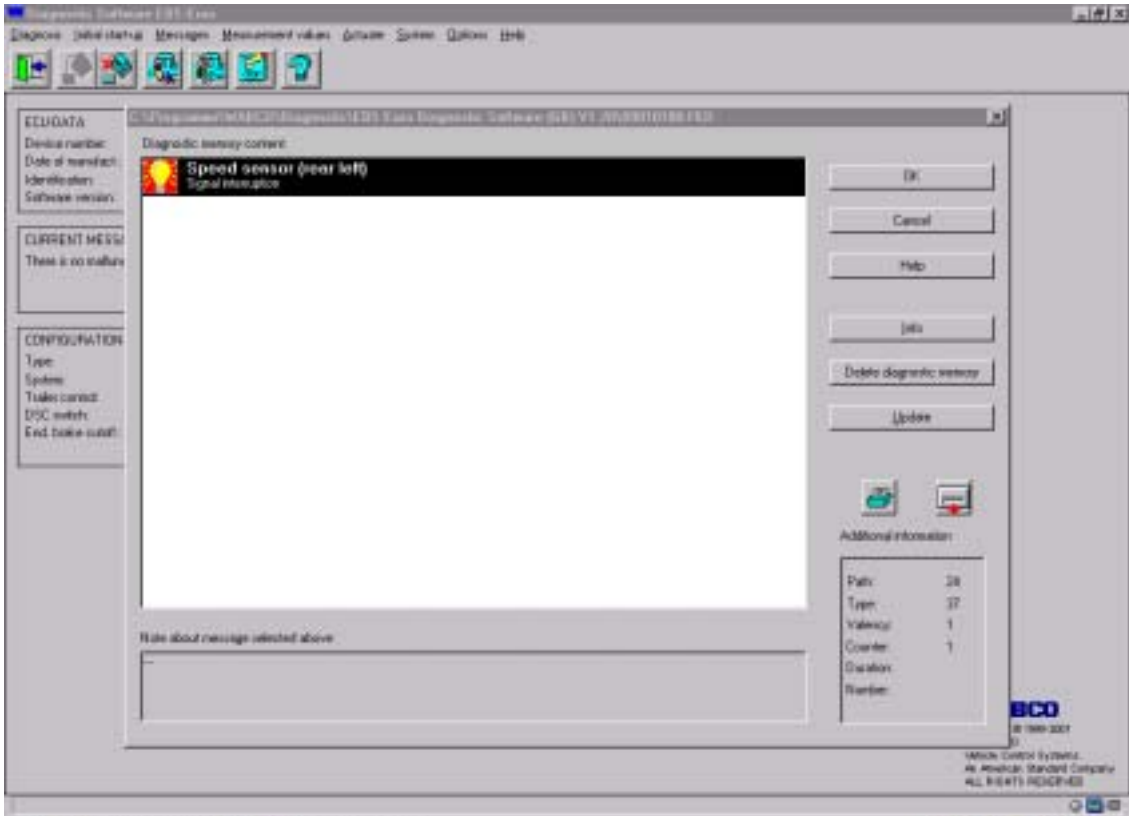
Diagnostic cable

Diagnostic software EBS	446 301 548 0 for PC diagnosis
Diagnostic Interface	446 301 021 0 for PC-Diagnostic
Program card EBS Euro	446 300 769 0 (D)
Diagnostic cable	446 300 344 0

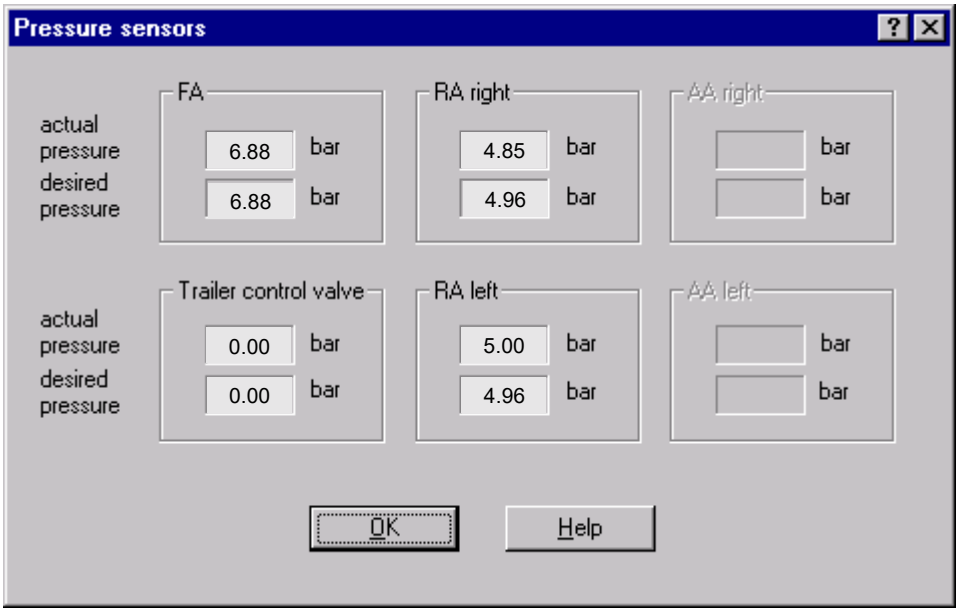
Start monitor PC Diagnosis EBS Euro:



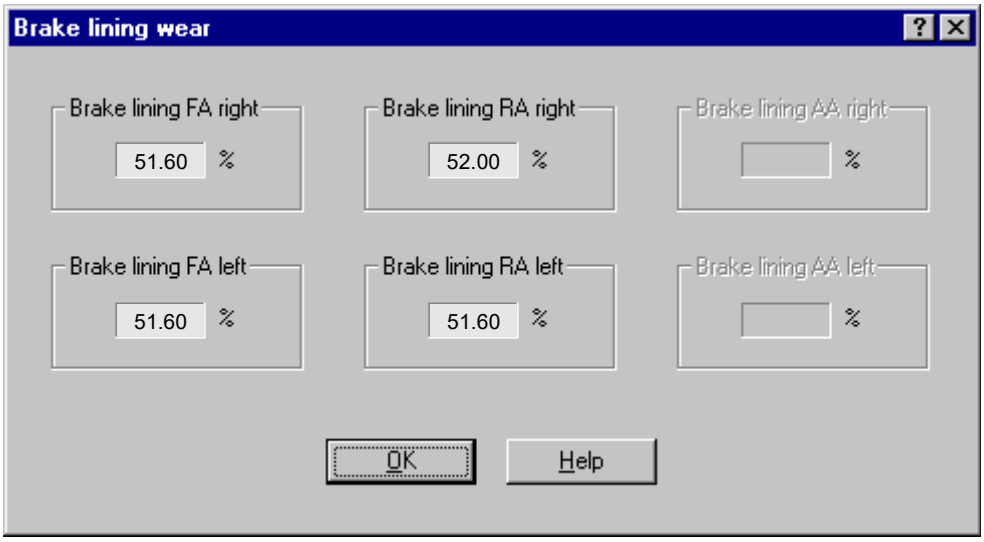
Read out diagnosis memory:



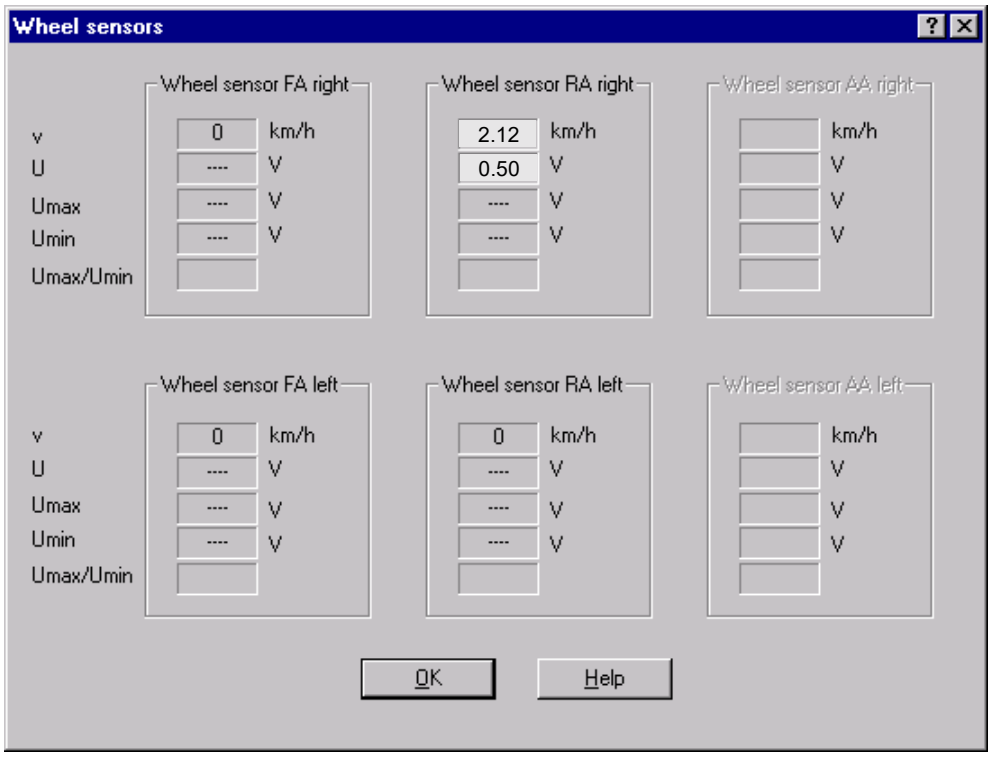
Reading out measured values: Pressure sensors



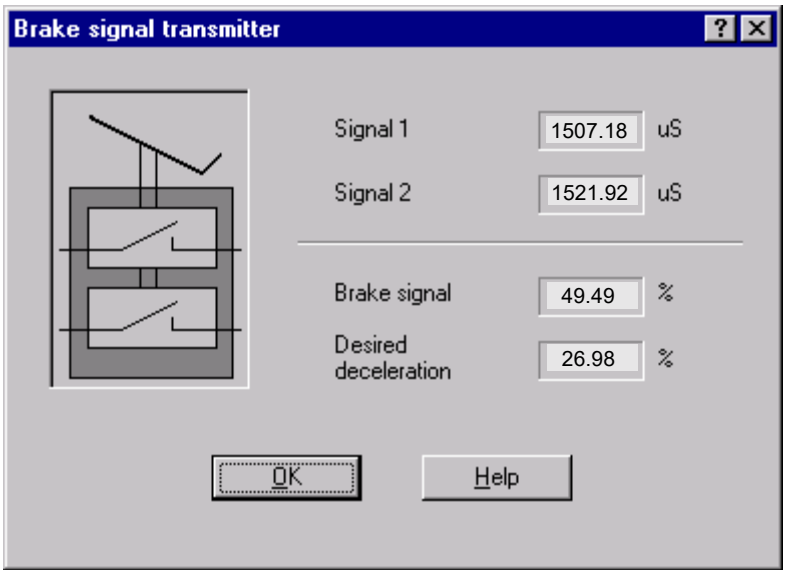
Reading out measured values: Wear values



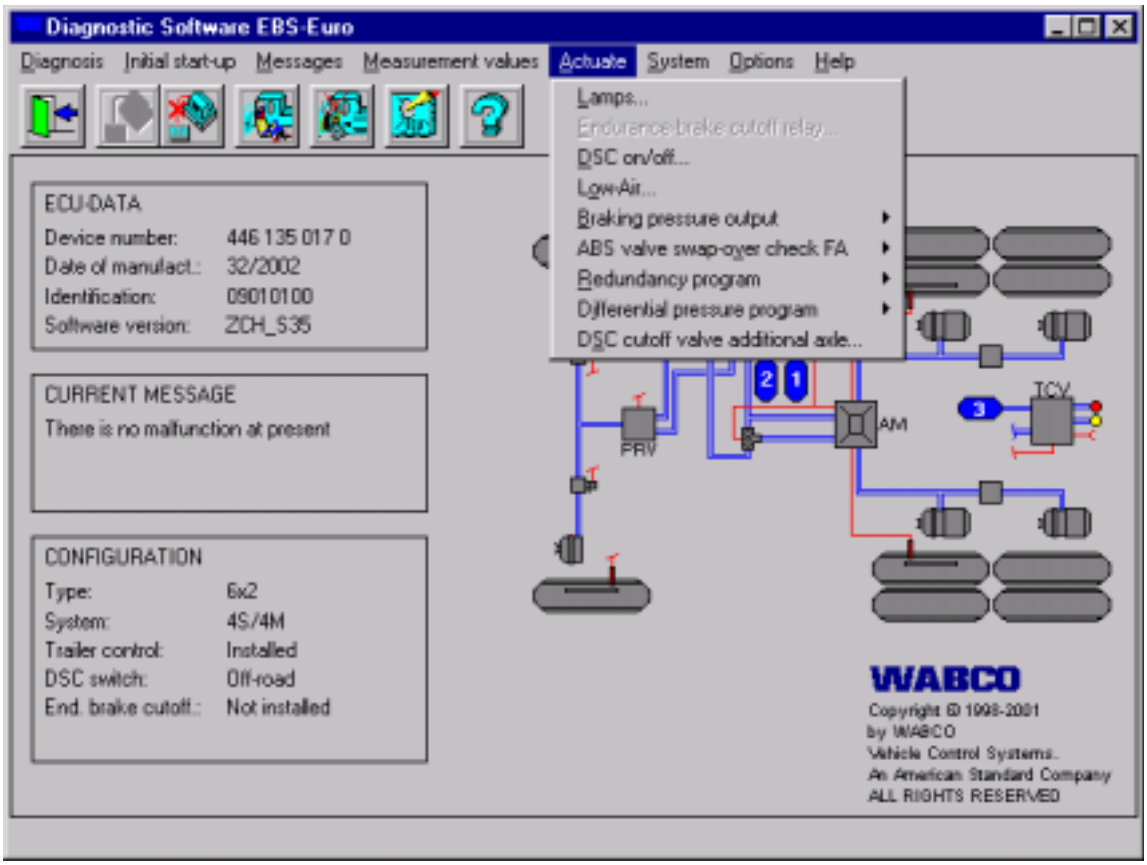
Reading out measured values: Speed sensors



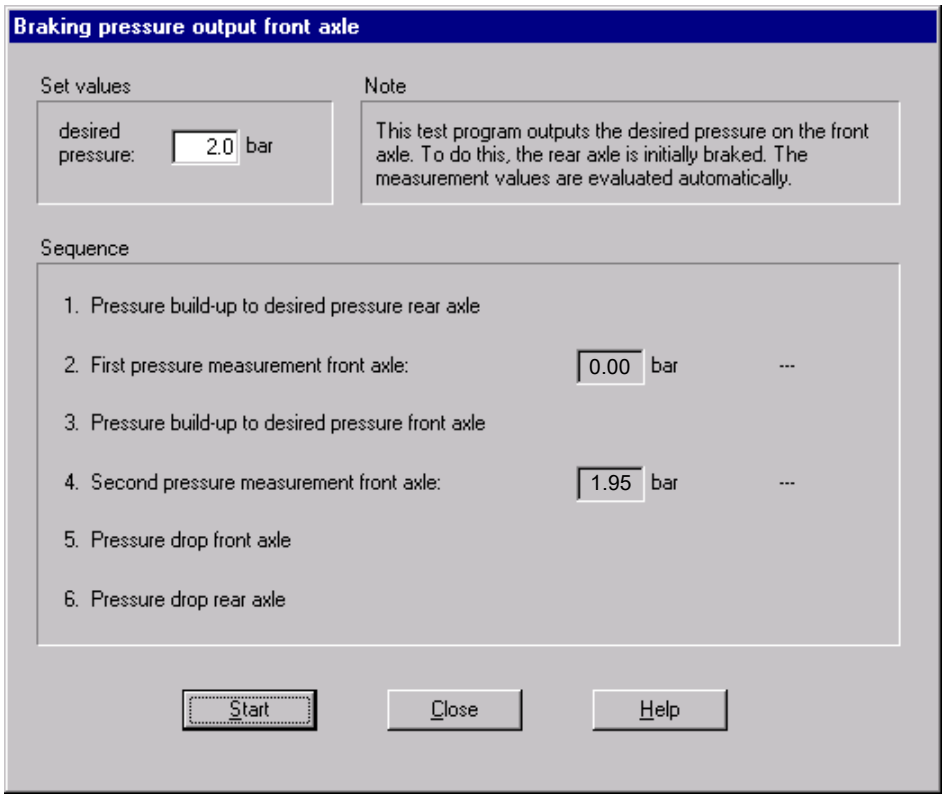
Reading out measured values: Brake signal transmitters



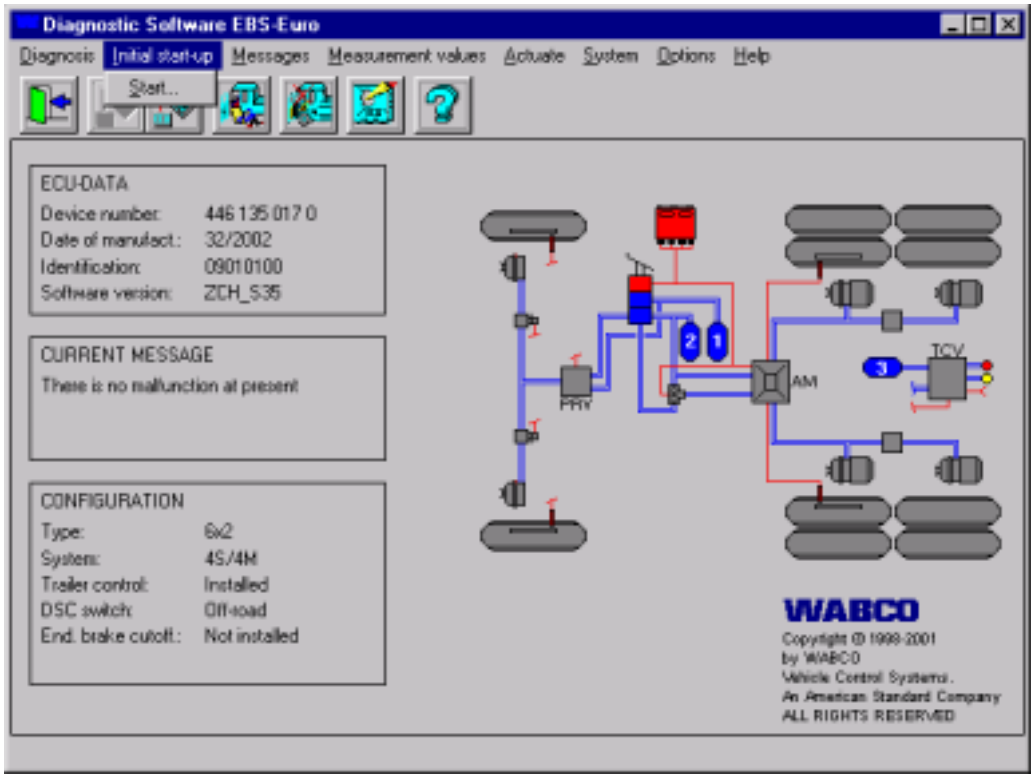
Selection menu Control:



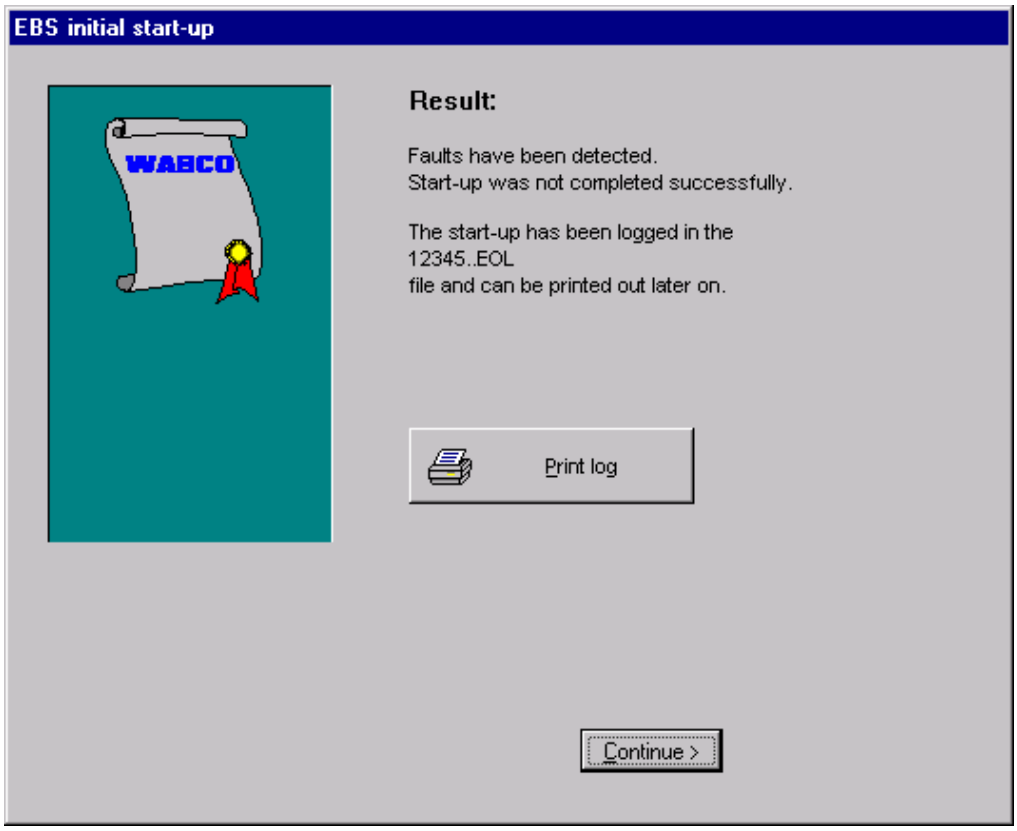
Control: Braking pressure control on front axle



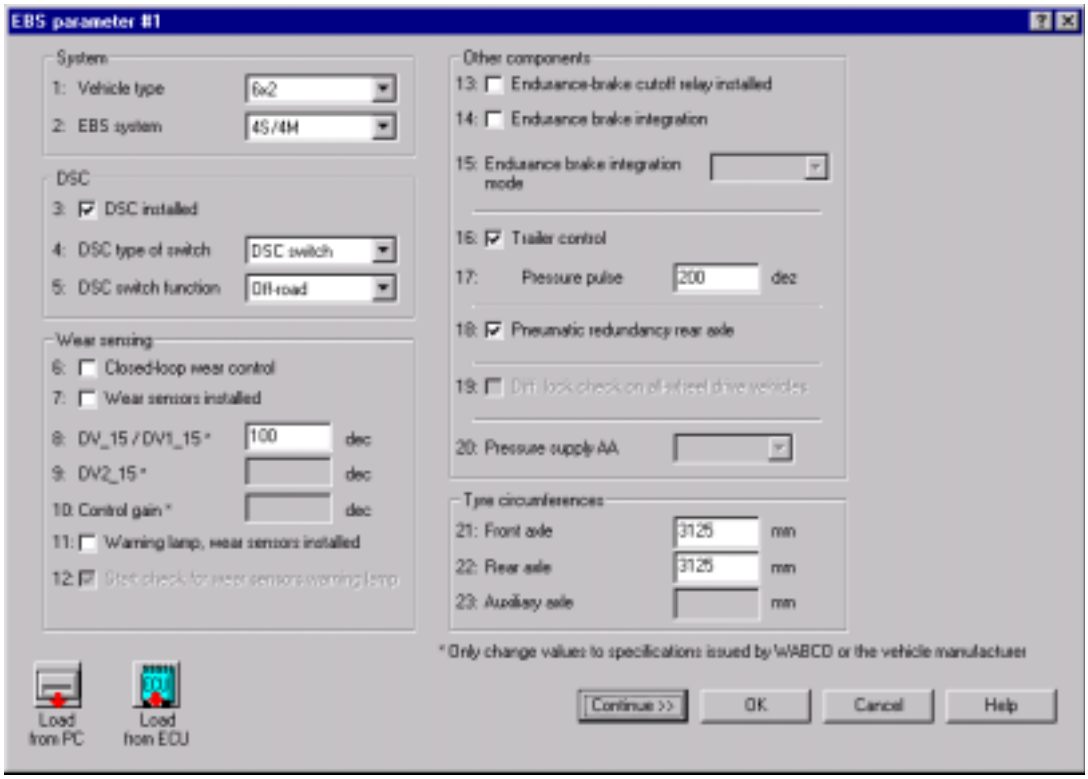
Start-up:



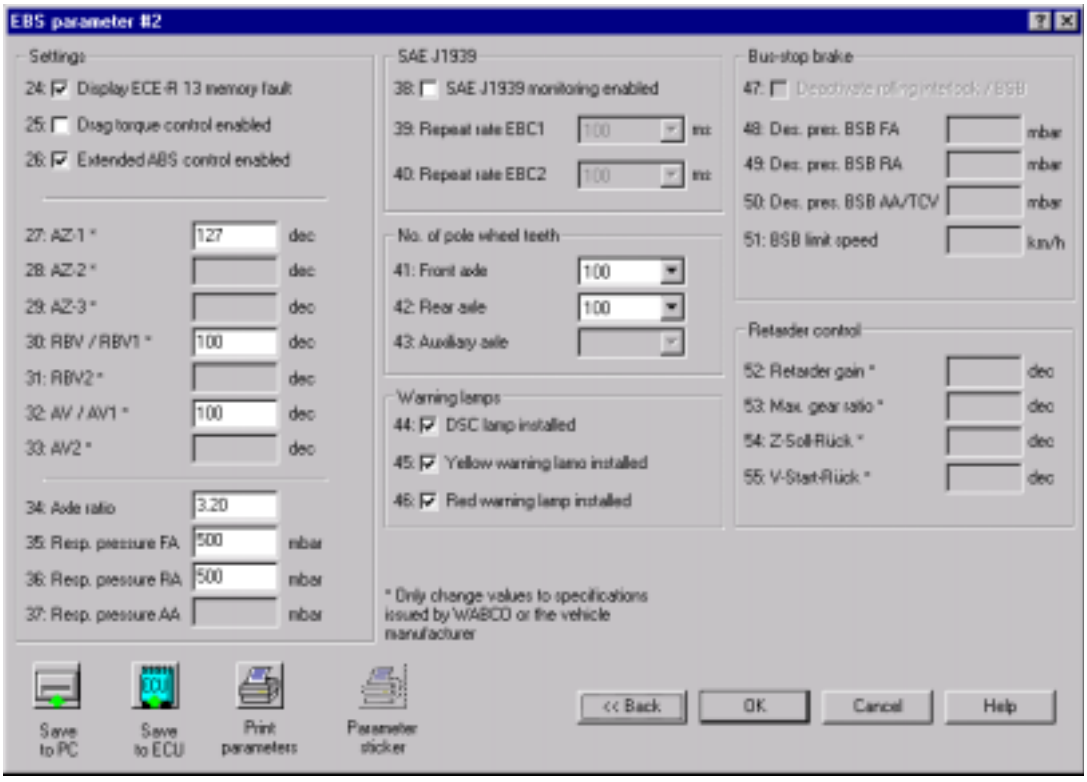
Pressure possibility Start-up protocol:



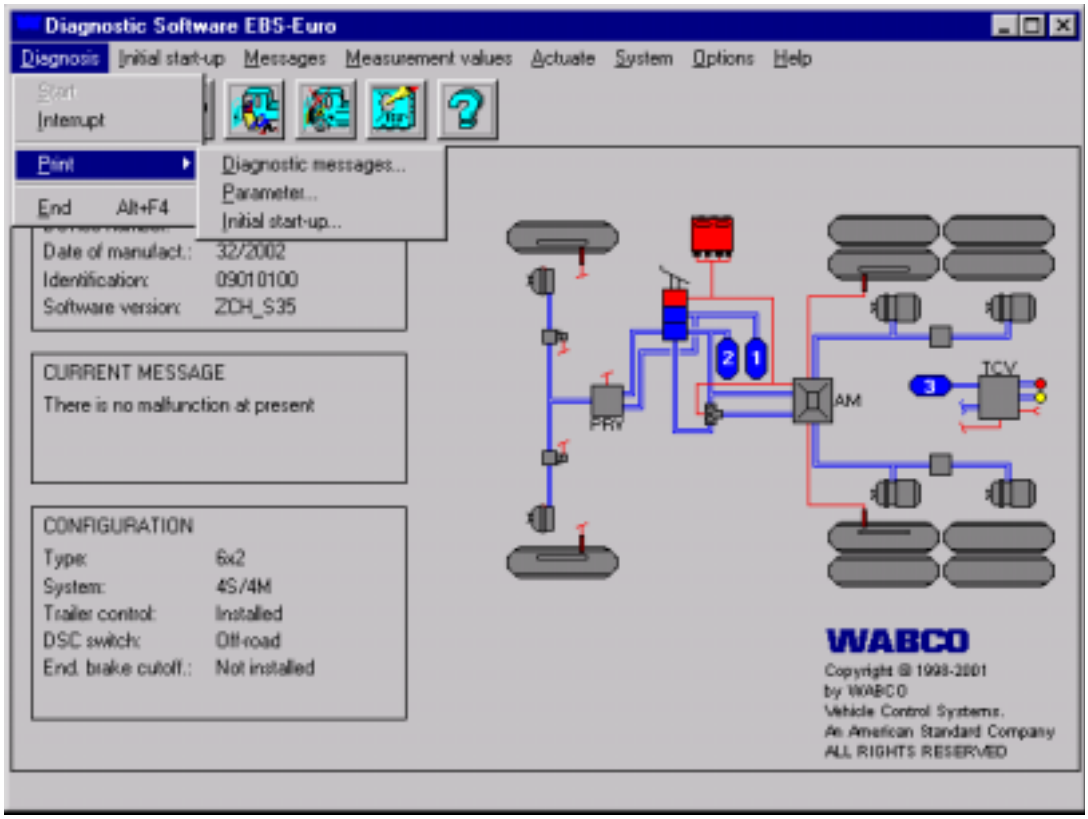
EBS parameter: Input mask No. 1



EBS parameter: Input mask No. 2



Pressure options



Parameter meaning:

System

Vehicle type

This parameter indicates vehicle type and affects system configuration.

EBS system:

Indicates the EBS system design.

ASR

ASR integrated:

ASR function is permanently activated if this checkbox is ticked.

ASR switch type:

You can indicate here whether a switch (in both positions) or a push-button is fitted.

ASR switch function:

You can choose here whether the ASR off-road function should be activated, or the ASR function deactivated when the ASR off-road switch is activated.

Wear sensing

Wear control:

If this parameter is not activated, only wear control will be possible, irrespective of whether or not sensors are integrated.

Wear sensors present:

If wear sensors are fitted on the front and rear axles and must be evaluated, this checkbox must be ticked. Standard setting: ”Wear sensors present”.

DV1_15 and DV2_15:

Basic braking pressure settings: VA to HA or HA to ZA in the wear area. The value should only be changed according to the specifications of the vehicle manufacturer, or by WABCO. These parameters do not apply if sensors are integrated, and control is active.

Warning light fitted with wear sensors:

If this checkbox is ticked, a warning light or a relay for switching wear display is monitored.

Start check for warning light wear sensors:

If this checkbox is ticked, the warning light for wear display is activated during start check.

Other components

Endurance brake cut-off relay present:

If this checkbox is ticked, an endurance brake cut-off relay is controlled and monitored.

Cut-off of Endurance Brake Integration (EBI):

Endurance brake integration is activated if the ”Endurance Brake Integration” checkbox is ticked.

Endurance Brake Integration (EBI) mode:

This parameter is used to adjust the EBI to the city or tourist coach driving profile. The available vehicle type parameter settings should only be changed with the consent of the vehicle manufacturer, or by WABCO.

Trailer control valve present:

If this checkbox is ticked, a trailer control valve is controlled and monitored.

Tire circumferences:

The rolling circumference of the tire equipment must be entered here according to the vehicle manufacturer or tire equipment manufacturer’s specifications. Permitted values for Pole wheel 100Z is 2550 to 3850, step size 25 mm. Difference between parameter value and tire circumference: maximum 5%.

Settings:

Display ECE R13 Memory error:
If this checkbox is ticked, the error memory bit required in ECE R13 are displayed when certain errors occur.

Drag torque control released:

Drag torque control is released if this checkbox is ticked.

Extended ABS control released:

Extended ABS control is released if this checkbox is ticked.

AZ1:

This parameter is used to coordinate braking force distribution. The value should only be changed according to the specifications of the vehicle manufacturer, or by WABCO.

BV1 and RBV2:

This parameter is used to coordinate braking force distribution. The value should only be changed according to the specifications of the vehicle manufacturer, or by WABCO.

AV1 and AV2:

This parameter is used to coordinate braking force distribution. The value should only be changed according to the specifications of the vehicle manufacturer, or by WABCO.

Retarder inclination:

This parameter is used to coordinate braking force distribution. The value should only be changed according to the specifications of the vehicle manufacturer, or by WABCO.

I-Getriebe:

This parameter is used to coordinate braking force distribution. The value should only be changed according to the specifications of the vehicle manufacturer, or by WABCO.

Z-soll-Rück:

This parameter is used to coordinate braking force distribution. The value should only be changed according to the specifications of the vehicle manufacturer, or by WABCO.

V-Start-Rück

This parameter is used to coordinate braking force distribution. The value should only be changed according to the specifications of the vehicle manufacturer, or by WABCO.

Light ASR integrated:

This parameter indicates that the warning light is directly controlled by the EBS control device, and that the exit is monitored. Alternatively, the information can be evaluated on the SAE bus.

Yellow warning light present:

This parameter indicates that the warning light is directly controlled by the EBS control device, and that the exit is monitored. Alternatively, the warning light information can be evaluated on the SAE bus.

Red warning light present:

This parameter indicates that the warning light is directly controlled by the EBS control device, and that the exit is monitored. Alternatively, the information can be evaluated on the SAE bus.

Deactivate roller lock / halt brake:

This parameter is used to lock both functions.

Nominal pressure HSB VA, HA and ZA:

The nominal pressure for the halt brake and roller lock of the front axle, rear axle, and possibly of the additional axle is entered here. The value should only be changed according to the specifications of the vehicle manufacturer, or by WABCO.
Parameter value x 0.05 bar = nominal pressure.

Limit speed HSB:

The halt brake and roller lock are not activated by the EBS if the preset maximum speed is exceeded.

Axle ratio:

The ratio i of the driving axle control must be entered here as specified by the vehicle manufacturer.
The value entered is ratio i x 25.

Response pressure VA, HA, ZA:

The response pressure of the front axle, rear axle, and possibly additional axle must be entered here. The value should only be changed according to the specifications of the vehicle manufacturer, or by WABCO.
Parameter value x 0.05 bar = response pressure.

SAE J1939

SAE J1939 monitoring released:

Communication on the SAE J1939 data bus is monitored if this checkbox is ticked.

Repeat rate EBC1:

The repeat rate for EBC1 messages can be chosen here. Only the values 20ms or 100ms are supported. The value should only be changed according to the specifications of the vehicle manufacturer.

Repeat rate EBC2:

The repeat rate for EBC2 messages can be chosen here. The values 20 ms, 50ms or 100ms are supported. The value should only be changed according to the specifications of the vehicle manufacturer.

Pole wheel teeth number

Front axle, rear axle, and additional axle:

The Pole wheel teeth number can be entered here for speed sensing on the corresponding axle. At the moment only the value ”100” is released.

CITIPORT



WORKSHOP MANUAL

Assembly and

Maintenance of Disc Brake

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Exploded view of the exchange units NG 22			28

Note:

The Service Instruction focuses on trained specialists. Operations on the brake can only be carried out if the appropriate paragraphs have been read through and understood. The safety instructions according to paragraph 2.1 are to be considered and to be followed.

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1. Description of the Mechanical Sliding Caliper Disc Brake

1.1 Introduction

The brake **"NG 22"** is a new developed one-piston-brake, which is intended for use in commercial vehicles and trailers on front and rear axles for 22,5" wheel rims as service, auxiliary and parking brake. It is actuated mechanically via a diaphragm brake cylinder or a spring brake actuator. This is mounted to the end cover of the brake caliper.

A very compact unit is achieved by the direct mounting of the brake cylinder onto the caliper. This enables optimal utilisation of the installation situations.

The complete disc brake including brake cylinder consists of two assemblies:

- **Brake caliper (1)**
- **Brake carrier (2)**

The brake caliper (1) moves axially on guide pins (8, 9) of the brake carrier (2). In the brake carrier the brake pad (36) are guided and supported axially relocatable. The brake pad (35) on the wheel side is reinforced directly in the brake caliper. The fastener of the brake pads works with a hold-down hoop (38) and hold-down springs (37) - see pictures 1 to 3.

The radially open design of the brake caliper allows simple and quick changes of the brake pads.

Brake pads with a large wear volume are used in order to prolong the pad replacement intervals with this brake.

For compensating the pad wear the actuating mechanism of the brake is equipped with an kraftabhängigen, stufenlosen, automatic adjuster mechanism. This maintains a predetermined clearance independend from overall load configuration and different operating conditions. This, together with a stable and stiff construction of the brake caliper, results in a safe control of the pedal travel and increases the distance reserve for emergency braking.

The internal moving components are lubricated for life and all sealing components are maintenance free unless damaged.

The disc brake is equipped with an electrical wear indicator / sensor (40).



Fig. 1

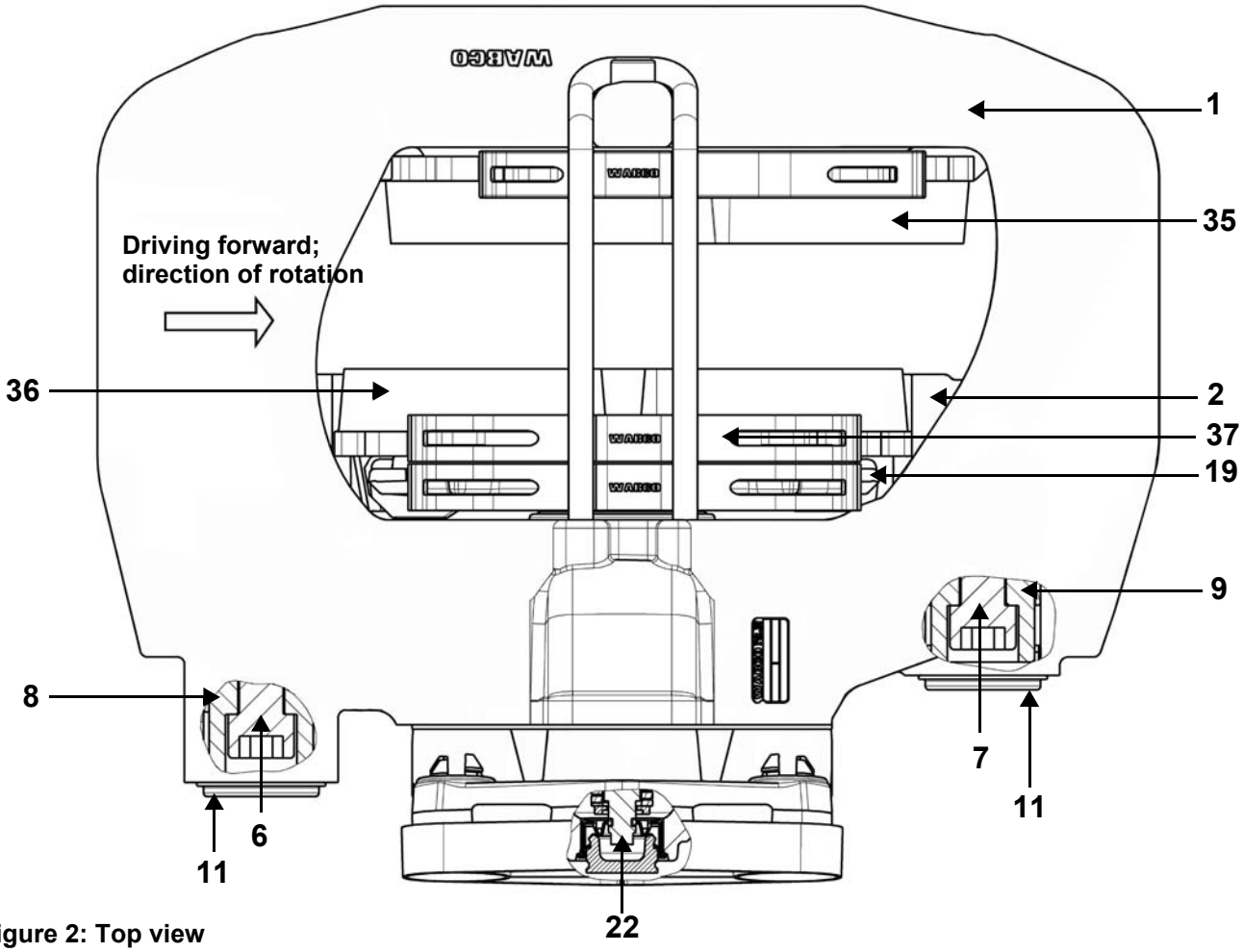


Figure 2: Top view

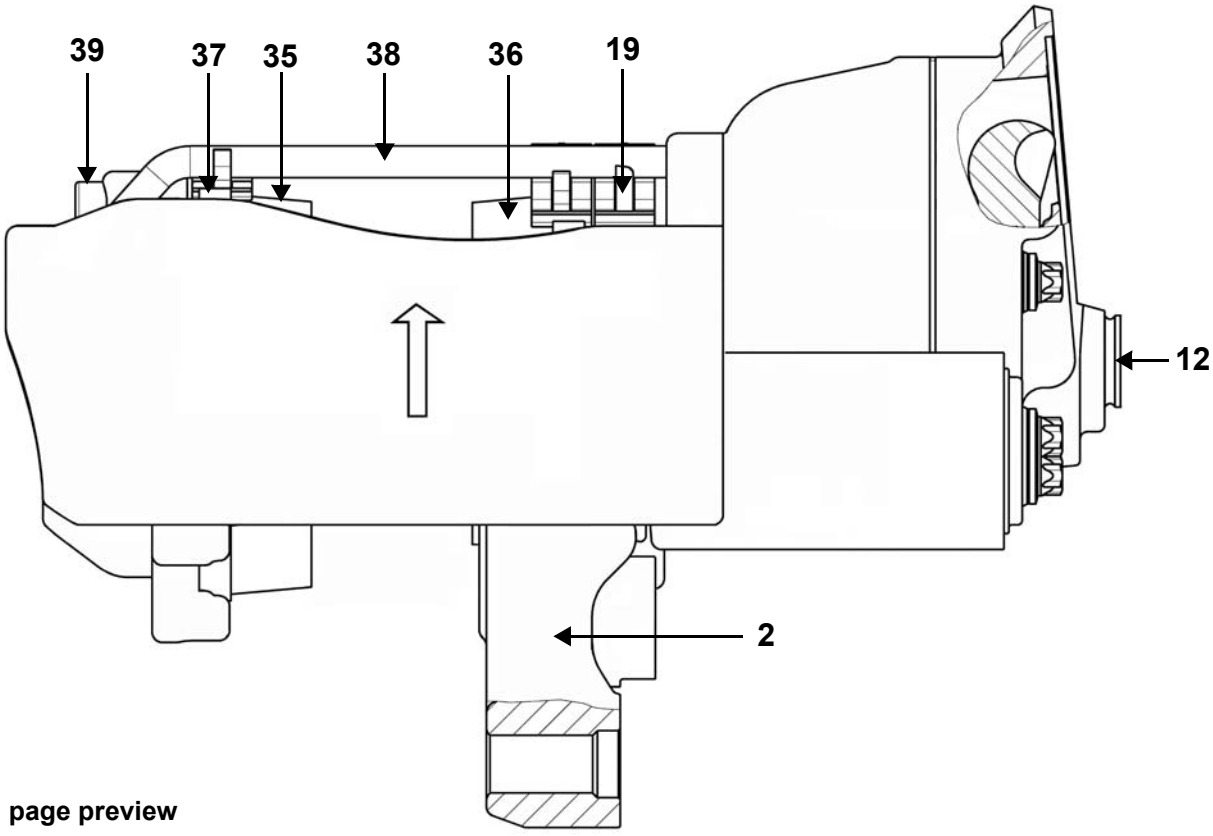


Figure 3: page preview

2. Service Instructions

This instruction with the following pictures contains the required steps and work sequences to replace the available repair kits. The spanner size and the tightening torques in the sequences are listed in table 1 (see page 27).

For lubrication use only the tube of grease supplied with the WABCO brake repair kit.

2.1 Safety tips to be considered during repair

The flawless technical condition of the disc brake is most important to ensure good driving and safe braking characteristics.



Observe brake pad and disc wear limits! Worn-out pads and discs reduce the brake effectiveness and cause brake failure! Danger of accidents! Burned, glazed or oil contaminated brake pads must be replaced immediately.

Always replace brake pads on a per axle basis!



During repairs on the brake the vehicle must be parked on a level surface and blocked to prevent rollaway. Only approved and suitable fixtures are to be used for the lifting and blocking of the vehicle. While working on the brake ensure that the brake cannot be actuated inadvertently.

Do not actuate the brake while the brake pads are removed. Danger of bodily injury!



Do not clean the brake with pressurised air or other high cleaning pressure apparatus. **Danger of bodily injury!** Danger of destruction of rubber parts!



Keep hands and fingers out of the inside of the caliper to avoid injury!



A second technican must assist during removal and installation of the brake. Heavy load - **Danger of bodily injury!**



During repairs outside of the vehicle, the brake must be secured in a fixture, such as a heavy vise as high torque is required during removal and installation of the bolts. Large loosening and tightening torques of the screw connexions - **Danger of bodily injury!**

The brake caliper with clamping unit shall not be opened. Therefore the bolts holding the cover shall not be loosened.

Only original and genuine WABCO Service Parts and approved brake pads are to be used.

During repairs use only recommended tools. Do not use a power-driven socket or tools! Tighten nuts and bolts only to specified torque limits.

With newly installed brake pads during the first 50 km no emergency stops should be made if possible. Also avoid long braking cycles and forced braking.

When wear of the cast brake parts such as cracks or heavy abrasion is noticied replace the entire brake assembly according to the instructions.

Upon completion of repairs the vehicle's braking system must be tested on a roller dynamometer. If no roller dynamometer is available a driving test with brake applications must be perfomed.

2.2 Checking brake function



Attention:
Do not use a power-driven socket! While working at the brake or moving the brake caliper handle the caliper only from outside to avoid injury!

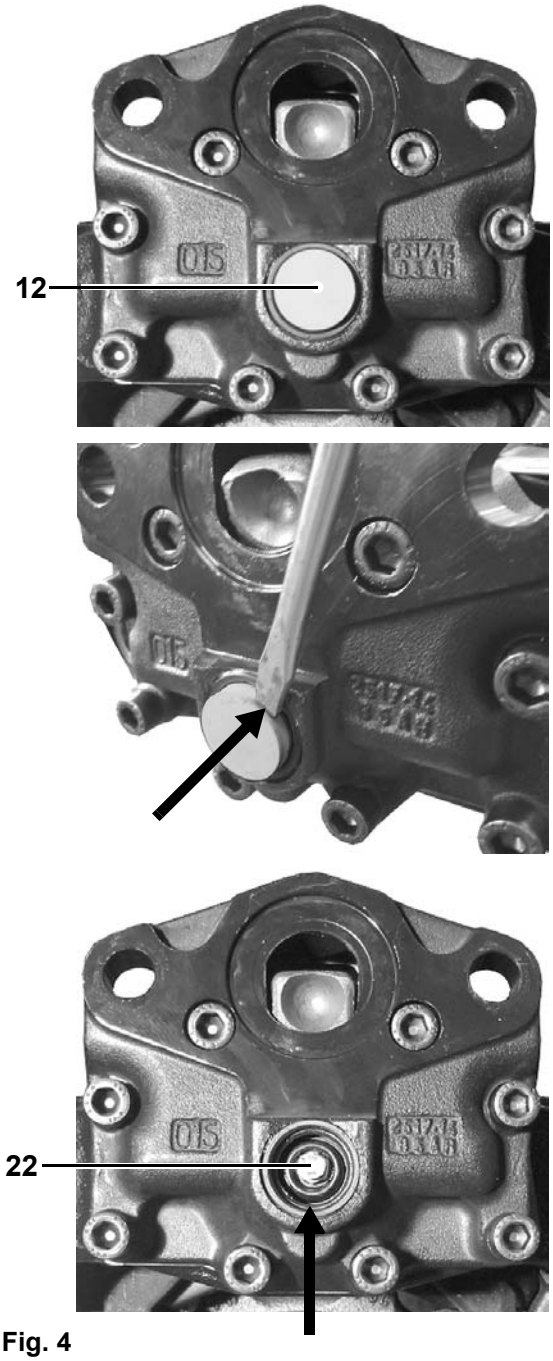


Fig. 4

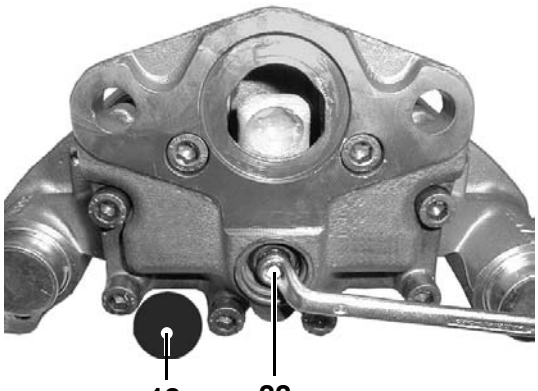


Fig. 5

2.2.1 Checking the adjustment

General note:

The turning directions and the torques for the hexagon on the adjuster nut are given in table 1, position I. The actuation cylinder does not need to be removed for this check.

Work sequences:

- Remove plug (12) for the adjuster from the caliper (22) carefully.

Caution: On disassembly the proper tool position is against the plug (12) set in the anular groove!

Caution: Internal seal with the development do not damage!

- Using a AF 8 ring spanner turn the adjuster (22) hexagon approx. 1/2 turn in the clockwise direction.

Attention: Do not overload the adjuster hexagon (22)! Do not use an open-ended spanner. With the ring spanner mounted on the adjuster nut ensure that there is sufficient such that it will not be prevented from turning during the adjuster check!

- Actuate the brake about approx. 5 times (apprx. 1 bar) The adjuster is functioning when the ring spanner turns anti-clockwise with every brake actuation.

Note: With increasing adjustment increments the angular movement of the attached ring spanner becomes smaller.
The adjuster is in order when the ring spanner rotates as described above.

- Remove ring spanner.
- Refit plug (12) **ensure that the plug is placed properly.**

Failures that might occur:

If the adjuster (22) respectively the attached ring spanner (arrow)
a) does not turn.
b) turns only with the first actuation.
c) moves back and forth with every actuation, which means the adjustment is not OK.

If so, replace the brake according to section 4!

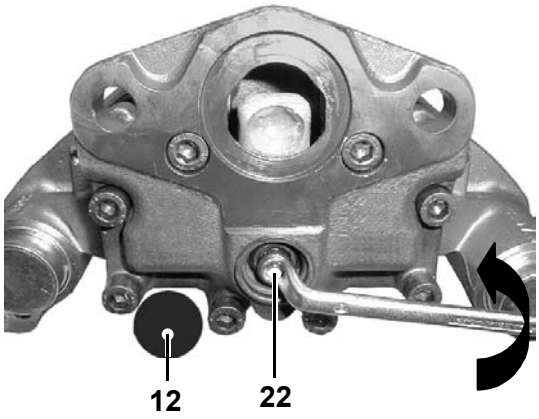


Fig. 6

2.3 Checking brake pads

Note: The brake pad thickness is to be checked regularly depending on operating conditions during maintainance intervals and under applicable local laws and regulations. Burned, glazed or oil contaminated brake pads must be replaced immediately.

Always replace brake pads on a per axle basis!

Work sequences:

Caution: To avoid damage to the brake disc, the brake pads should be replaced at the latest when the thinnest section of the friction material is 2 mm.

The thickness of the residual friction material should not be less than 2 mm.

A = residual friction material thickness 2 mm

B = total friction material thickness 23 mm.

At residual friction material thickness **A < 2 mm**, renew brake pads according to section 3.

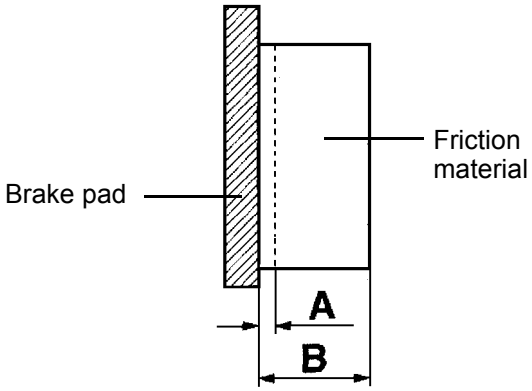


Fig. 7

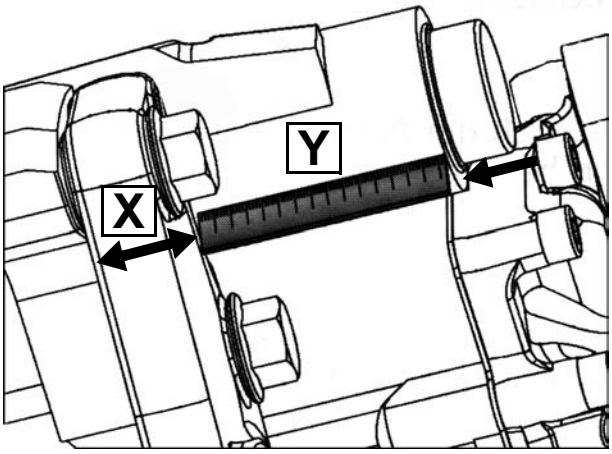


Fig. 8

Measuring of wear

The average brake pad wear can be measured, depending on the access, at the close fit (longer guide pin at the brake disc entry) or at the clearence fit (shorter guide pin at the brake disc exit).

Therefore measure the thickness **(X)** of the flange of the axle and the distance **(Y)** between the flange and the edge of the brake caliper of the particular close fit (arrows).

The maximum wear is reached or exceeded wtih the following values.

Shorter guide pin:

maximum wear X + Y > 90.5 mm
Change lining

Longer guide pin:

maximum wear X + Y > 129.5 mm
Change lining

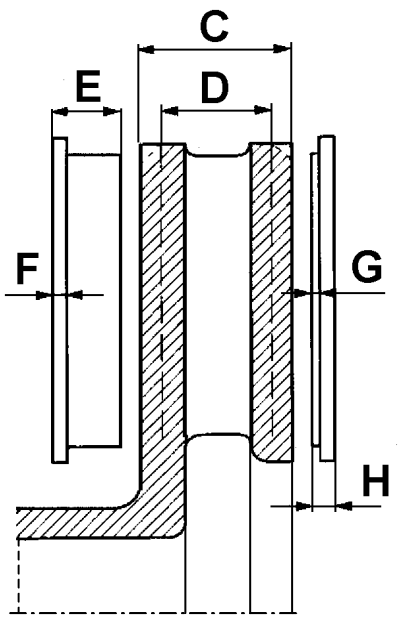


Fig. 9

2.4 Checking brake disc

Work sequences:

- Remove brake pads according to section 3.
- Measure disc thickness over the rubbing faces.

C = total disc thickness - new 45 mm

D = wear allowance limit 37 mm, the brake disc must be renewed. The renewal is recommended on a per axle basis.

E = total pad thickness - new 32 mm

F = pad backplate thickness 9 mm

G = minimum residual friction material thickness 2 mm

H = absolute minimum pad and pad backplate thickness 11 mm, the brake pads must be renewed.

Attention:
Observe brake pad and disc wear limits! Worn-out pads and discs reduce the brake effectiveness and cause brake failure! Danger of accidents!

3. Renewing brake pads

Attention:
Do not use a power-driven socket. While moving the brake handle the caliper only from outside to avoid injury!

Working sequences for removal of pads:

- Disconnect cable of the wear indicator (40) at the plug (arrow).
- Remove internal hexagon bolt (39) with spanner (table 1, position II) from pad hold-down hoop (38).

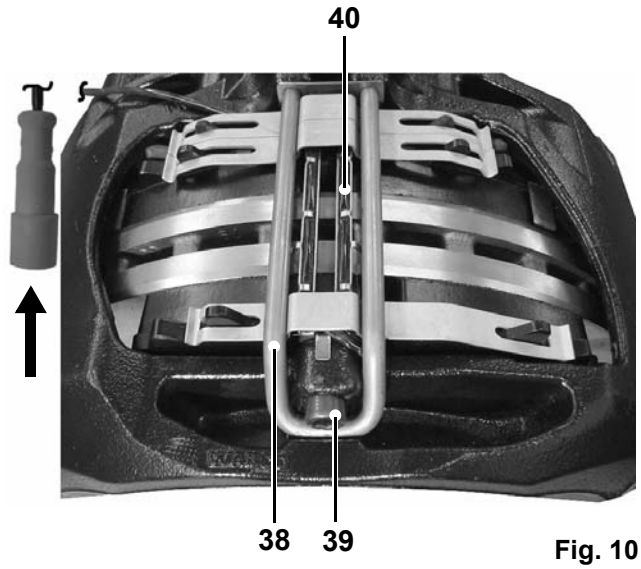


Fig. 10

- Pad hold-down hoop (38) has to be withdrawn from the caliper (1).

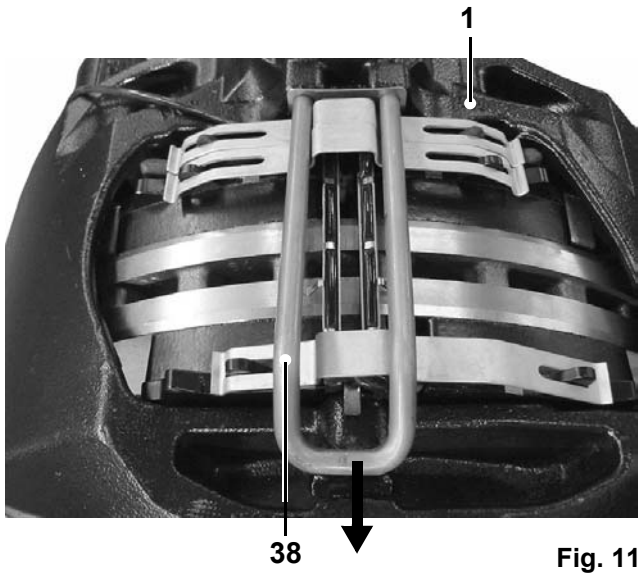


Fig. 11

- Remove three hold-down springs (37) from the brake pads (35 and 36) and the spreader plate (19).
- Remove cable guide (40) and contacts from the brake pads.

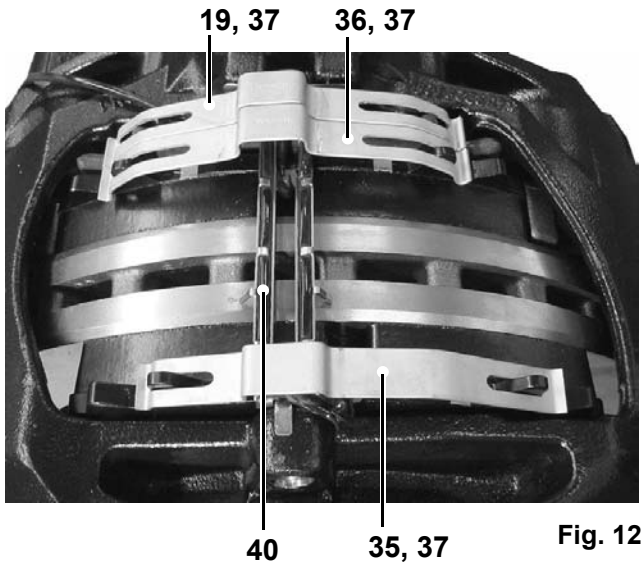


Fig. 12



Fig. 13

- Remove plug (12) for the adjuster (22) of the caliper (1).

Attention:
While disassemblying plug (12) please note the instructions for fig. 4!

- De-adjust the brake by rotating the hexagon on the adjuster nut (22) with a ring spanner as far as it will go and then release it by approx. 1/4 turn.

Note: The turning direction to de-adjust is to the right, that means clockwise.

Caution:
When re-adjusting push back the spreader plate (19) by hand to ensure (fig. 14, see arrow) that the pin as torsion lock (see fig. 19) for the adjusting screw does not slip out of its groove. Otherwise the adjuster screw will turn and thereby damage its gaiter!

Do not actuate the brake while the brake pads are removed.

Attention: Danger of bodily injury!

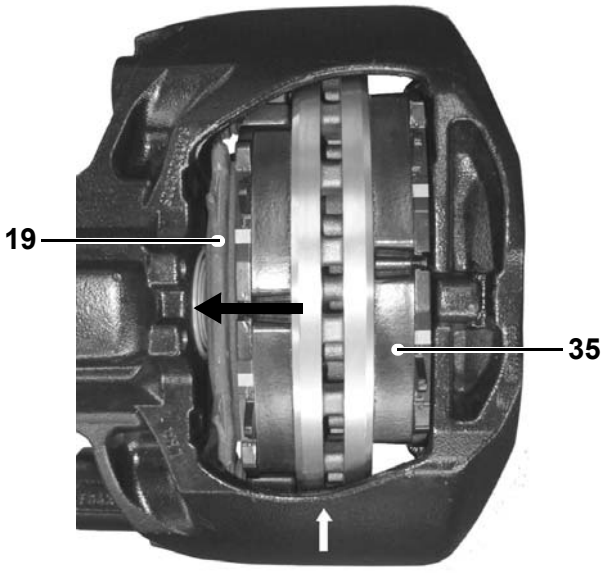


Fig. 14

- Slide the caliper (1) by hand towards the wheel side and remove the brake pad (35).

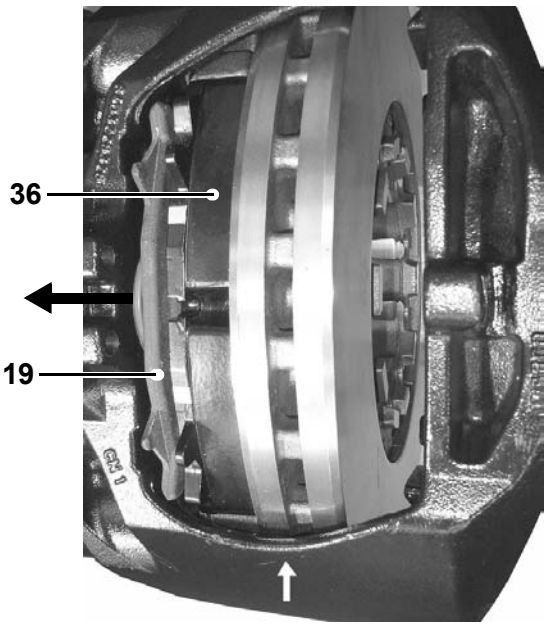


Fig. 15

- Slide the caliper (1) by hand towards the cylinder side (arrow) and remove the brake pad (36) and the spreader plate (19).

Attention:
Do not actuate the brake while the brake pads are removed.
Danger of bodily injury!

- Using a wire brush remove any corrosion from the spreader plate, brake pad slot and brake pads guide surfaces.

Caution:
Take care not to damage the dust caps (5, 10). The guide surfaces must be free of grease!

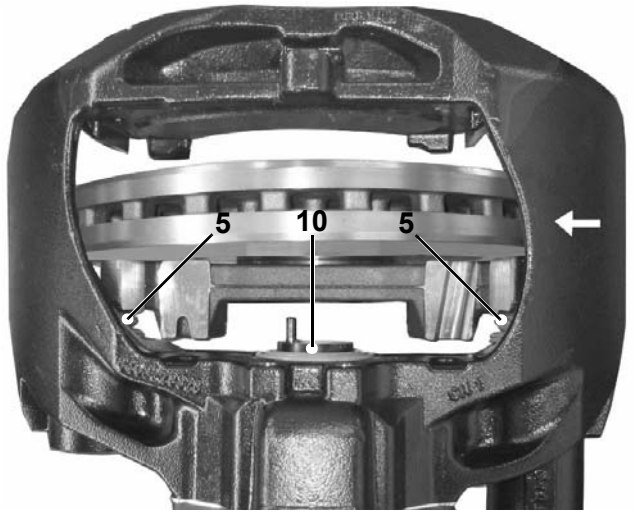


Fig. 16

Checking the dust caps (gaiters) and the brake caliper movement:

- Slide the caliper towards the side to allow examination of the gaiters (5, 10), the guide pins (8, 9) and the adjuster screw (21) for wear and damage. **Renew defective gaiters! (see section 5.1 and 5.2).**

Caution:
In case of a defective the gaiter (10) must be checked if dirt or water has already entered or damaged the inner parts of the brake or the gaiter seat in the caliper by corrosion. In case of doubt the brake must be renewed according to section 4. If the gaiter (10) is damaged while the brake is serviced, the gaiter must be renewed according to section 5.2.

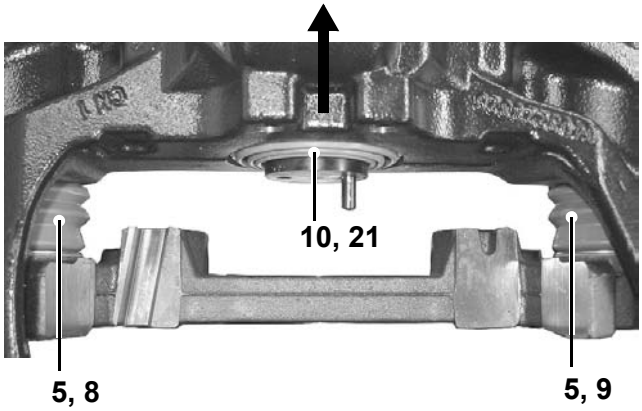


Fig. 17

- Slide the caliper on the guide pins by hand over its total displacement and check for freedom of movement. **If the movement is restricted renew the guide pins bushes and gaiters according to section 5.1**

Caution:
Do not squeeze the dust caps of the guide pins against the brake carrier!

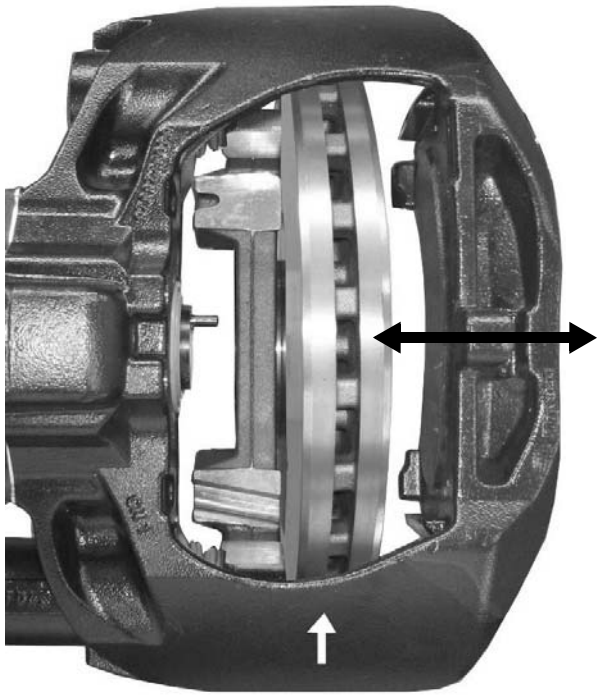


Fig. 18

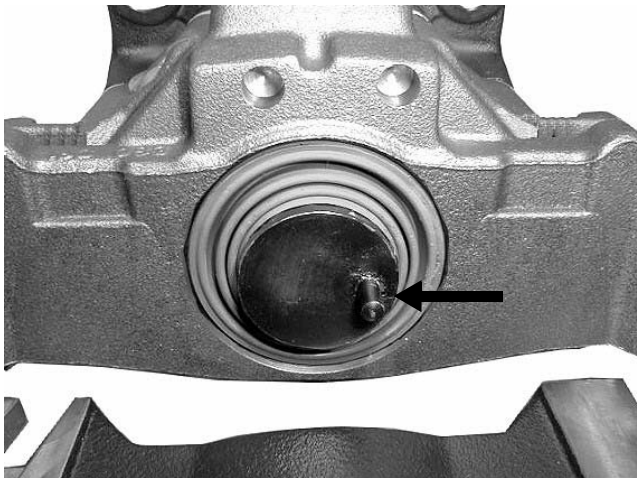


Fig. 19

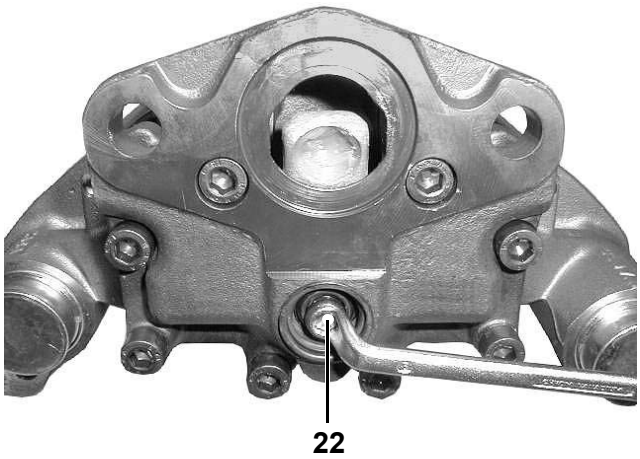


Fig. 20

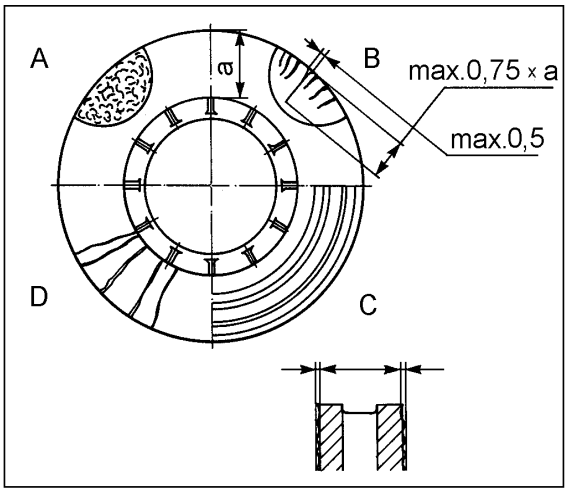


Fig. 21

Checking of the adjuster unit (clamping unit):

- Secure the adjuster nut during checking and turning on the hexagon from twisting, e.g. by holding the pin (see arrow).

- Extend the adjuster (22) towards the brake disc by turning the adjuster hexagon in the anti-clockwise direction with a ring spanner and check for ease of movement.
- After checking the adjuster unit return the adjuste screw completely by turning in the clock-wise direction.

Note: The torque to return the adjuster screw is greater than the torque to turn the torque towards the disc.

Caution:
Do not overload the adjuster hexagon! Do not use an open-ended spanner. With the ring spanner mounted on the adjuster nut ensure that there is sufficient such that it will not be prevented from turning during the adjuster check.

- Actuate the brake lightly several times and check that the adjuster unit automatically adjusts. The ring spanner will turn with every brake actuation.

Attention: Do not touch any part of the brake while testing.

Brake disc condition inspection:

Check brake disc for cracks, condition of the rubbing faces and maximum wear dimension.

A=	crazing	= permissible
B =	Radial cracks to max: 0.5 mm width	= permissible
C =	unevennedd under 1.5 mm of the plate surface	= permisssible
D =	continuous cracks	= not permissible
a=	braking surface	

Checking brake disc runout:

- Mount a dial indicator on the brake carrier.
- With the disc installed measure the runout by rotating the hub as shown in fig. 22. Limit 0.15 mm.

Note: At higher values rework or renew the disc. Installation of cleaned brake discs only. The brake discs must be free of grease!

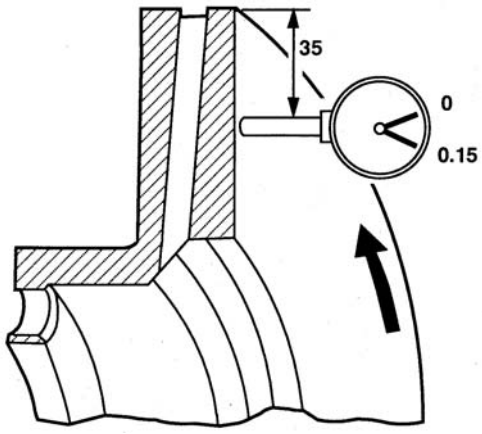


Fig. 22

Working sequence for pad installation:

- Slide the caliper until there is sufficient space between the actuation side and the disc to insert the brake pad.
- Insert spreader plate (19) in the brake carrier and engage with the adjuster screw (21).

Caution:
The spreader plate must be located within the brake carrier abutments and the pin in the adjuster screw must be located in the slot of the spreader plate. Otherwise the function of the adjuster mechanism is not ensured! The adjuster screw can be turned to obtain alignment. The gaiter may not be twisted!

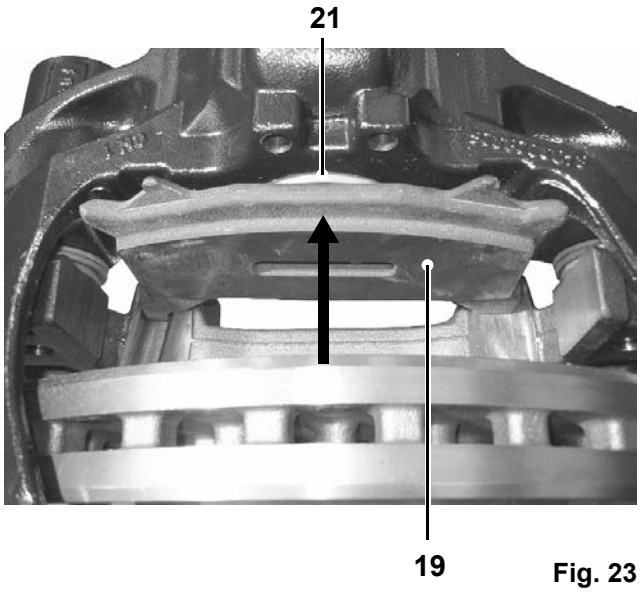


Fig. 23

- **New** brake pad (36) has to be inserted on the actuating side
- Slide the caliper toward the wheel until the brake pad (36) contacts the disc.

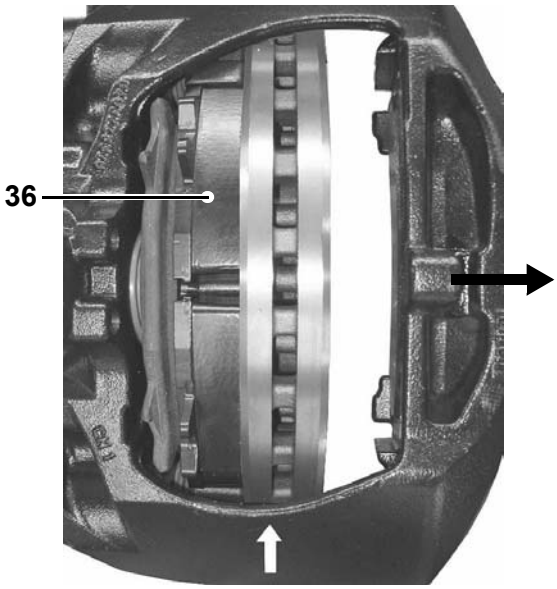


Fig. 24

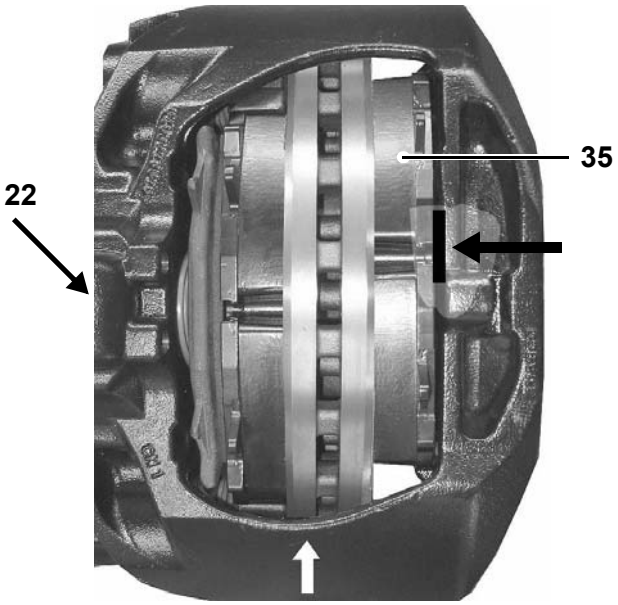


Fig. 25

- **New** brake pad (35) has to be inserted on the wheel side.
- Using a 1 mm thick feeler gauge (arrow) inserted between the contact surface of the backing plate of the brake pad on the wheel side and the brake caliper, turn the hexagon (22) of the adjuster nut with a ring spanner until both brake pads contact the brake disc.

Caution:
Do not overload the adjuster hexagon (22)!

Note: The turning direction to adjust the break is to the left, that means anti-clockwise. Do **not** fit pad hold-down hoop before adjusting air gap.

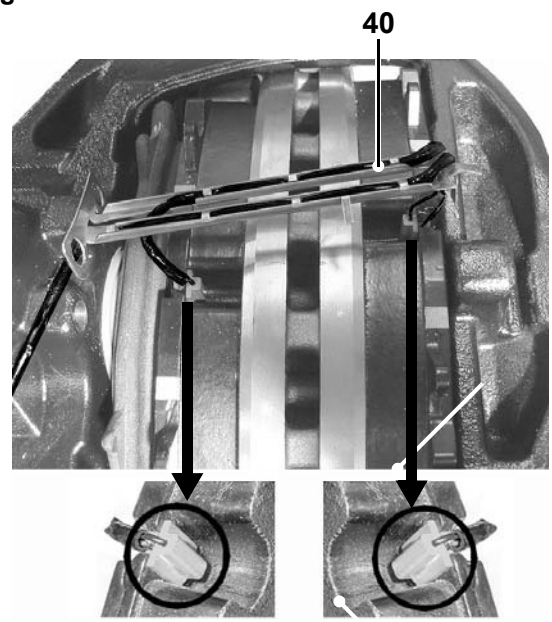


Fig. 26

- Place the **new** pre-assembled wear indicators and the cable guide (40) on the caliper and insert the sensor contact (see arrows) into the brake pads.

Attention:
The cable side of the sensor contacts need to point towards the brake disc and the sensor contact needs to be inserted in the brake pad correctly!

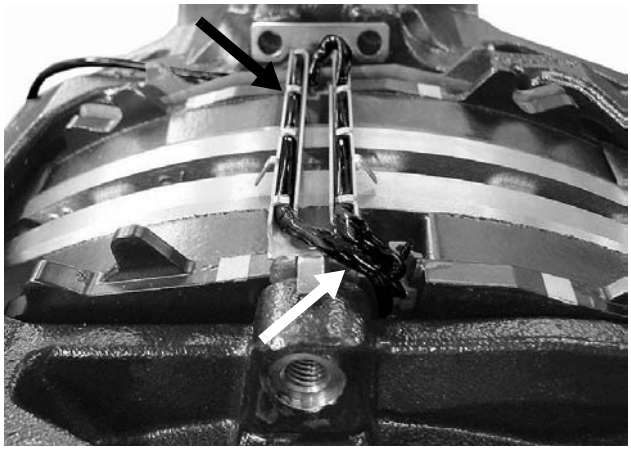


Fig. 27

- Position cable guide (40) and cable exit of the wear indicators on the brake caliper.

Caution:
Lay cables (see arrows) on the actuation side so that they are not located on the brake pad (see cable position in fig. 27).

- Position the **new** hold down springs (37) over the cable guide and on top of the spreader plate (19) and the brake pads (35, 36).

Caution: The hold-down spring (37) is placed with the long side on the brake pad (35). The long side of the hold-down spring points to the brake disc trailing side (arrow).

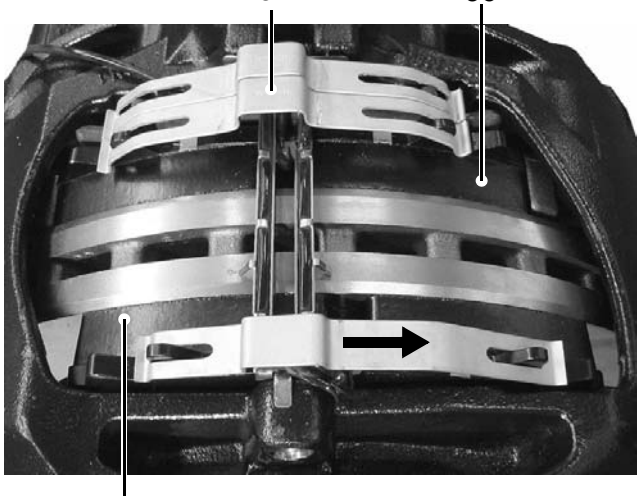


Fig. 28

- Slide **new** hold down hoop 38 through opening in the cable guide and openings in the brake caliper, then push downward so that the radial corners of the hold down springs snap into the hold down hoop.

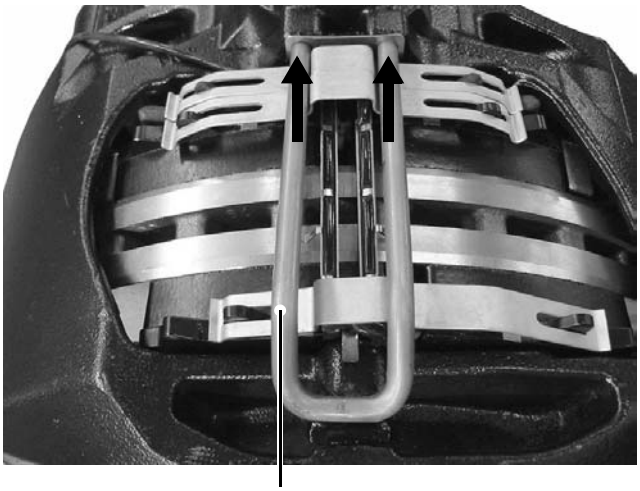


Fig. 29

- Fit **new** internal hexagon bolt (39) to the brake caliper (Table 1 Position II) with required tightening torque.

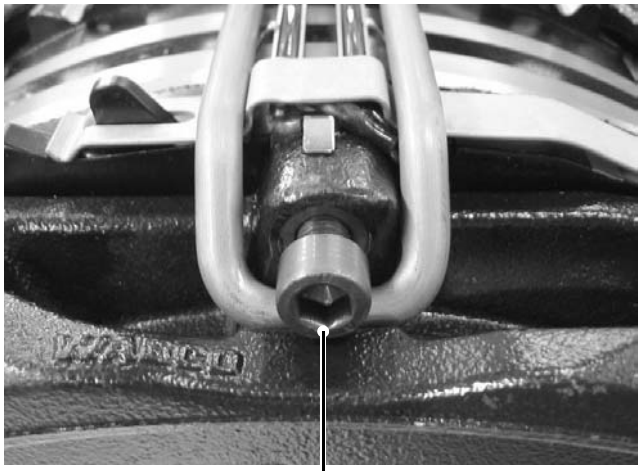


Fig. 30



Fig. 31

- Plug in the plug of the wear indicator in the connector coupling (arrow).
- **Check the correct cable position visually.**

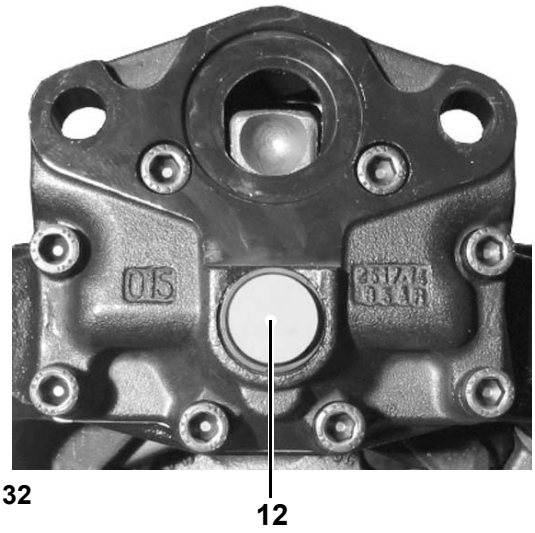


Fig. 32

- **Fit** new plug (12) to the opening in the brake caliper! **Check and make sure the correct seat!**
- Ensure that the wheel hub turns freely.

Caution:
Upon completion test the brakes on the roller dynamometer!

4. Renewing brake

Attention:
Do not use a power-driven socket! While working at the brake or moving the brake caliper handle the caliper only from outside to avoid injury!

Note: The new brake is supplied as a pre-assembled unit and may be mounted to the vehicle's axle via the brake carrier. **Pay attention to the correct mounting side in the vehicle directed forward (left brake, left vehicle side; right brake, right vehicle side).** The removed brake pads must be tested for wear according to section 2.3. **If the use of new brake pads is necesary the renewal is recommended on a per axle basis.**

Work sequences for brake removal:

- Remove brake pads according to section 3.
- Remove brake cylinder from brake caliper according to section 6.
- Dismantle the caliper with the carrier from the axle (see table 1, position III).
- Check brake disc according to section 2.4.

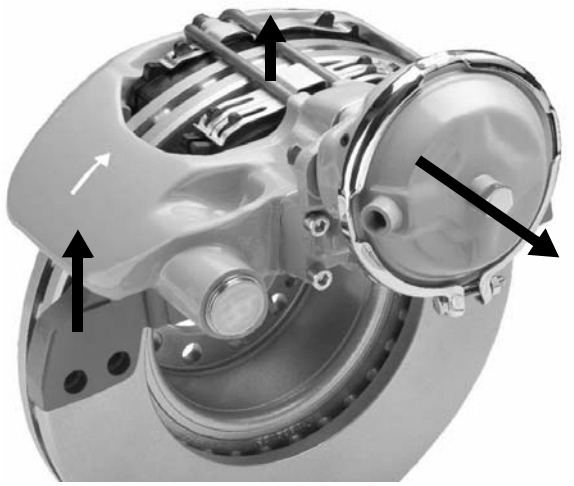


Fig. 33

Work sequences for installing brake:

- Place the **new** brake with the brake carrier over the brake disc and mount on the axle. Tighten hexagon bolts with spanner (table 1, position III).

Note: Observe vehicle manufacturer's special assembly instructions when assembling brakes.

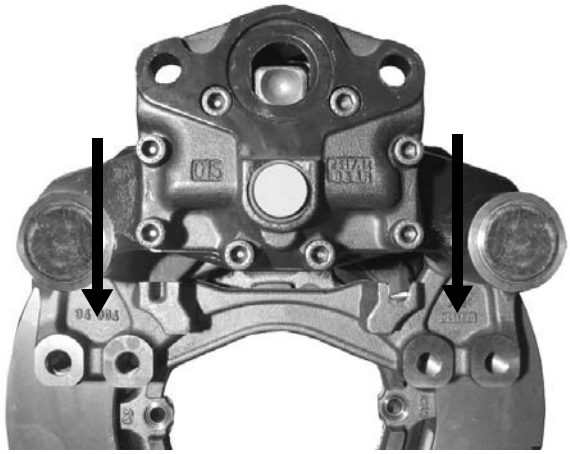


Fig. 34

- Remove the transport protection cap from the cylinder flange on the brake caliper.

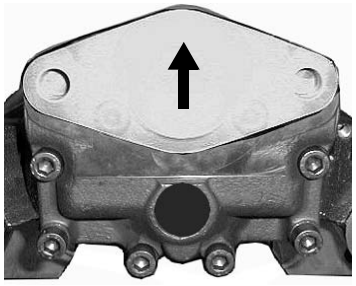


Fig. 35

- Refit brake pads and sprader plate according to section 3.
- Refit the brake cylinder on the caliper according to section 6.

Caution:
With the brake cylinder in its installed position, ensure that the lower drainage hole facing the ground is open! All other holes must be plugged!

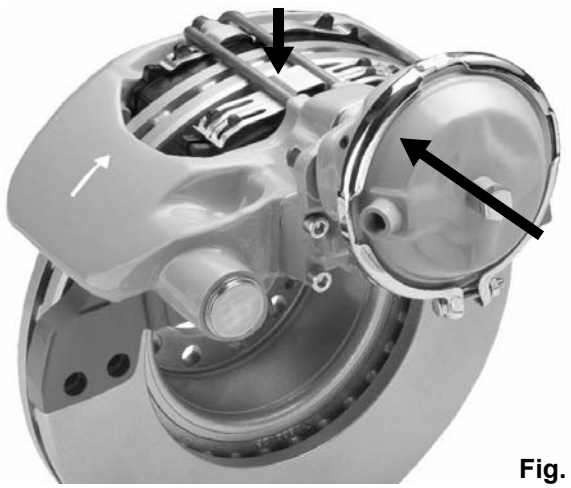


Fig. 36

5. Renewing gaiters

Attention:
Do not use a power-driven socket! While working at the brake or moving the brake caliper handle the caliper only from outside to avoid injury!

Note: When replacing all of the gaiters in the caliper, the work sequences 5.1 and 5.2 are to be combined. In this case work sequences do not need to be repeated several times.

When replacing individual gaiters, follow the corresponding work sequences of the sections 5.1 and 5.2.



Fig. 37

5.1 Renewing guide pin gaiters and bushes

Working sequences for removal:

- Remove brake pads according to section 3.
- Remove brake cylinder from brake caliper according to section 6.
- Dismantle the caliper with the carrier from the axle according to section 4.

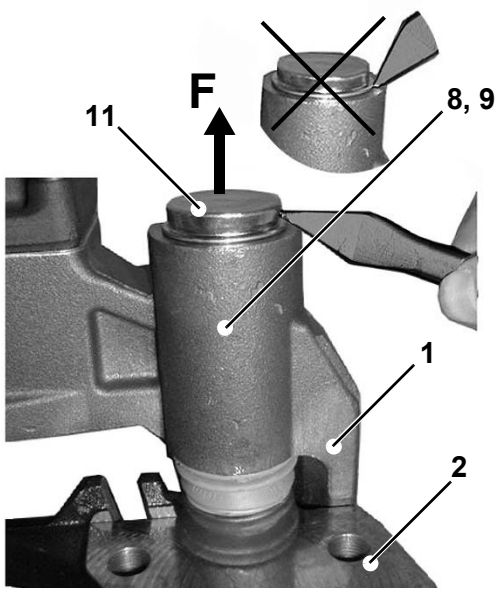


Fig. 38

- Dismantle brake caliper (1) from brake carrier (2) by removing sealing caps (11) of the guide pins (8, 9) from the caliper (1) with a suitable tool, e.g. chisel.

Caution:
Take care not to damage cover bores in housing. Position the proper tool on the cover.

- Release the screws (6, 7) with a spanner (table 1, position IV) and separate the caliper (1) from the carrier (2).

Attention:
Moving brake caliper: danger of bodily injury!

- Clean the mating surfaces (collars) of the carrier (2).

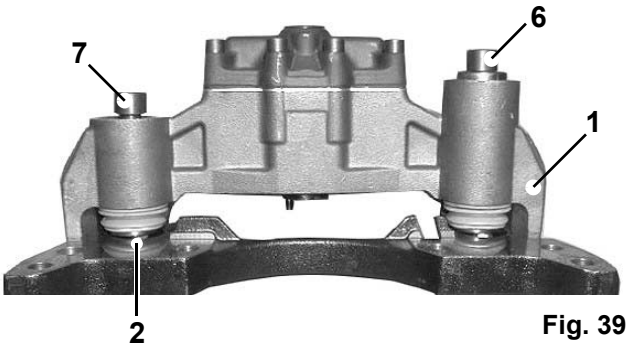


Fig. 39

- Withdraw the guide pins (8, 9) and remove the gaiters (5) from the caliper (1).

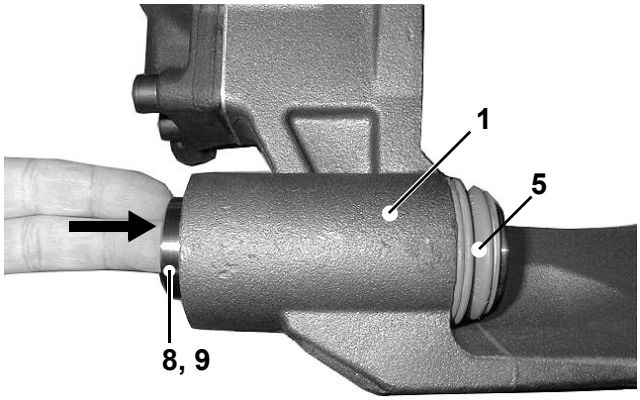


Fig. 40

- Place the caliper (1) on a firm base to push out the bushes (4), so that the caliper opening is facing upwards.



Fig. 41

- Press the bushes (4) out of the caliper (1) using a mandrel.
- Clean the bores in the caliper.

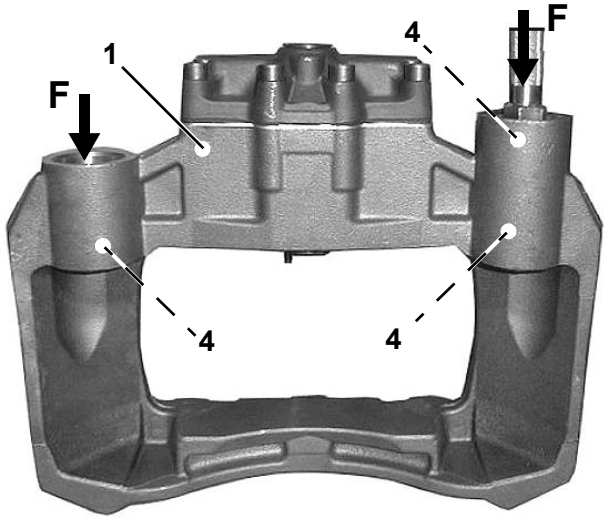


Fig. 42

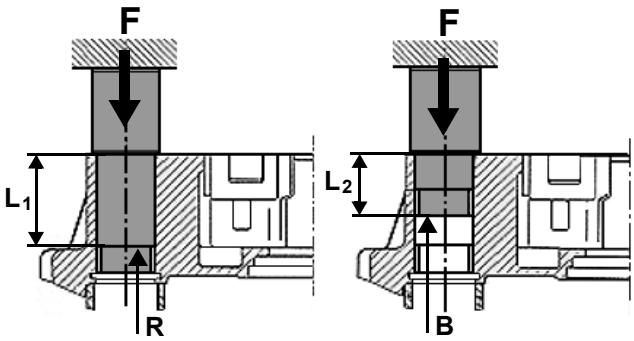


Fig. 43

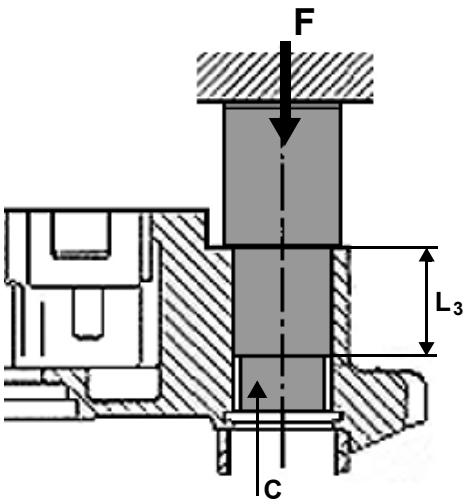


Fig. 44

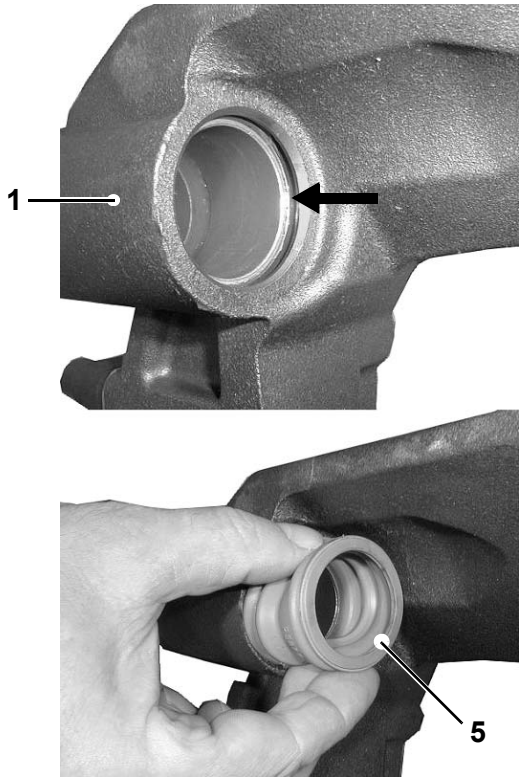


Fig. 45

Working sequence for installation:

Press in two **new** bushes for the longer guide pin.

- Firstly (A) fit the inner bush with the special fitting tool (L_1 = at specifications from WABCO), and secondly (B) the outer bush with the special fitting tool (L_2 = at specifications from WABCO) by pressing in as far as the mandrel will go.
- Check seat of the bushes for burrs, remove them if necessary.
- Grease the bushes and the space between them.

- Press in **new** bush 4 for the shorter guide pin 9.
- Fit the bush (C) with special fitting tool (L_3 = at specifications from WABCO) by pressing in as far as the mandrel will go.
- Check seat of the bush for burrs, remove them if necessary.
- Grease the bush.

- Fit **new** green gaiters 5 in the gaiter seats (ring groove/arrow) in the brake caliper 1.

Note: Clean gaiter seats before fitment. The **sealing seats** must be **free of grease**. It is possible to fit the gaiters by hand. **Ensure that the gaiter lip in the annular groove in the caliper sits free of folds!**

- Grease the sliding surfaces of the guide pins (8, 9) and the inner lip of the gaiters (5).
- Insert the **new** guide pins from the cylinder side into the caliper (1).
- Mantle guide pins with gaiters (5) and insert them into the guide pin seat (8, 9).
- Move guide pins backwards and forwards as shown in fig. 46 several times.

Caution:
The longer guide pin 8 is a close fit and is located at the brake disc leading side. The shorter guide pin (9) is a clearence fit and is located at the brake disc trailing side.

Remove all excess grease. The brake carrier end of the guide pins (arrow) and the mating surfaces of the carrier must be free of grease!

Do not lose the metal-ring on gaiter (5) and check for proper seat (right side in fig. 46)!

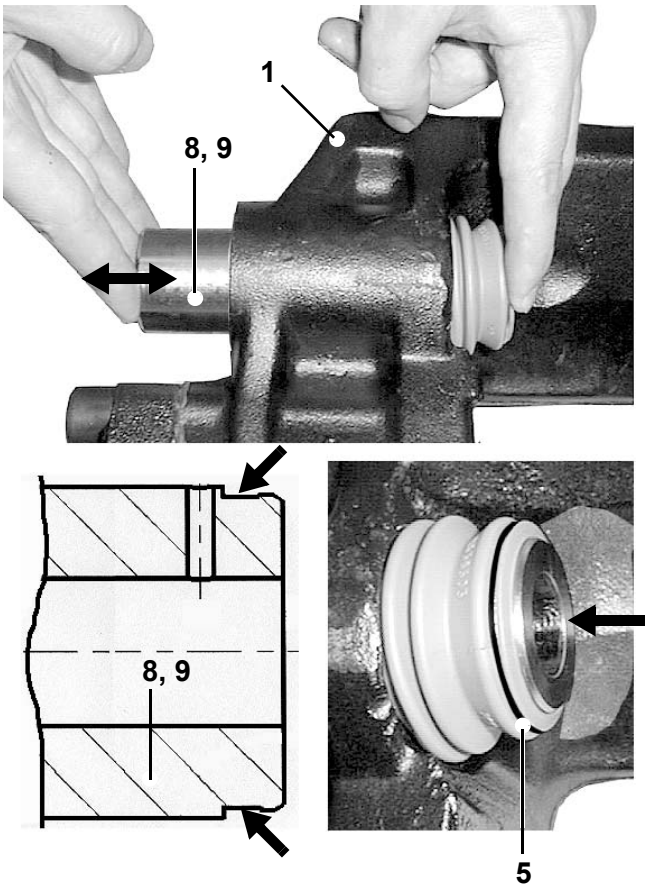


Fig. 46

- Place the caliper (1) on the carrier (2) and insert the guide pins (8, 9) into the collars in the carrier.
- Insert **new** bolts (6) (long for close fit pin 8), (7) (short for clearance fit pin 9) into the guide pins in the brake caliper (1) and srew with spanner (see table 1, position IV) on the carrier (2).

Caution:
On assembly ensure that the gaiters 5 are not damaged or twisted during tightening the bolts.

Firstly, always tighten the bolt for the close fit longer pin (8), followed by the bolt for the clearance fit shorter pin (9).

If during the maintenance work the guide pin (8 and 9) fastening to the carrier (2) is loosened, then new bolts (6 and 7) must be used when reasssembling!

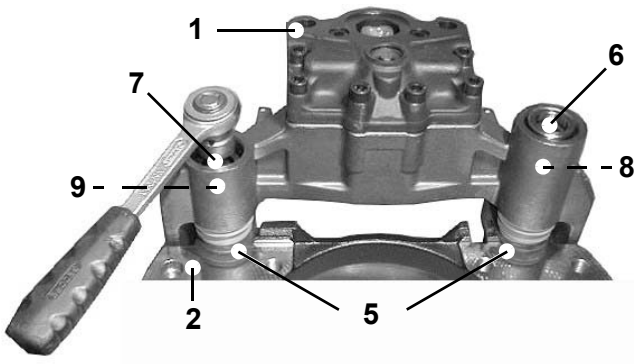


Fig. 47

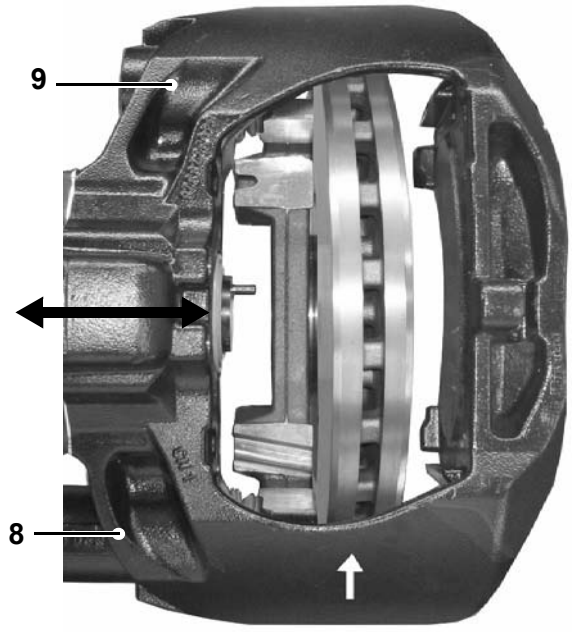


Fig. 48

- Move brake caliper backwards and forwards on guide pins (8, 9) several times. Check for ease of movement.

Caution:
Do not squeeze the dust caps of the guide pins against the brake carrier!

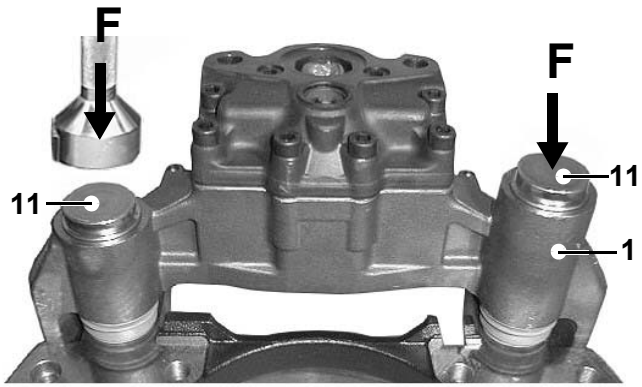


Fig. 49

- Grease the bore holes for the covers (11) in the brake calipers (1).
- Place **new** caps (11) in the bores in t he brake caliper 1 and press home with a suitable tool.

Note: Take care to avoid damaging the covers.



Fig. 53

- Mount brake over the brake disc on the axle according to section 4.

Note: Observe vehicle manufacturer's special assembly instructions when assembling brakes.

- Install brake pads and set clearence. Carry out according to section 3 and pay attention to notes.
- Before refitting the brake cylinder clean the sealing surface on the caliper and grease the concave seat (arrow) in the brake lever.
- Refit the brake cylinder on the caliper according to section 6.

Caution:
With the brake cylinder in its installed position, ensure that the lower drainage hole facing the ground is open! All other holes must be plugged!

5.2 Renewing adjuster screw gaiter

Note: If the gaiter only is to be renewed it is not necessary to dismantle the brake caliper and cylinder.



Fig. 51

Working sequences for removal:

- Remove brake pads and spreader plate according to section 3.

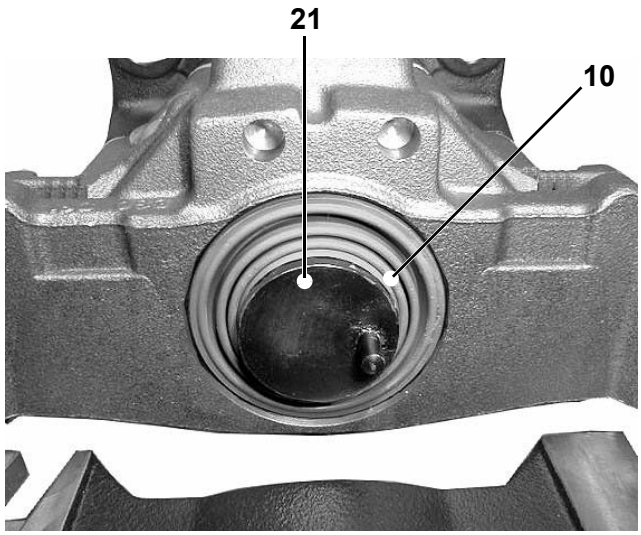


Fig. 52

- Pull brake caliper to actuation / cylinder side by hand.
- Pull the gaiter (10) out the annular groove in the adjuster screw (21).
- Remove the gaiter from the seat in the brake caliper by means of a screwdriver.

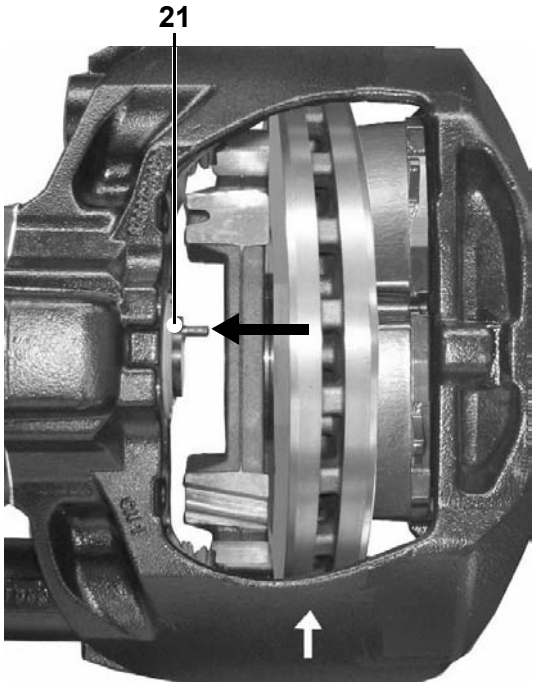


Fig. 53

- Check the adjuster screw thread (21).

Note: For this purpose refit the wheel side brake pad so that the adjuster screw cannot be screwed completely out of the adjuster. **After the thread check remove the brake pad.**

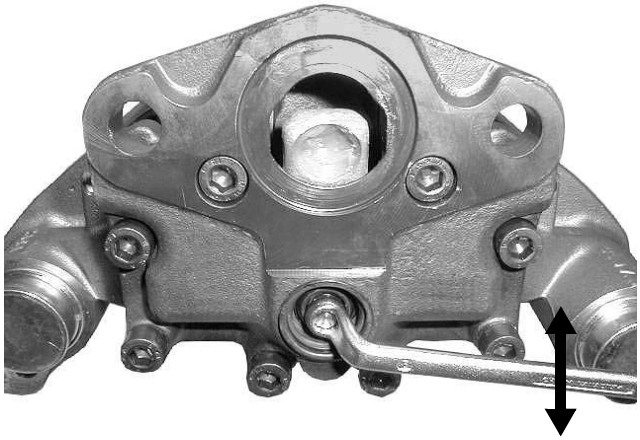


Fig. 54

- Secure adjuster screw (21) against turning (arrow Fig. 53) and screw out the adjuster screw c. 30 mm by turning the adjuster hexagon in the anti-clockwise direction with a ring spanner.
- Examine the thread for corrosion and damage whilst screwing out.

Caution:
The gaiter (10) can be renewed, if definitely no dirt or water has penetrated into the brake caliper, or if the gaiter has been directly damaged during servicing the brake. In case of doubt the brake must be replaced according to section 4, if internal parts are corroded.

- After examination grease the thread and partly screw back the adjuster screw clockwise.

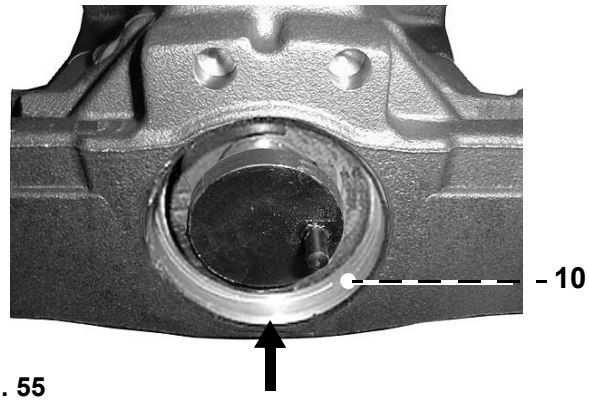


Fig. 55

Working sequence for installation:

- Clean the gaiter seat (10) (arrow) in the caliper.

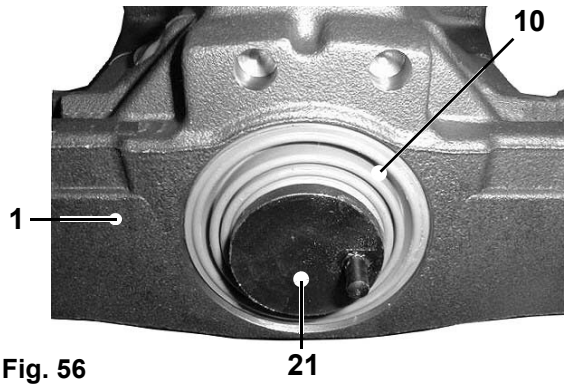


Fig. 56

- Push **new** gaiter (10) over the adjuster screw, centre it and push down the gaiter into the seat of the caliper (1) manually.
- Grease the gaiter lips (10) and insert the gaiter (10) into the seat of the adjuster screw (21).

Note: Ensure that the gaiter lip in the annular groove in the adjuster screw sits free of folds!



Fig. 57

- Install brake pads and set clearence. Carry out according to section 3 and pay attention to notes.

6. Renewing brake cylinder

Attention:
Do not use a power-driven socket! While working at the brake or moving the brake caliper handle the caliper only from outside to avoid injury!

Note: Only use cylinders as specified by vehicle manufacturer. The following work sequences onla inform in principle about the assembly and disassembly of the brake cylinder on the axles.

Detailed assembly and check instructions have to be used according to the cylilnder type and the instructions of the cylinder manufacturer.

Working sequences for removal:

- Make sure that the brake hoses are pressureless.
- Disconnect air line to cylinder (according to cylinder manufacturer's data).
- Remove brake cylinder from caliper by releasing cylinder nuts (table 1, position V).



Fig. 58

Working sequence for installation:

Caution:
With the brake cylinder in its installed position, ensure that the lower drainage hole facing the ground is open! All other holes must be plugged!

- Before refitting the brake cylinder clean the sealing surface on the caliper and grease the concave seat (arrow) in the brake lever.
- Fit brake cylinder to the caliper and tighten nuts crossed using a spanner (table 1, position V).
- Screw brake hose to brake cylinder (according to cylinder manufacturer's data).

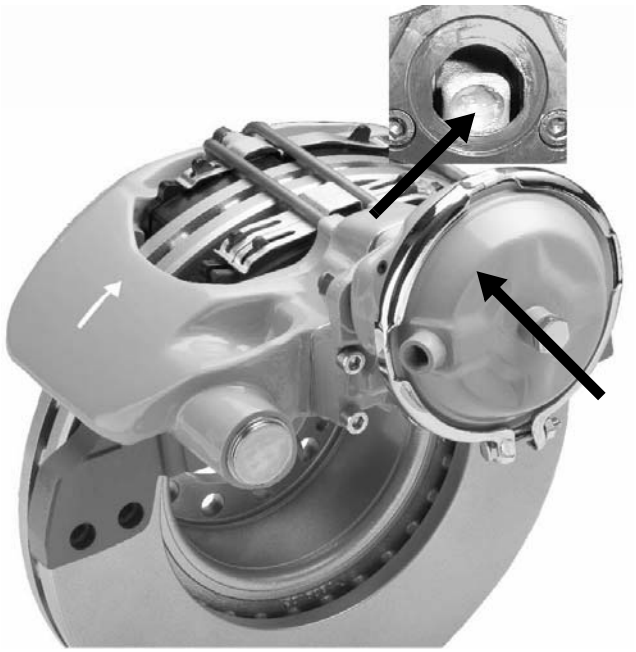


Fig. 59

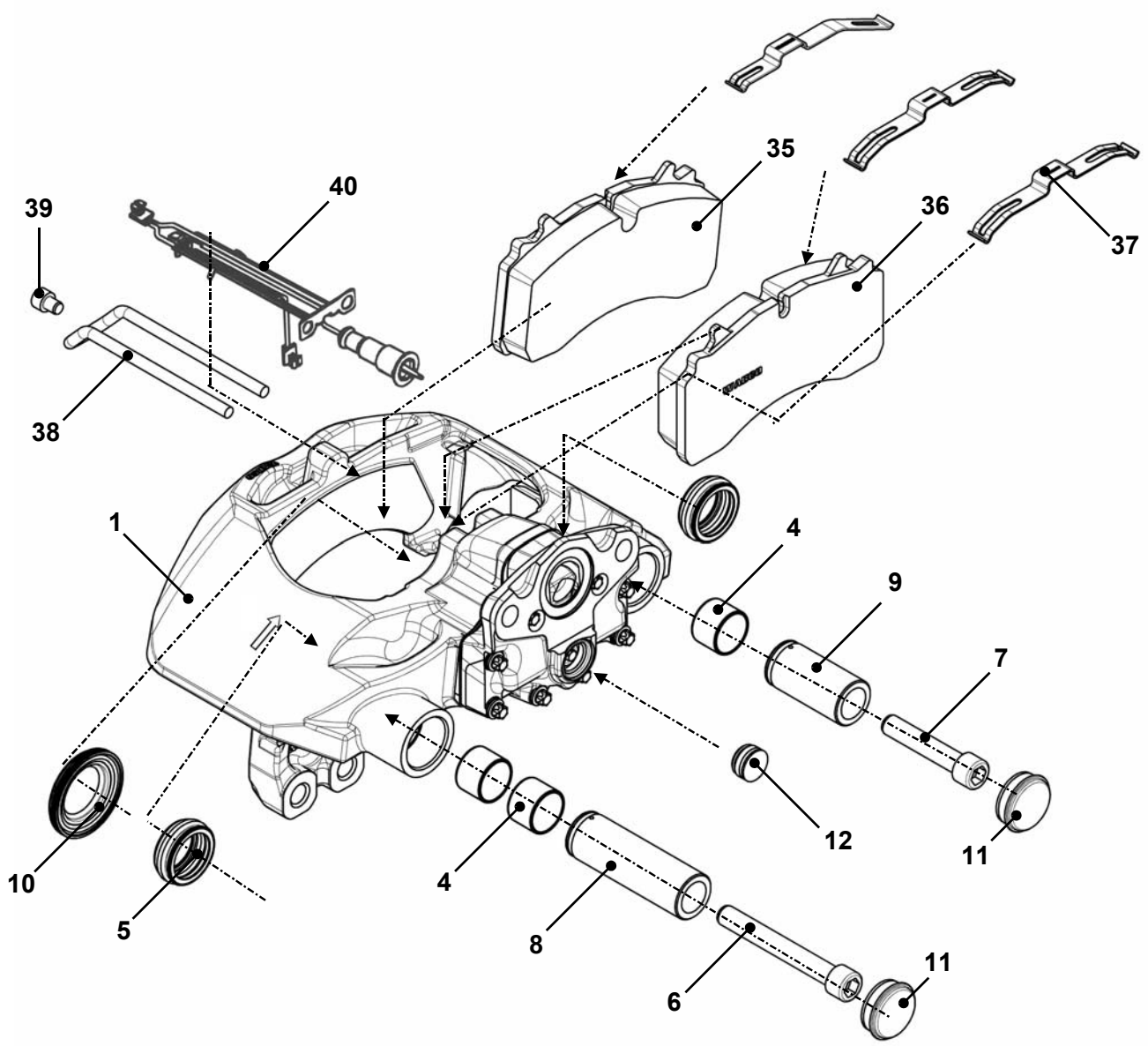
Note: The brake hose must not be twisted or located such that it will rub against anything! The brake hose of the air supply is not allowed to have an influence on the movability of the brake caliper.

- Test air connection for leaks (according to cylinder manufacturer's data).
- Carry out function and effectiveness check. Pay attention to the regulations of the cylinder manufacturer!

Table 1: Tightening torques

Position	Name	Spanner width [AF]	hexagon		Tightening torque: [Nm]
			External	Internal	
I	Hexagon Adjuster	8	X	–	Turning direction of the hexagon: • Adjust, anti-clockwise (left) maximum 3, clearance decreases. • De-adjust, clockwise (right), maximum 12, clearance increases. **Caution:** **Do not use a power-driven socket!**
II	Internal hexagon bolt / Pad hold down pin	8	–	X	30 + 15
III	Brake fixation	27	X	–	450 ± 30 recommended. Please pay attention to special assembly instructions and if applicable to wrench size of the vehicle manufacturer!
IV	Coupling guide pin	14	–	X	310 ± 30 Tightening order for guide pins: 1. Close fit pin (long internal hexagon bolt) 2. Clearence fit pin (short internal hexagon bolt)
V	Coupling brake cylinder	24	X	–	210 - 30 Please pay attention to special assembly instructions and if applicable to wrench size of the cylinder manufacturer!

Exploded view of the exchange units:



Key:

1	Brake caliper with brake carrier	11	Closing cover
4	Bushes for guide pins	12	sealing plugs
5	Gaiters for guide pins	35	Brake pad wheel side with wear indicator
6	Internal hexagon bolt (long)	36	Brake pad actuation side with wear indicator
7	Internal hexagon bolt (short)	37	Hold-down springs
8	Guide pin (long)	38	Pad hold down pin
9	Guide pin (short)	39	Internal hexagon bolt
10	Gaiter for adjuster screw	40	Cable guide with wear indicator (pre-assembled)

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SERVICE MANUAL

Overview of Tool Kits and Service Manuals for Knorr-Bremse Air Disc Brakes

Brake	Tool Kit	Alternative
SB5...	II37951004	K039062K50 + Z001105
SB6... SB7...	II37951004*	K039062K50 + Z001105
SN5...	K037001	
SN6... SN7... SK7...	K039062K50	K000469 + Supplemental Kit K017062 + Supplemental Kit K046291K50 K005972 + Supplemental Kit K017062 + Supplemental Kit K046291K50 K016947 + Supplemental Kit K046291K50
SL7...	K039062K50	K016947 + Supplemental Kit K046291K50
SM7...		
ST7...	K039062K50	K016947 + Supplemental Kit K046291K50

*) Additional tools are required -
obtainable in kits K000469, K005972, K016947 and K039062K50

Brake	Service Manual
SB5... SB6... SB7...	C16352-#
SN5...	Y015044-#
SN6... SN7... SK7...	Y006471-#
SL7...	Y081564-#
SM7...	
ST7...	Y173241-#

- Refer to website for latest revision **www.knorr-bremseCVS.com**

Disclaimer

The information contained in this document is intended for the exclusive use of trained persons within the commercial vehicle industry, and must not be passed on to any third party. All recommendations regarding products and their servicing or usage are with reference to Knorr-Bremse products and should not be considered applicable to products from other manufacturers.

This information does not purport to be all-inclusive and no responsibility is assumed as a result of its use. We cannot accept any liability nor offer any guarantee regarding data accuracy, completeness or timeliness. The information does not represent any guarantee or ensured characteristics of the Products or Systems described. No liability can be accepted based on the information, its use, recommendations or advice provided. In no event may we be held liable for any damage or loss except in the case of wilful intent or gross negligence on our part, or if any mandatory legal provisions apply.

Any legal disputes arising from the use of this information shall be subject to German law.

Note: If service work is carried out on the vehicle, it is the responsibility of the workshop to ensure the vehicle is fully tested and in full functional order before the vehicle is returned into service. Knorr-Bremse accepts no liability for problems caused as a result of appropriate tests not being carried out.

This disclaimer is an English translation of a German text, which should be referred to for all legal purposes.

Revision Details

Rev. 007	August 2019	Complete overhaul of layout and diverse text changes throughout

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SAFETY AND ENVIRONMENT GUIDELINES

Note: *The safety advice listed below is applicable to general service and diagnostic work on braking systems. Also observe any recommendations from the axle or vehicle manufacturer concerning towing, jacking-up and securing the vehicle.*

CAUTION: KNORR-BREMSE IS NOT LIABLE FOR ANY INJURIES OR DAMAGES CAUSED BY IMPROPER USE OF SPECIFIED SERVICE KITS AND/OR SERVICE TOOLS. FURTHERMORE, MISUSE OF TOOLS OR INCORRECT INSTALLATION OR APPLICATION OF SERVICE KITS MAY RESULT IN DAMAGE OR POTENTIALLY UNSAFE VEHICLE OPERATIONS. IN THIS CASE, KNORR-BREMSE DOES NOT HAVE ANY WARRANTY OBLIGATIONS.

Before and whilst working on or around compressed air systems and devices, the following precautions should be observed, along with the many hazard notes contained throughout the document:

1 Always wear safety glasses when working with air pressure.

2 Never exceed the vehicle manufacturer's recommended air pressures.

3 Never look into air jets or direct them at anyone.

4 Never connect or disconnect a hose or line containing pressure; it may whip as air escapes.

5 When removing or servicing a product, ensure all pressure related to the specific system it is contained in has been depleted to 0 bar. Be aware that if the vehicle is equipped with an air dryer system, it can also contain air pressure along with its purge reservoir, if fitted, even after pressure has been drained from the other reservoirs.

6 If it is necessary to drain the air pressure from reservoirs, etc., keep away from brake actuator push rods and levers since they may move as system pressure drops. On vehicles fitted with air suspension, it is advised when undertaking such work, to support the chassis from sudden lowering and therefore prevent any possibility of being trapped between the chassis and axle or ground.

7 Park the vehicle on a level surface, apply the parking brakes, and always chock the wheels as depleting vehicle air system pressure may cause the vehicle to roll.

8 When working under or around the vehicle, and particularly when working in the engine compartment, the engine should be shut off and the battery disconnected. Where circumstances require that the engine be running, EXTREME CAUTION should be taken to prevent personal injury resulting from contact with moving, rotating, leaking, heated or electrically charged components. Additionally, it is advisable to place a clear sign on or near the steering wheel advising that there is work in progress on the vehicle.

9 When working on vehicles equipped with air suspension, to guard against injury due to unexpected downward movement of the chassis caused by sudden pressure loss in the suspension system, ensure that the vehicle chassis is mechanically supported with a 'prop' between the chassis and the axle or between the chassis and the ground.

10 Examine all pipework for signs of kinks, dents, abrasion, drying out or overheating. Be aware that kinks in pipework may result in air pressure being trapped in the pipework and associated equipment. Replacement hardware, tubing, hose, fittings, etc. must be of equivalent size, type and strength as original equipment and be designed specifically for such applications and systems. Check the attachment of all pipework; it should be installed so that it cannot abrade or be subjected to excessive heat.

11 Components with stripped threads or damaged/corroded parts must be replaced completely. Do not attempt repairs requiring machining or welding unless specifically stated and approved by the vehicle or component manufacturer.

12 Never attempt to install, remove, disassemble or assemble a device until you have read and thoroughly understood the recommended procedures. Some units contain powerful springs and injury can result if not properly dismantled and reassembled. Use only the correct tools and observe all precautions pertaining to use of those tools.

13 Before removing any device note its position and the connections of all pipework so that the replacement/serviced device can be properly installed. Ensure that adequate support or assistance is provided for the removal/installation of heavy items.

14 Use only genuine replacement parts, components and kits as supplied by Knorr-Bremse or the vehicle manufacturer containing original Knorr-Bremse parts Only use the recommended tools as specified in related Knorr-Bremse instructions.

15 The serviced or replaced product must be checked for correct function and effectiveness.

16 If products have been dismantled, serviced or replaced, whose performance could affect braking performance or system behaviour, this should be checked on a roller dynamometer. Bear in mind that a lower performance may be experienced during the bedding-in phase if new brake pads/linings and/or brake discs/drums have been fitted.

17 The use of impact screwdrivers or impact wrenches in conjunction with Knorr-Bremse service tools for air disc brakes is not permitted. The service tools are not designed for such use. It is likely that the tools or the vehicle will be damaged and there is a serious risk of injury – see Caution above.

18 Do not use compressed air to clean the disc brake. Avoid air contamination of brake dust.

19 Prior to returning the vehicle to service, make certain that all components and the complete brake systems are leak free and restored to their proper operating condition.

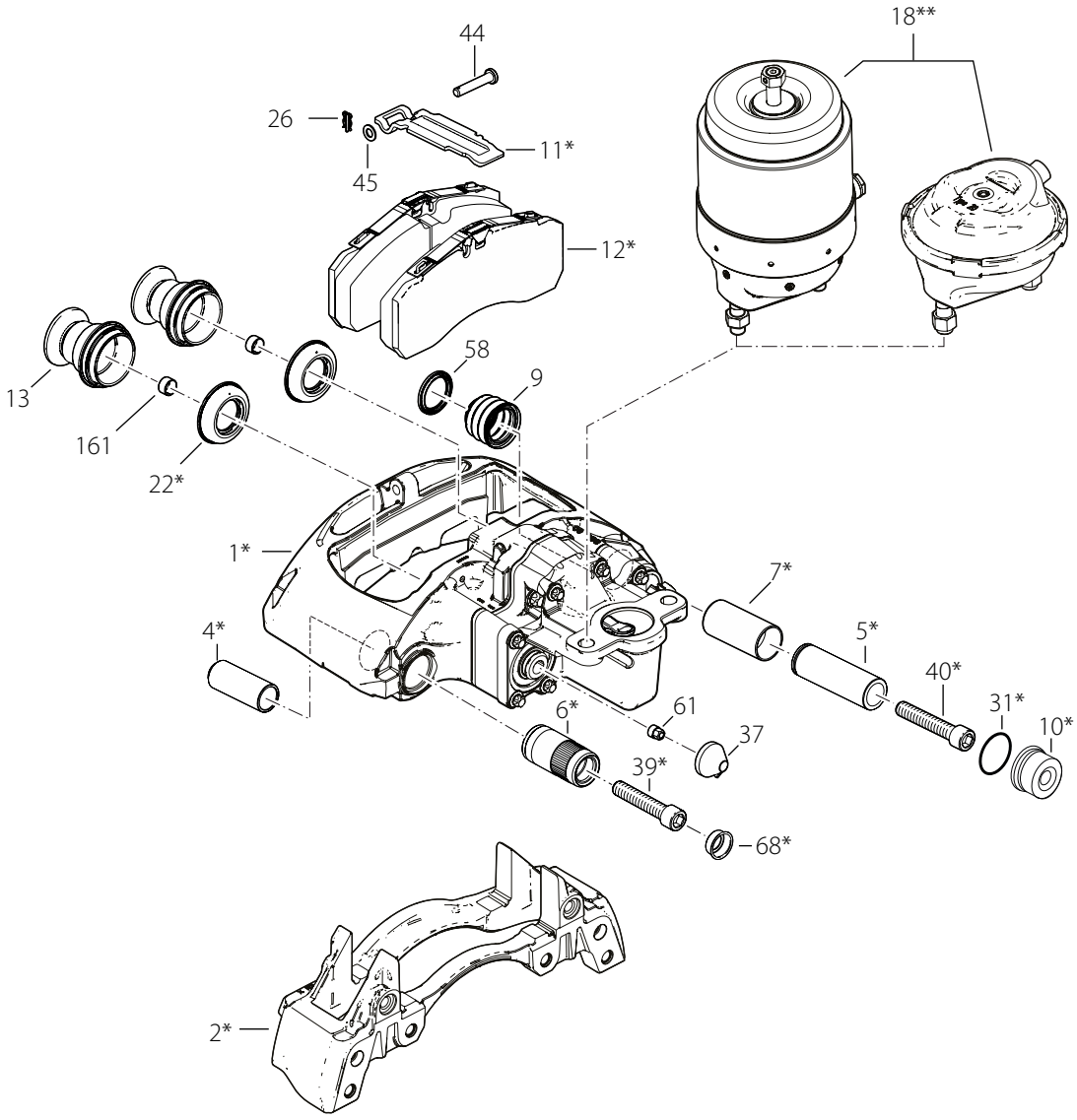


Disposal of Waste Equipment by Business Users in the European Union

This symbol on the product, packaging or in user instructions, indicates that this product must not be disposed of with other general waste. Instead, it is your responsibility to dispose of the waste electrical and electronic parts of this product by handing them over to a company or organisation authorised for the recycling of waste electrical and electronic equipment. For more information about arrangements for waste equipment disposal please contact your Knorr-Bremse distributor or local Knorr-Bremse representative.

1. OVERVIEW

1.1 Disc Brake Components



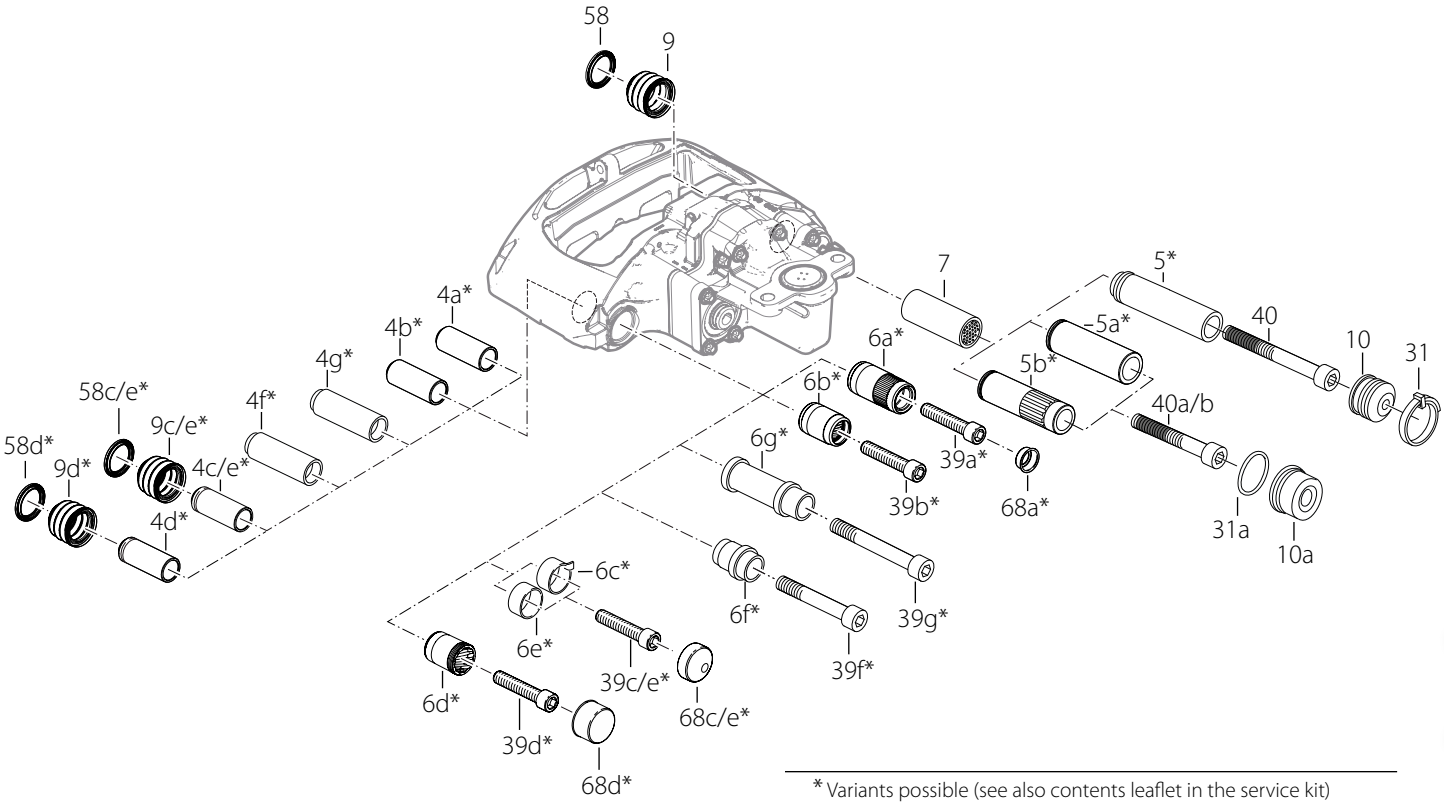
Legend

1 Caliper*
2 Carrier*
4 Guide Pin*
5 Guide Pin*
6 Rubber Bush or Guide Sleeve* (floating bearing side)
7 Brass Bush* (fixed bearing side)
9 Inner Boot*
10 Cover*
11 Pad Retainer*
12 Pad (complete)*
13 Tappet and Boot Assembly
18 Brake Actuator**
22 Inner Seal*
26 Spring Clip
31 O-Ring
37 Adjuster Cap
39 Caliper Bolt*
40 Caliper Bolt*
44 Pad Retainer Pin
45 Washer
58 Ring*
61 Shear Adapter
68 Cover*
161 Tappet Bush

* Variants possible
(see also contents leaflet in the service kit)

** Brake chamber or spring brake

1.1.1 Identification of the Guide and Seal Kit Variants



* Variants possible (see also contents leaflet in the service kit)

Floating Bearing (6) variants:

a) Rubber Bush



b) Open Bearing



c) and e) Guide Sleeve



d) Capped Rubber Sleeve



f) Short Rubber Sleeve



g) Long Rubber Sleeve



1.1.2 Grease Application Table of the Fixed and Floating Bearings

Bearing side	Guide Pin pos. No.	Guide Bush/Sleeve type	White Grease II14525; K093430; II32868	Green Grease II32793; Z000046
Fixed Bearing	5	7 Brass Bush	X	
Fixed Bearing	5a	7 Brass Bush	X	
Fixed Bearing	5b	7 Brass Bush	X	
Floating Bearing	4a	6a Rubber Bush	X	
Floating Bearing	4b	6b Open Bearing	X	
Floating Bearing	4c	6c Guide Sleeve	X	
Floating Bearing	4d	6d Capped Rubber Sleeve	X	
Floating Bearing	4e	6e Guide Sleeve	X	
Floating Bearing	4f	6f Short Rubber Sleeve		X
Floating Bearing	4g	6g Long Rubber Sleeve		X

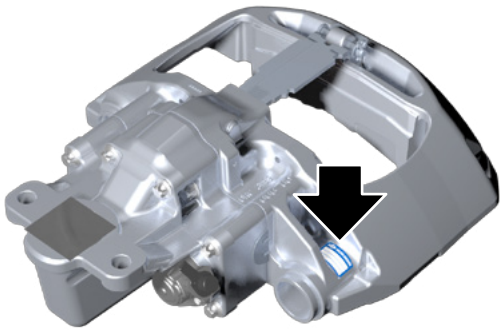
1.2 Brake Identification and Service Kits

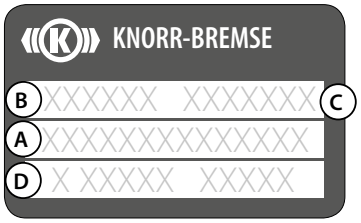
A = Axle or vehicle manufacturer's identification number

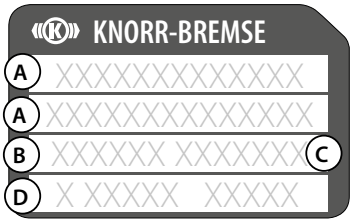
B = Knorr-Bremse brake type number

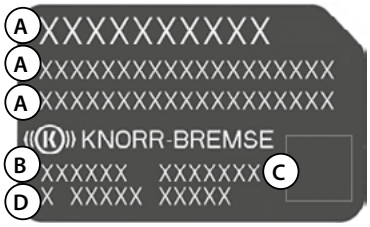
C = Knorr-Bremse part number

D = Knorr-Bremse date of manufacture









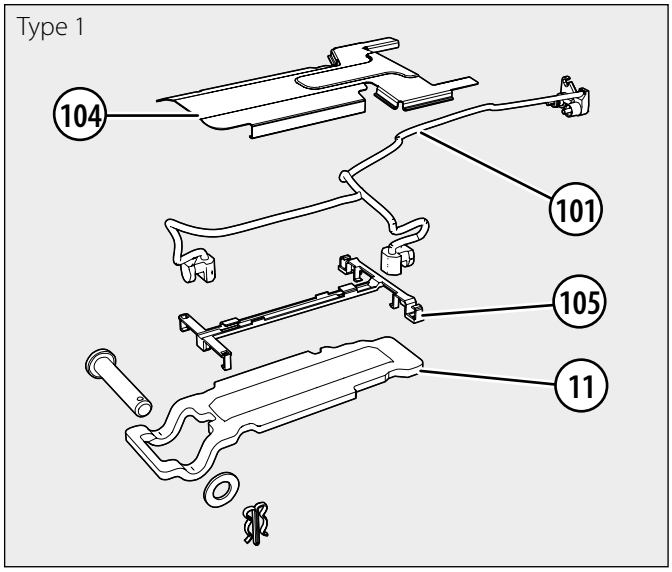
Use only genuine Knorr-Bremse parts!

The following service kits are available:

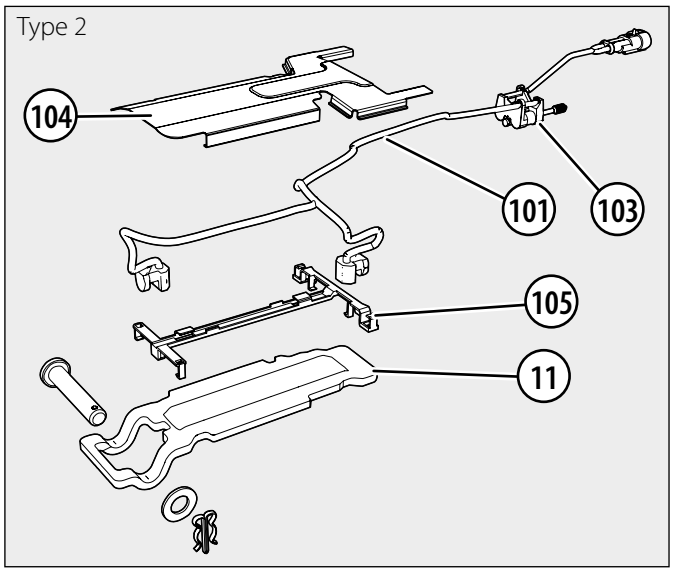
Description	Content (Position No.)	
Carrier	Carrier (2) 1x	For specific service part numbers allocated to the disc brake see: www.Knorr-BremseCVS.com www.Knorr-BremseCVS.biz
Guide and Seal Kit	Guide Pin (4a, 4b, 4c, 4d, 4e, 4f, 4g, 5, 5a, 5b) Guide Sleeve (Floating bearing) (6a, 6b, 6c, 6d, 6e,6f, 6g) Brass Bush(Fixed bearing)(7) Inner Boot (9,9c, 9d, 9e) Cover (10, 10a) Caliper Bolt (39a, 39b, 39c, 39d, 39e, 39f, 39g, 40, 40a, 40b) Ring (58a, 58b, 58c, 58d, 58e) Cap (68a, 68c, 68d, 68e) Securing Tie (31) O-Ring (31a)	
Tappet and Boot Kit	Tappet and Boot (13) 2x Inner Seal (22) 2x Tappet Bush (161) 2x	
Adjuster Cap	Adjuster Cap (37) 10x Shear Adapter (61) 10x	
Brake Pads (axle set)	Pad Retainer (11) 2x Brake Pad (12) 4x Spring Clip (26) 2x Adjuster Cap (37) 2x Pad Retainer Pin (44) 2x Washer (45) 2x Shear Adapter (61) 2x	
Caliper	Supplied **without** carrier (2) and **without** brake pads (12). Guide Pins and Seals kit included for assembly of caliper to existing brake carrier	Knorr-Bremse offers a range of specifically designed rationalised calipers to service a wide range of disc brakes. For specific caliper part number, see: www.Knorr-BremseCVS.com www.Knorr-BremseCVS.biz

1.2.1 Wear Indicator Kits

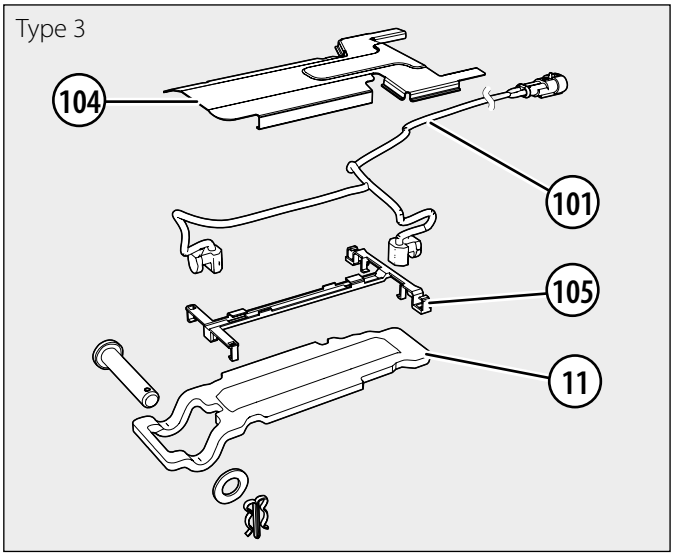
Type 1



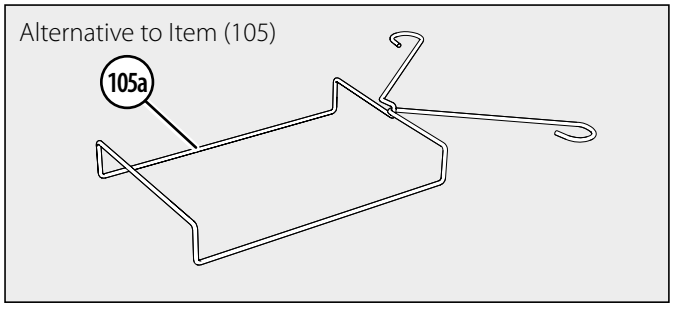
Type 2



Type 3



Alternative to Item (105)



11	Pad Retainer*
101	Sensors with cable*
103	Cable to electrical supply*
104	Cable protection plate
105	Cable guide
105a	Cable guide

* Variants possible

1.3 Brake Disc

Replacing brake discs is subject to the instructions of the vehicle or axle manufacturer, including when fitting Knorr-Bremse brake discs.

When replacing brake discs, make sure to use the correct connections and tightening torques.

The use of non-approved brake discs will reduce levels of safety, and will not be covered by any Knorr-Bremse liability.

Knorr-Bremse recommends the brake disc be changed as an axle set. Brake discs can be ordered through the Knorr-Bremse aftermarket organisation.

Additionally Knorr-Bremse recommends brake discs be changed at the latest every 6 years, even if the wear limits have not been reached.

2. GENERAL INFORMATION

The use of impact screwdrivers / impact wrenches in conjunction with Knorr-Bremse service tools for air disc brakes is not permitted. The service tools are not designed for such use.

Never turn the Adjuster (23) without Shear Adapter (61). If the given shear point of the Shear Adapter (61) is reached, the adapter will fail. Try again using a brand new shear adapter. If the adapter fails a second time, the whole caliper will need replacing due to internal damage. Do not use an open-ended spanner on the adapter as this could damage it.

Attention: Risk of injury. Knorr-Bremse accepts no liability for damage or injury resulting from negligence; any damage to service tools resulting from such actions will void all warranty.

2.1 Service Tools

Tool	Description	Consisting of tool components:
(A)	Wedged fork for removal of tappet and boot assembly (13)	T15
(C)	Pull-in tool for inner boot (9), capped rubber sleeve (6d)	T06, T07, T08, T10
(D)	Pull-in/Pull-out tool including grooving tool for brass bush (7) + press in tool for cover (68d)	T08, T12, T13, T14, T16
(E)	Press-in tool for tappet and boot assembly (13)	T02 T03, T04, T28, T56
(G)	Press-in tool for cover (10a)	Z001105
(K)	Press-in tool for cap (68a)	T11
(L)	Press-in tool for inner seal (22)	T03, T04, T09
(M)	Press-in tool for cover (68c)	T27 (replaces T25)
(N)	Pull-in/Pull-out tool for guide sleeve (6c and 6e)	T05, T06, T08, T14, T20, T21
(R)	Pull-in/Pull-out tool for rubber bush (6a) and open bearing (6b)	T05, T06, T18, T19,T20, T21, T22

Note: The current service tool kit (Part No. K039062K50) contains the above listed tool components. Older tool kits can be updated by purchasing supplementary tools (see table on page 2).

2.2 Diagnostic Equipment

Part No.	Description
K154433N50	A Knorr-Bremse hand-held device for checking potentiometer function (see also Service News Y123889).

2.3 Lubricant

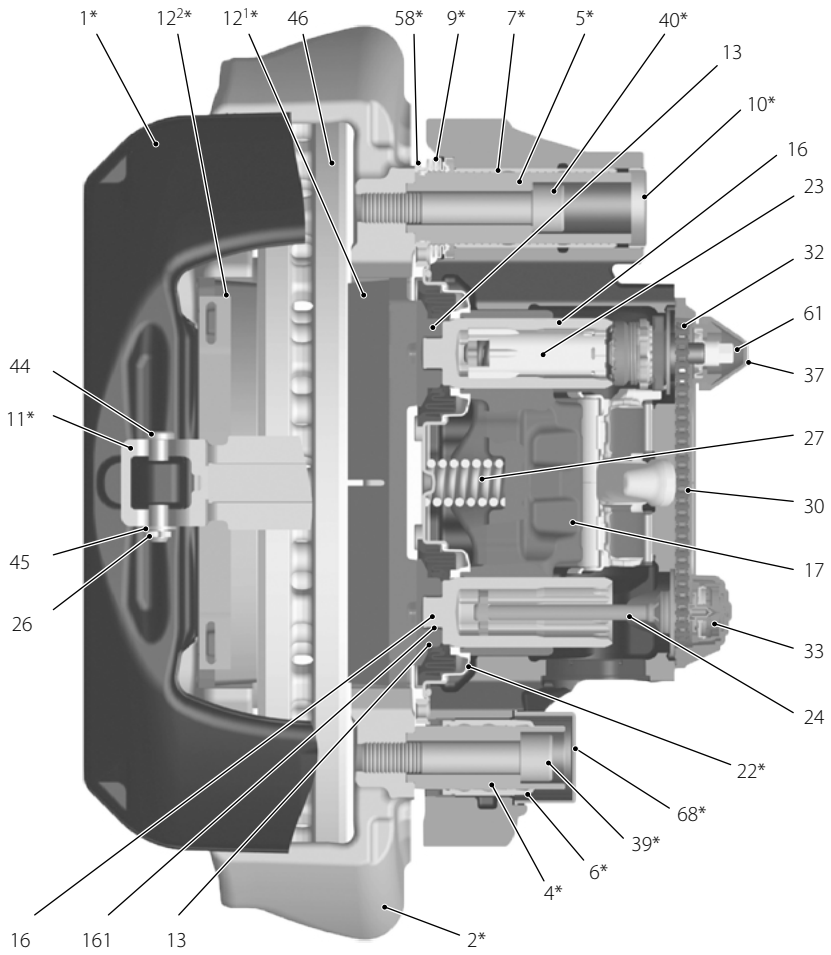
Part No.	Quantity	Colour	Application
II14525	5g	white	see section: 5.3; 7.2; 8.2; 9.3; 9.5 und 11
K093430	10g	white	see section: 5.3; 7.2; 8.2; 9.3; 9.5 und 11
II32868	500g	white	see section: 5.3; 7.2; 8.2; 9.3; 9.5 und 11
II32793	8g	green	see section: 5.3 und 9.3.9
Z000046	500g	green	see section: 5.3 und 9.3.9
K125122N50	1000g	weiß	see section: 6.3

2.4 Torque Requirements

Item No.	Description	Torque	Spanner Size (mm)
39; 40	Caliper bolts (2x) M16x1.5 (hexagon socket head)	180 Nm plus 90°	14 (Hexagon key)
18	Brake chamber or spring brake	Follow the instructions of the brake actuator or vehicle manufacturer	-

3. DESCRIPTION AND FUNCTION

3.1 Axial Disc Brake Sectioned View

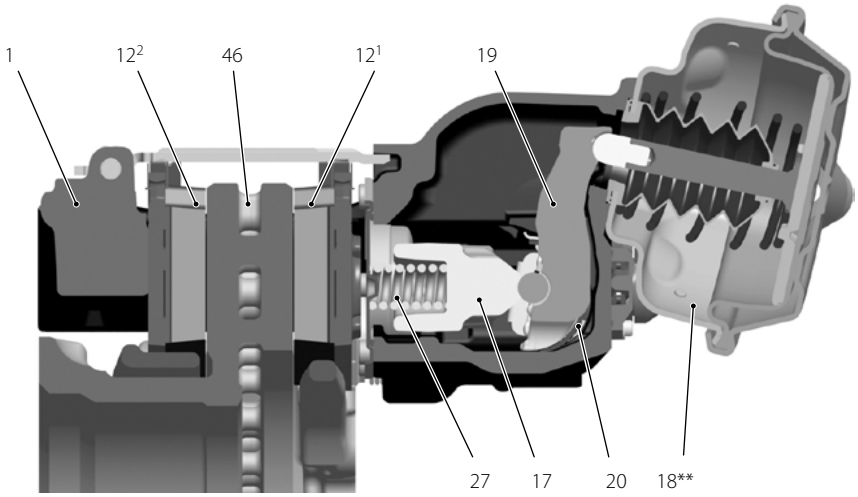


Legend

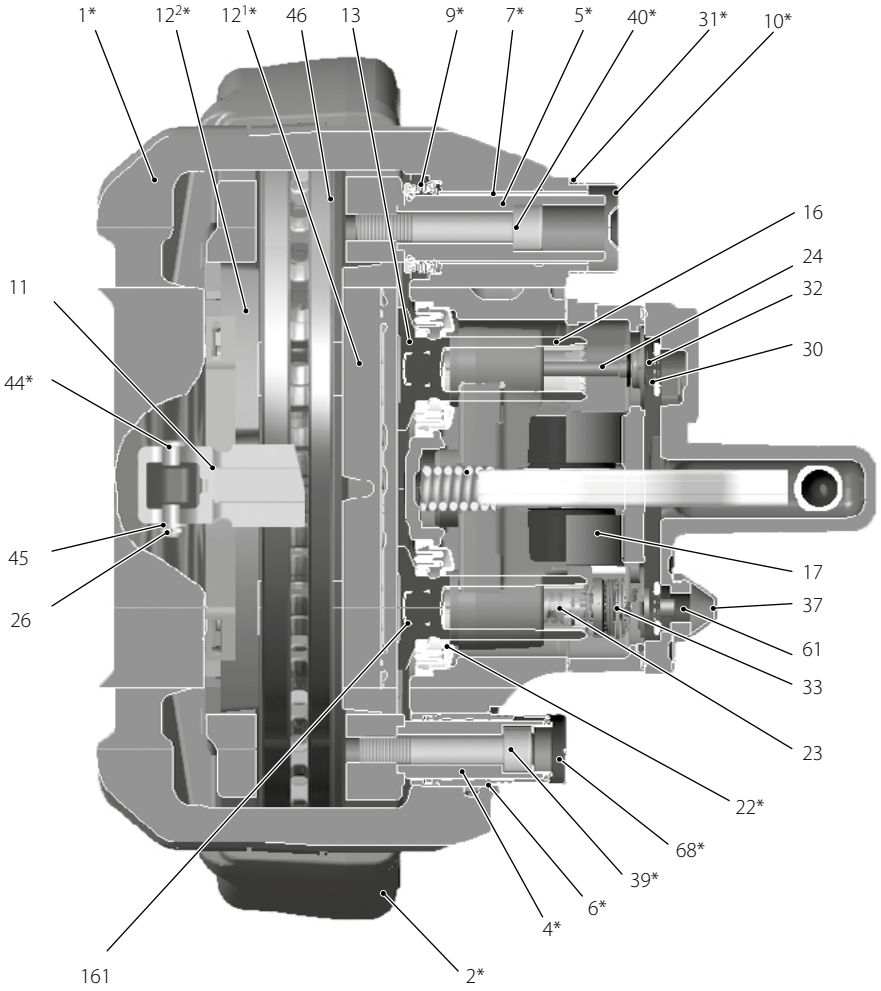
1	Caliper*
2	Carrier*
4	Guide Pin*
5	Guide Pin*
6	Rubber Bush / Guide Sleeve (floating bearing side)*
7	Brass Bush (fixed bearing side)*
9	Inner Boot*
10	Cover*
11	Pad Retainer*
12^1	Pad (inboard)*
12^2	Pad (outboard)*
13	Tappet and Boot Assembly
16	Threaded Tube
17	Bridge
18	Brake Actuator**
19	Lever
20	Eccentric Bearing
22	Inner Seal*
23	Adjuster Unit
24	Turning Device
26	Spring Clip
27	Spring
30	Chain
32	Chain Wheel
33	Wear Sensor
37	Adjuster Cap
39	Caliper Bolt*
40	Caliper Bolt*
44	Pad Retainer Pin
45	Washer
46	Disc
58	Ring*
61	Shear Adapter
68	Cover*
161	Tappet Bush

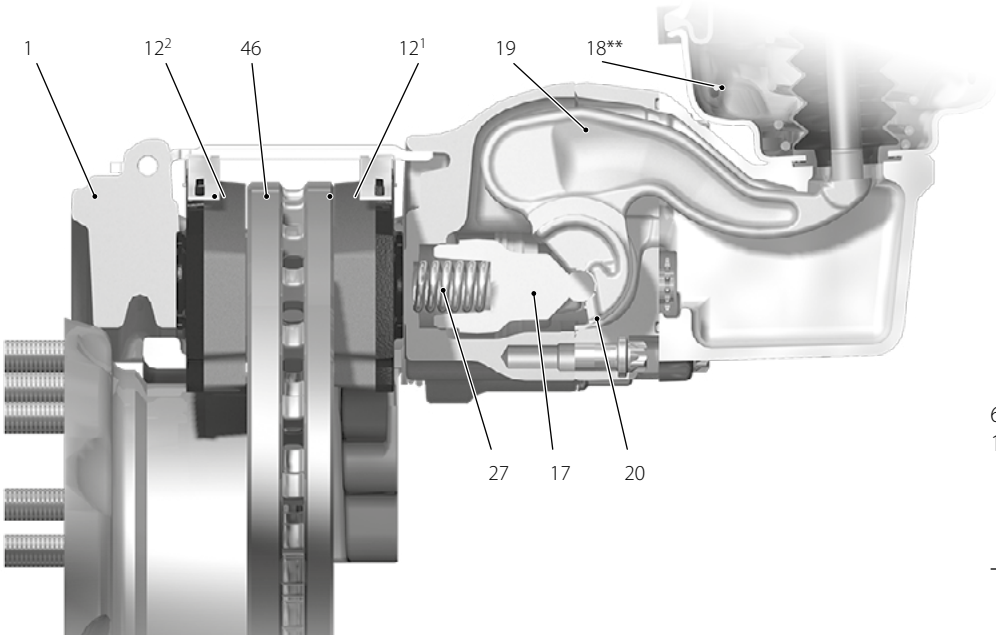
* variants

** Brake Chamber or Spring Brake



3.2 Radial Disc Brake Sectioned View





Legend

1	Caliper*
2	Carrier*
4	Guide Pin*
5	Guide Pin*
6	Rubber Bush / Guide Sleeve (floating bearing side)*
7	Brass Bush (fixed bearing side)*
9	Inner Boot*
10	Cover*
11	Pad Retainer*
12¹	Pad (inboard)*
12²	Pad (outboard)*
13	Tappet and Boot Assembly
16	Threaded Tube
17	Bridge
18	Brake Actuator**
19	Lever
20	Eccentric Bearing
22	Inner Seal*
23	Adjuster Unit
24	Turning Device
26	Spring Clip
27	Spring
30	Chain
31	O-Ring*
32	Chain Wheel
33	Wear Sensor
37	Adjuster Cap
39	Caliper Bolt*
40	Caliper Bolt*
44	Pad Retainer Pin
45	Washer
46	Disc
61	Shear Adapter
68	Cover*
161	Tappet Bush

* variants

** Brake Chamber or Spring Brake

3.3 Description of Operation

(Floating caliper principle)

Brake Actuation

During actuation, the push rod of the actuator (18) moves the lever (19). The input forces are transferred via the eccentric roller bearing (20) to the bridge (17). The force is then distributed by the bridge (17) and the two threaded tubes (16) to the tappet and boot assemblies (13) and finally to the inboard pad (12^1).

After overcoming the running clearance between the inboard pad (12^1) and the brake disc (46), the reaction forces are transmitted by the caliper to the outboard pad (12^2). The clamping forces on the pads and the disc (46) generate the braking force for the wheel.

Brake Release

After releasing the air pressure, the return spring (27) pushes the bridge (17) with the threaded tubes and lever (19) back to the start position.

Brake Adjustment

The so called running clearance of the disc brake is the air gap between the brake pad (12) and the brake disc (46). This distance is necessary to achieve a free running (and therefore unbraked) disc when the brakes are in a 'non applied' state. Too large a running clearance can lead to a greater braking distance.

The designated running clearance is so designed to compensate for changes under typical use such as:

- expansion of parts due to high temperatures.
- viscoelastic effect of the brake pads.
- finish and runout tolerances of a brake disc and possible lip development.

To ensure a constant running clearance between pads and disc, the brake is equipped with a non-wearing, automatic adjuster mechanism. The adjuster (23) operates with every cycle of actuation due to the mechanical connection with lever (19).

As the pads and disc wear, the running clearance increases. The adjuster (23) and turning device (24) turn the threaded tubes (16) by an amount necessary to compensate for this wear.

4. INSPECTION POINTS

Despite the use of long-life materials, it is necessary to check some of the components regularly for their general condition. The following inspection points will ensure a long-life and trouble-free operation of the disc brake.

Every 3 months

The pad wear must be checked visually and independent of any wear indicator fitted to the vehicle (see Sections 5.1).

With every pad replacement

It is important to check for the correct functioning of the adjuster (see Section 5.2) and the smooth operation of the caliper over its full range of movement (see Section 5.3). Also inspect the tappet and boot assemblies (13), the adjuster cap (37) and the sealing elements (9, 58) for correct fitting and condition as well as the caliper bearing in the area of the rubber bush/guide sleeve (6) (see Section 5.5.3).

Annually

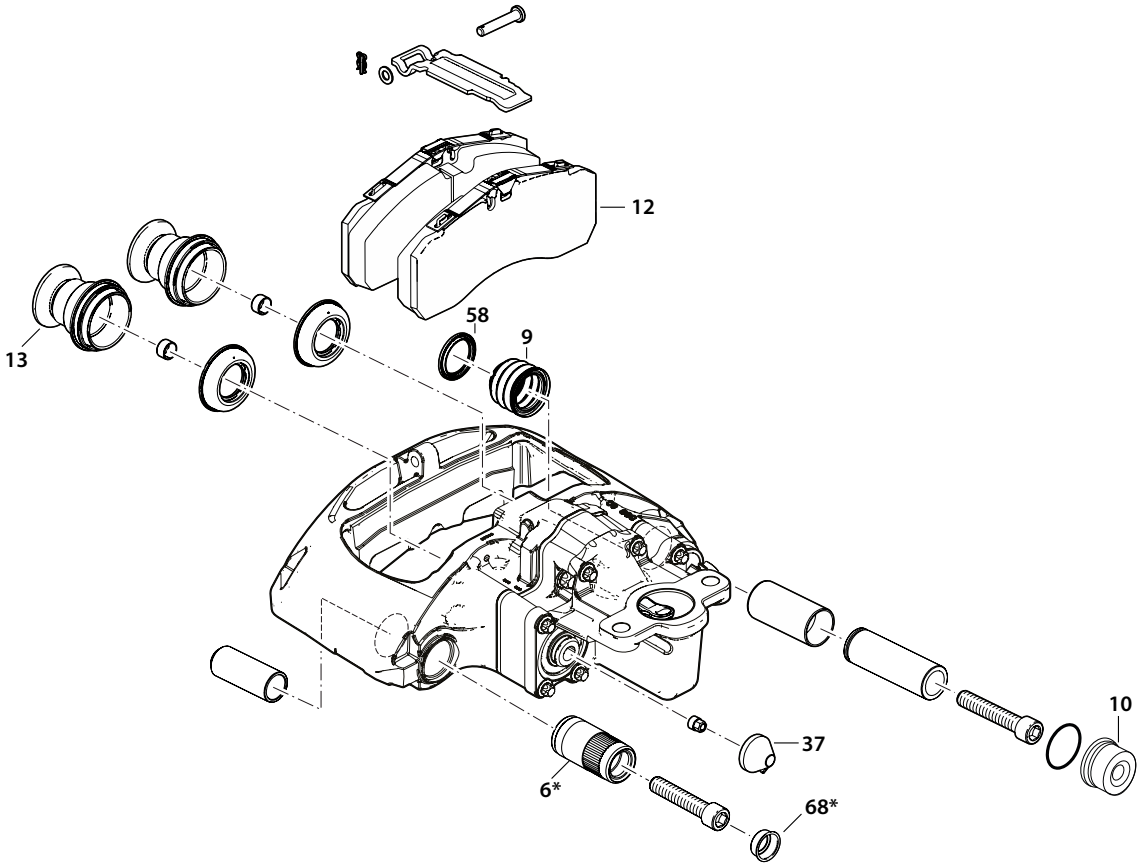
Check the caliper running clearance (see Section 5.3.) and the correct fitting and condition of the cover (10), the adjuster cap (37) and cover (68c, 68d or 68e) (depending on the bearing variant).

Note: These frequencies are a minimum and, depending on the vehicle application, a more frequent check of the components may be necessary.

Refer also to vehicle and/or axle manufacturer's instructions in regard to service intervals.

The discs should be checked according to the specification of the axle or vehicle manufacturer.

In the unlikely event of a problem, all relevant components must be returned in order that an objective investigation of the cause can be made.
For further information please refer to the Knorr-Bremse Dokument Y333409.



* Variants possible

4.1 Safety Instructions for Service Work and Repair Work

Observe relevant safety instructions for service work and repair work on commercial vehicles, especially for jacking up and securing the vehicle.

Use only genuine Knorr-Bremse parts.

⚠ *Before starting service work, ensure the service brake and parking brake, as well as the bus stop temporary hold brake, if fitted, are not applied and that the vehicle cannot roll away.*

Please follow service manual instructions and adhere to the wear limits of the pads and the discs (see Section 5.1).

Use only recommended tools (see Section 2.1).

Tighten bolts and nuts to the prescribed torque values (see Section 2.4).

⚠ *Screw threads and tapped holes must be free of lubrication and residuals of thread locking products.*

After re-fitting a wheel according to the vehicle manufacturer's recommendations, ensure that there is sufficient clearance between the tyre inflation valve, the caliper and the wheel rim, to avoid damage to the valve and the wheel.

⚠ *After any service work:*

Check the brake performance and the system behaviour on a roller dynamometer. Check function and effectiveness. Bear in mind that a lower performance can appear during the breaking-in phase of the brake pads and/or the brake disc.

Observe the "**Safety and Environment Guidelines**" section on pages 5 and 6.

5. FUNCTIONAL AND VISUAL CHECK

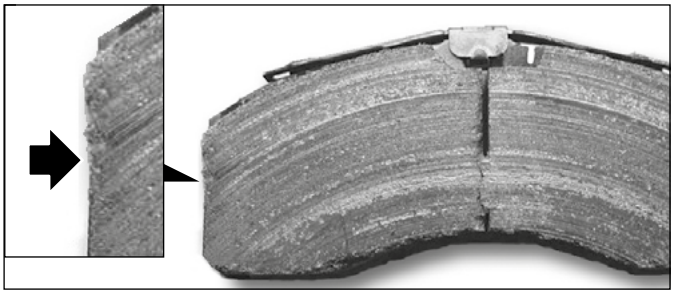
5.1 Wear Check of Pads and Brake Discs

For optimum safety, the pad and disc wear limits must not be exceeded.

Brake Pads

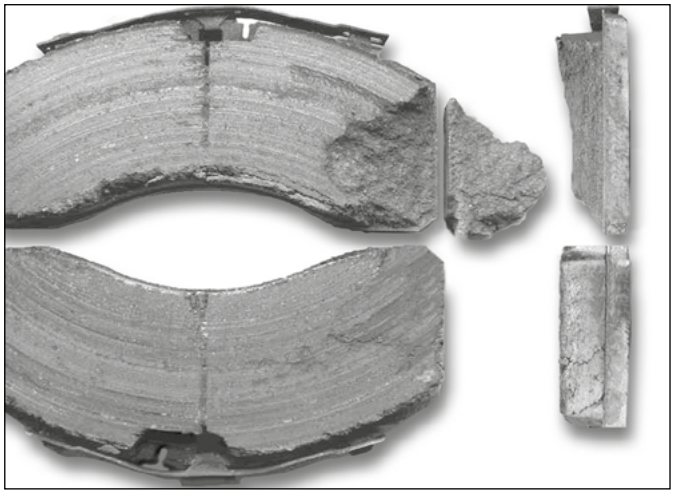
The thickness of the pads must be checked regularly dependent on the usage of the vehicle. The pads should be checked corresponding to any legal requirements that may apply. Even if a wear indicator is fitted and connected, this must be at least every 3 months.

5.1.1 Minor breakouts at the edges are permitted (see arrow).



5.1.1 - Brake pad with minor damage (permitted)

5.1.2 Major breakouts on the surface of the brake pad are not permitted (see Fig.).



5.1.2 - Brake pad with major damage (not permitted)

5.1.3 If the thickness of the friction material at its thinnest point is less than **2 mm** (dimension **C**) the pads must be replaced (see Fig.).

SB6, SB7 and SB7 radial

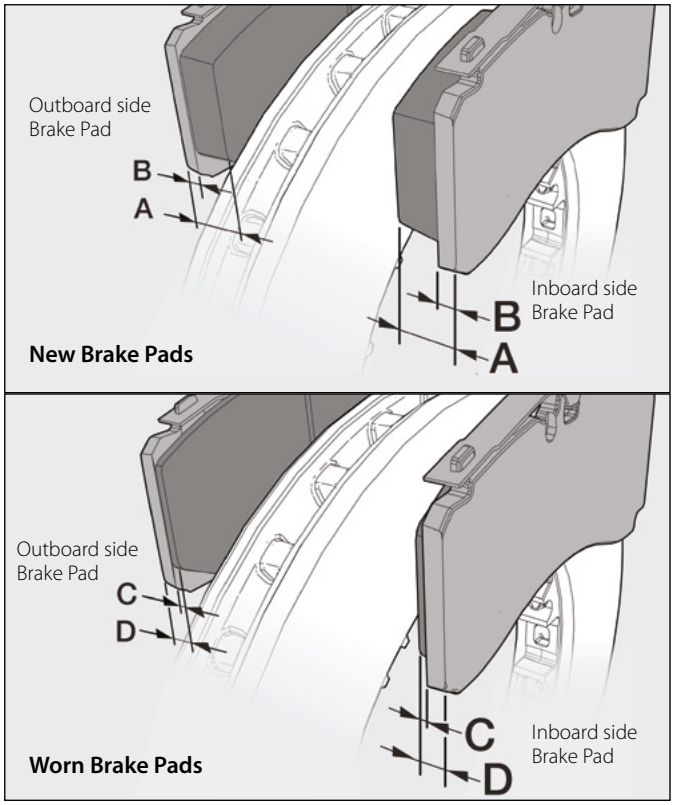
A = Overall thickness of new brake pad **30 mm**

B = Backplate **9 mm**

C = Minimum thickness of friction material **2 mm***

D = Minimum allowed thickness in worn condition for backplate and friction material:
- With a **9 mm** backplate D = **11 mm***

*If these minimum allowed thicknesses are reached, brake pads must be replaced as an axle set.



5.1.3a - Brake pad thicknesses for SB6, SB7 and SB7 radial

SB5

C1 = Overall thickness of new **outer** brake pad **27 mm**

C1 = Overall thickness of new **inner** brake pad **34 mm**

D1 = Outer backplate **8 mm**

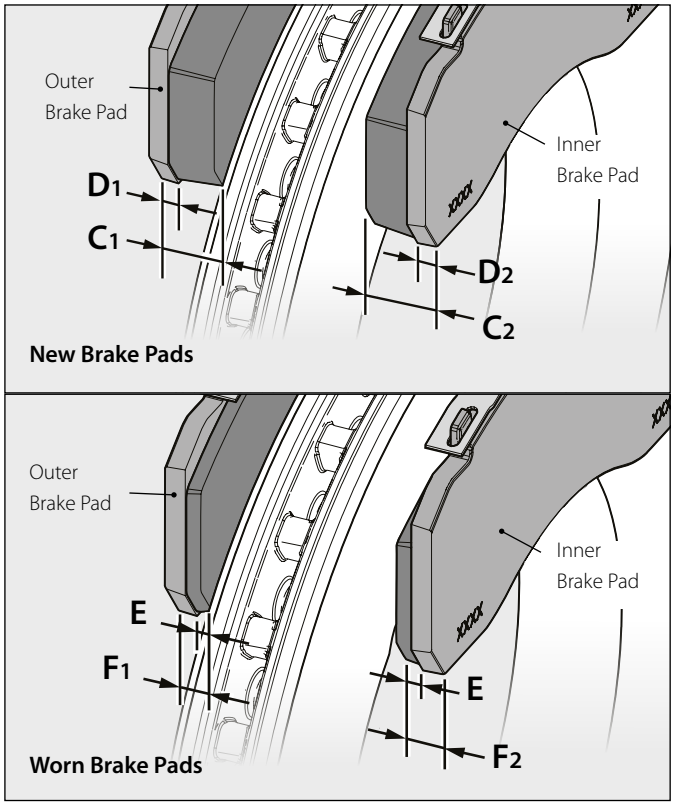
D2 = Inner backplate **15 mm**

E = Mininum thickness of the friction material is **2 mm***

F1 = Minimum allowed total thickness of **outer** brake pad (backplate + friction materia) in worn condition is **10 mm***.

F2 = Minimum allowed total thickness of **inner** brake pad (backplate + friction materia) in worn condition is **17 mm***.

*If these minimum allowed thicknesses are reached, brake pads must be replaced as an axle set.

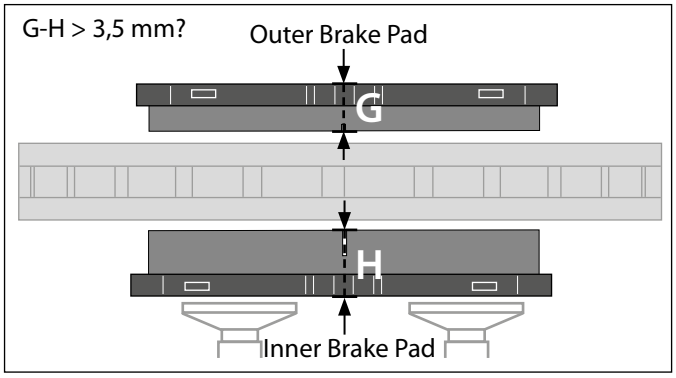


5.1.3b - Brake pad thicknesses for SB5

Exaggerated wear difference between inner and outer brake pads

5.1.4 The total thickness of the friction material of the inner and outer pad should be equal. If the difference between the two pads is greater then **3.5 mm** (see Fig.), then the following checks are necessary:

- Bearing clearance check (see Section. 5.3 and 5.4)
- Free movement of the brake pads (see Section. 5.2)
- Contact with parts around the axle, vehicle frame or body
- Excessive dirt and grime present, if necessary contact vehicle manufacturer
- Interference of Pressure supply



5.1. 4 -Exaggerated wear difference between inner and outer brake pads

Example:

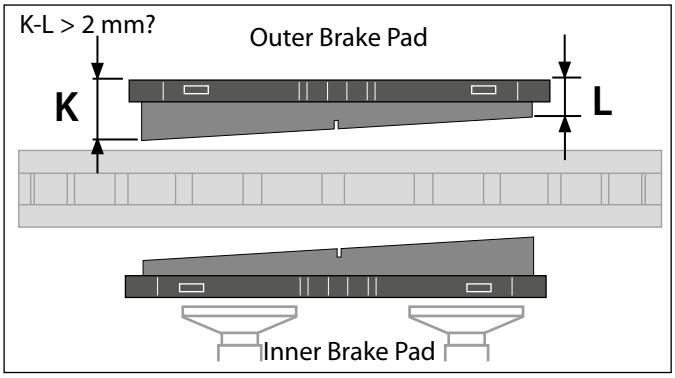
a) G=19 mm
H=15 mm **NOT OK**

b) G=11,5 mm
H=13 mm **OK**

Exaggerated tangential oblique wear of brake pads

5.1.5 The total thickness of the friction material at either end of the pad should be equal. If the difference between the two ends is greater than **2 mm** (see Fig.), then the following checks are necessary:

- Bearing clearance check (see Section. 5.3 and 5.4)
- Free movement of the brake pads (see Section. 5.2)



5.1.5 - Exaggerated tangential oblique wear of brake pads

Example:

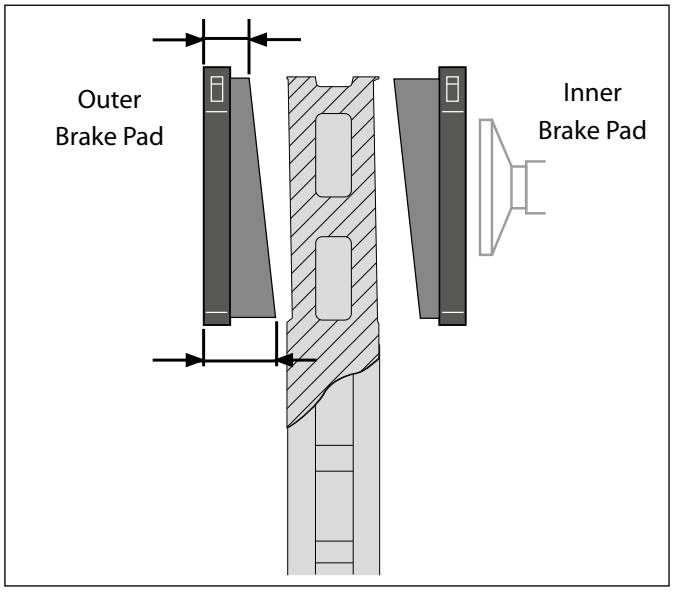
1) K=21 mm
L=18 mm **NOT OK**

2) K=18 mm
L=19 mm **OK**

Exaggerated taper wear of brake pads

5.1.6 The total thickness of the friction material in the radial direction should be equal. If the difference between the top and bottom ends is greater than **1 mm**, then the following checks are necessary:

- Bearing clearance check (see Section. 5.3 and 5.4)
- Free movement of the brake pads (see Section 5.2).
- Contact with parts around the axle, vehicle frame or body
- Excessive dirt and grime present, if necessary contact vehicle manufacturer



5.1.6 - Exaggerated wear difference between inner and outer brake pads

Brake Disc

5.1.7 Measure the thickness of the brake disc at the thinnest point. Be aware of possible burring at the edge of the disc.

M = Total thickness of the brake disc

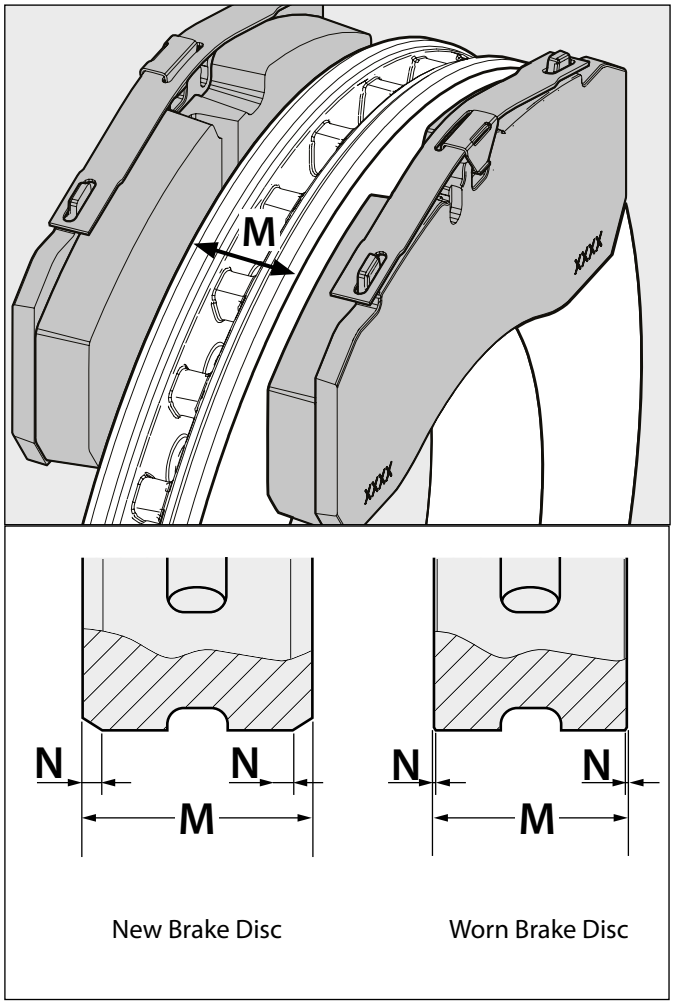
New condition = **45 mm** (**34 mm** for SB5).

Worn condition = **37 mm** (**28 mm** for SB5) or **N = 0 mm**- the disc must be replaced.

If the disc dimension **M ≤ 39 mm** (**30 mm** for SB5) or **N ≤ 1 mm**, it is recommended that all brake discs on the same axle be renewed when the brake pads are changed.

Brake discs from Knorr-Bremse have an optical wear indicator as a chamfer on the outer edge of the disc (N). Therefore the brake disc wear should be checked whenever the brake pads are checked (see Fig.).

If these recommendations are ignored, there is a danger of brake failure and therefore increased safety risk.



5.1.7 - Brake disc thicknesses and optical wear indicator

5.1.8 Check the disc of an axle at each change of pads for grooves and cracks. If necessary replace the disc.

The figure shows possible surface conditions of the brake disc.

A_1 = Small cracks spread over the surface are **allowed.**

B_1 = Cracks less than **1.5 mm** deep or wide, running in a radial direction are **allowed.**

Cracks to a max. length of 0.75 x '**a**' are **allowed**

(**a** = width of the friction ring).

C_1 = Unevenness of the disc surface less than **1.5 mm** deep is **allowed.**

D_1 = Cracks going through to the cooling duct or onto the inner or to the outer edge of the friction ring are **not allowed** and the discs on the same axle **MUST BE REPLACED**.

The adjacent picture shows some examples of cracks and grooves on a brake disc.

Note:

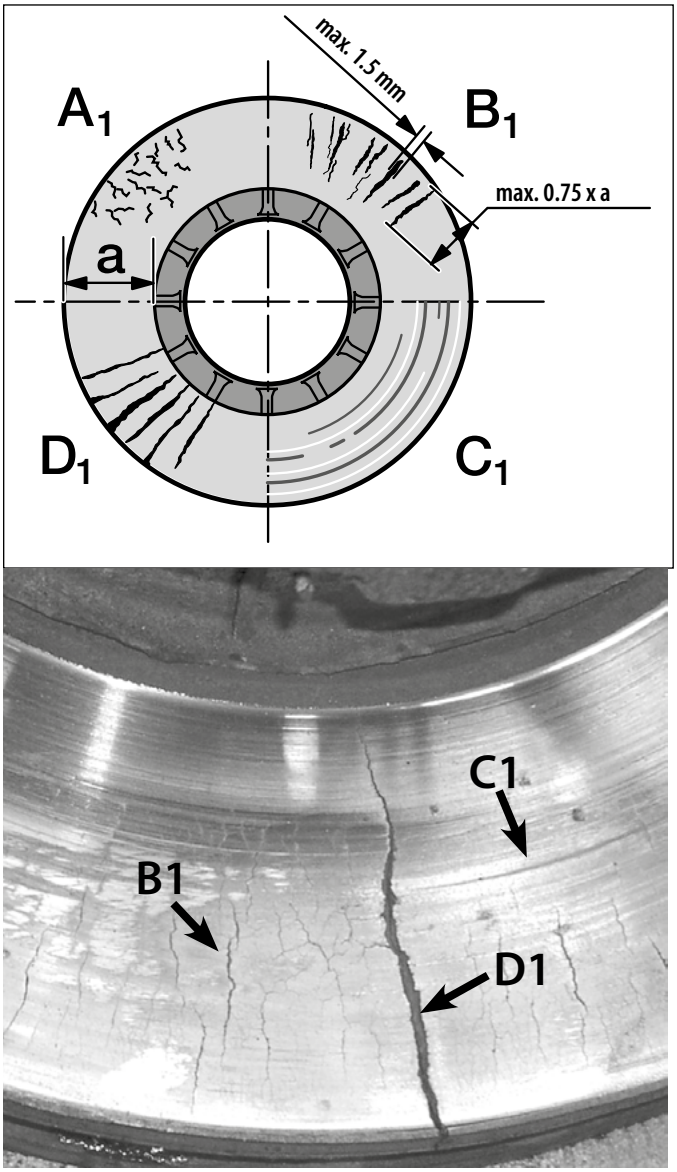
In case of surface conditions **A_1**, **B_1** or **C_1**, the disc can continue to be used until the minimum thickness **M = 37 mm** is reached.

Knorr-Bremse discs are normally service-free and grinding when changing pads is not necessary. However, grinding could be useful, e.g. to increase the load-bearing surface of the pads after severe grooving on the entire friction surface has occurred. To meet safety requirements, the minimum thickness after machining must be greater than **39 mm**.

In addition, the recommendations of the vehicle manufacturer about the machining of the brake disc MUST be followed.

Grinding of a Knorr-Bremse Splined Disc® is not allowed.

If these recommendations are ignored, there is a risk of an accident. If the brake pads and/or the brake disc are worn down excessively, brake performance will be reduced and may be lost completely.



5.1.8 - Tolerances and examples of cracks and grooves on a brake disc.

Brake Pad/Disc Wear Check (on vehicle) with bearing variant (6a; Rubber Bush)

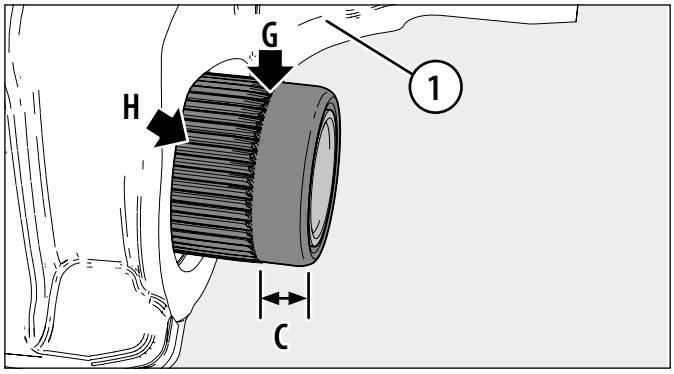
For all disc brakes equipped with rubber bush type (6a) with axial ribbing (see arrow **H**).

5.1.9 The pads/disc wear can be visually determined without removing the wheel, by noting the position of the wear marker point see arrow **G** - the change-over point from the ribbed to the smooth surface) (see Figs.).

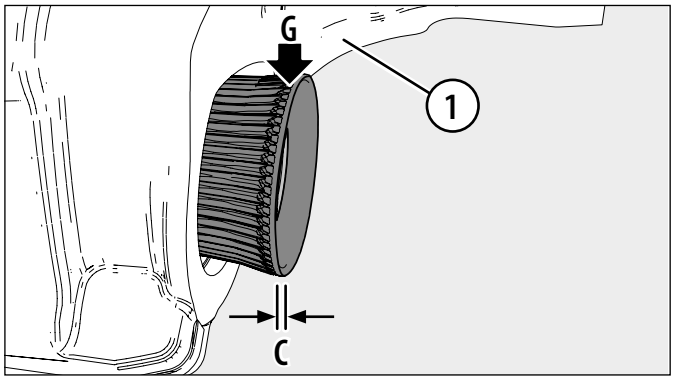
If dimension **C** is less than **1 mm** (see Fig. 5.1.9b), the brake pad thickness and brake disc must be checked with the wheel removed. Depending on operating conditions, it may be necessary to check brake pad thickness and brake disc even when dimension **C** is greater than **1 mm**.

If any minimal tolerance limits of the brake pads/disc have been reached (see Section 5.1) the pads and/or disc must be replaced.

Brake Discs and Pads must be replaced as an axle set (see Section 6).



5.1.9a - Dimension **C** with new disc and brake pads



5.1.9b - Dimension **C** - requires inspection of pad and discs with wheel removed

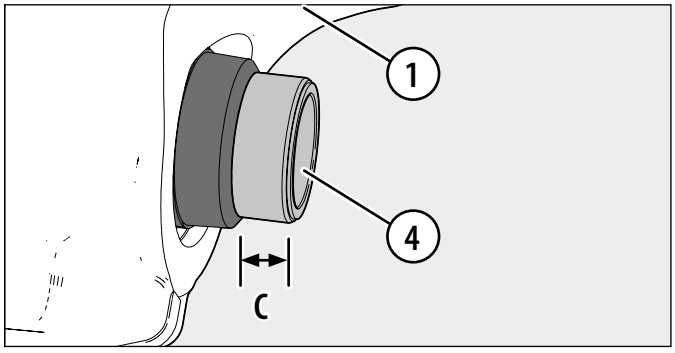
Brake Pad/Disc Wear Check (on vehicle) with bearing variant (6b; Open Bearing)

5.1.10 The pads/disc wear can be visually determined without removing the wheel by checking the position of the caliper (1) compared to the fixed guide pin (4).

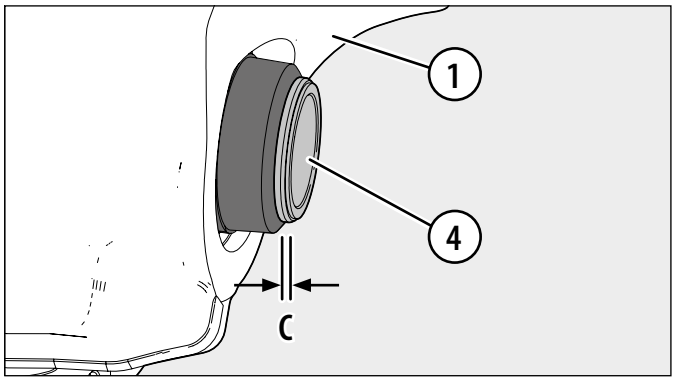
If dimension **C** is less than **1 mm** (see Fig. 5.1.10b), the brake pad thickness and the brake disc must be checked with the wheel removed. Depending on operating conditions, it may be necessary to check brake pad thickness and brake disc even when dimension **C** is greater than **1 mm.**

If any minimal tolerance limits of the brake pads/disc have been reached (see Section 5.1) the pads and/or disc must be replaced.

Brake Discs and Pads must be replaced as an axle set (see Section 6).



5.1.10a - Dimension **C** with new brake pads and disc



5.1.10b - Dimension **C** with worn disc/brake pads, to which it is a requirement to check pad and discs with wheel removed

Brake Pad/Disc Wear Check (on vehicle) using Carrier to Caliper position with bearing variant (6c and 6e) Guide Sleeve and variant (6d) Capped Rubber Sleeve

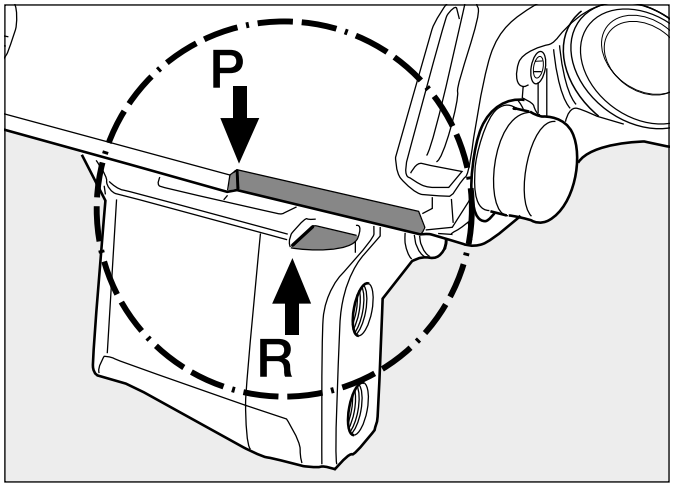
For all disc brakes which are equipped with a caliper to carrier marking.

5.1.11 The pad/disc wear can be visually determined without removing the road wheel by viewing the position of the caliper position **P** compared to the carrier marking **R** (see Figs.).

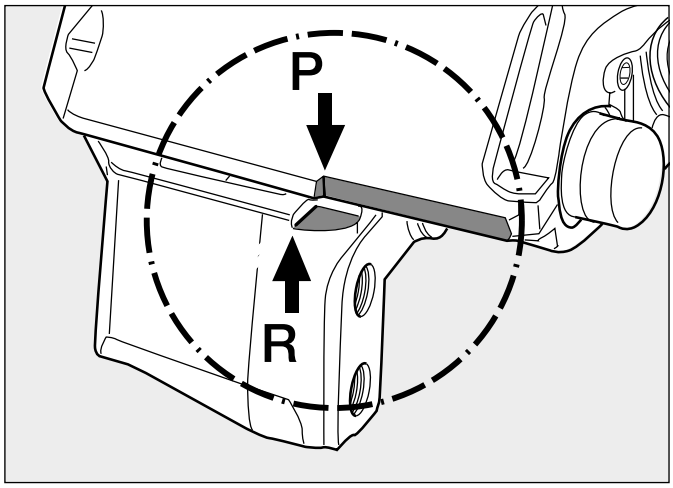
If the positions of **P** and **R** are similar to those shown in 5.1.11b, the brake pad thickness and the brake disc must be checked with the wheel removed. Depending on operating conditions, it may be necessary to check brake pad thickness and brake disc even before these dimensions are reached.

If any minimal tolerance limits of the brake pads/disc have been reached (see Section 5.1) the pads and/or disc must be replaced.

⚠ *Brake Discs and Pads must be replaced as an axle set (see Section 6).*



5.1.11a - Position of points **P** and **R** with new brake pads and disc



5.1.11b - Brake pad and brake disc inspection required with the wheel removed.

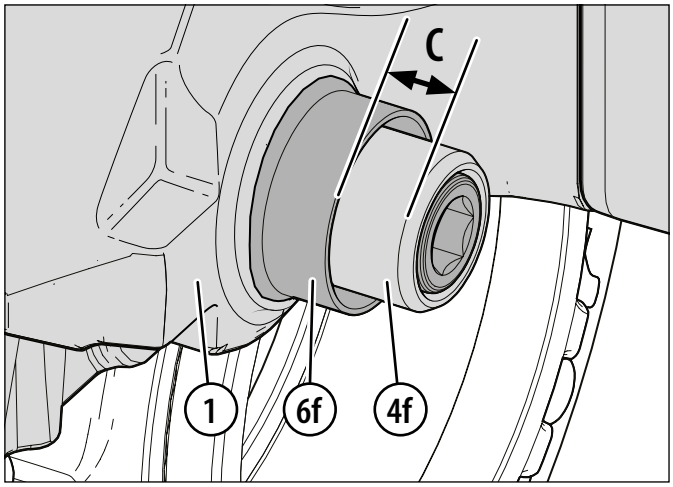
Brake Pad/Disc Wear Check (on vehicle) with bearing variant (6f; Short Rubber Sleeve)

5.1.12 The condition of the Pads can be visually determined without removing the road wheel by viewing the position of the Guide Pin (4f) in relation to the Short Rubber Sleeve (6f) on Caliper (1).

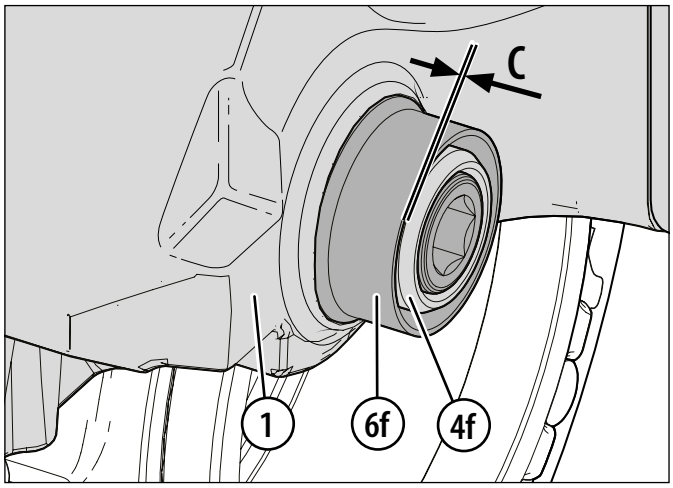
If dimension **C** is less than **1 mm** (see Fig. 5.1.12b), the brake pad thickness and the brake disc must be checked with the wheel removed. Depending on operating conditions, it may be necessary to check brake pad thickness and brake disc even when dimension **C** is greater than **1 mm.**

If any minimal tolerance limits of the brake pads/disc have been reached (see Section 5.1) the pads and/or disc must be replaced.

⚠ *Brake Discs and Pads must be replaced as an axle set (see Section 6).*



5.1.12a - Dimension **C** with new disc and brake pads



5.1.12b - Brake pad and brake disc inspection required with the wheel removed.

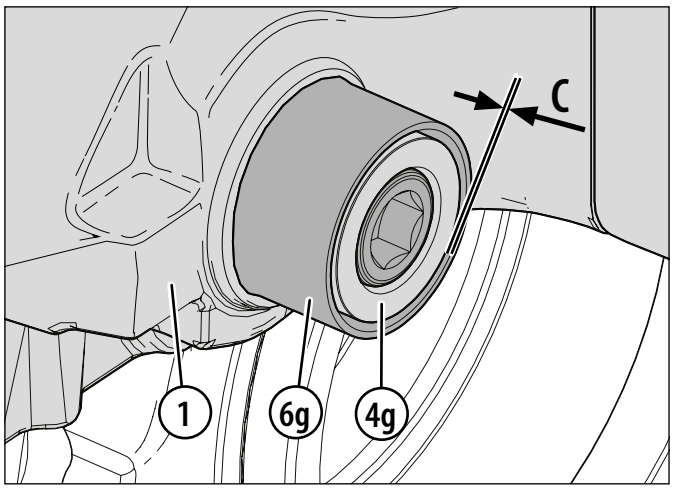
Brake Pad/Disc Wear Check (on vehicle) with bearing variant (6f; Long Rubber Sleeve)

5.1.13 The condition of the Pads can be visually determined without removing the road wheel, by viewing the position of the Guide Pin (4g) in relation to the Long Rubber Sleeve (6g) on Caliper (1).

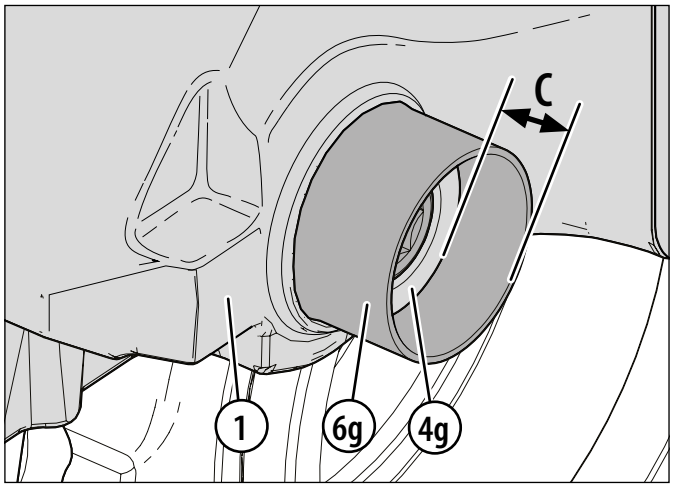
If dimension **C** is greater than **18 mm** (see Fig. 5.1.13b), the brake pad thickness and the brake disc must be checked with the wheel removed. Depending on operating conditions, it may be necessary to check brake pad thickness and brake disc even when dimension **C** is less than **18 mm.**

If any minimal tolerance limits of the brake pads/disc have been reached (see Section 5.1) the pads and/or disc must be replaced.

⚠ *Brake Discs and Pads must be replaced as an axle set (see Section 6).*



5.1.13a - Dimension **C** with new disc and brake pads



5.1.13b - Brake pad and brake disc inspection required with the wheel removed.

Wear Indicators

5.1.14 Due to different vehicle manufacturers and vehicles there are several types of pad wear indicator used.

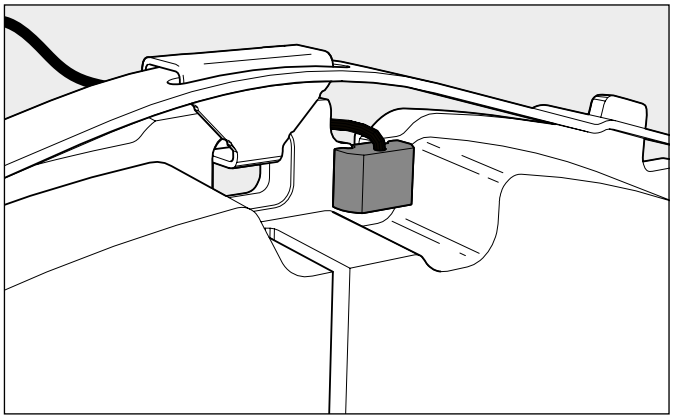
a) In-pad normally **closed** indicator - circuit is broken when pad wear reaches limit (see Fig.).

b) In-pad normally **open** indicator - circuit is made when pad wear reaches limit (see Fig.).

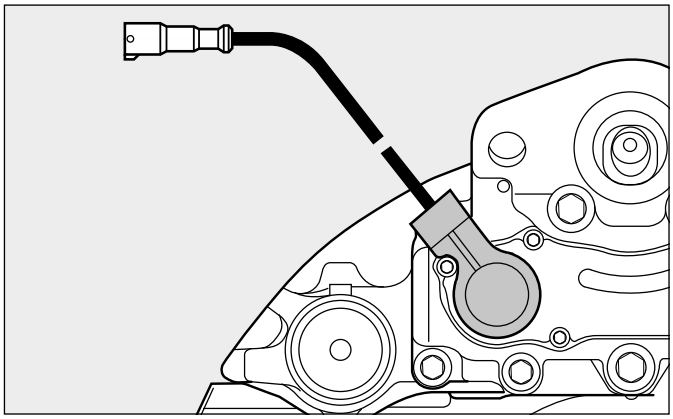
c) Wear indicator using built-in potentiometer. This is available either as an **on/off** version or as a **continuous** signal version which can be linked to the vehicle's electronic monitoring systems (see Fig.).

Either acoustic or optical diagnostic units can be connected.

Note: *Please also refer to specifications provided by the vehicle manufacturer.*



5.1.14a - 5.1.14b - In-pad wear Indicator



5.1.14c - Wear Indicator with built-in potentiometer

Knorr-Bremse diagnostic unit K154433N50
The Knorr-Bremse Potentiometer Tester serves;

- To test the Potentiometer function on Knorr-Bremse disc brakes
- To check the wear condition of the brake pads and brake discs

5.1.15 The Tester can be used on all current Knorr-Bremse brake types with continues or black/white Potentiometer.

Note: *Knorr-Bremse recommends that before replacing a brake caliper with a suspected potentiometer failure, that it first be tested using the Potentiometer Tester. If no defect is found, the cause is not with the brake caliper and therefore does not need replacing.*



5.1.15 - Knorr-Bremse diagnostic unit K154433N50

5.2 Adjuster Check

5.2.1.1 Before starting work, ensure that the wheels are chocked and the vehicle cannot roll away.

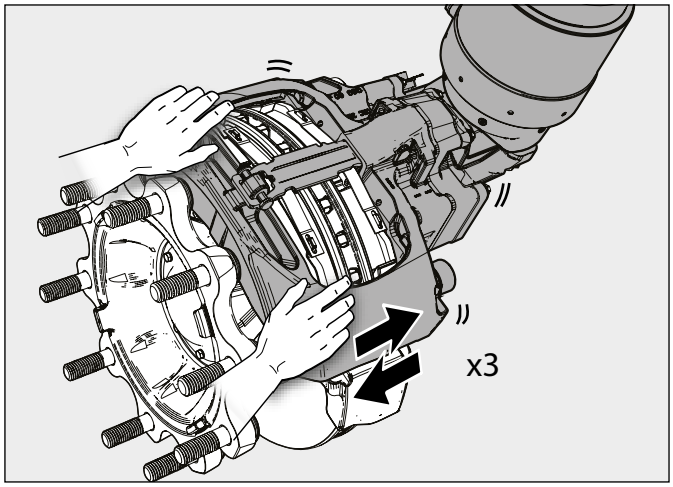
5.2.1.2 Ensure that service brake and parking brake, as well as bus stop temporary hold brake, if fitted, are in the released condition.

5.2.1.3 Check the supply pressure of the brake system (should be **> 6.5 bar**). Connect an additional external supply to prevent pressure drop.

5.2.1.4 Jack up the axle and remove the wheel (refer to the respective vehicle /axle manufacturer's instructions)

5.2.1.5 Check the brake disc temperature, it should be between -10°C and 50°C.

5.2.2 Push and pull caliper three times in axial direction to assess any existing air gap (see Fig.). If no movement is possible, clean the disc brake and if necessary, replace the bearings (see Section 9). Once movement is obtained, continue as follows:



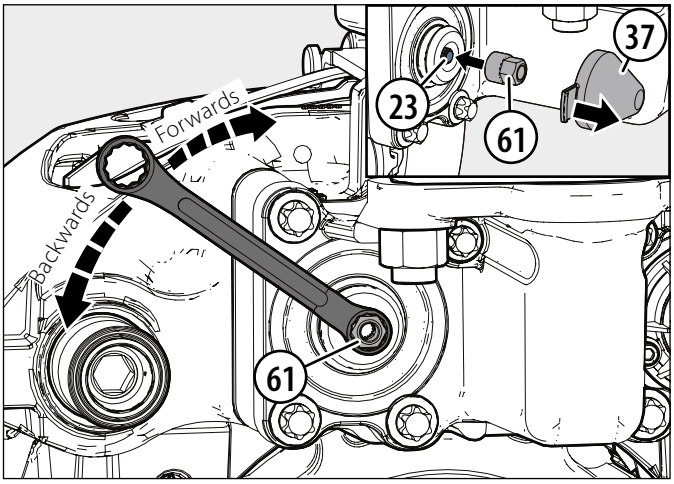
5.2.2 - Push caliper three times in axial direction

5.2.3 Pull off the adjuster cap (37) using the tag, taking care not to lose the shear adapter (61) (see Fig.).

Removal of the adjuster cap (37) with a screwdriver, or similar, is not allowed since the seal may be damaged.

5.2.4 Insert new brake pads (see Section 6.2).

5.2.5 Set the starting gap by turning the adjuster (23) with the shear adapter (61) backwards and then forwards (note that when turning backwards a noticeable clicking can be heard and felt), until a value of **1.3 mm** air gap has been achieved (measure between the brake pad and Tappets (13).



5.2.3 - 5.2.5 - Remove cap, insert new brake pads, set the starting gap

5.2.6 Apply the brakes **20x** with medium pressure (ca. 2-3 bar).

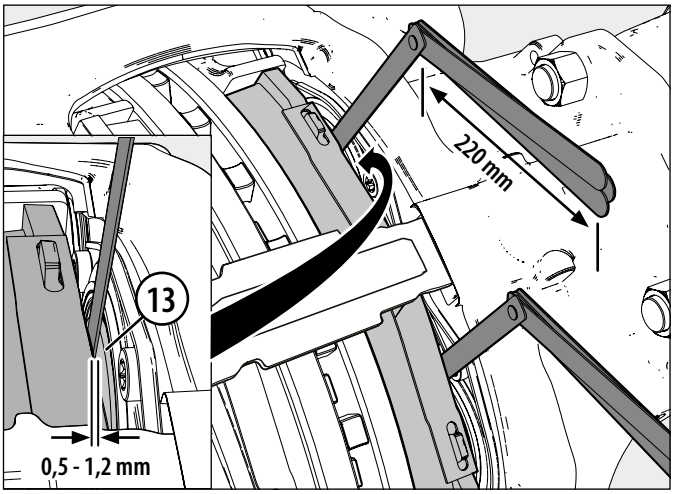
5.2.7 Check the gap between each of the tappets (13) and inboard pad backplate (12). This must be measured over the whole tappet surface of both tappets using two feeler gauges simultaneously (feeler gauges must be at least **220 mm** long) (see Fig.).

If the gap difference between the two tappets is **> 0.25 mm** then the caliper bearing clearance must be checked (see Section 5.3).

In addition each gap must measure between **0.5 - 1.2 mm.**

The minimum tolerance of 0.6 mm is only valid for brakes unmanufactured after May 2014. For brakes prior to this date, the minimum tolerance can be increased by a further 0.1 mm.

If the clearance is too great, there is a danger of brake failure. If the clearance is too small, there is a danger of overheating that may lead to consequential damage.

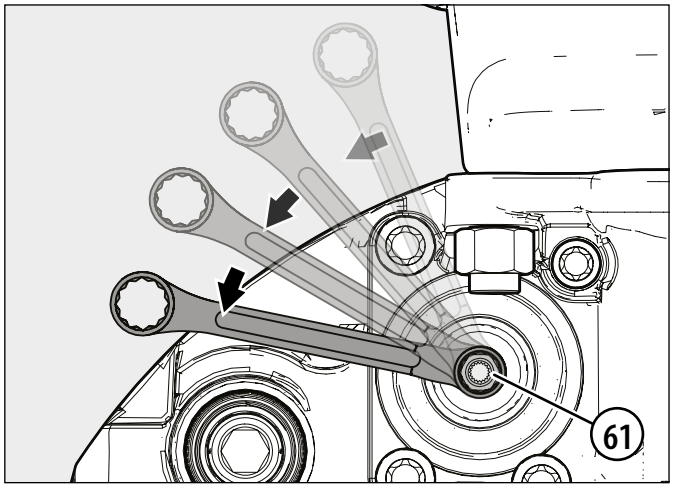


5.2.7 - Check gap between tappets and inboard pad

5.2.8 If the air gap is larger than 1.2 mm the adjuster must be checked as follows:

5.2.8.1 Turn the adjuster with adapter (61) **3 clicks** anti-clockwise (increasing the air gap) (see Fig.).

⚠ *Make sure the ring spanner or socket can turn freely clockwise during the following procedure.*

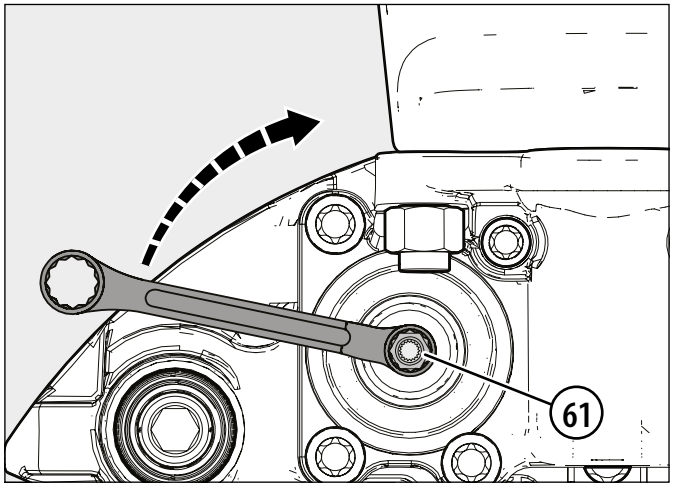


5.2.8.1 - Turn adapter **3 clicks** anti-clockwise

5.2.8.2 As a visual aid, position a ring spanner or socket onto the adjuster (including Adapter (61)) as shown. Apply the brake **5 to 10 times** (ca. 2 bar), the spanner or socket should turn clockwise (viewed from actuator side) in small increments if the adapter is functioning correctly (see Fig. and note below).

Note: *As the number of applications increases, incremental movement of the ring-spanner or socket will decrease.*

If the spanner or socket does not turn or turns only with the first application or turns forward and backward with every application, the automatic adjuster has failed and the caliper must be replaced.

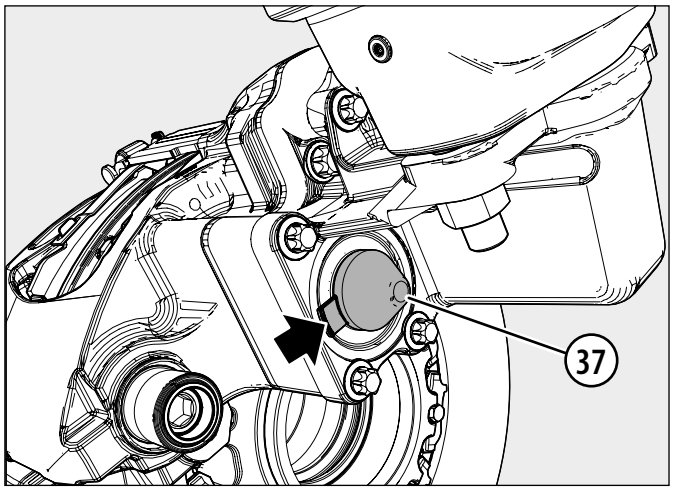


5.2.8.2 - Apply the brake **5-10 times**, spanner turns clockwise

5.2.8.3 If necessary, clean the area prior to replacing the cap. Lightly grease the contact surface of the cap with white grease (available as Part No. II14525, K093430 or II32868).

The tag of the adjuster cap (37) should be positioned as shown by the arrow in the adjacent figure. This ensures access is maintained for subsequent removal (see Fig.).

Note: *A new adjuster cap (37) should be fitted even if the brake pads are not being replaced.*



5.2.8.3 - Tag positioning of the cap

5.2.9 If the air gap is smaller than 0.6 mm the parameters and functions must be checked as follows:

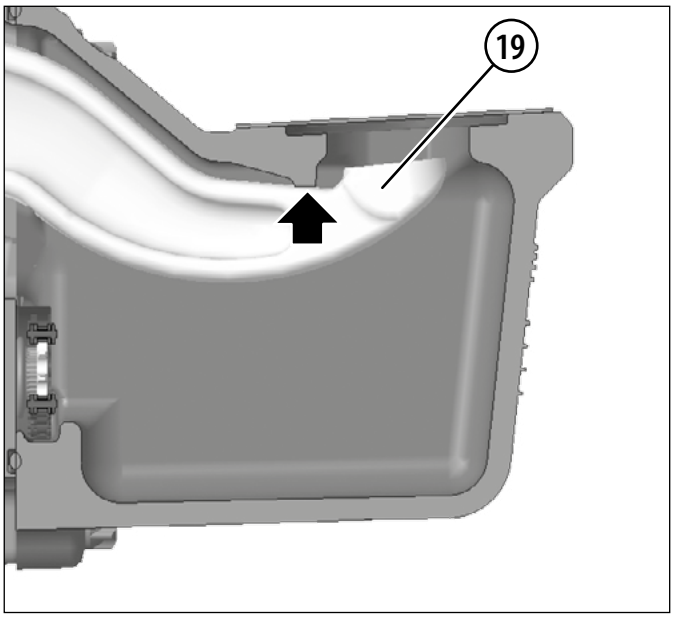
The minimum tolerance of 0.6 mm is only valid for brakes manufactured from May 2014. For brakes prior to this date, the minimum tolerance can be increased by a further 0.1 mm.

5.2.9.1 Function of the brake actuator, refer to specifications provided by the manufacturer.

5.2.9.2 Remove brake actuator (18) (see section 11.1 and 11.3).

5.2.9.3 Check position of lever (19) inside the caliper in its released state (see arrow).

The graphic depicts the position of the lever in an unoperated state specific to brakes manufactured from May 2014. For brakes previous to this date, other positions of the lever are valid.



5.2.9.3 - Check lever position

5.2.9.4 Remove brake pads (12) (see section 6.1). If necessary, remove dirt from brake pads, caliper and carrier.

- Check brake pads for wear from the tappets and if necessary replace brake pads.
- Check for abnormal wear of the contact areas of the carrier. If necessary replace the carrier.

5.2.9.5 Check the brake disc. For Knorr-Bremse brake discs see section 5.1. For other manufacturers refer to their specifications.

5.2.9.6 Check caliper running clearance (see Section 5.3.).

5.2.9.7 Fit the brake pads (see Section 6.2).

5.2.9.8 Fit the brake actuator (see Section 11.2 or 11.4.).

5.2.9.9 Recheck the adjuster (see Section 5.2.6.).

If the air gap is still smaller than **0.5 mm** between both tappets, the brake caliper must be replaced.

5.2.10 Refit the wheel according to the vehicle manufacturers specifications.

5.3 Caliper Check

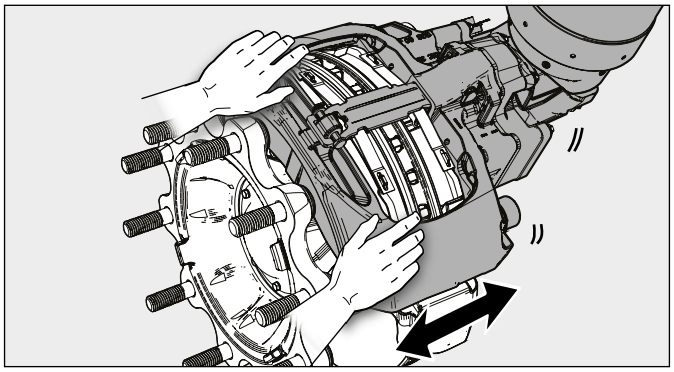
Caliper Running Clearance

⚠ *Before starting work, ensure that the wheels are chocked and the vehicle cannot roll away.*

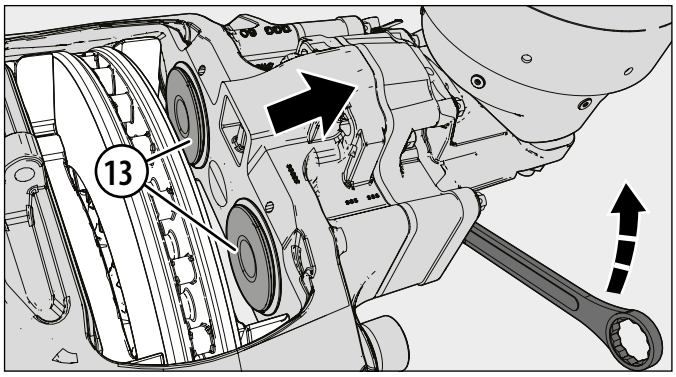
Ensure that service brake and parking brake, as well as the bus stop temporary hold brake, if fitted, are in the released condition.

5.3.1 By pushing and pulling the caliper in an axial direction by hand, a movement within the running clearance (see Section 5.2) must be possible (see Fig.).

If, even using a high level of hand pressure (no tools), the caliper is not moveable the caliper guide pin seals must be examined (see Section 5.5).



5.3.1 - Push and pull hand test



5.3.5 - 5.3.6 -Rewind tappets completely and push caliper in direction of middle of vehicle

Caliper Movement along Guide Pins

5.3.2 With the open bearing variant (6b and 6f), if necessary clean the protruding area of the guide pin (4b and 4f) from outside of the caliper and remove any light corrosion using an emery cloth.

5.3.3a Lightly apply white grease (order No. II14525, K093430 or II32868) to guide pin (4b).

5.3.3b Lightly apply green grease (order No. II32793 or Z000046) to guide pin (4f).

5.3.4 Remove brake pads (see Section 6.1).

5.3.5 Fully wind back the tappets (13) using a ring spanner and shear adapter (61) (see Fig.).

5.3.6 Push caliper inboard towards vehicle's centre (see Fig.)

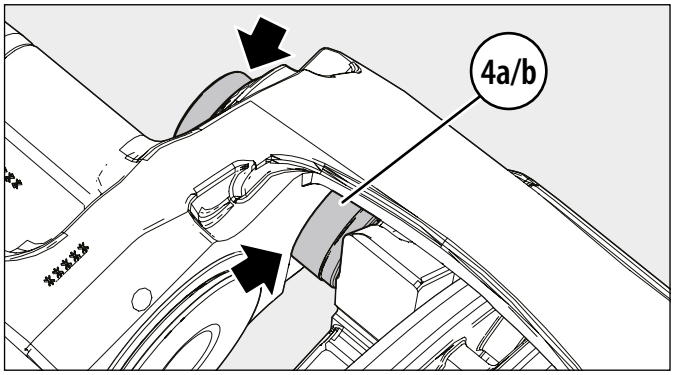
5.3.7 With both open bearing variants (6a, 6b, 6f and 6g), clean guide pin (4a, 4b, 4f und 4g) from the inner area of the caliper, removing any dirt or corrosion.

5.3.8a Lightly apply **white** grease (order No. II14525, K093430 or II32868) to guide pin (4a or 4b).

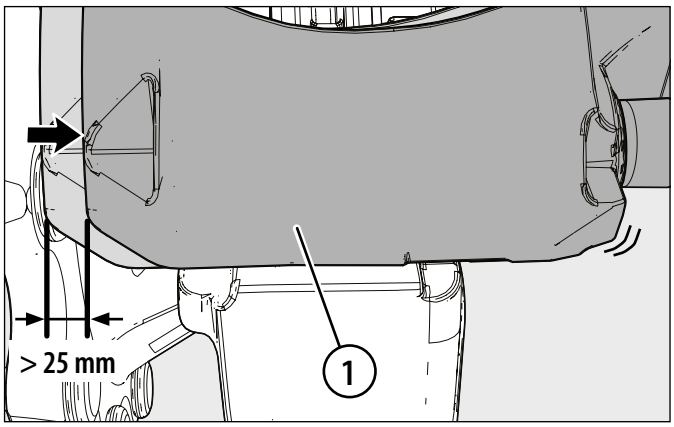
5.3.8b Lightly apply **green** grease (order No. II32793 or Z000046) to guide pin (4f or 4g).

5.3.9 Caliper (1) must slide freely along the whole length of the guide pin arrangement; movement should be greater than **25 mm**. (see Fig.).

If the caliper does not move at least **25 mm**, the caliper guide pin seals must be examined (see Section 5.5).



5.3.7 - Free guide pin of dirt



5.3.9 - Free movement of caliper > **25 mm**

5.4 Clearance Measurement Check of Bearing Variants (6)

Note: *Before commencing (removing the wheel), make sure there is no contact between caliper and axle, vehicle, chassis sections or carrier. In such cases it will be necessary to replace the caliper bearings (see Section 9).*

To measure the clearance, the following steps must be taken:

5.4.1 Remove the wheel, refer to vehicle manufacturer's recommendations.

5.4.2 Remove pad retainer (11) (see Section 6.1.2).

To achieve the correct reading it is necessary to have a pair of new brake pads fitted. If the clearance measuring is not taking place during a brake pad replacement, the current position of the assembled pads must be noted before removing, so that they can be re-assembled in the same position.

Remove old pads (see Section 6) (at this point Section 5.1 "Wear Check of Pads and Brake Discs" must also be observed) and replace with a pair of new pads.

5.4.3 Fasten a magnetic dial-gauge holder to the carrier (2) on the floating bearing side of the caliper (1). Use the casting tag on the caliper (1) as the measuring point - see arrows **A** (see Fig.).

5.4.4 Set the dial-gauge to zero.

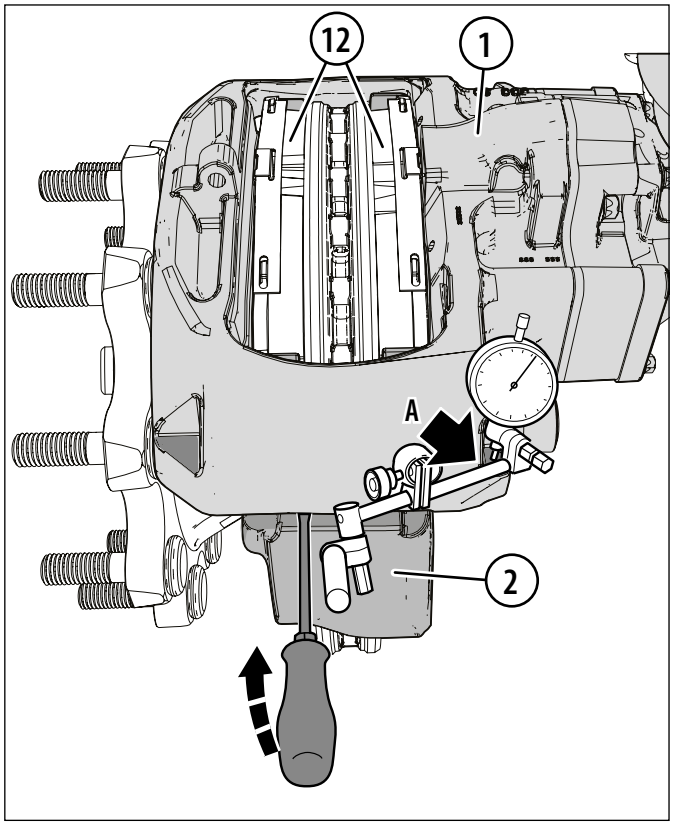
5.4.5 Place a suitable tool (e.g. screwdriver with at least 200 mm in length) in a central position between carrier (2) and caliper (1) and lever them in opposite directions (using normal hand-force) (see Fig.).

5.4.6 Read the maximum value of the bearing clearance on the dial-gauge and compare with the values in the table (see Table).

If the clearance exceeds the given tolerance, the complete bearing will need replacing using the relative service kit (see Section. 1.2 and Section. 9).

If the clearance measuring is not taking place during a brake pad replacement, the new pads should be removed and the previously marked brake pads fitted in their original positions, otherwise renew the brake pads as an axle set and adjust the air gap (see Section 6.2).

5.4.7 Fit the wheel (refer to vehicle manufacturer's recommendations). After replacing the wheel check that it runs interference free.



5.4.3 - 5.4.5 - Obtaining maximum value of bearing clearance

Bearing variants (6) variants	Max. bearing clearance
6a Rubber Bush	2 mm
6b Open Bearing	2 mm
6c Guide Sleeve	1 mm
6d Capped Rubber Sleeve	2 mm
6e Guide Sleeve	1 mm
6f Short Rubber Sleeve	3 mm
6g Long Rubber Sleeve	3 mm

5.4.6 - Maximum bearing clearance tolerances of bearing variants

5.5 Sealing Elements Check

Caliper Guide Pin Seals

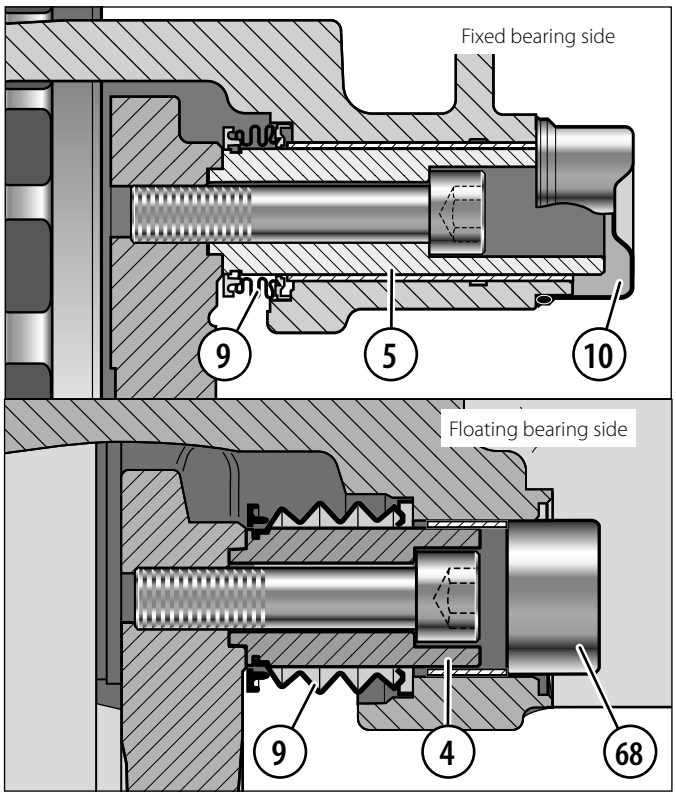
5.5.1 The guide pin (5 or 5a) (as fitted to the fixed bearing side) is sealed with cover (10 or 10a) and inner boot (9a or 9b) (see also Section 1.1.1).

The floating bearing side with guide pin (4c, 4d or 4e) is sealed with inner boot (9c, 9d or 9e) and with cover (68c 68d or 68e). All variants (9), (10) and (68) must be free of any signs of damage (see Fig.).

Check for correct location and fitting.

If necessary, remove pads (12) to inspect the inner boots (9) (see section 6.1).

If necessary, repair caliper with suitable service kit (see Section 1.2 and Section 8).



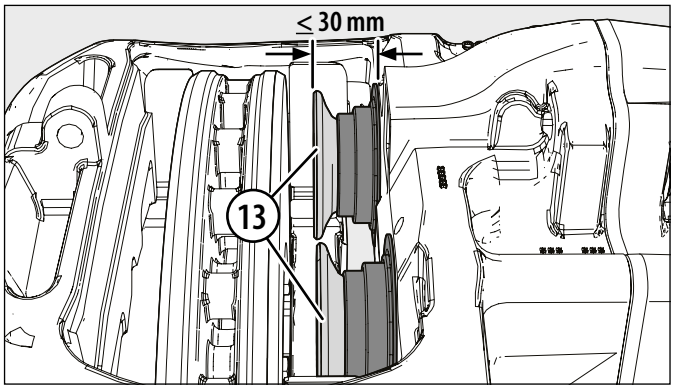
5.5.1 - Checking of guide pin and seals

Checking of Tappet and Boot Assemblies (13)

Remove pads (12) (see Section 6.1).

5.5.2 Screw out the tappets (13) using the shear adapter (61) clockwise until the boots are clearly visible (see Fig).

⚠ *The tappets must not be extended more than **30 mm**, otherwise synchronisation is lost and the caliper must be replaced.*



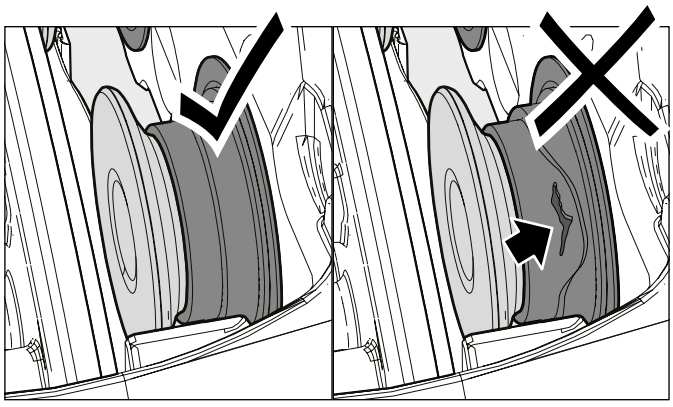
5.5.2 - Screw out tappets - max. **30 mm**

5.5.3 The rubber boots on the tappets (13) must not have any cuts/tears or show any other signs of damage (see Fig.).

Check for correct location and fitting.

***Note:** The penetration of dirt and moisture into the brake will lead to corrosion and impair the function of the clamping mechanism and wear adjuster.*

If necessary replace tappet and boot assemblies (see Section 7).



5.5.3 - Check rubber boots for damage

6 BRAKE PAD REPLACEMENT

Before starting work, ensure that the wheels are chocked and the vehicle cannot roll away.

Ensure that service brake and parking brake, as well as bus stop temporary hold brake, if fitted, are in the released condition.

6.1 Removal of Brake Pads

6.1.1 Remove wheel (refer to vehicle manufacturer's recommendations).

Important!

Also be aware of the inspection points detailed in chapter 4 as well as the caliper running clearance in chapter 5.3.

Depending on the orientation of the caliper on the axle, brake pads could fall out when removing the pad retainer (11).

6.1.2 Remove spring clip (26) and washer (45), depress the pad retainer (11) and remove pin (44) (see Fig).

If necessary remove any in-pad wear sensor components (see Section 6.3).

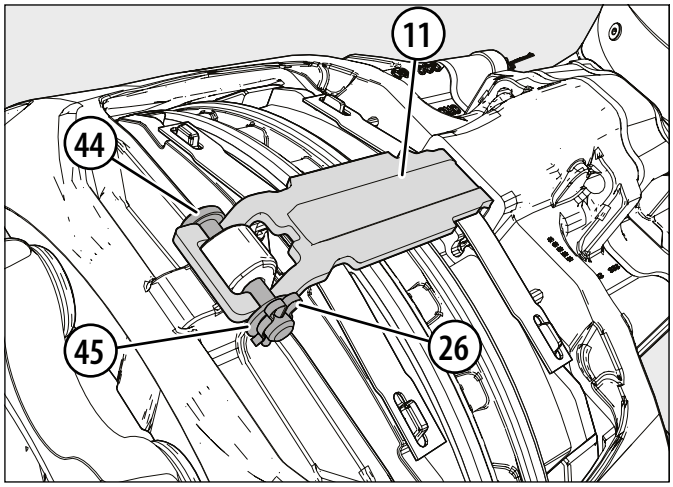
6.1.3 Pull off the adjuster cap (37) using the tab, taking care not to lose the shear adapter (61) (see Fig. insert).

Do not use any tools to remove the cap (37) as this can damage the sealing elements of the adjuster.

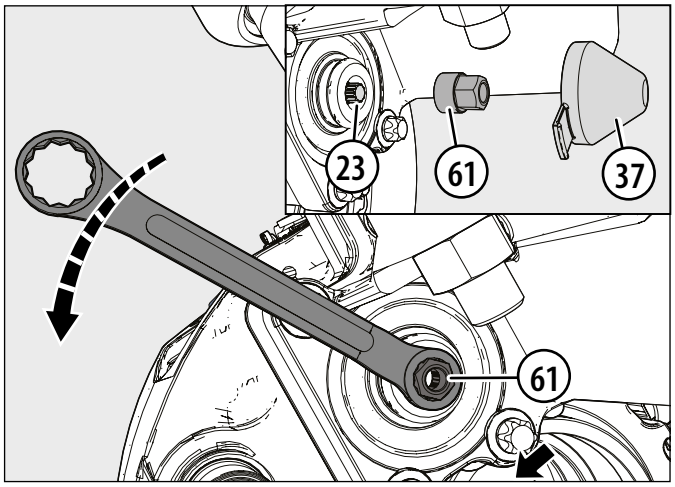
6.1.4 Fully wind back the tappet and boot assemblies (13) by rotating the adjuster (23) via the shear adapter (61) in an anti-clockwise direction (as viewed from actuator side) – a loud clicking noise is generated (see Fig.).

6.1.5 Remove brake pads (12^1) and (12^2) (see Fig.).

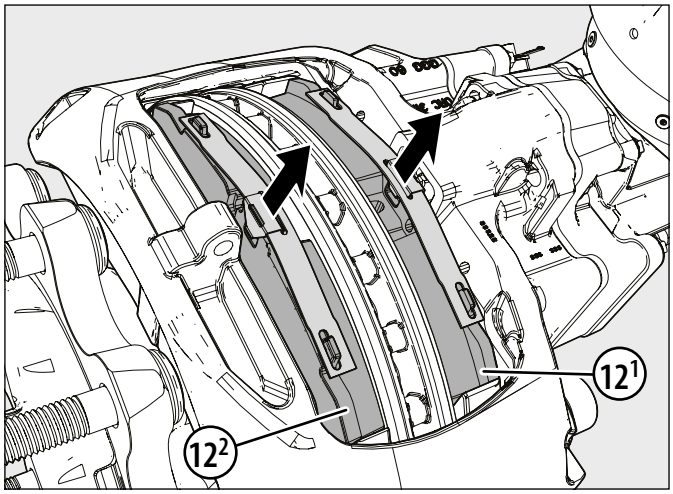
6.1.6 Check caliper running clearance (see Section 5.3).



6.1.2 - Removing pad retainer



6.1.3 - 6.1.4 - Rewind adjuster using shear adapter



6.1.5 - Remove brake pads

6.2 Fitting of Brake Pads

Pads must be changed as an axle set and NOT individually. Use only pads which are permitted by the vehicle manufacturer, axle manufacturer and disc brake manufacturer. Failure to comply with this will invalidate any Knorr-Bremse warranty.

6.2.1 Depending on the intensity of contamination, clean the brake pad bay area. use suitable tools (wire brush, caliper file, blunt scraper).

Important! Take care not damage the Carrier and/or Rubber Bush/Guide Sleeve seals.

6.2.2 Check the carrier (2) and rubber seals for damage, replace if necessary.

Important! Brake Pad contact surface must be clean, devoid of moisture and free from any dirt and debris.

6.2.3 Depending on the application, it may be necessary for the abutments of the carrier and guiding surfaces of the brake pad to be thinly coated with lubricant (order No. K125122N50) (see Fig).

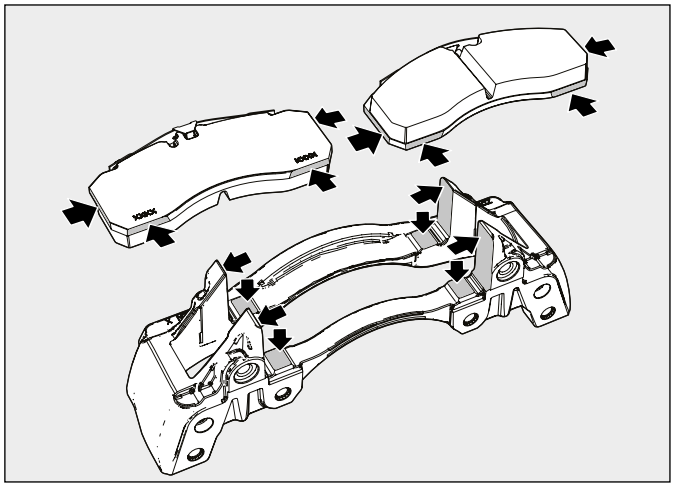
Important! Do not use copper based lubricant.

Important! Do not get any lubricant on the pad and/or disc face or guide sleeve parts.

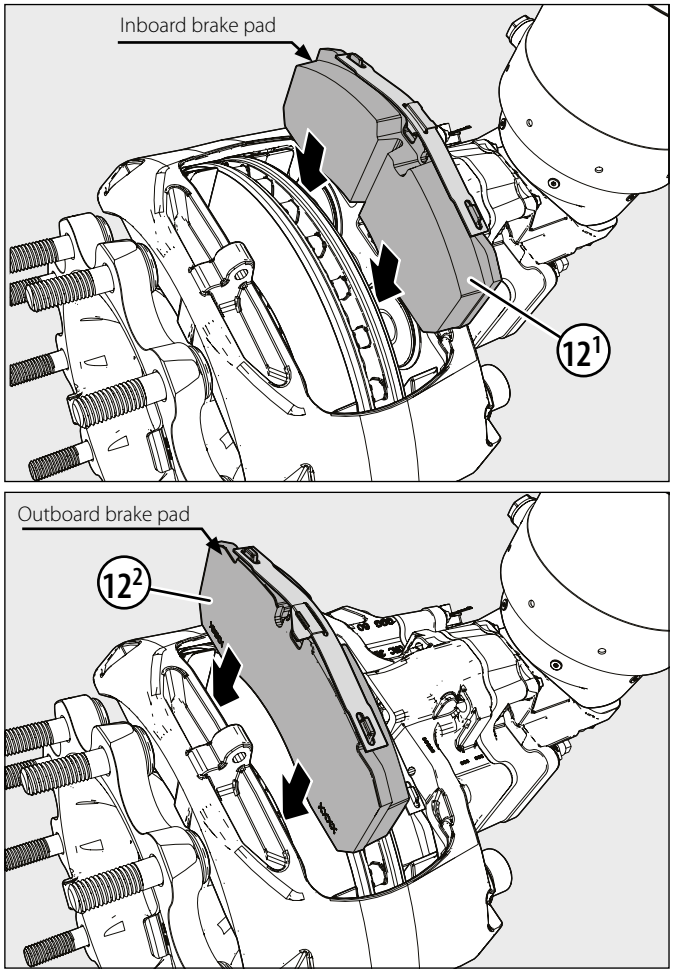
Refer also to specifications provided by the vehicle, axle and brake system manufacturer.

Before inserting the brake pads, fully wind back the tappet and boot assemblies (13) by rotating the shear adapter (61) in an anti-clockwise direction (see Section 5.2).

6.2.4 Insert the brake pads (12).

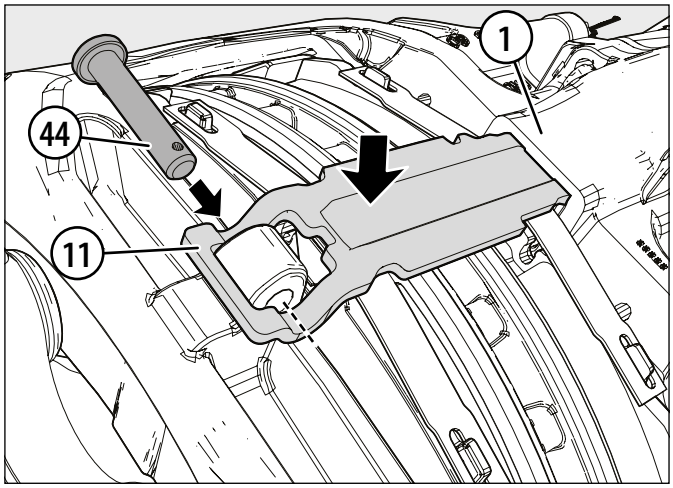


6.2.3 - Areas to apply suitable lubricant



6.2.4 - Insert inner and outer brake pad

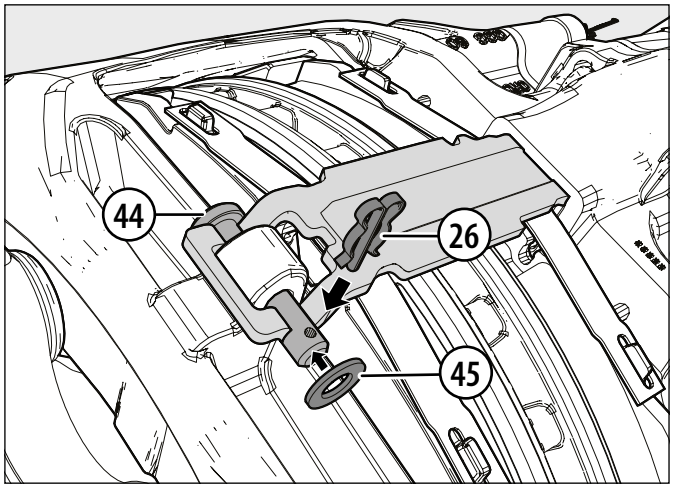
6.2.5 Wind out the Adjuster (23) with shear adapter (61) until the brake pads come into contact with the disc. Then turn back the adjuster **three clicks** and check the running clearance (see Section 5.2) .



6.2.6 - Fitting pad retainer and pin

6.2.6 After fitting the pad retainer (11) into the groove of caliper (1), it must be depressed to enable the insertion of the pad retainer pin (44) (only use new parts) (see Fig.).

6.2.7 Fit new washer (45) and then new spring clip (26) to the pad retainer pin (44) (use only new parts) (see Fig.).



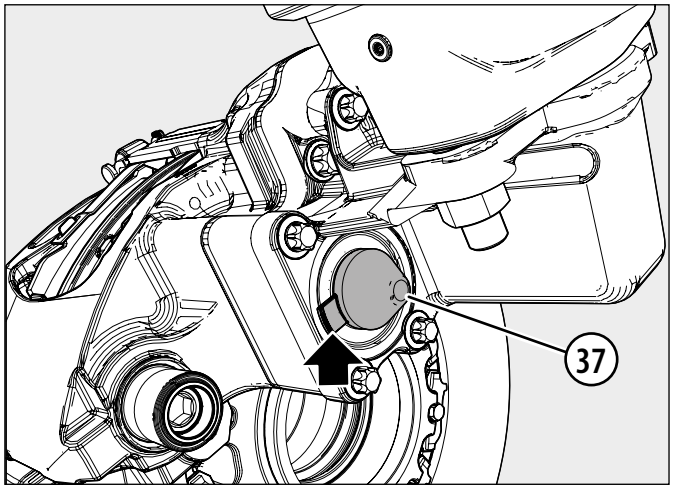
6.2.7 - Fit new washer and new spring clip

6.2.8 If necessary clean the area prior to fitting the adjuster cap (37).

The adjuster cap (37) must then be replaced (use only a new cap) having lightly greased its contact surface with grease (available as Part No. II14525, K093430 or II32868) (see Fig.).

Note: *The tag of the adjuster cap (37) should be positioned as shown (see arrow). This ensures access is maintained for subsequent removal.*

If required, fit cable guides and pad wear indicators (see Section 6.3).



6.2.8 - Fit new adjuster cap, note tab position

6.2.9 Re-fit wheel according to the vehicle manufacturer's recommendations.

⚠ *After any service work: Check the brake performance and the system behaviour on a roller dynamometer. Check function and effectiveness.*

Bear in mind that a lower performance can appear during the breaking-in phase of the brake pads and/or the brake disc.

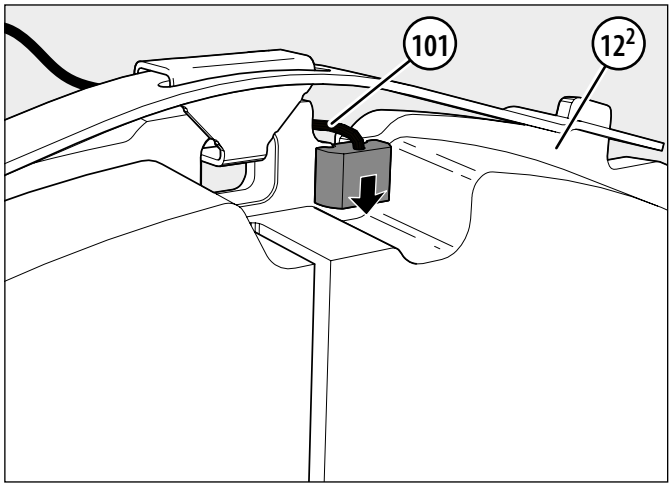
6.3 Fitting Pad Wear Indicators

⚠ *Only use new pad wear indicators. The fitting of used pad wear indicators is not allowed.*

For pad removal see section 6.1.

The components of the wear indicator kits are shown in section 1.2.1.
Note: *The longer end of the cable fits onto the outboard pad (12^2), the short end onto the inboard pad (12^1).*

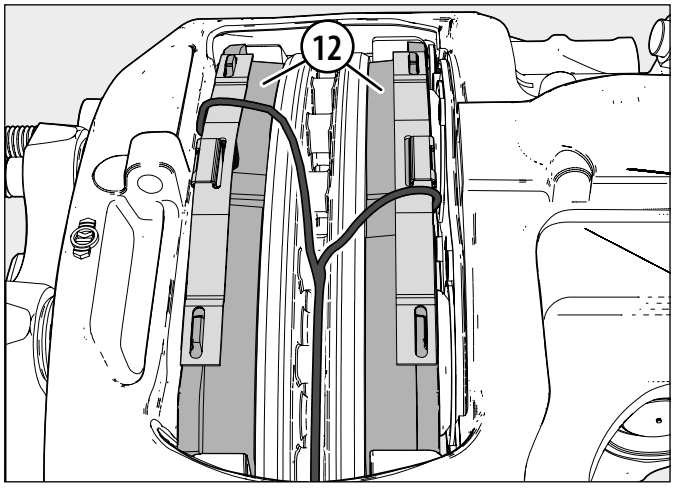
6.3.1 Align each sensor in the groove of a brake pad (12) and press down until it locks into place (see Fig.).



6.3.1 - Fitting pad wear indicators

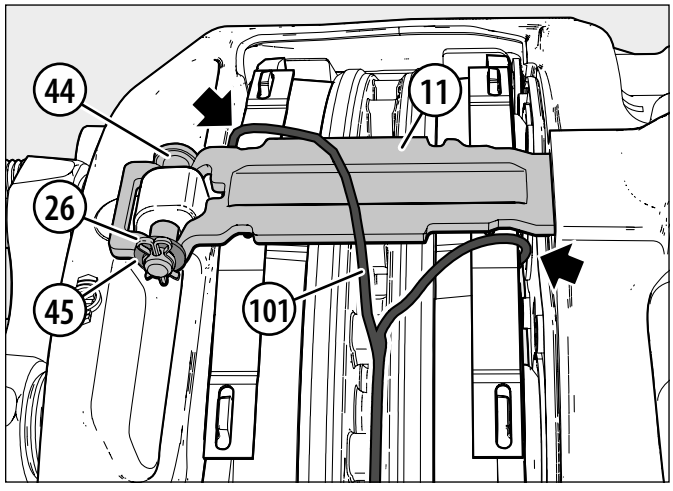
6.3.2 Insert the brake pads (12) with pre-assembled wear indicators into their respective brake pad bay area (see Fig.).

Note: *See also section 6.2.*



6.3.2 - Insert pre-assembled pads

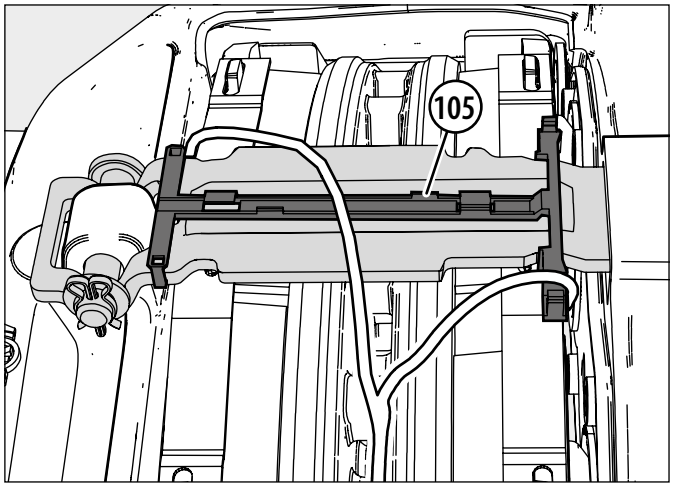
6.3.3 Fit pad retainer (11) with retainer pin (44), washer (45) and spring clip (26) (see Fig. and Section 6.2). Note the correct position of the cables (101) (see arrows).



6.3.3 - Fit pad retainer

Fitting of Cable Guide Variant (105)

6.3.4 Fit the cable guide variant (105) onto the pad retainer (11). When correctly positioned, and whilst applying light pressure, the cable guide (105) will lock easily into place (see Fig.).

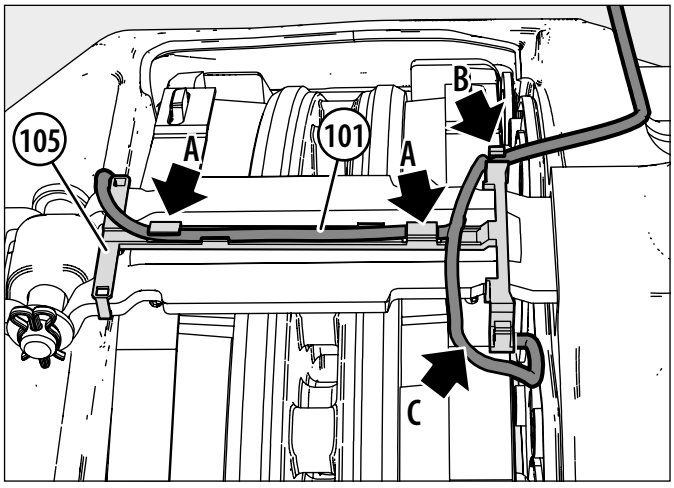


6.3.4 - Fitting cable guide

6.3.5 Carefully insert the cable (101) into the retainer tabs (arrows **A**) of the cable guide (105). Note that the shorter cable from the inboard pad is not fixed to any part of the cable guide (105) (arrow **C**).

Depending on the vehicle type, the supply line of the cable (101) is fixed into one of the outer retainer clips (arrow **B**).

Note: *The short cable (inboard side) remains loose (arrow **C**).*



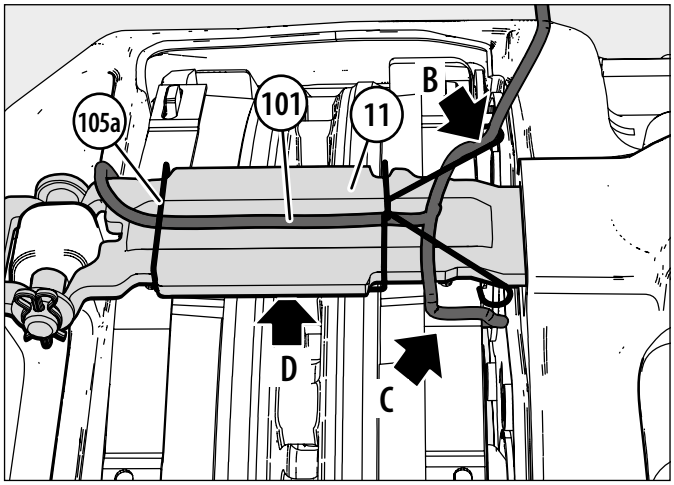
6.3.5 - Cable fixture position on cable guide (105)

Fitting of Cable Guide Variant (105a)

6.3.6 Lay the cable (101) centrally on the pad retainer (11). Position the cable guide (105a) at the side of the pad retainer (11) (arrow **D**) and with light pressure clip into place on the opposite side (see Fig.).

Depending on the vehicle type, the supply line of the cable (101) is fixed into one of the outer retainer clips (arrow **B**).

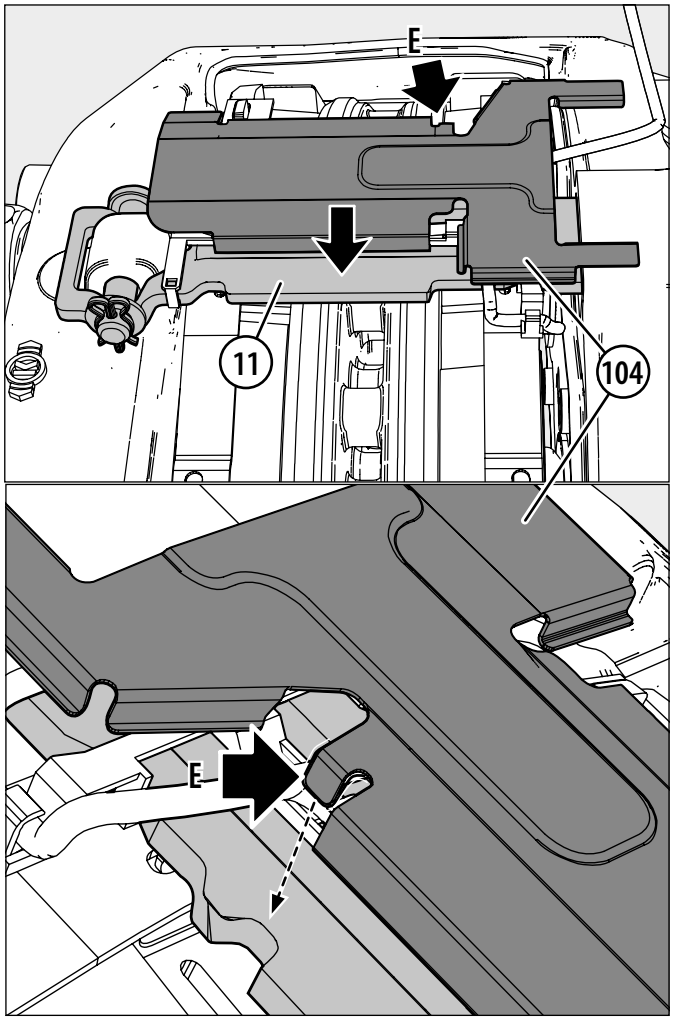
Note: *The short cable (inboard side) remains loose (arrow **C**).*



6.3.6 - Cable fixture position on cable guide (105a)

Fitting of Cable Protection Plate (104)

6.3.7 Position cable protection plate (104) on one side of the pad retainer (11), making sure the tab (arrow **E**) is located correctly. By applying central pressure on plate (104) the tab will snap into place (see main Fig. and detailed view).

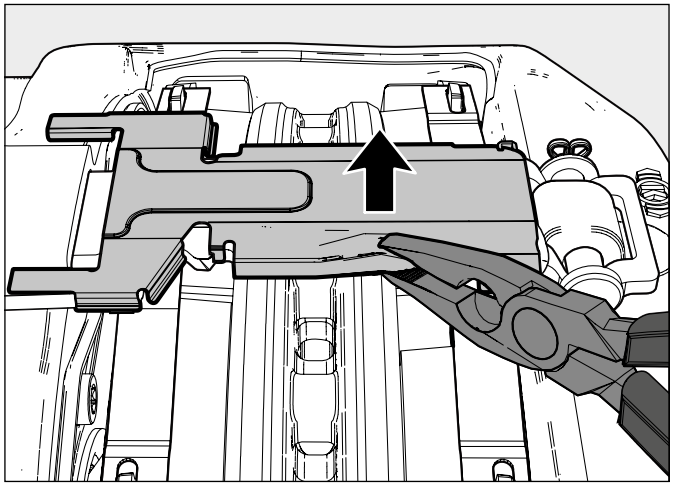


6.3.7 - Fitting cable protection plate

Removing Cable Protection Plate (104)

6.3.8 Using a suitable tool, loosen one side of the cable protection plate (104) and remove.

It is not permitted to reuse a cable protection plate.

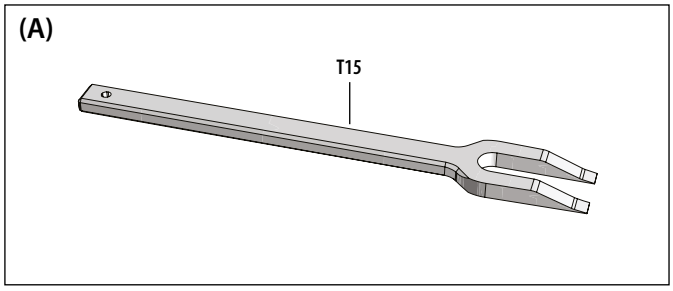


6.3.8 - Removing cable protection plate

7. TAPPET AND BOOT ASSEMBLIES (13) AND INNER SEALS (22) REPLACEMENT

For ease of reference, each component of a tool is referred to by an identification number; a complete tool (containing one or more such components) has been given a letter code - see section 2.1.

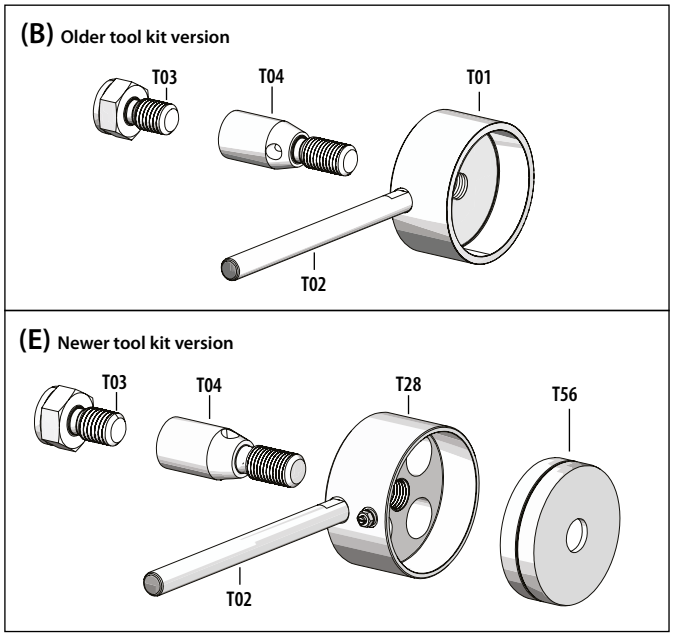
To remove the tappet and boot assemblies (13) use the wedge fork (**A**) (see Fig 7a).



7a - Tool for replacing the tappet and boot assemblies

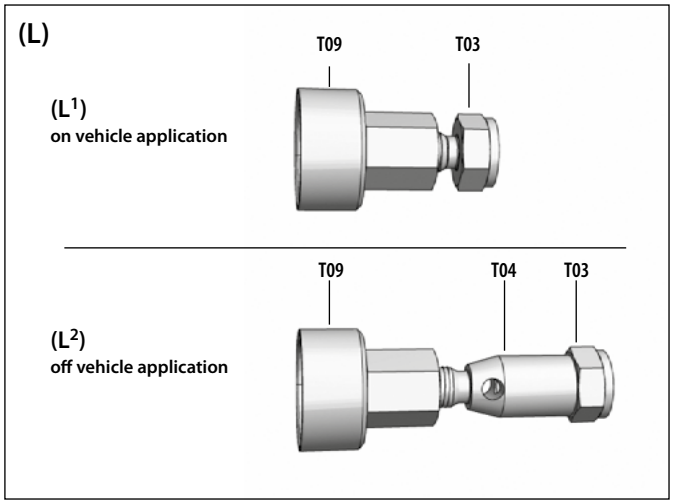
To fit the tappet and boot assemblies (13), use tool (**E**) (see Fig 7b).

Note: Older versions of the tool kit were supplied with tool (***B)***, which in this case, can be used instead of (***E***). Refer to the service manual included in the old service kit.



7b - Tool for fitting the tappet and boot assemblies

To fit the inner seal (22), use tool (**L**) in configuration (**L**^{1}) when the caliper is mounted on the vehicle or configuration (**L**^{2}) when removed from the vehicle (see Fig 7c).



7c - Tool for fitting the inner seal

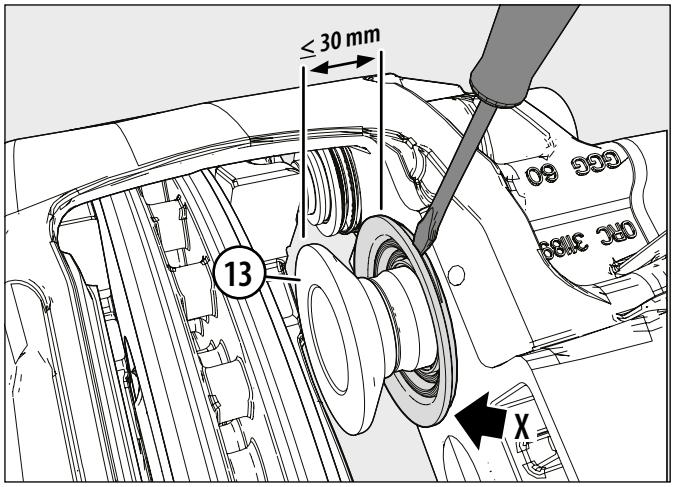
7.1 Removal of Tappet and Boot Assemblies (13)

Note: *The removal of the tappet and boot assemblies (13) can be done with the brake caliper fitted to, or removed from, the vehicle (see Section 8).*

With caliper installed on the vehicle:

7.1.1 Wind-out the adjuster (23) using the shear adapter (61) until the boots are easily accessible (**max. 30 mm**) and with a suitable lever carefully prise the boot away from the caliper (see Fig.).

Take extra care not to damage the sealing surface on the caliper for the inner boot (arrow **X**) as this cannot be replaced (see Fig.).

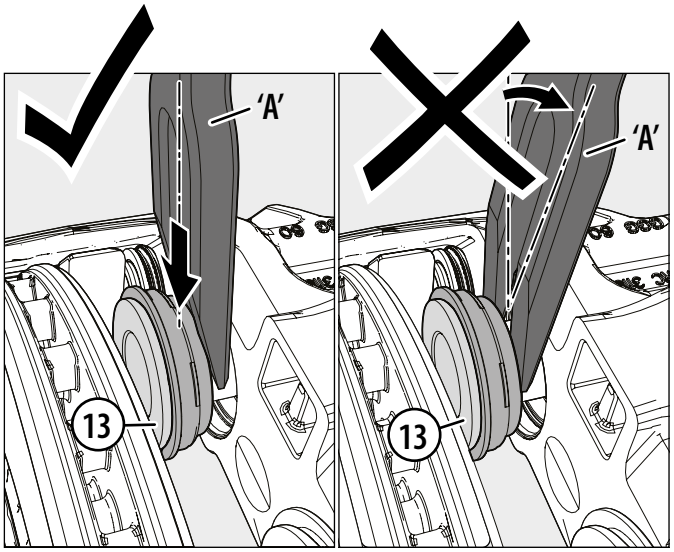


7.1.1 - Wind-out the adjuster, prise out the inner boot.

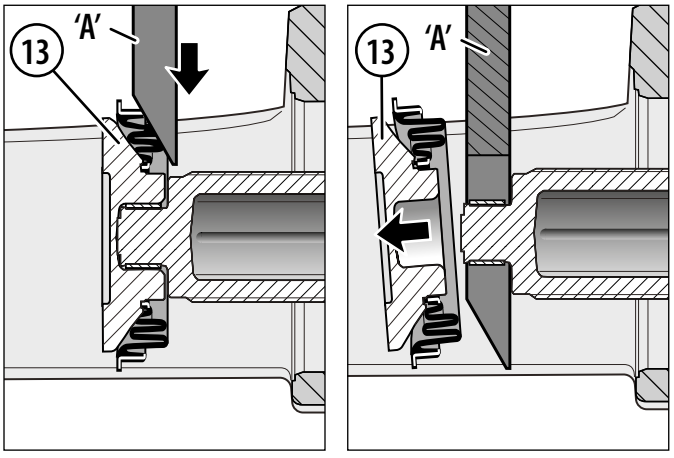
7.1.2 Using tool (**A**), correctly positioned between the caliper and the boot, carefully drive it down with the aid of a hammer to release each tappet and boot assembly (13) from its threaded tube (16). Take care to stay perpendicular and not damage the threaded tube (see Figs. 'a' and 'b').

⚠ *Make sure to keep tool (**A**) perpendicular to the threaded tube.*

⚠ *Do not remove the tappet by levering with tool (**A**) at an angle, this will damage the internal mechanism.*



7.1.2a - Remove tappet and boot assembly using tool (**A**)



7.1.2b - Drive down wedge fork using hammer

7 TAPPET AND BOOT ASSEMBLIES (13) AND INNER SEALS (22) REPLACEMENT

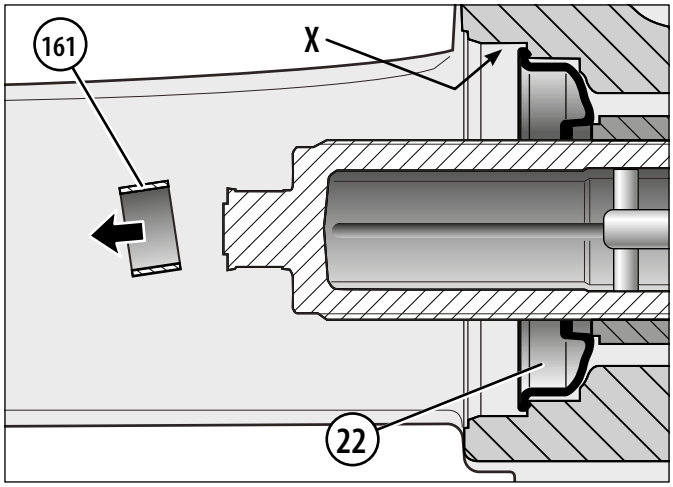
7.1.3 Remove the old tappet bush (161) (see Fig.).

7.1.4 Check inner sealing face (arrow **X**) (see Fig.).

⚠ *This sealing face* (arrow **X**) *must not be damaged. It cannot be replaced. If it is damaged, the caliper must be replaced. (see Section 8).*

If the seal is damaged then the caliper must be replaced (see Section 8).

Note: *When replacing tappet and boot assemblies (13), the inner seals (22) must also be replaced (see Section 7.2).*



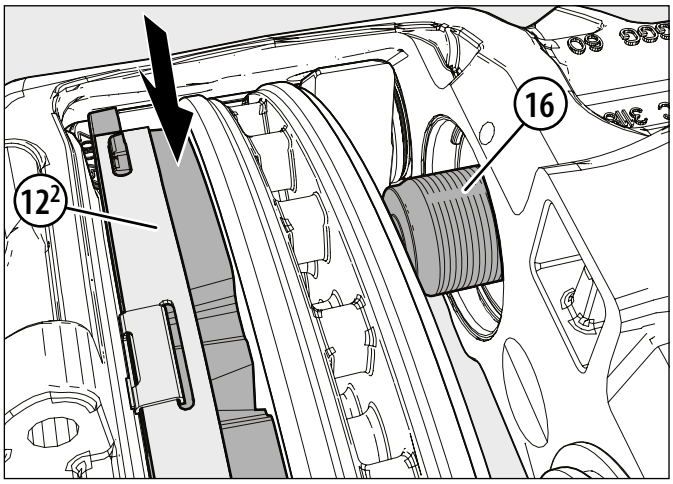
7.1.3 - 7.1.4 -Remove tappet bush, check sealing face

Inspection of Threaded Tube (16)

7.1.5 Place a new brake pad (12) in the outboard position and wind-out the threaded tube (16), by turning the shear adapter (61), until it touches the brake disc. Check the threads when winding-out for corrosion and damage (see Fig.).

In case of water ingress or corrosion, the caliper must be replaced (see Section 8).

⚠ *The threaded tubes must **not** extend more than **30 mm**, otherwise synchronisation is lost and the caliper must be replaced.*

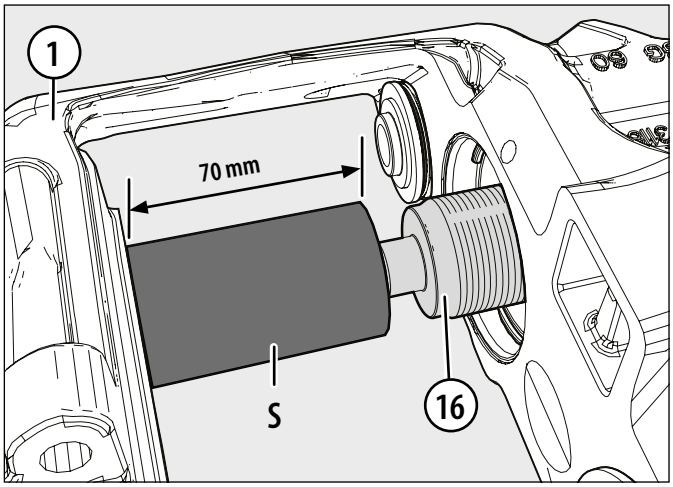


7.1.5 - Inspection of threaded tube (installed on vehicle) using new brake pad

With caliper removed from the vehicle:

7.1.6 If the caliper is not installed on the vehicle, place spacer **S** (length = **70 mm**) into the caliper (1) to avoid loss of thread engagement of the threaded tubes (16). Check the threads when winding-out for corrosion and damage (see Fig.).

In case of water ingress or corrosion, the caliper must be replaced (see Section 8).



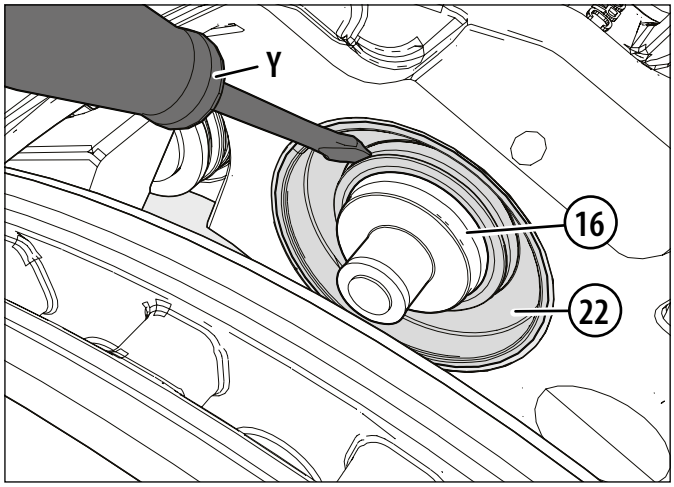
7.1.6 - Inspection of threaded tube (removed from vehicle) using spacer

7.2 Replacement of Inner Seals (22)

7.2.1 Fully wind back the threaded tubes (16) by turning the shear adapter (61) (see Section 6.1.4).

7.2.2 Clean area of the inner seal (22) and then, using a suitable lever (**Y**), carefully remove the inner seal (22) (see Fig.).

⚠ *The sealing surface for the inner seal (22), must not be damaged else the caliper must be replaced.*



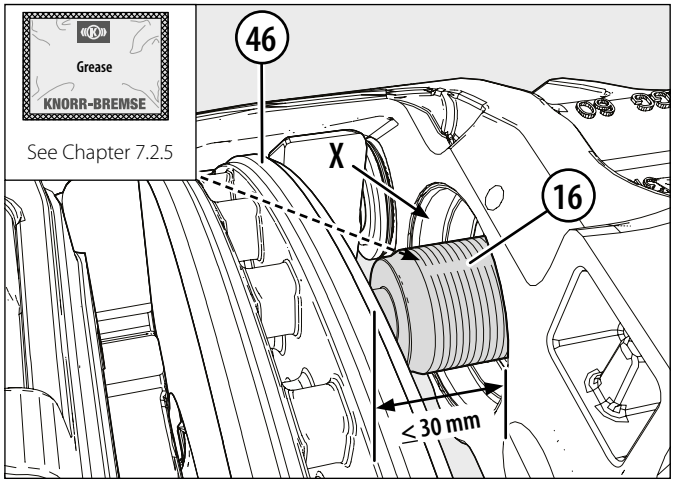
7.2.2 - Clean area and remove inner seal

7.2.3 Clean sealing surface (**X**) (see Fig.).

7.2.4 Wind-out the threaded tubes via the shear adapter (61) to a maximum of **30 mm** whilst at the same time inspecting them for corrosion or damage (see Section 7.1.5 -7.1.6).

7.2.5 Lubricate threads with white grease (Part No. II14525, K093430 or II32868) and then wind back the threaded tubes until they stop (see Fig.).

7.2.6 Fit new inner seals (22) onto the threaded tubes (16) and carefully push into position.



7.2.3 - 7.2.5 - Wind out threads, inspect, grease threads and wind back

7 TAPPET AND BOOT ASSEMBLIES (13) AND INNER SEALS (22) REPLACEMENT

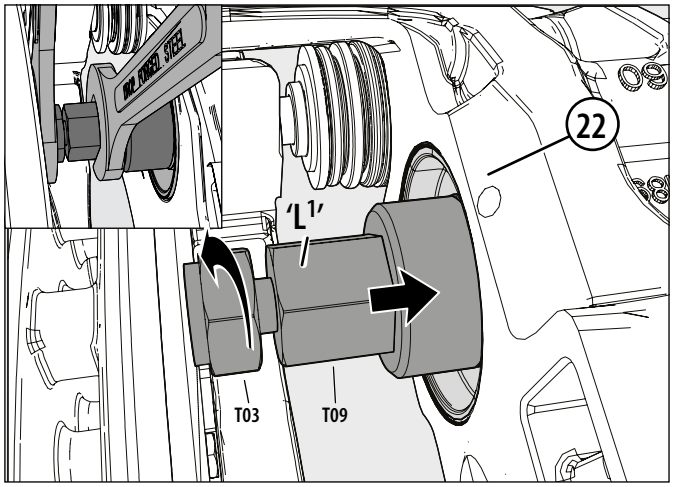
With caliper installed on the vehicle:

7.2.7 Guide the tool (**L**[1]) over the spigot of the threaded tube (16) as shown, screw out (T03) until it touches the brake disc (see Fig.).
Note: *The tappet bush (161) must be absent for this procedure.*

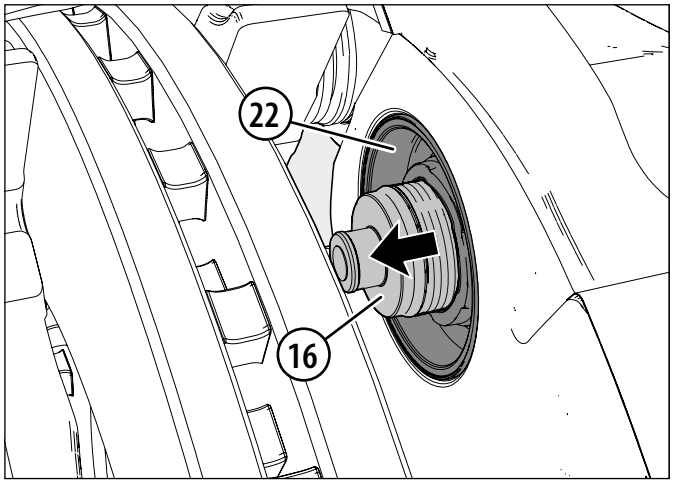
7.2.8 Fully press in the inner seal (22) by securing (T09) with a spanner 27 A/F and rotating (T03) against the brake disc using a second spanner until it stops (see Fig.).

7.2.9 Unscrew (T03) and completely remove tool (**L**[1]).

7.2.10 Check the correct fitting of the inner seal (22) by winding out the threaded tubes (16) four or five threads via the shear adapter (61).
Note: *The inner seal (22) must not turn.*



7.2.7 - 7.2.8 - Using press-in tool **L**[1] to fully press in inner seal



7.2.10 - wind out threaded tubes 4-5 threads via shear adapter

With caliper removed from the vehicle:

The fitting sequence of inner seal (22) is basically the same as when the caliper is installed on the axle (see previous section), except the press-in tool (**L**[2]) with (T03+**T04**+T09) is required to press in inner seal (22).

7.2.11 Guide the tool (**L**[2]) over the spigot of the threaded tube (16), screw out (T03) until it touches the brake disc.
Note: The tappet bush (161) must be absent for this procedure.

7.2.12 Fully press in the inner seal (22) by securing (T09) with a spanner 27 A/F and rotating (T03) against the brake disc using a second spanner until it stops.

7.2.13 Unscrew (T03) and completely remove tool (**L**[2]).

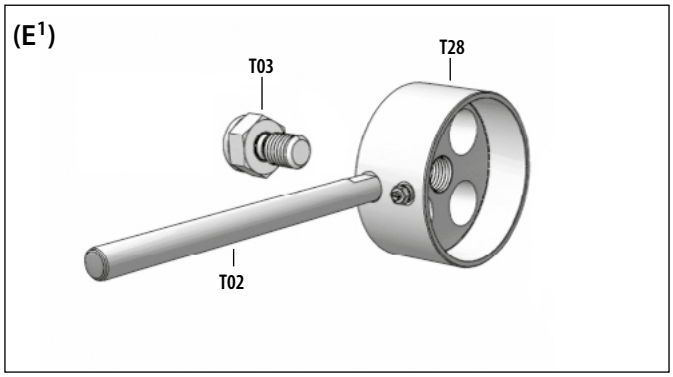
7.2.14 Check the correct fitting of the inner seal (22) by winding out the threaded tubes (16) four or five threads via the shear adapter (61). Check that the inner seals (22) do not turn.

Note: *If the inner seal (22) turns, then the seal must be removed and the procedure repeated using a new inner seal.*

7.3 Fitting of Tappet and Boot Assemblies (13)

With caliper installed on the vehicle:

7.3.1. To fit the tappet and boot assemblies (13), use tool (**E**[1]) (see Fig.).

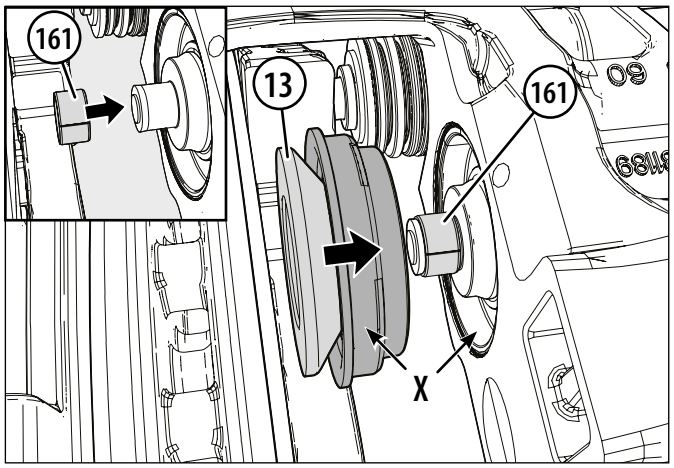


7.3.1 - Press-in tool (**E**[1])

7.3.2. Wind back fully the threaded tube (16) until it stops and then wind forward one full turn (see Section 6.1.4).

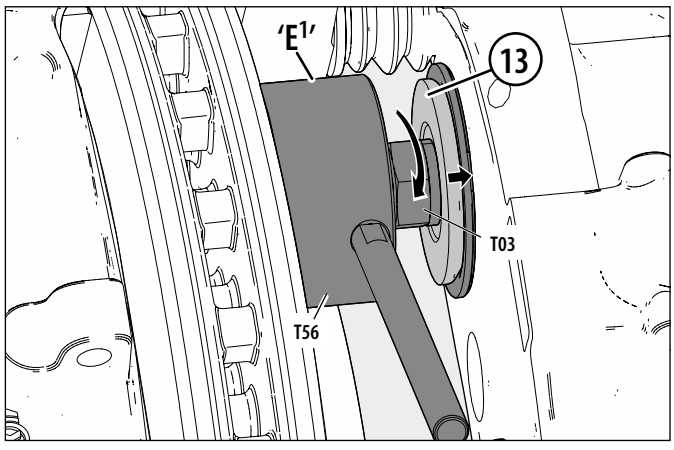
7.3.3. Fit new tappet bushes (161) onto the spigots of the threaded tubes (16), then follow with the tappet and boot assemblies (13) pushing them into position (see Fig.).

Note: The sealing surface (***X***) on the boot and in the caliper must be clean and free of lubrication.



7.3.3 - Fit new tappet bush / tappet with boot assembly to the spigot

7.3.4. Position tool (**E**[1]) so that (T56) touches the brake disc. Using a spanner, screw out (T03) to press tappet and boot assembly (13) into place (see Fig.).



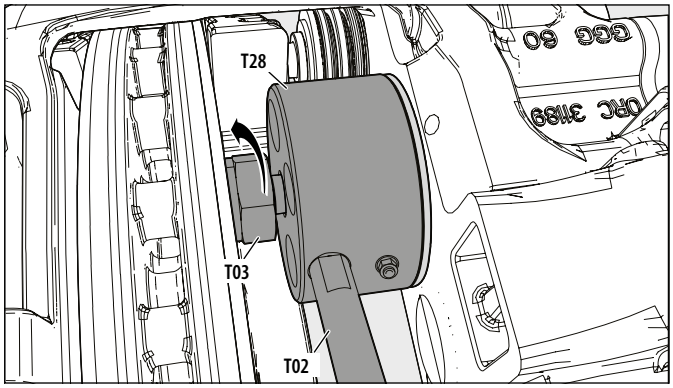
7.3.4 - Press in the tappet using tool (**E**[1])

7 TAPPET AND BOOT ASSEMBLIES (13) AND INNER SEALS (22) REPLACEMENT

7.3.5 Release tool (**E[1]**) and then turn it over so that tool (T28) can make contact with the boot.

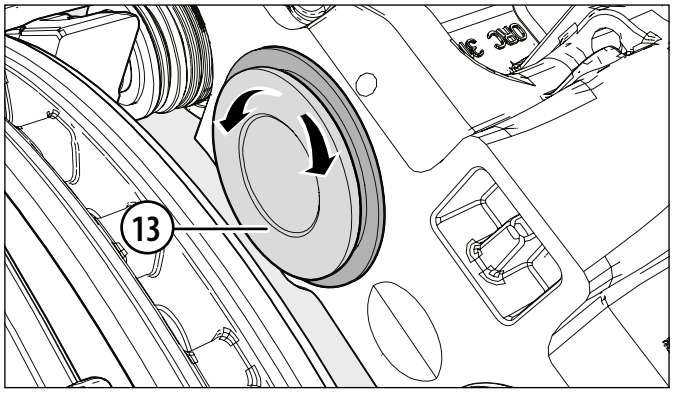
7.3.6 Bring tool (**E[1]**) into position making sure it is centralised to the tappet (see Fig.).

7.3.7 Press-in the boot of the tappet (13) using tool (**E[1]**) by winding out (T03) against the brake disc (see Fig.).



7.3.6 - 7.3.7 - Press-in boot using tool (**E[1]**).

7.3.8 Check that the tappet (13) turns slightly in each direction (take care not to overstretch the tappet boot) (see Fig.).



7.3.8 - Tappet should turn slightly in each direction

With caliper removed from the vehicle:

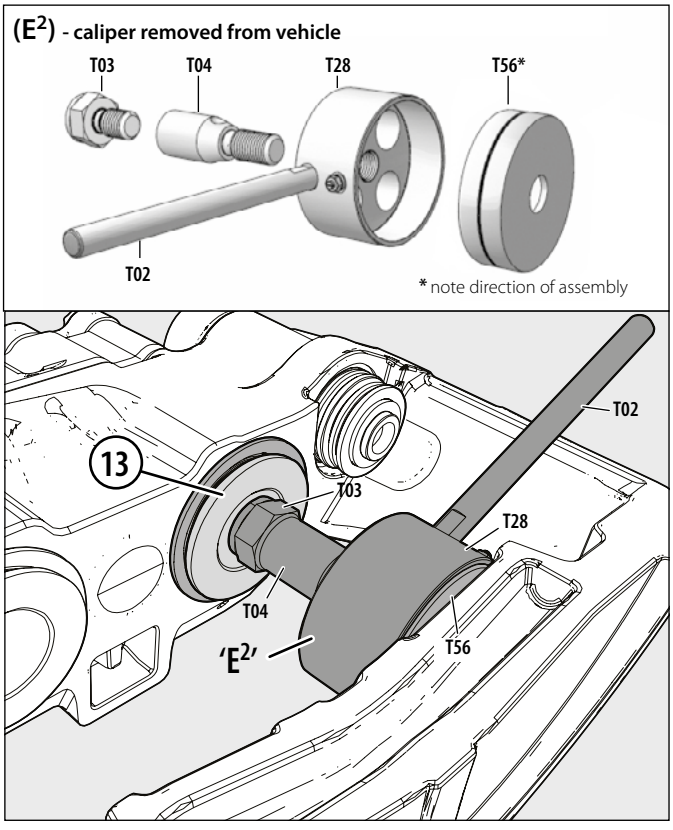
The fitting of each tappet and boot assembly (13) requires tool (**E[2]**) (see Section 7).

7.3.9 Wind back fully the threaded tube (16) using shear adapter (61) until it stops and then wind forward one full turn (see Section 6.1.4).

Note: *The sealing surface (**X**) on the boot and in the caliper must be clean and free of lubrication.*

7.3.10 Fit new tappet bushes (161) onto the spigots of the threaded tubes (16), then follow with the tappet and boot assemblies (13) pushing them into position (see Section 7.3.3).

7.3.11 Position tool (**E[2]**) as shown. Note that tool (T56) must be inserted into tool (T28) with closed side facing out. Using a spanner screw out (T03) to press tappet and boot assembly (13) into place.
Note: *Tool (T56) is required to maximise grip on the caliper.*

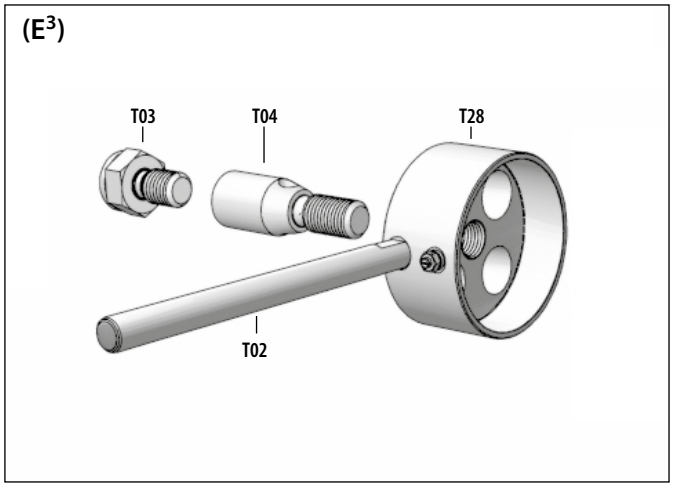


7.3.11 - Press in tappet using tool (**E[2]**) (with T56)

TAPPET AND BOOT ASSEMBLIES (13) AND INNER SEALS (22) REPLACEMENT

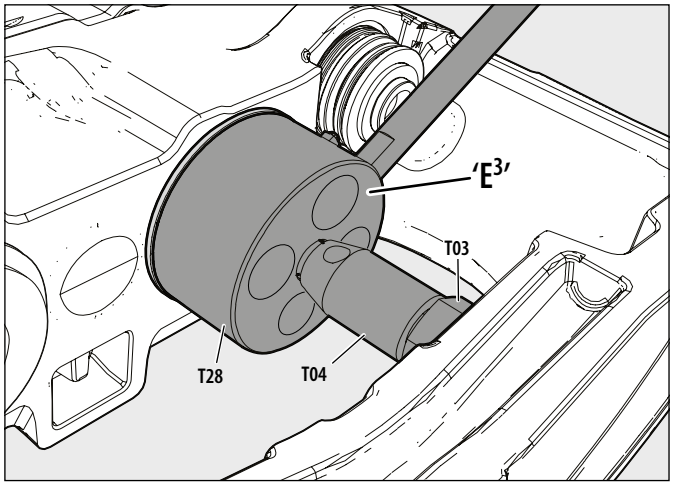
7.3.12 Release and remove tool (**E²**).

7.3.13 To press in the boot of the tappet (13) tool (**E³**) is required (see Fig.).



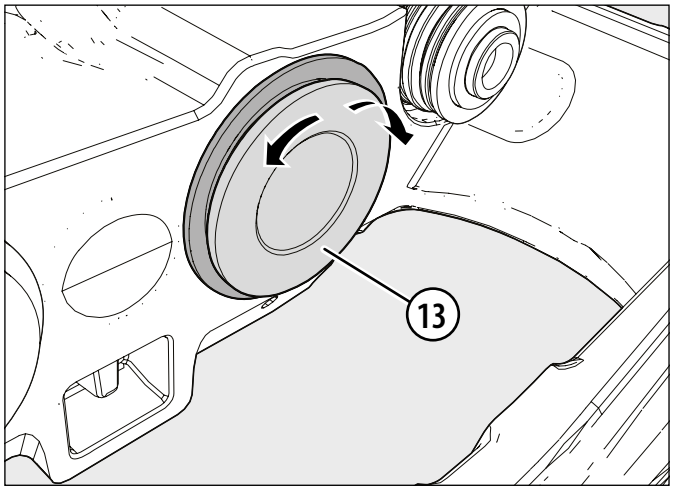
7.3.13 - Tool (**E³**)

7.3.14 Position tool (**E³**) so that (T03) screws out against the caliper as shown. Using a spanner, screw-out (T03) to press-in the boot (see Fig.).



7.3.14 - Press-in the boot of the tappet using tool (**E³**)

7.3.15 Release and remove tool (**E³**), check that the tappet (13) turns slightly in each direction (take care not to overstretch the tappet boot) (see Fig.).

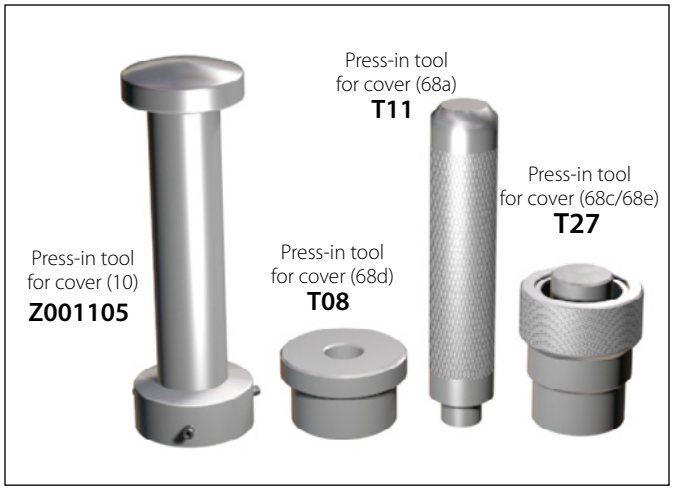


7.3.15 - Tappet should turn slightly in each direction

8. CALIPER REPLACEMENT

8.0 To replace the cover (10; fixed bearing) use the press-in tool (**Z001105**), for cover (68a; floating bearing) use press-in tool (**T11**), for cover (68c and 68e; guide sleeve) use press-in tool (**T27**) and for cover (68d; capped rubber sleeve) tool (T08) is required (see Fig.).

For ease of reference, each component of a tool is referred to by an identification number; a complete tool (containing one or more such components) has been given a letter code - see section 2.1.



8.0 - Press-in tools for cap and covers

8.1 Removal of Caliper from Carrier

8.1.1 Remove the brake pads (12) (see Section 6.1).

8.1.2 Remove brake actuator (see Section 12). If fitted, remove wear indicator cable and potentiometer.

⚠ *Do not touch electrical contact points - possible static discharge!*

Note: *It may be necessary for reasons of accessibility to remove the caliper and carrier from the axle (refer to vehicle manufacturer's recommendations) or remove only the caliper.*

Removal of Ribbed Cover (10) or Steel Cap (10a)

8.1.3

Variant with ribbed cover (10) and securing tag-

Securing tag (31) loosen and remove, the ribbed cover can then be removed.

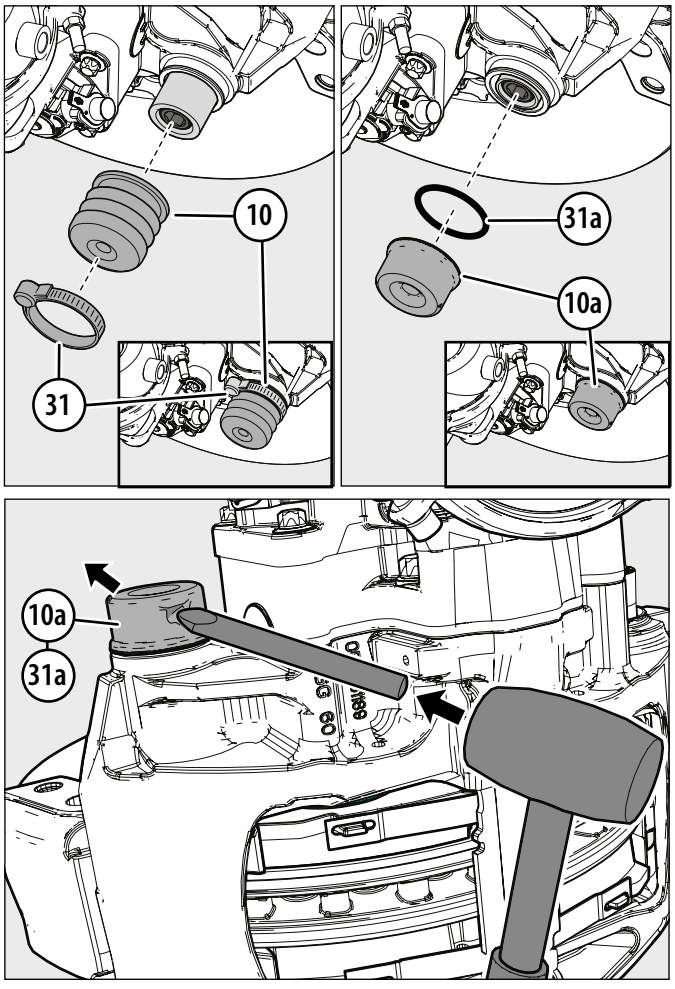
or

Variant with Steel Cap (10a) and O-Ring (31a).

The removal procedure is from the side and in an upward direction as shown (see Fig.).

Note: *Do not hit the cover (10a) in direction of the caliper as damage may occur to the caliper.*

Check the inside area of the bearing and the cover for dirt or corrosion. If necessary replace with a new guide and seal kit. In case of damage or excessive corrosion, the caliper must be replaced.



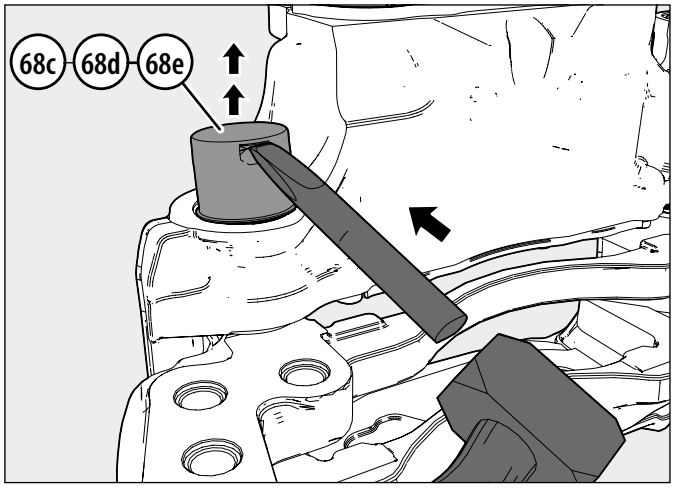
8.1.3 - Remove cover variants

Removal of Cover (68c, 68e; Guide Sleeve) or (68d; Capped Rubber Sleeve)

8.1.4 Due to the protrusion of covers (68c, 68d or 68e), the removal procedure is from the side and in an upward direction as shown (see Fig.).
Note: *Do not hit the covers* (68c, 68d or 68e) in direction of the caliper as damage may occur to the caliper.

Check the inside area of the bearing and the cover for dirt or corrosion. If necessary replace with a new guide and seal kit. In case of damage or excessive corrosion, the caliper must be replaced.

⚠ *The capped rubber sleeve (6d) will release itself from the carrier bore with cover (68d).*

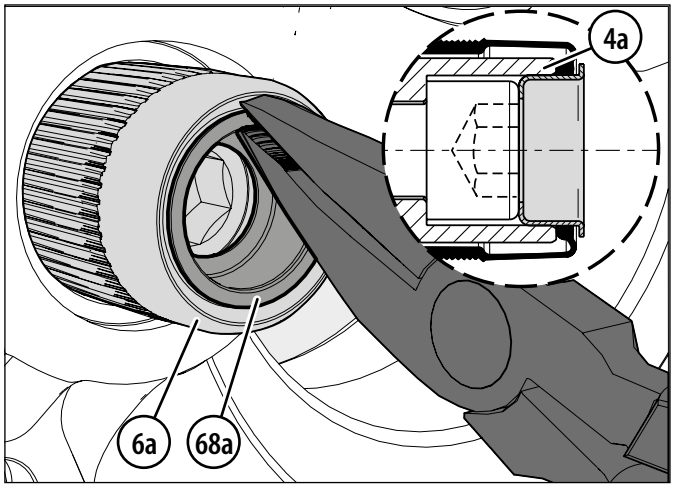


8.1.4 - Removal of cover (68c, 68d or 68e)

Removal of Cap (68a; Rubber Bush)

8.1.5 Carefully remove cap (68a) from the guide pin (4a) using a suitable tool, avoid damaging the cap.

Take care not to damage the rubber bush (6a).



8.15 - Removal of cap (68a)

Removal of Caliper from Carrier

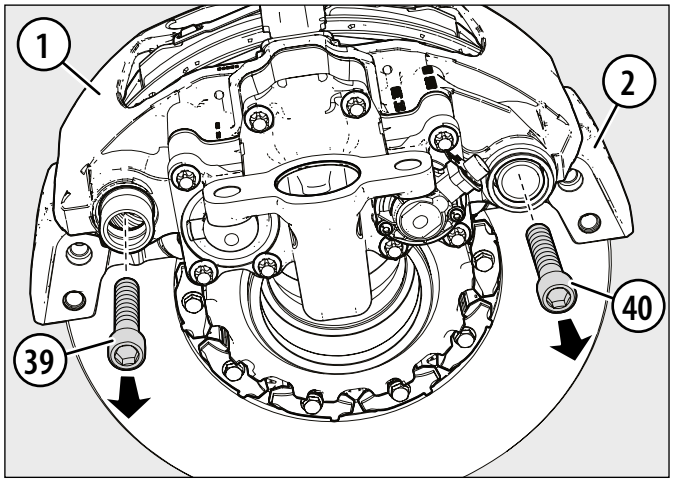
⚠ *Before removing the caliper bolts (39 and 40) ensure that the caliper (1) cannot move or fall when the caliper bolts are removed causing damage or injury.*

8.1.6 Screw out the caliper bolts (39) and (40) (see Fig.).

⚠ *Never hold the caliper with your fingers between caliper and carrier - there is a risk of injury! Do not fasten any lifting device to the pad retainer (11), since this could be damaged.*

⚠ *The opening or dismantling of the caliper is not authorised. Use only genuine Knorr-Bremse replacement calipers.*

8.1.7 Remove caliper (1) from carrier (2).



8.1.6 - Remove caliper bolts

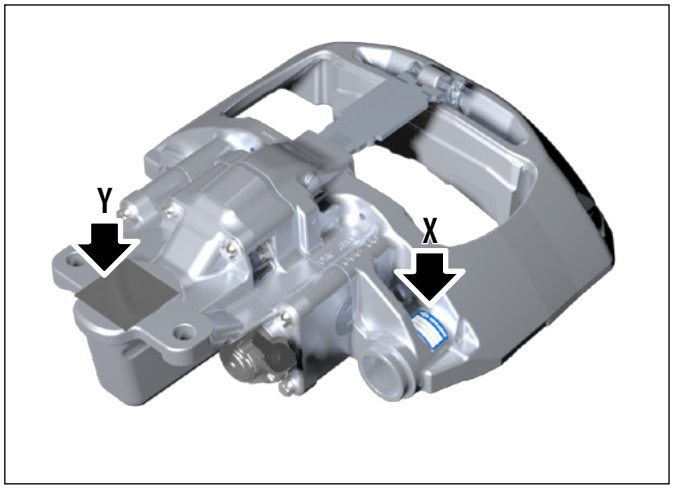
8.2 Fitting Caliper to Carrier - (Carrier assembled on vehicle)

Only use original Knorr-Bremse replacement calipers!

8.2.1 The correct choice of caliper must be ensured by checking the part number on the identification label (arrow **X**) (see also Section 1.2).

Note: *The replacement caliper includes seals and guide pins as well as bolts and bushes for fitting the caliper to the carrier. Brake pads and wear sensors are not included.*

If the replacement caliper is equipped with a potentiometer, then the connection must be made using the appropriate mating plug - refer to vehicle manufacturer's recommendations.



8.2.1 - Note identification label, remove adhesive tape

The caliper guide sleeves should be overhauled with the respective guide and seal kit (see Section 9 and 10), or the caliper replaced with the compatible rationalised caliper.

⚠ *The guide pins (4) and (5) as well as the caliper bolts (39) and (40) are highly stressed items. They must be replaced whenever the caliper (1) is removed from the carrier (2).*

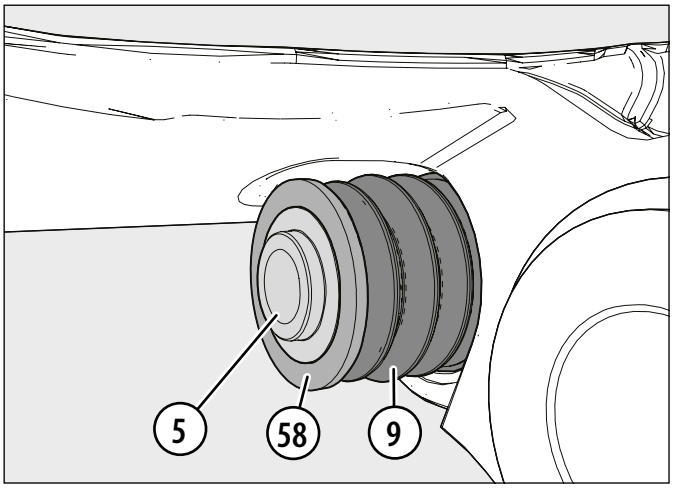
⚠ *Never hold the caliper with your fingers between caliper and carrier - there is a risk of injury! Do not fasten any lifting device to the pad retainer (11), since this could be damaged.*

8.2.2 Guide pins (4 and 5) and bearings (6 and 7) should be thinly greased - see the grease application table Section 1.1.2.

8.2.3 For bearing variant (6a rubber bush; 6b open bearing; 6f short rubber sleeve; 6g long rubber sleeve) insert the guide pins from inside the caliper to the outside for both fixed and floating bearings.

8.24 For bearing variant (68b; open bearing, 68c and 68e; metal guide sleeve and 68d; Capped rubber sleeve) insert the guide pins from inside the caliper to the outside for both fixed and floating bearings (see also Section 9.5 and 9.6).

8.2.5 Check that the inner boot (9) and ring (58) sit correctly on the guide pin (4 and 5) (see Fig.), (see also Section 9.7).



8.2.5 - Check inner boot and ring

Screw threads and contact surface area of the guide sleeves (4 and 5) must be clean and dry (free of lubrication and residuals of pre-applied adhesive).

8.2.6 Place caliper (1) onto the carrier (2) and insert the caliper bolts (39) and (40). Tighten bolts to 180 Nm, then tighten by a further 90° (**use only new parts**) (see Fig.).

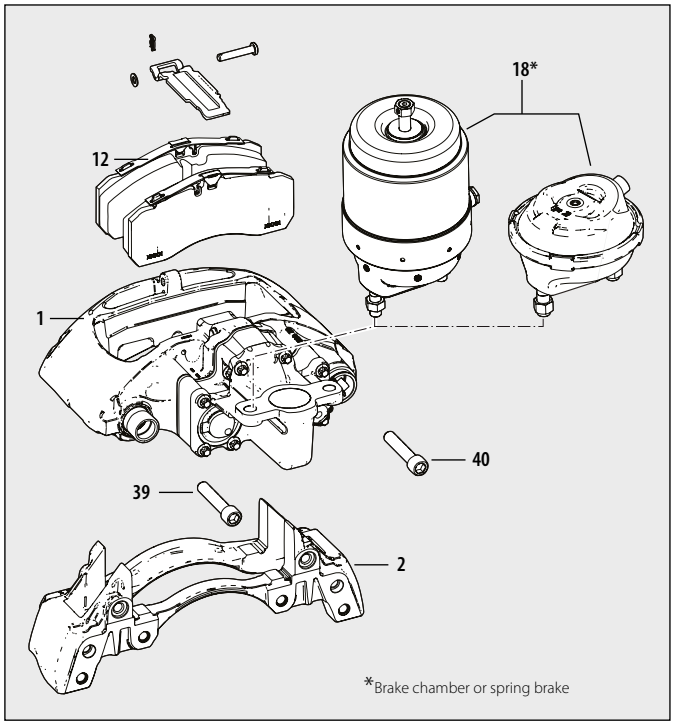
8.2.7 Check that the caliper slides easily on the guide pins. (see Section 5.3).

8.2.8 Fit brake pads (12) (see Fig. and Section 6.2).

8.2.9 If present, remove plastic cover or adhesive tape in the area of the actuator attachment from the replacement caliper (see Fig 8.2.1 arrow **Y**).

8.2.10 Fit brake actuator (18) (see Fig. and Section 11.2 or 11.4).

8.2.11 Check adjuster function (see Section 5.2).



8.2.6 - 8.2.10 - Fit caliper onto carrier, tighten caliper bolts , fit brake pads, fit brake actuator

Fitting of Cover Variants

Fitting of covers can only be done after the caliper has been fully bolted to the carrier (see Section 8.2).

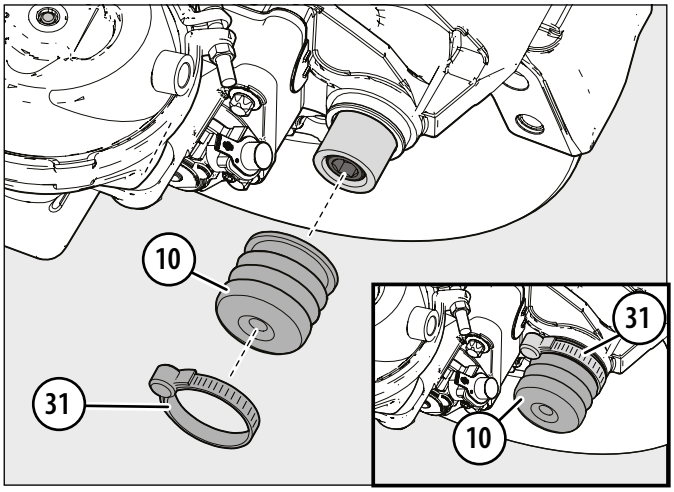
Fitting Ribbed Cover (10) - Fixed Bearing Side

Caliper bores and cover must be clean and free from lubrication.

Before fitting the cover (10), push the caliper as far as possible in direction to the outside of the vehicle.

8.2.12 Place the ribbed cover (10) and securing tag (31) in position on the caliper, check both sit correctly and then tighten the securing tag using a suitable tool.

Once tightened check again that both sit correctly and are not damaged.



8.2.12 - Fit cover over bearing

Fitting Steel Cover (10a) - Fixed Bearing Side

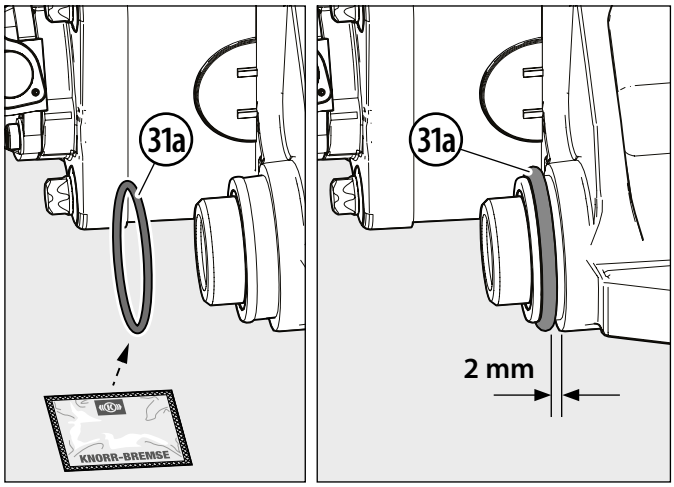
⚠ *The ribbed cover (10) can only be exchanged for the steel cap (10a) when in conjunction with guide pin (5a), the O-Ring (31a) and the caliper bolt (40a). Only after agreement with the Axle / Vehicle manufacturerer. With SB6... (19.5"), only from production date A0026 (see identification label).*

Depending on installation access on the vehicle, it may be easier to fit the steel cap if the air disc brake is first removed from the vehicle.

⚠ *The steel cap (10a) and the O-Ring (31a) are to be used once only. After disassembly, they are not to be reused.*

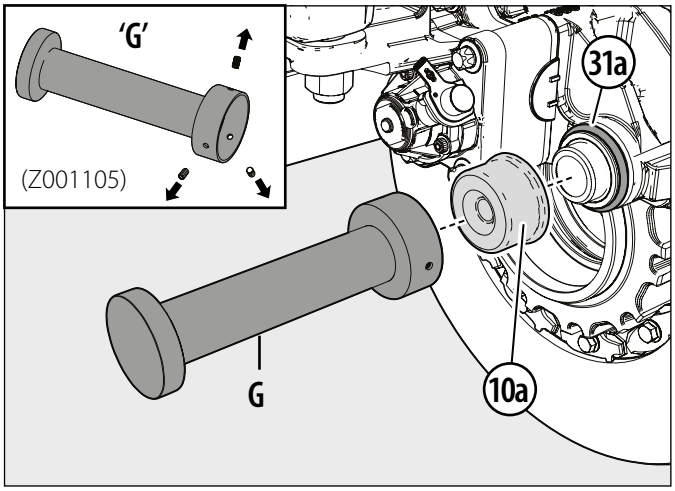
The fitting must be carried out with brake pads in place!

8.2.13 Clear in and around the assembly area. Lightly apply **white** assembly grease (I14525 or II32868) to the O-Ring (31a) and push into place onto the caliper as shown with **2 mm** gap (see Fig.).



8.2.13 - Grease O-Ring and fit into place

8.2.14 Prepare tool (**G**) by removing the grub screws. Then lightly hold the steel cap (10a) with the help of tool (**G**) into position over the fixed bearing.

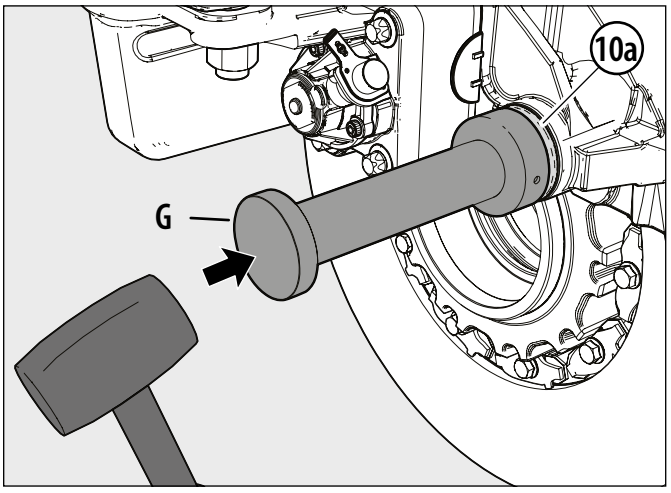


8.2.14 - Remove grub screws from tool (G)

8.2.15 With both the steel cap (10a) and tool (**G**) in place, use a hammer to carefully push into place.

After assembly, check that the steel cap (10a) sits correctly and has not been deformed.

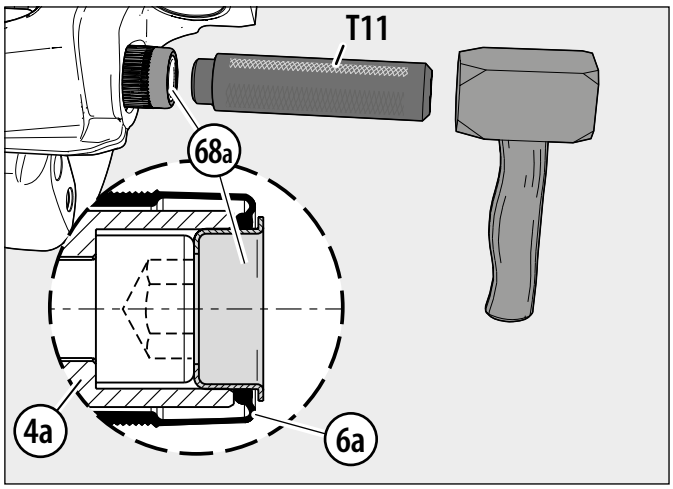
Place the grub screws back into tool (**G**).



8.2.15 -Fit the steel cap using tool (G)

Cap (68a; Rubber Bush) - Floating Bearing Side

8.2.16 Fit the cap (68a) using tool (**T11**) and a hammer. Force the cap into the guide pin (4a) until firmly seated. The seal is achieved by the compression of the lip of the rubber bush (6a) between th guide pin (4a) and cap (68a) (see Fig.).

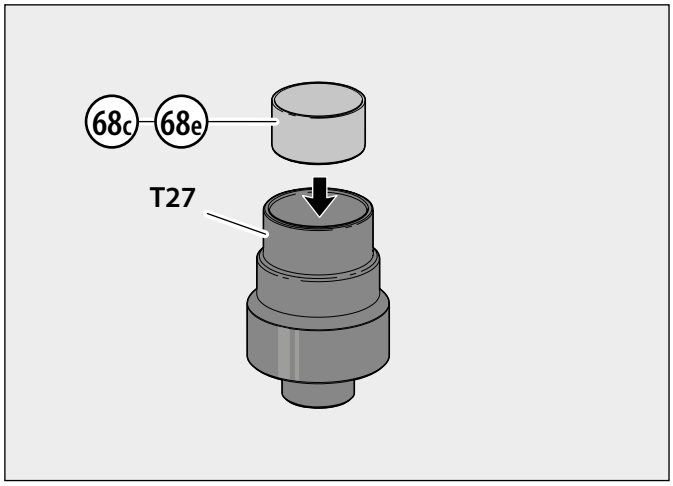


8.2.15 - Insert Cap into Guide Pin using tool (**T11**)

Cover Variant (68c and 68e; Guide Sleeve) - Floating Bearing Side

Caliper bores and cover must be clean and free from lubrication.

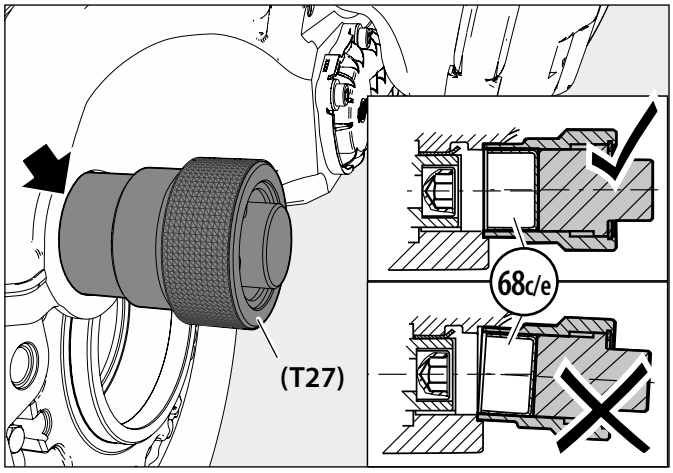
8.2.17 Clean the new cover (68c or 68e) and the interior of the press-in tool (**T27**) and insert the cover as shown (see Fig.).



8.2.17 - Insert cover into tool (**T27**)

8.2.18 Check the plane surface of caliper bore is clean and not damaged (see arrow). Position the press-in tool (**T27**) including cover (68c or 68e) squarely and check it sits correctly as shown (see Fig.).

Note: *Do not tilt the tool!*

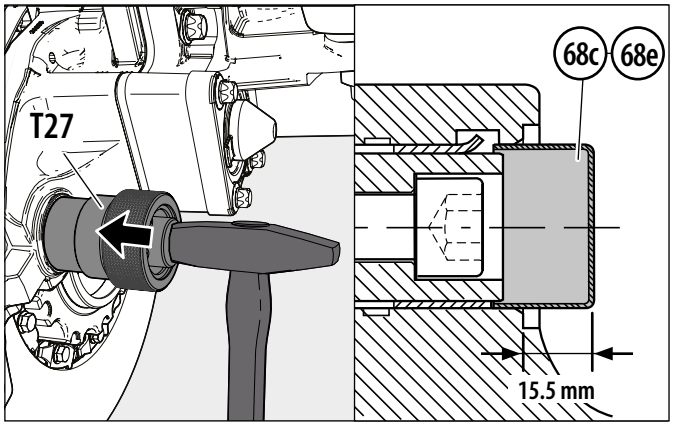


8.2.18 - Press-in tool (**T27**) with cover in position on the plane surface of the caliper

⚠ *The inner boot (9) must be in a compressed condition otherwise the caliper´s freedom of movement will be limited.*

8.2.19 Press the mandrel of the press-in tool (**T27**) firstly by hand until it stops, then, using a hammer on the mandrel, insert the cover to the end stop (see Fig.).

Note: *After fitting the new cover (68c or 68e), ensure that it protrudes* ***15.5 mm*** *from the plane surface of the caliper (see Fig.).*

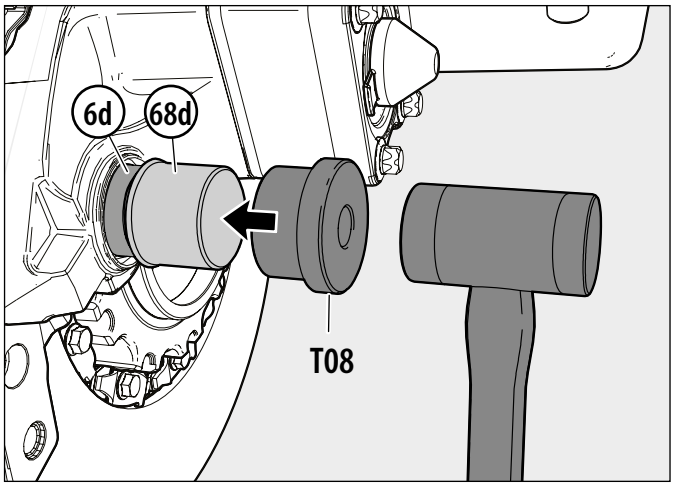


8.2.19 - Fit cover to stop, cover should protrude **15.5 mm**

Cover Variant (68d) - Floating Bearing Side

8.2.20 Push cover (68d) over capped rubber sleeve (6d) by hand. Place tool (T08) onto cover (68d) and using a soft faced hammer fit cover (68d) to the end stop (see Fig.).

Note: *Use a soft faced hammer to avoid damage to tool (T08).*



8.2.20 - Fitting cover (68d)

Fitting of Cover Variants with Caliper (1) and Carrier (2) Removed from the Vehicle:

8.2.21 Check caliper slides freely along the whole length of the guide pin arrangement (see Section 5.3).

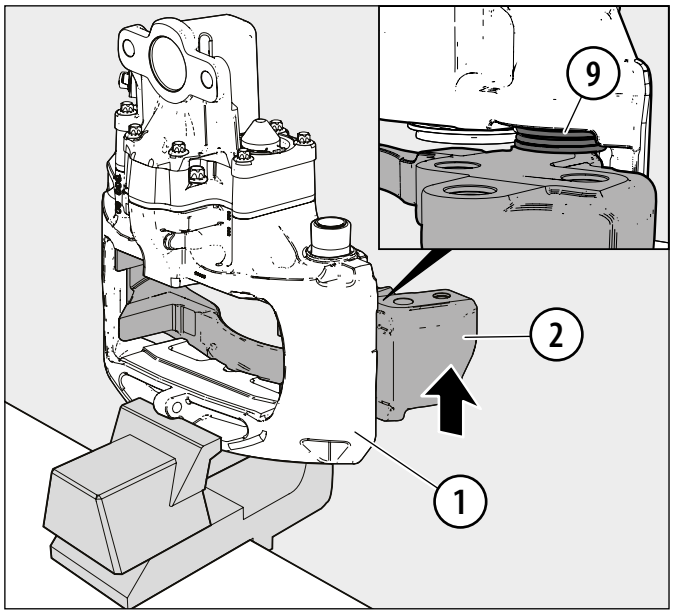
8.2.22 Fix the carrier securely as shown i.e. bench vice, and push the carrier against the caliper to ensure the inner boots (9) are fully compressed (see Fig).

The inner boots (9) must be in a compressed state otherwise the caliper´s freedom of movement will be limited.

8.2.23 Assembly of covers (10), (68a; rubber bush, 68b; open bearing, 68c and (68e; guide sleeve and 68d; capped rubber sleeve) can now proceed as previously described (see Section 8.2.12 - 8.2.19).

8.2.24 Fit the caliper complete with carrier onto the axle using new bolts. Note the required torque value.

Note: *When fitting to the axle, refer to axle and/or vehicle manufacturer's recommendations*



8.2.22 - Fix carrier, push carrier (2) against caliper (1)

8.2.25 Fit brake pads (see Section 6.2).

8.2.26. Check adjuster function (see Section 5.2).

8.2.27. Fit brake actuator (18) (see Section 11.2 or 11.4).

8.2.28 Fit wheel (refer to axle and/or vehicle manufacturers recommendations).

After any work carried out on air disc brakes, a thorough testing of functioning and effectiveness is required. Note that during the start-up phase, new discs and/or pads usually have a bedding-in period before maximum performance is reached.

9 CALIPER BEARINGS REPLACEMENT

To replace the caliper bearings, all components of the fixed and floating bearing must be replaced by new components.

For ease of reference, each component of a tool is referred to by an identification number; a complete tool (containing one or more such components) has been given a letter code - see section 2.1.

9.1 Removal of Inner Boot (9)

9.1.1 Remove caliper (see Fig. and Section 8.1).

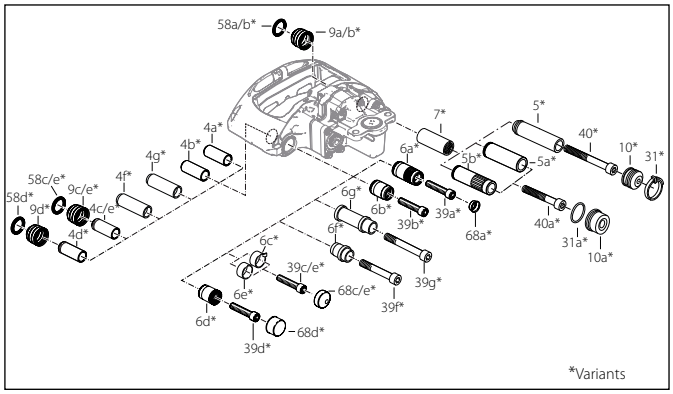
9.1.2 Remove ring (58) (see Fig.).

9.1.3 Pull out guide pins (4 and 5) (see Fig.).

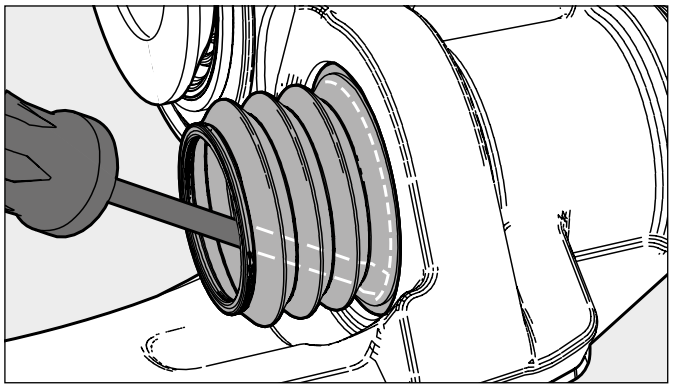
9.1.4 Ease out inner boot (9) with a screwdriver or similar tool (see Fig.).

9.1.5 Check the sealing face of inner boot (9) for damage or corrosion (see Fig. arrow **A**).

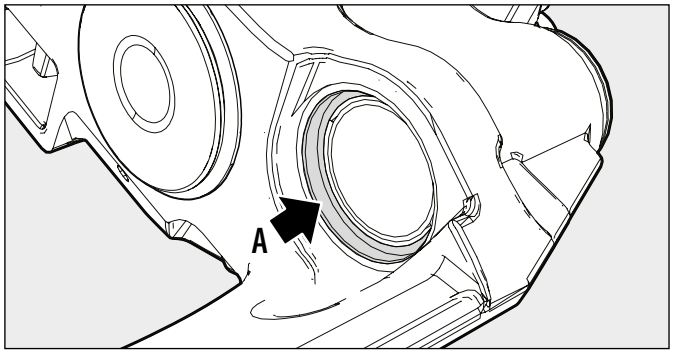
Note: *For caliper variants having an inner boot (9) on both bearing sides, the steps 9.1.1 - 9.1.5 are to be carried out on both sides.*



9.1.1 - 9.1.3 - Remove parts as described



9.1.4 - Remove inner boot



9.1.5 - Check for damage or corrosion

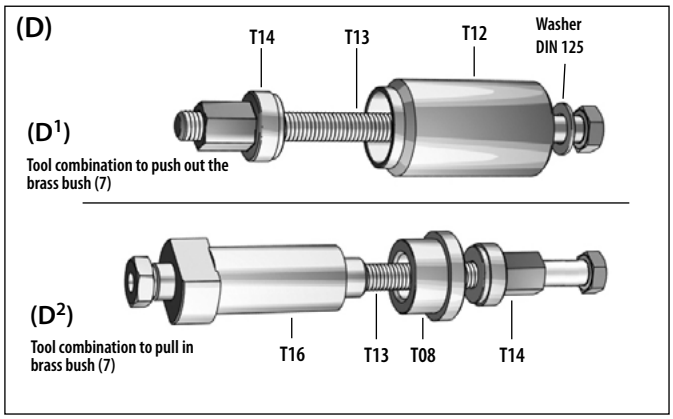
9.2 Replacement of Brass Bush (7a or 7b) Fixed Bearing Side

For ease of reference, each component of a tool is referred to by an identification number (see section 2.1).

Before starting the removal procedure, smear the Washer DIN 125 on both sides with white grease.

To remove the brass bush (7a or 7b) use the pull-out combination (**D**[1]).

To fit and groove the brass bush (7a or 7b) use the pull-out/ pull-in and grooving tool (**D**[2]).



9.2 - Tool combination (**D**)

Removal of Brass Bush (7a or 7b)

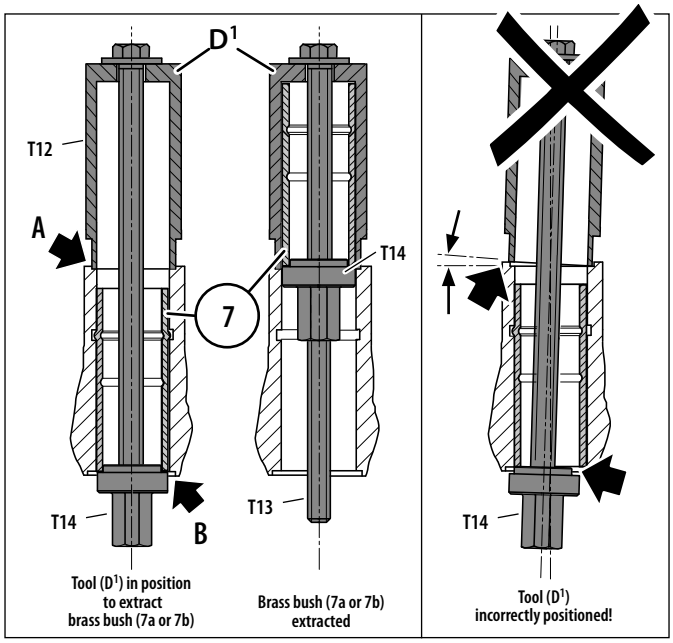
The use of impact screwdrivers / impact wrenches in conjunction with Knorr-Bremse service tools for air disc brakes is not permitted. The service tools are not designed for such use.

Risk of injury. Knorr-Bremse accepts no liability for damage or injury resulting from negligence, any damage to service tools resulting from such actions will void all warranty.

9.2.1 Clean the contact surface area (arrows **A** and **B**) as well as the brass bush (7a or 7b) (see Fig.).

9.2.2 Place tool (**D[1]**) in position as shown and ensure that (T14) sits correctly into brass bush (7a or 7b). Pull out brass bush (7a or 7b) via spindle (T13) using a ring spanner (see Fig.).

Note: *Make sure that (T14) sits in the brass bush (7a or 7b).Tool (T12) must be placed square on the surface (see arrow **A**). Do not tilt the tool when removing!*



9.2.1 - 9.2.2 - Remove old brass bush using tool combination (**D[1]**)

Fitting of Brass Bush (7a or 7b)

9.2.3 Prepare tool (**D[2]**) by firstly screwing (T14) onto the spindle (T13) until it stops and then place (T08) onto (T13). Place new brass bush (7a or 7b) onto (T16).

9.2.4 From opposite ends place the prepared parts through the caliper bore and screw (T13) into (T16) by hand until it stops. Check the free movement of (T16); (T08) must lie square on the surface (arrow **A**) (see Fig.).

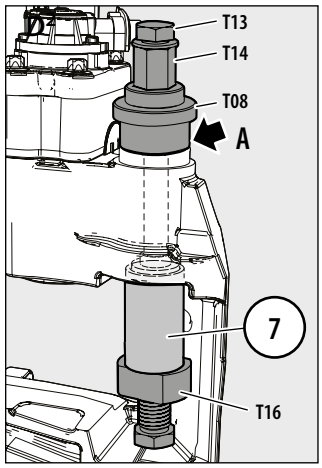
9.2.5 Pull-in brass bush (7a or 7b) by turning (T14) until it stops (see Fig.).

9.2.6 To prevent longitudinal displacement of brass bush (7a or 7b) it must be "grooved" (see arrow **B**). The hexagon bolt (arrow **C**) of tool (T16) must be screwed in up to its stop. This process causes deformation within the brass bush (see Fig.).

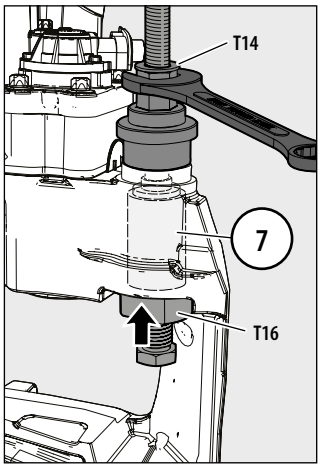
9.2.7 Wind back the hexagon bolt (arrow **D**) of tool (T16) approximately **20 mm**. Slacken brass nut (T14) and rotate tool (T16) approximately **60°**. Re-tighten brass nut (T14)and repeat step 9.2.6.

The brass bush (7a or 7b) is now secured against longitudinal displacement. Before removing tool (**D[2]**) the hexagon bolt of tool (T16) must be screwed out again approximately **20 mm**.

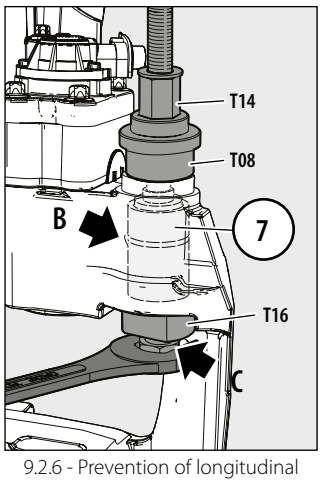
9.2.8 Remove tool (**D[2]**) and check contact area of brass bush (7a or 7b) and remove any burrs if necessary. Grease bush (7a or 7b) with white grease (Part No. II14525, K093430 or II32868).



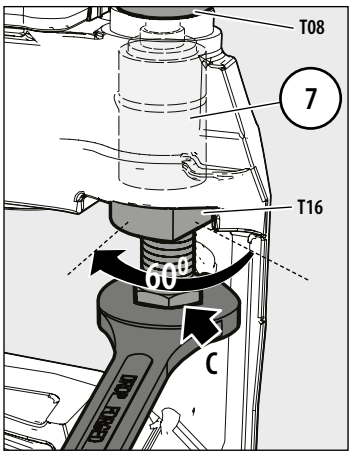
9.2.4 Positioning of tool (D[2]) with new brass bush



9.2.5 - Pull-in brass bush by turning (T14)



9.2.6 - Prevention of longitudinal displacement



9.2.7 - Rotate 60°, repeat grooving

9.3 Replacement of Guide Sleeve Variant (6a, 6b, 6c, 6d or 6e) Floating Bearing

For ease of reference, each component of a tool is referred to by an identification number (see section 2.1).

Guide sleeve variants are:

- 6a - Rubber bush
- 6b - Open bearing
- 6c and 6e - Guide sleeve
- 6d - Capped rubber sleeve
- 6f - Short rubber sleeve
- 6g - Long rubber sleeve

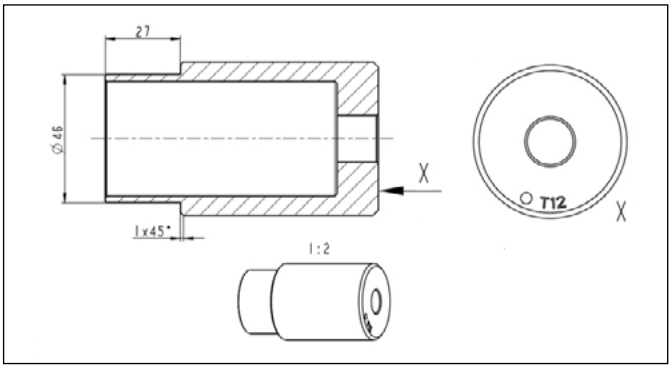
With air disc brakes manufactured from Sepetmber 2015, it is a requirement to use tool T12 when removing the guide sleeve (see Fig. 93c).

The following tool combinations are used depending on the variant:

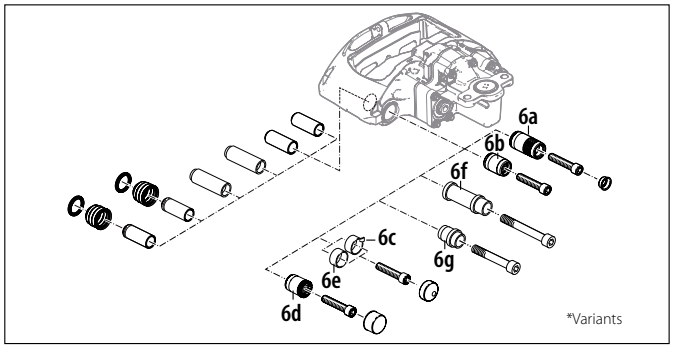
Guide sleeve (6a rubber bush and 6b open bearing) requires tool (**R**) - (**R**^{1}) for removal with manufacturing date before 09/2015, (**R**^{3}) for removal from 09/2015 and (**R**^{2}), for fitting (see Fig.9.3a).

Note: *Depending on the model type, the relevant diameter of tool (T06) is required to successfully remove the guide sleeve (6a) or (6b).*

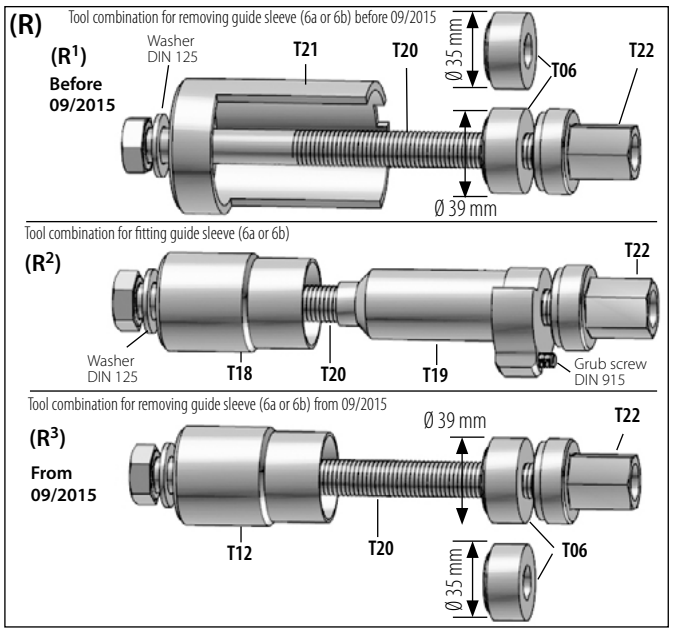
Guide sleeve (6c and 6e; metallic version) requires tool (**N**) - (**N**^{1}) for removal with manufacturing date before 09/2015, (**N**^{3}) for removal from 09/2015 and (**N**^{2}), for fitting (see Fig. 9.3b).



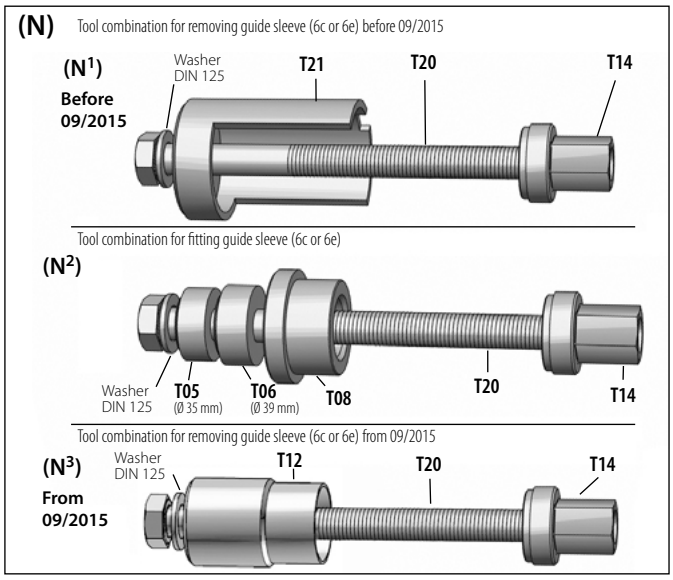
9.3c - Tool combination (**R**)



9.3 - Guide sleeve variants



9.3a - Tool combination (**R**)



9.3b - Tool combination (**N**)

Guide sleeve (6d capped rubber sleeve) requires tool (**C**) - (**C²**) with tool (T06) for fitting only. Variant (**C¹**) is not required at this time.

Note: *The guide sleeve (6d) is removed at the time the cover (68d) is removed (see Section 8.1.5). Therefore no special tool for the removal process is required. Tool (**C**) is also required for the fitting of the inner boot (9) variants.*

9.3.1 Removal of Guide Sleeve (6a Rubber Bush or 6b Open Bearing) Floating Bearing

9.3.1.1 If present, remove guide pin (4a or 4b).

9.3.1.2 Clean the area around the bearing.

9.3.1.3 Prepare tool combination (**R¹**) with the correct diameter tool (T06) depending on the guide sleeve model. The correct tool (T06) sits perfectly into place.

For brakes with manufacture date up to 09/2015

9.3.1.4 Place tool (**R¹**) in position on the caliper and if necessary use suitable tool(s) to stabilise its position. Hand tighten (T22) (see Fig.).

9.3.1.5 Hold (T22) using a ring-spanner 24 A/F and pull-out the rubber bush (6a) or open bearing (6b) by turning tool (T20) with a suitable tool (see Fig.a).

Continue with 9.3.2.

For brakes with manufacture date from 09/2015

9.3.1.4 Place tool (**R³**) in position Hand tighten (T22) (see Fig.).

9.3.1.5 Hold (T22) using a ring-spanner 24 A/F and pull-out the rubber bush (6a) or open bearing (6b) by turning tool (T20) with a suitable tool (see Fig.b).

9.3.2 Removal of Guide Sleeve (6c and 6e; Guide Sleeve) Floating Bearing

9.3.2.1 Remove guide pin (4c or 4e).

9.3.2.2 Clean the area around the bearing.

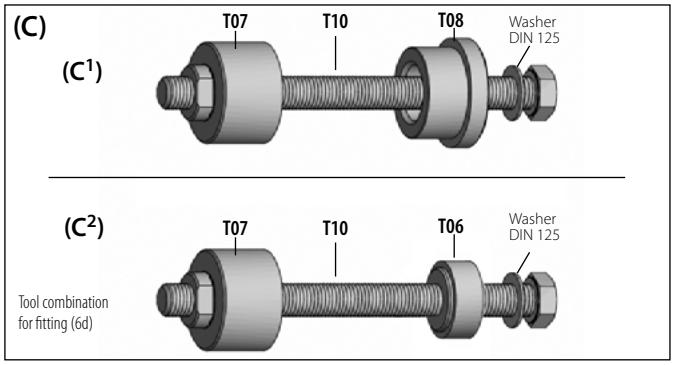
9.3.2.3 *This procedure is only for guide sleeve (6c) with tab. For (6e) without tab continue from 9.3.2.5.*

Use a suitable tool to separate the tab from the guide sleeve (6c) as described below:

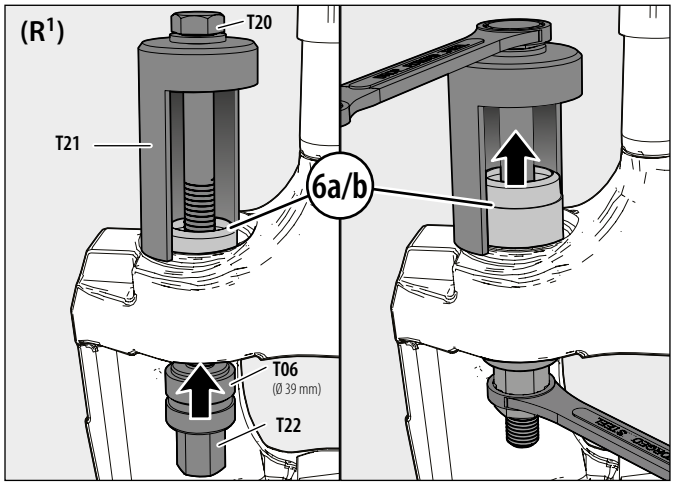
The head of the screwdriver (or suitable tool) should be slightly narrower than the tab and placed as close as possible to its base (see Fig.).

9.3.2.4 separate the tab by striking the screwdriver in the direction of the tab.

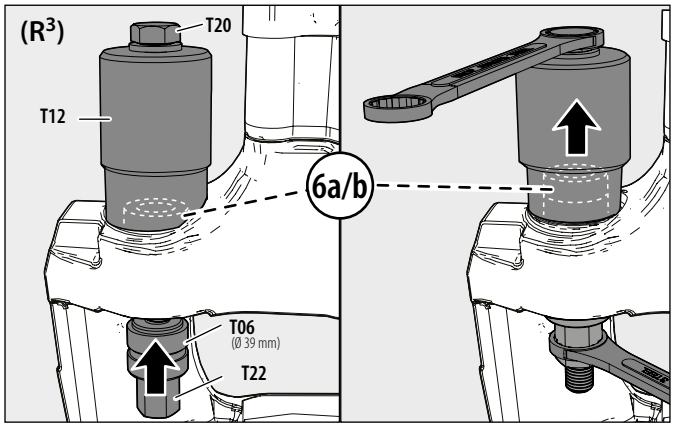
Note: *The tab can be found positioned either left or right in the caliper bore.*



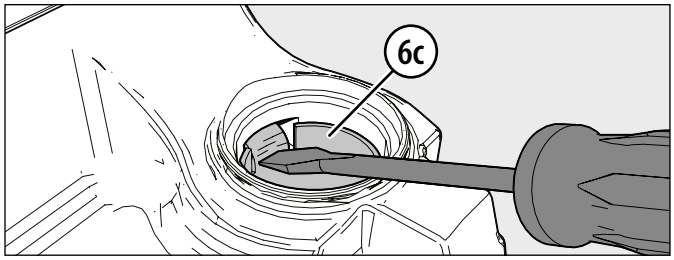
9.3c - Tool combination (**C**)



9.3.1.4a - 9.3.1.5a - Removal of guide sleeve (6a or 6b) pre 09/2015



9.3.1.4b - 9.3.1.5b - Removal of guide sleeve (6a or 6b) post 09/2015



9.3.2.3 - 9.3.2.4 - Breaking off the tab from guide sleeve (6c)

9.3.2.5 Clean the area around the bearing and brake pads.

For brakes with a manufacturing date before 09/2015

9.3.2.6 Position the tool (**N[1]**) as shown (see Fig.).

9.3.2.7 Hand tighten (T14).

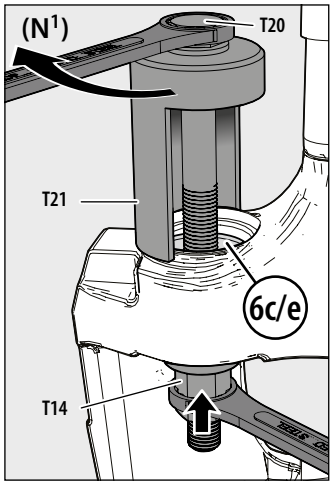
9.3.2.8 Hold (T14) using a ring spanner 24 A/F and ease out the guide sleeve (6c or 6e) by turning tool (T20) with a suitable tool (see Fig.).

For brakes with a manufacturing date after 09/2015

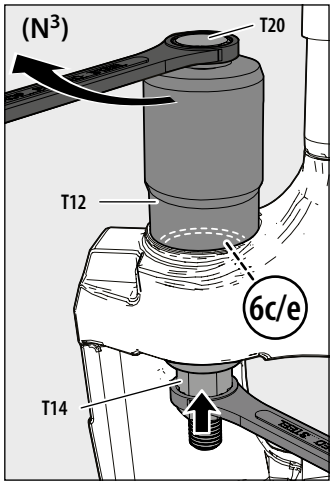
9.3.2.6 Position the tool (**N[3]**) as shown (see Fig.).

9.3.2.7 Hand tighten (T14).

9.3.2.8 Hold (T14) using a ring spanner 24 A/F and ease out the guide sleeve (6c or 6e) by turning tool (T20) with a suitable tool (see Fig.).



9.3.2.6 - 9.3.2.8 -Removal of guide sleeve (6c or 6e) before 09/2015



9.3.2.6 - 9.3.2.8 -Removal of guide sleeve (6c or 6e) after 09/2015

9.3.3 Removal of Guide Sleeve (6d Capped Rubber Sleeve) Floating Bearing

***Note**: Capped rubber sleeve (6d) is removed when the cover (68d) is removed. If not, then follow the removal procedure as described in 9.3.2.*

9.3.4 Removal of Guide Sleeve (6f Short Rubber Sleeve or 6g Long Rubber Sleeve) Floating Bearing

Remove by hand the Short Rubber Sleeve (6f) or Long Rubber Sleeve (6g) from the bearing.

9.3.5 Fitting of Guide Sleeve (6a Rubber Bush or 6b Open Bearing) Floating Bearing

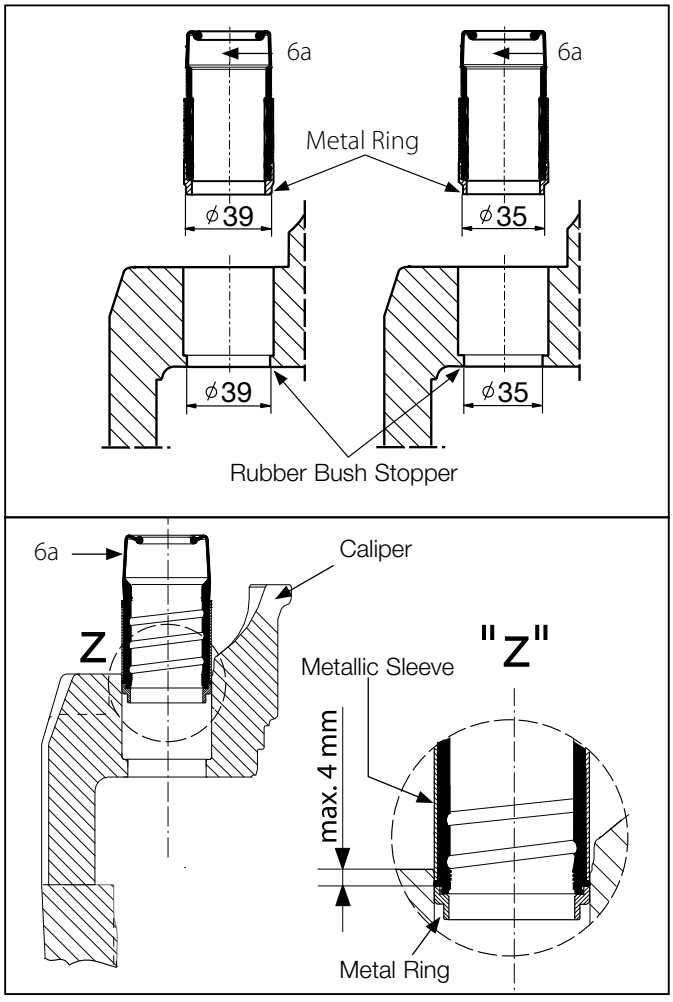
9.3.5.1 Check bore for corrosion and if necessary clean it.

Rubber Bush (6a) exists in two different versions.

Make sure, that the diameter (ø) of the Metal Ring is the same as the diameter (ø) of the rubber bush stopper.

⚠ *If the wrong Rubber Bush (6a) is fitted, it can become loose, affect the caliper movement along the guide pins and reduce the braking force.*

Insert Metal Ring of the Rubber Bush (6a or 6b) into the caliper bore.



9.3.5.1 -Inserting Guide Sleeve 6a/6b

9 CALIPER BEARINGS REPLACEMENT

9.3.5.2 Wind out the grub screw (from (T19) on the tool (**R²**) so it cannot contact the caliper surface (see Fig. insert).

9.3.5.3 Push rubber bush (6a) or open bearing (6b) into (T18) of tool (**R²**) (see Fig.).

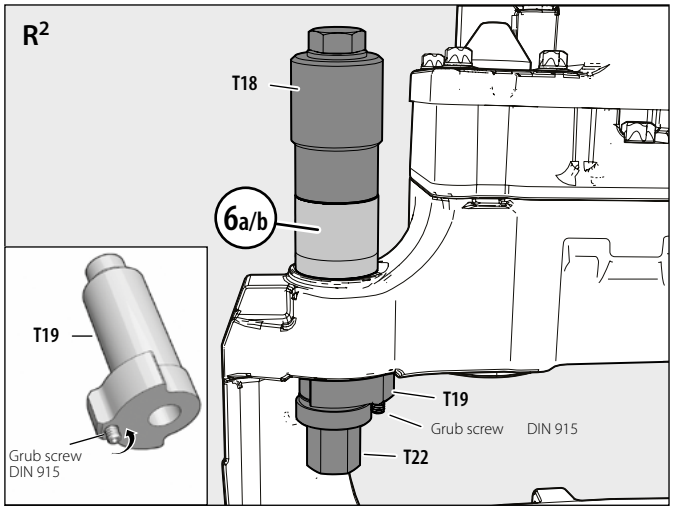
9.3.5.4 Place tool (**R²**) with assembled rubber bush (6a) or open bearing (6b) in position on the caliper as shown (see Fig.).

9.3.5.5 Hand tighten (T22).

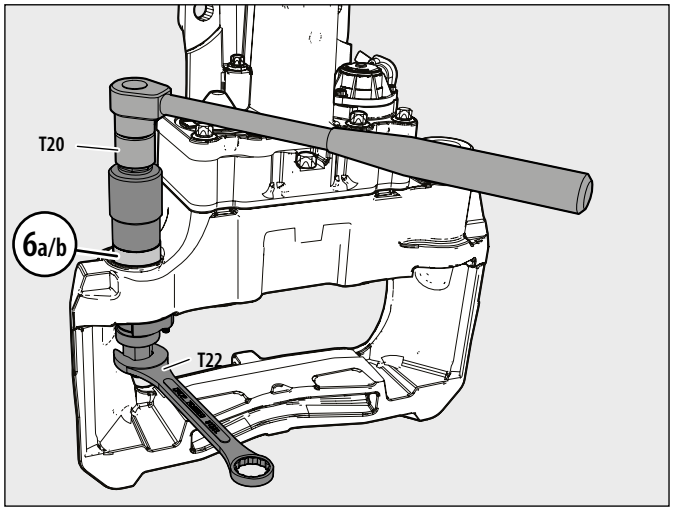
Note: *Take care not to tilt the rubber bush (6a) or open bearing (6b) when winding in.*

9.3.5.6 Stabilise (T22) using an open spanner 24 A/F and using a torque wrench (**max. 45 Nm**) turn (T20) to pull-in the rubber bush (6a) or (6b) until it stops (see Fig.).

⚠ *If the torque is **< 8 Nm** or **> 45 Nm**, then the caliper must be replaced.*



9.3.5.3 - 9.3.5.5- Rubber bush and tool combination (**R²**) in situ



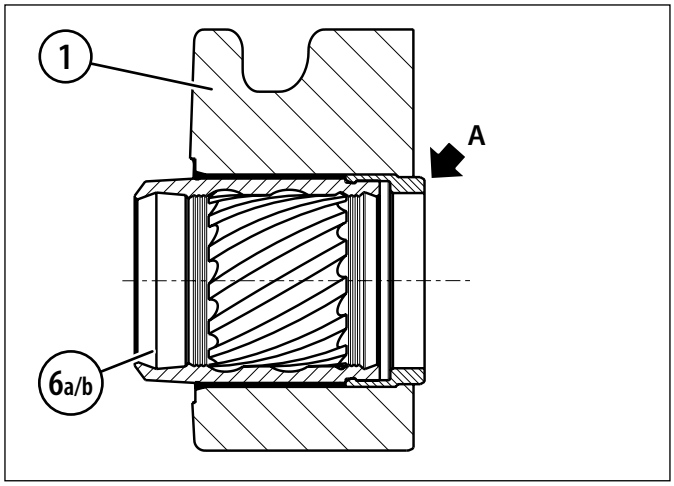
9.3.5.6 - Pull-in guide sleeve - max. torque **45 Nm**

9.3.5.7 Remove tool (**R²**).

9.3.5.8 Check that the metal ring of the rubber bush (6a) or open bearing (6b) does not move (see Fig. arrow **A**).

When checking for movement, ensure that the sealing elements are not damaged.

9.3.5.9 Grease inside the rubber bush (6a) or open bearing (6b) with white grease (Part No. II14525, K93430 or II32868).



9.3.5.8 - Check metal ring of guide sleeve

9.3.6 Fitting of Guide Sleeve (6c - Guide Sleeve)

The guide sleeve (6c) must be positioned so that its tab and the groove in the caliper bore are aligned.

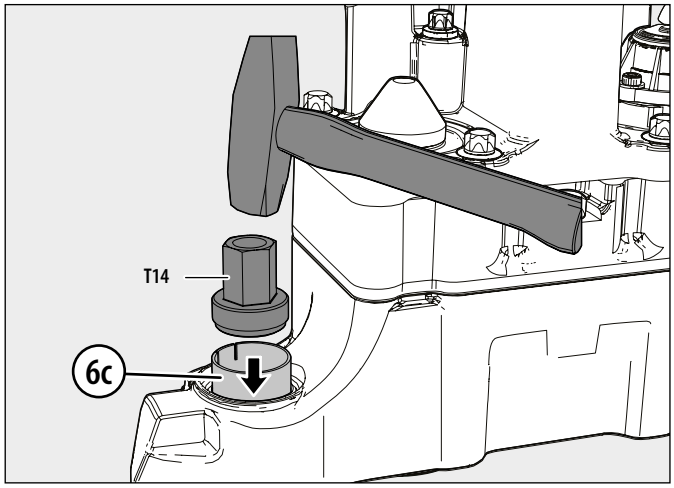
Note: *Caliper groove can be on the left or right side of the caliper bore.*

9.3.6.1 Place (T14) onto the aligned guide sleeve (6c) and lightly tap with a hammer to make sure it is seated correctly in the caliper bore (see Fig.).

9.3.6.2 Complete the positioning of tool (**N²**) through the caliper bore and guide sleeve (6c) (see Fig.).

9.3.6.3 Hand tighten spindle (T20).

9.3.6.4 Stabilise spindle (T20) using a ring spanner on (T14) and by using a torque wrench (**max. 18 Nm**) turn the spindle (T20) to pull-in the guide sleeve (6c) until it stops (see Fig.).

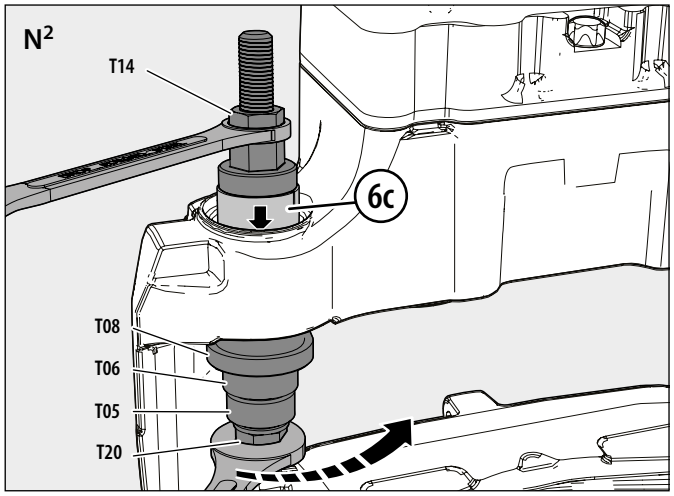


9.3.6.1 - Guide sleeve (6c) lightly tapped in position

*If the torque value is **< 4 Nm** or **> 18 Nm**, the caliper must be replaced.*

Do not turn (T14) as this may cause the guide sleeve (6c) to turn and lose its alignment with the groove in the caliper bore.

Remove all assembly tools.

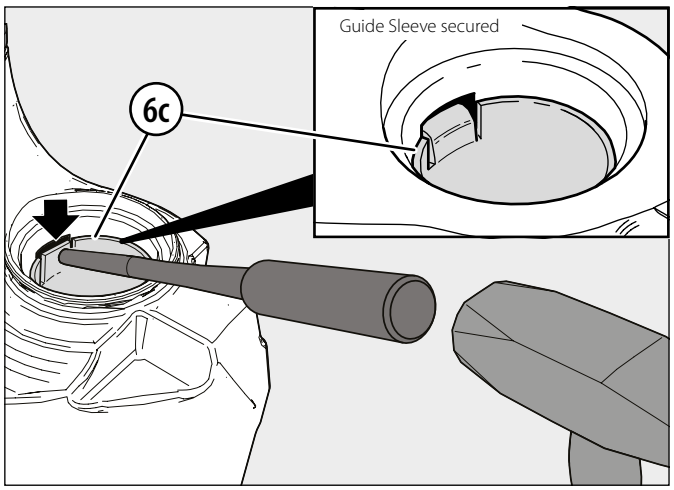


9.3.6.2 - 9.3.6.4 tool combination (**N²**) in position

9.3.6.5 Press in the tab of the Guide Sleeve (6c) using a punch or similar tool whose width is smaller than the tab. Place the punch as close as possible to the top of the tab and, using a hammer, bend the tab into the groove of the caliper (see fig.).

9.3.6.6 The guide sleeve (6c) is now secured against rotational and axial movement.

Grease inside the guide sleeve (6c) with white grease (Part No. II14525, K093430 or II32868).



9.3.6.5 - press in the tab of the guide sleeve

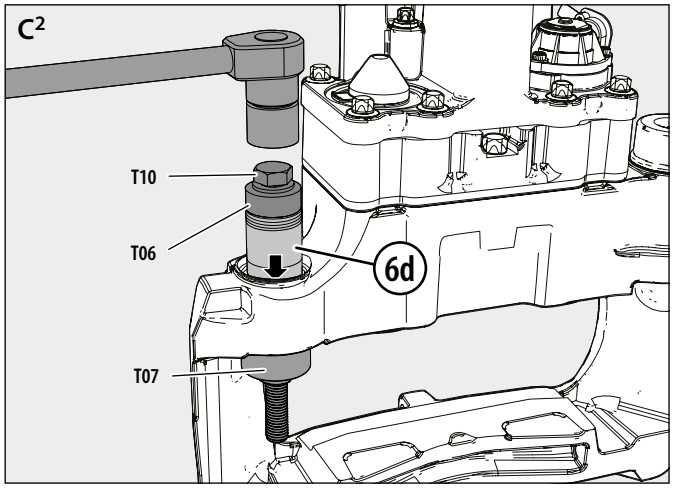
9.3.7 Fitting of Guide Sleeve (6d - Capped Rubber Sleeve)

9.3.7.1 Clean the area around the bearing.

9.3.7.2 Place capped rubber sleeve (6d) onto (T06) of tool (**C²**) and place in position on caliper bore.

9.3.7.3 Bring the rest of tool (**C**) into position as shown (see Fig.).

9.3.7.4 Using a torque wrench turn (T10) to pull-in (6d) until it stops with a torque between **8 Nm - 30 Nm** (see Fig.).



9.3.7.3 - 9.3.7.4 Tool combination (**C²**) in position

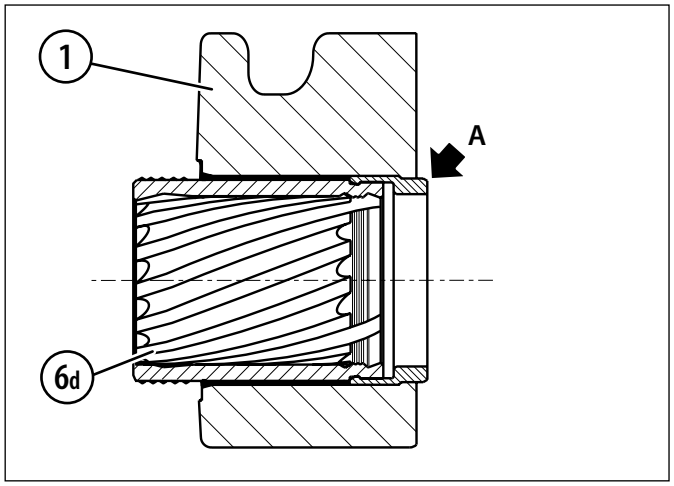
If the torque value is **< 8 Nm or > 30 Nm** *the caliper must be replaced.*

9.3.7.5 Remove tool (**C²**)

9.3.7.6 Check that the metal ring of the capped rubber sleeve (6d) cannot move (see Fig. arrow **A**).

When checking for movement, ensure that the sealing elements of the capped rubber sleeve (6d) are not damaged.

9.3.7.7 Grease inside the capped rubber sleeve (6d) with white grease (Part No. II14525, K93430 or II32868).



9.3.7.6 - Check metal ring of capped rubber sleeve

9.3.8 Fitting of Guide Sleeve (6e - Guide Sleeve)

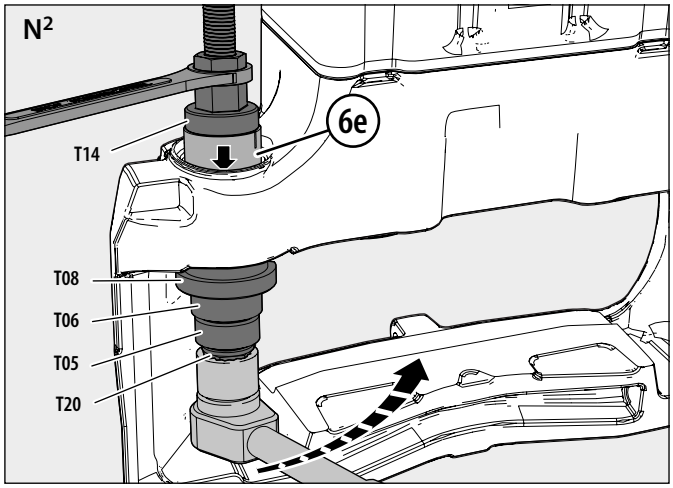
9.3.8.1 Place guide sleeve (6e) onto position on the caliper bore and place (T14) onto the aligned guide sleeve (6e).

9.3.8.2 Complete the positioning of tool (**N²**) through the caliper bore, so that spindle (T20) passes through the guide sleeve (6e) and into (T14) (see Fig.).

9.3.8.3 Hand tighten spindle (T20).

9.3.8.4 Stabilise spindle (T20) using a ring spanner on (T14) and by using a torque wrench (**max. 25 Nm**) turn the spindle (T20) to pull-in the guide sleeve (6e) until it stops (see Fig.).

⚠ *If the torque value is **< 4 Nm or > 25 Nm**, the caliper must be replaced.*



9.3.8.2- 9.3.8.4 - Fit guide sleeve using tool combination (**N²**)

9.3.8.5 Remove all assembly tools.

9.3.8.6 Apply **white** grease (Part No. II14525, II32868 or K093430) inside the guide sleeve (6e).

9.3.9 Fitting of Short (6f) or Long (6g) Rubber Sleeve

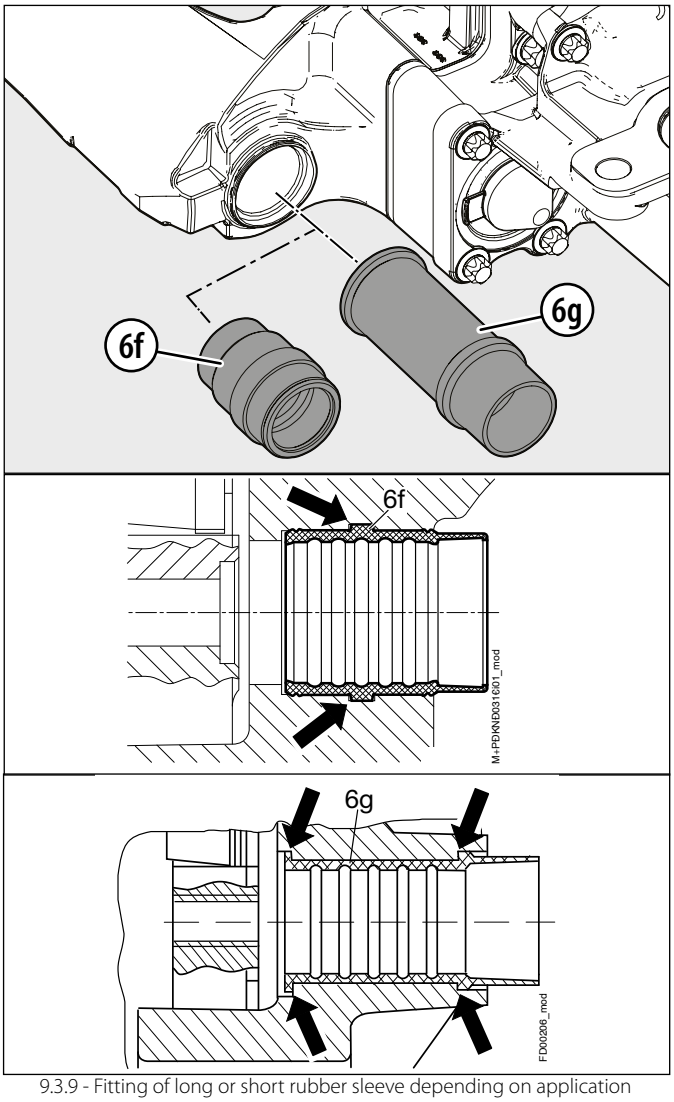
Note: *Depending on application, either the Short (6f) or Long (6g) Rubber Sleeve is fitted. The two variants are **not** interchangeable (see Fig. 9.3.9).*

Inspect the bore for corrosion. If necessary clean and then protect it using an appropriate corrosion protector.

Note: *Apply **green** grease (Part No. II32793 or Z000046) to the inside of the rubber sleeve (6f) or (6g).*

⚠ *The mineral based white grease **must not** be used for the rubber sleeve (6f) or (6g). Only the green grease is permitted (Part No. II32793 or Z000046).*

Lightly squeeze the rubber sleeve to allow it to be pushed into the bore of the caliper. Make sure it is pushed correctly into position and locked into place at the respective areas (see arrows Fig. 9.3.9).



9.3.9 - Fitting of long or short rubber sleeve depending on application

9.4 Fitting of Inner Boot (9a or 9b) Fixed Bearing or (9c, 9d, or 9e) Floating Bearing

For ease of reference, each component of a tool is referred to by an identification number; a complete tool (containing one or more such components) has been given a letter code - see section 2.1.

9.4.1 To fit the red coloured inner boot (9a, 9b, 9c or 9e) use the pull-in tool (**C¹**) containing (T08).

For the black coloured inner boot (9d), use pull-in tool (**C²**) containing (T06).

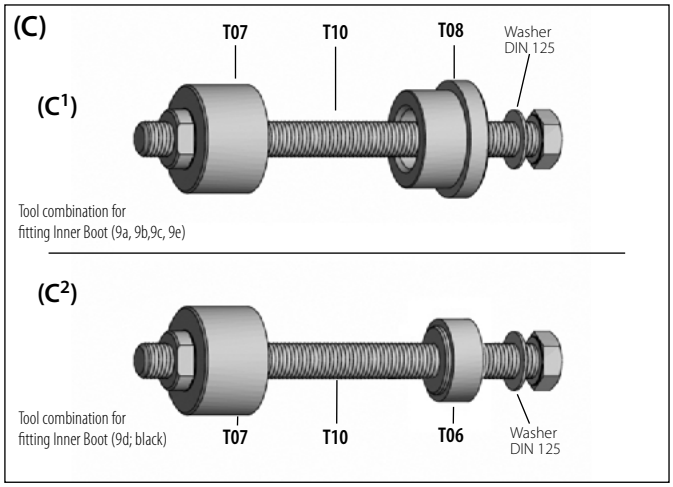
Note: *The following shows only the process for the fixed bearing side, but the assembly of the inner boot (9) is the same principle whether for the floating or fixed bearing side.*

9.4.2 The contact surface of the boot (9) on the guide pin (5) and the caliper (1) must be clean and free of lubrication.

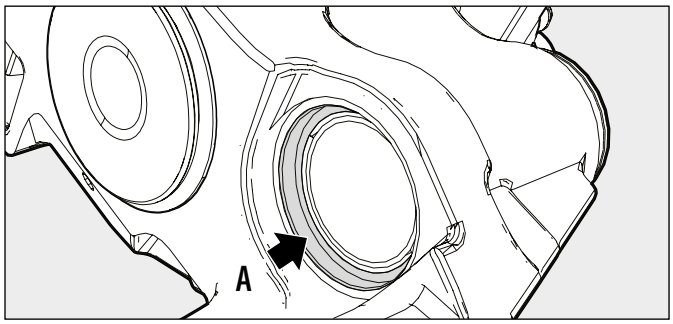
9.4.3 Check the sealing face of inner boot (9) for damage or corrosion (see Fig. arrow A).

9.4.4 Fit new inner boot (9) into sleeve (T07) of tool (**C¹** or **C²**). Make sure the rubber folds of the boot sit inside the tool (See Fig. arrow B).

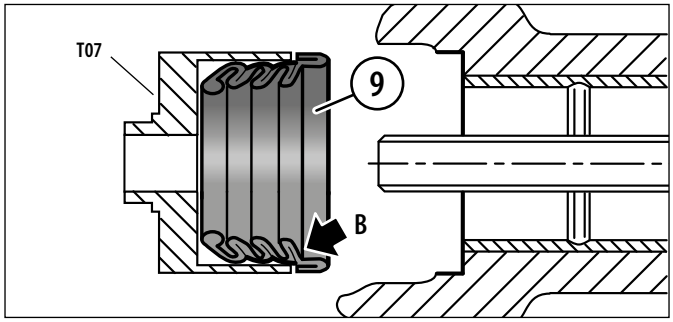
9.4.5 Position sleeve (T07) of tool (**C¹** or **C²**) into the caliper bearing bore. Then attach the assembled sleeve (T07) with inner boot (9), pulling-in firstly by hand by turning tool (T10) (see Fig.).



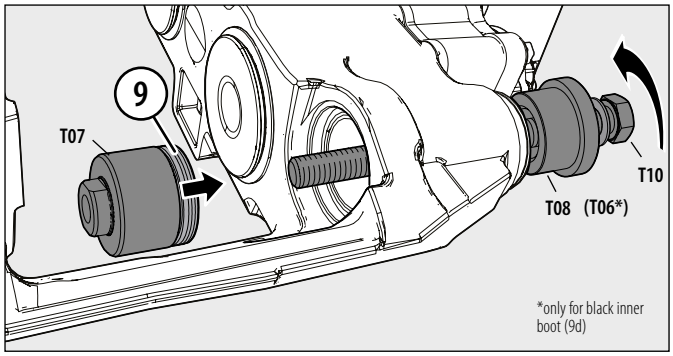
9.4.1 - Tool combination (**C**)



9.4.3 - check for corrosion and damage

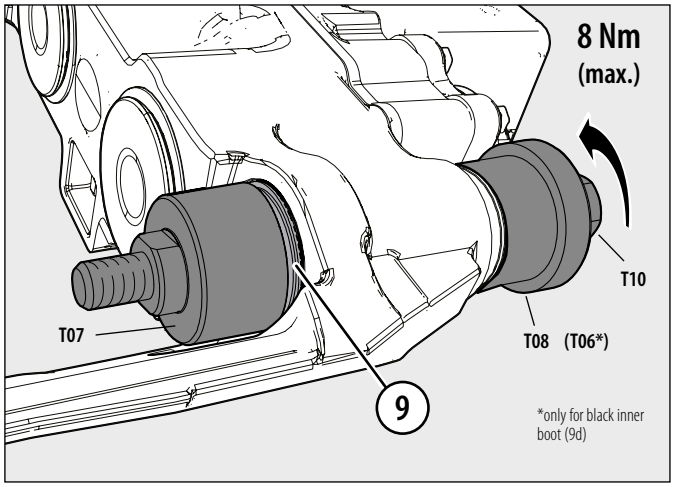


9.4.4 - Insert inner boot (9) in tool (T07)



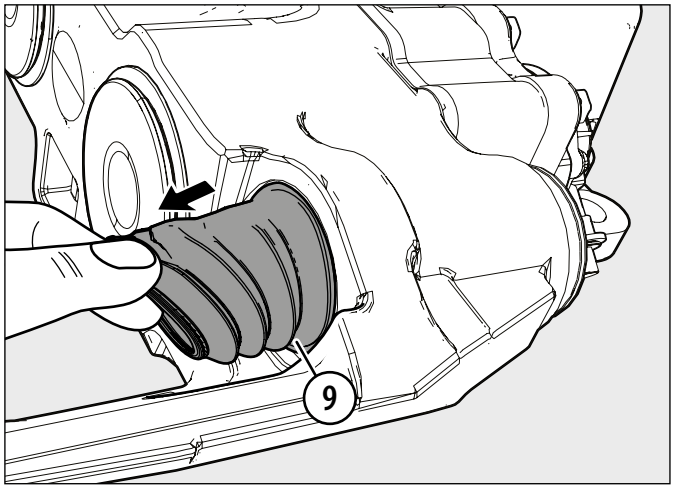
9.4.5 - Position tool (**C¹ or C²**) in the caliper bore and tighten by hand

9.4.6 Then, pull-in with a maximum torque of **8 Nm** (see Fig.).



9.4.6 - Pull-in with max. 8 Nm

9.4.7 Check correct fitment of inner boot (9) by carrying out a pulling test (see Fig.).

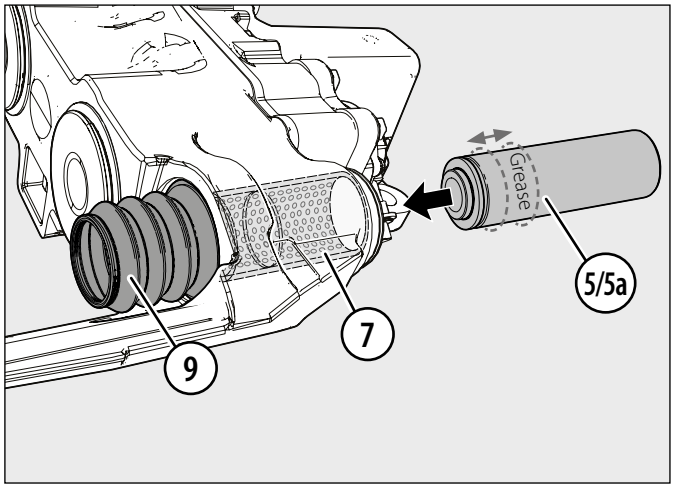


9.4.7 -Carry out pulling test on inner boot

9.5 Fitting of Guide Pin (5 or 5a) Fixed Bearing

9.5.1 Completely cover the inside of brass bush (7) with white grease and in the area on the guide pin (5 or 5a) as shown (Part No. II14525 , K093430 or II32868). Make sure the grease pockets of the brass bush (7) are filled (see Fig.).

9.5.2 Fit guide pin (5 or 5a) from outside the caliper into the caliper bore (see Fig.).



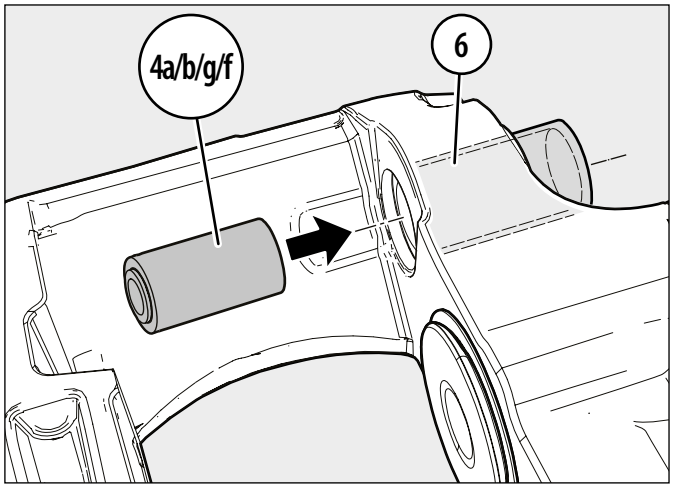
9.5.1 - 9.5.2 - Fit guide pin from outside

9.6 Fitting of Guide Pin (4a, 4b, 4c, 4d or 4e) Floating Bearing

9.6.1 Grease inside of all guide sleeve (6) variants according to the grease application table - see Section 1.1.2.

9.6.2 With bearing variant (6a; Rubber Bush); (6b; open bearing); (6f short rubber sleeve) or (6g long rubber sleeve):

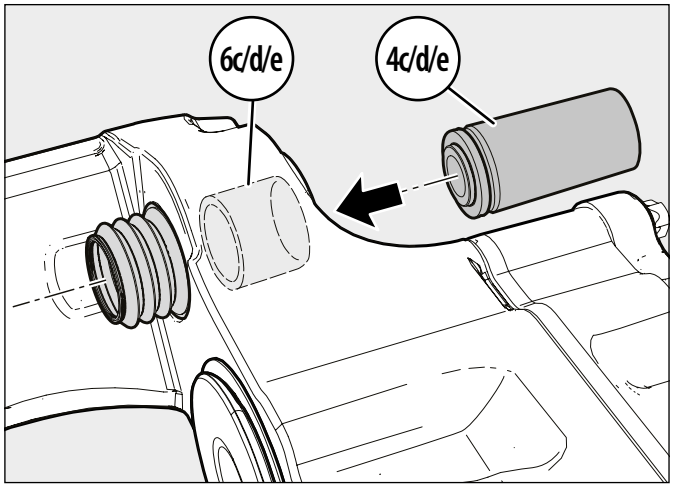
Fit guide pin (4a, 4b, 4g and 4f) from inside the caliper into the caliper bore (see Fig.).



9.6.1 - 9.6.2 - Fit guide pin from inside caliper

9.6.3 With bearing variant (6c, 6e; guide sleeve and 6d; capped rubber sleeve):

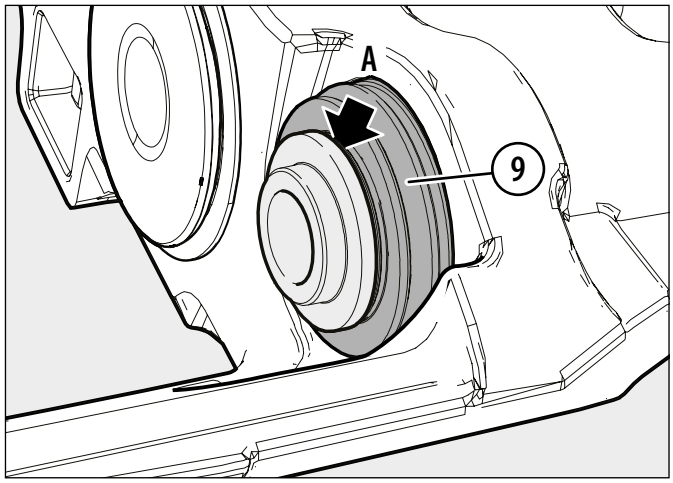
Fit guide pin (4c, 4d or 4e) from outside the caliper into the caliper bore (see Fig.).



9.6.3 - Fit guide pin from outside caliper

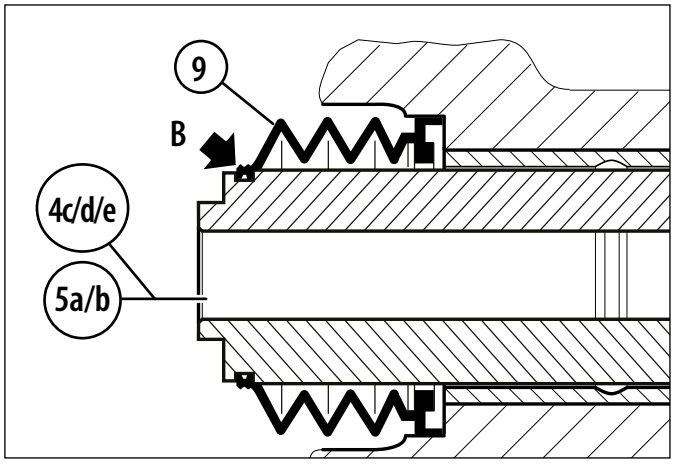
9.7 Engage Inner Boot (9) into Guide Pin (4c, 4d or 4e) Floating Bearing or (5, 5a or 5b) Fixed Bearing

9.7.1 The lip end of the inner boot (9) must engage in the groove of the respective guide pin variant (see Fig. arrow **A**).



9.7.1 - Lip of inner boot engages in groove on guide pin (arrow **A**)

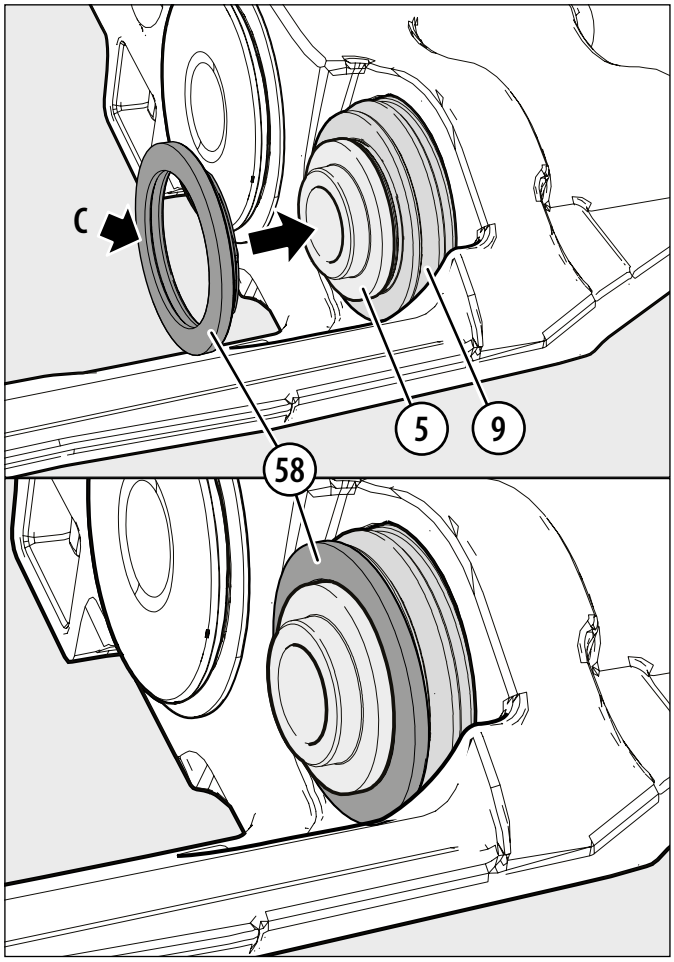
9.7.2 Make sure the lip of inner boot (9) has fully engaged right round the guide pin and is not twisted (see Fig. arrow **B**).



9.7.2 - Check complete engagement

9.7.3 Push on the ring (58) to secure engagement of inner boot (9) on guide pin (4 and/or 5) (see Fig.).

*The smooth face of the ring i.e. no lip (arrow **C**), must face towards the brake carrier i.e. away from inner boot (9).*



9.7.3 - Push on ring to secure boot in groove of guide pin

9.7.4 Fit brake caliper to carrier (see Section 8.2).

10. CARRIER REPLACEMENT

Depending on the installation, it may be possible to remove the caliper from the carrier and replace the carrier in situ. Else it may be necessary or more convenient to remove the complete carrier/calliper assembly from the vehicle where it can be separated and the carrier replaced.
Note: *The disc brake is very heavy, take great care in handling!*
Do not fasten any lifting device to the pad retainer (11) since this can be damaged.

⚠ *Use only new parts from the guide and seal kit when fitting the caliper to the carrier. This is not supplied with the caliper and must be ordered separately.*

Note: *The carrier is fitted to the vehicle according to the vehicle manufacturer's specifications and with bolts supplied by the vehicle manufacturer – they are not available from Knorr-Bremse.*

See section 8 as applicable:

Either:

10.1 Remove caliper from carrier (see Section 8).

10.2 Replace carrier – ensure new bolts and correct torques are used. Note, bolts to fit the calliper to the axle are not supplied by Knorr-Bremse but from the vehicle manufacturer. Refer to the vehicle manufacturer's fitting instructions and torque values.

10.3 Refit caliper to carrier (see Section 8).

Or:

10.1 Remove the complete caliper/carrier assembly.

10.2 Replace carrier (see Section 8).

10.3 Refit the complete caliper/carrier assembly – ensure new bolts and correct torques are used.

11. BRAKE ACTUATOR REPLACEMENT

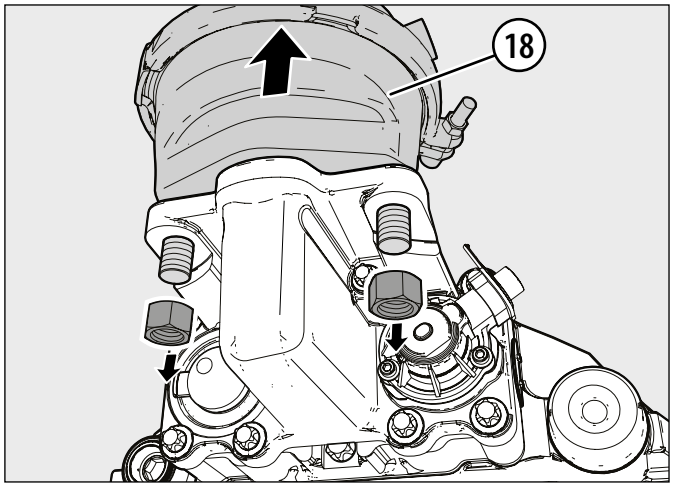
Note: *All references to brake actuators (brake chambers and spring brakes) in this section refer to Knorr-Bremse brake actuators. For other brake actuator manufacturers, follow their respective instructions.*

11.1 Removal of Knorr-Bremse Brake Chamber

11.1.1 Disconnect air connection from brake chamber (18) – **take care, air connection must be free of air pressure!**

11.1.2 Unscrew brake chamber mounting nuts and remove brake chamber (18) (see arrows in Fig.).

It is not allowed to reuse the nuts of the brake chamber (18).



11.1.2 - Brake chamber removal

11.2 Fitting of Knorr-Bremse Brake Chamber

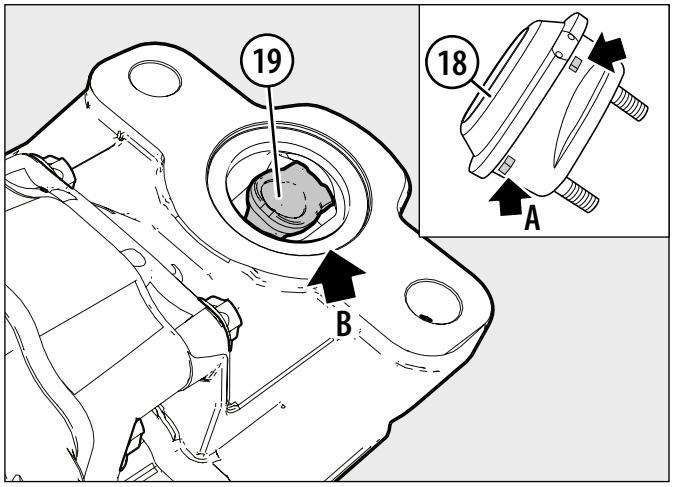
Note: *New brake chambers (18) have drain plugs installed (see arrow **A**). Remove lowest plug (as viewed when brake chamber is installed). All other drain holes should be plugged (refer to the vehicle manufacturer's recommendations).*

11.2.1 The sealing surface and the flange surface (see Fig. arrow **B**) must be:

- free from dust and corrosion
- free from damage
- flat

Take care that no dirt enters the brake caliper!

11.2.2 Before fitting the new brake chamber, the spherical cup (19) of the lever and the sealing surface of the caliper must be greased with white grease (Part No. II14525, K093430 or II32868).



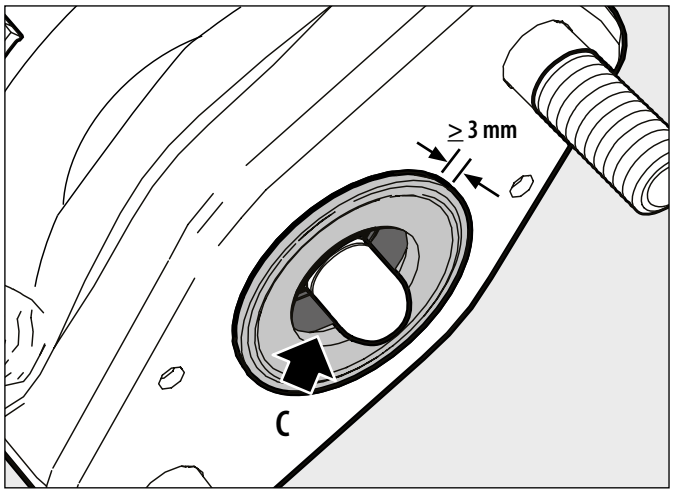
11.2.1 - 11.2.2 - Check seal and flange surface of caliper, grease spherical cup and flange surface

Do not use grease containing molybdenum disulphide. Use only actuators which are recommended by the vehicle manufacturer.

11.2.3. The seal, as well as the push rod area of the brake chamber (18) (see arrow **C**) must be clean and free of lubrication.

The seal must not show any signs of damage.

Note, if the brake chamber's seal protrudes less than **3 mm** the brake chamber must be replaced (see Fig.).



11.2.3 - Check seal, min. **3 mm**

11.2.4 Attach brake chamber using new nuts (see Fig.).

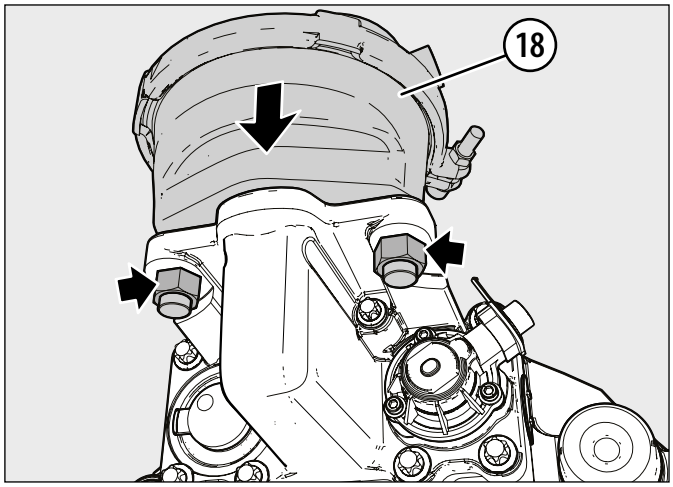
In order not to tilt the brake chamber during its attachment, the nuts must be gradually tightened symmetrically with a suitable tool.

11.2.5 Tighten the nuts according to the specifications of the actuator manufacturer.
Note: *only use new self-locking nuts.*

11.2.6 Connect the compressed air hose, making sure it is not twisted and chafing is not possible.

11.2.7 Check air connection for leakage.

⚠ *Check function and effectiveness of the service brake system.*



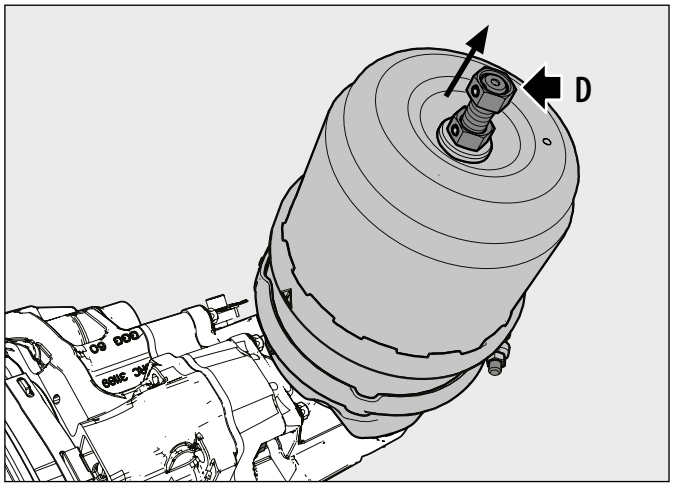
11.2.4 - Attach brake chamber

11.3 Removal of Knorr-Bremse Spring Brake

⚠ *Chock wheels before releasing spring brake to ensure the vehicle cannot roll away.*

11.3.1 Release parking brake.

11.3.2 Screw-out release bolt (arrow **D**) to the release position (refer to the vehicle manufacturer's recommendations) (see Fig.).



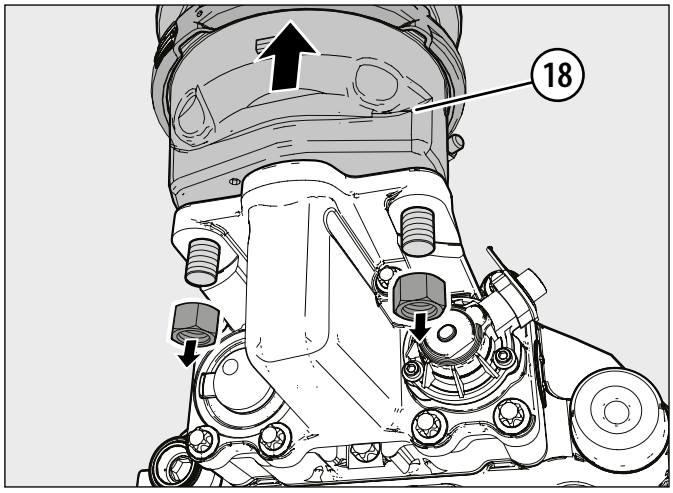
11.3.2 - Screw out release bolt

11.3.3 Apply parking brake.

11.3.4 Disconnect air connections from spring brake (18) – **take care**, **air connections must be free of air pressure**.

11.3.5 Unscrew spring brake mounting nuts (see arrows) and remove the spring brake (18) (see Fig.).

⚠ *It is not allowed to reuse the nuts of the spring brake (18).*



11.3.5 - Knorr-Bremse spring brake removal

11.4 Fitting of Knorr-Bremse Spring Brake

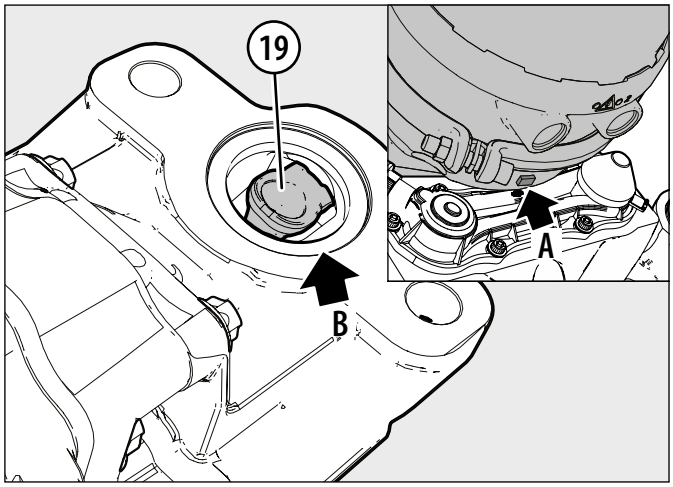
Note: *New spring brakes (18) have drain plugs installed (see arrow **A**). Remove lowest plug (as viewed when spring brake is installed). All other drain holes should be plugged. Refer to the vehicle manufacturer's recommendations.*

11.4.1 The sealing surface and the flange surface (see Fig. arrow **B**) must be:

- free from dust and corrosion
- free from damage
- flat

Take care that no dirt enters the brake caliper!

11.4.2 Before fitting the new spring brake, the spherical cup (19) in the lever and the sealing surface must be greased with **white grease** (Part No. II14525, K093430 or II32868).



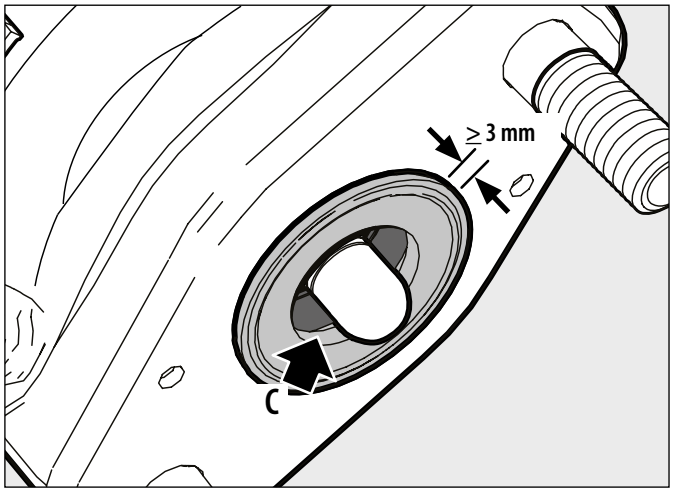
11.4.1 - 11.4.2 - Check seal and flange surface of caliper, grease spherical cup

⚠ *Do not use grease containing molybdenum disulphide. Use only actuators which are recommended by the vehicle manufacturer.*

11.4.3 The seal, as well as the push rod area of the spring brake (18) (see arrow **C**) must be clean and free of lubrication.

The seal must not show any signs of damage.

Note, if the spring brake's seal protrudes less than **3 mm** the spring brake must be replaced (see Fig.).



11.4.3 - Check seal, min. **3 mm**

11.4.4 Attach the spring brake using new nuts (see Fig.).
Note: *In order not to tilt the spring brake during its attachment, the nuts must be gradually tightened symmetrically with a suitable tool.*

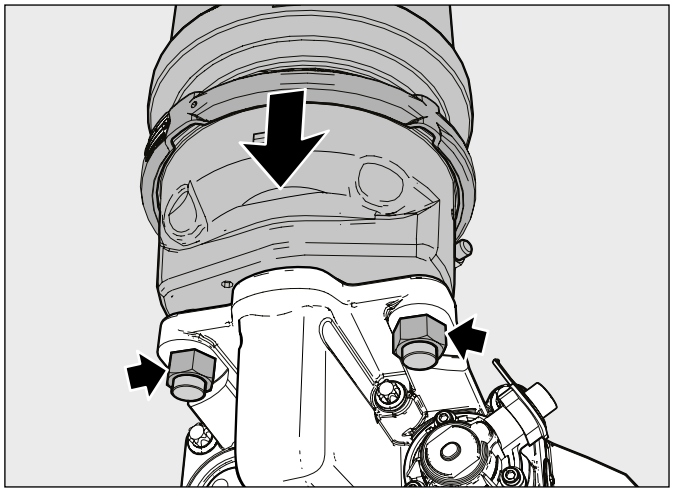
11.4.5 Tighten the nuts according to the specifications of the actuator manufacturer.
Note: *Only use new nuts.*

11.4.6 Connect the compressed air hose, making sure it is not twisted and chafing is not possible.

11.4.7 Release parking brake.

11.4.8 Screw in spring brake release bolt as per instructions on the spring brake itself.

11.4.9 Check air connections for leakage.



11.4.4 - Knorr-Bremse spring brake fitting

⚠ *Check function and effectiveness of the service brake system and parking brake system.*

CITIPORT



WORKSHOP MANUAL

Pan19 Disc Brakes

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1 Important instructions and safety instructions

1.1 General information

This publication describes maintenance and repair of the disc brakes PAN®19 including the individual operations and work processes required to replace components using available repair kits.

This publication is directed at trained service technicians employed at workshops for commercial vehicles.

– Before you begin with maintenance, repair, replacing a part etc., carefully read all the safety instructions as well as the repair and maintenance instructions included this publication. These instructions must be observed to avoid personal injury or material damage.
– WABCO only guarantees the safety, reliability and performance of its products and systems if all instructions, notes and safety instructions are observed.

Before you perform any work on the vehicle (repair, maintenance, replacing parts, etc.), you must ensure the following:

– Only trained and qualified personnel may perform repairs on the vehicle.
– Always follow the specifications and instructions of the axle or vehicle manufacturer.
– Always comply with the Company and national accident prevention guidelines and Health and Safety regulations.
– Wear suitable protective clothing as the situation requires.
– The workplace has to be dry, as well as sufficiently lit and ventilated.

1.2 Safety information

1.2.1 Danger of accidents

Warning! Reduced braking effect or brake failure

– Regularly check the wear limits of brake linings and brake discs.
– Replace worn, scorched, glazed, or oily brake linings immediately.
– Immediately replace worn or damaged brake discs.
– Always replace brake linings by axle and use a new retaining system for brake linings and pressure plates.

WARNING!
Rolling vehicle

– Position the vehicle on an even surface and secure it against rolling away with brake wedges.
– Only use approved devices to jack up and secure the vehicle.
– Make sure that the transmission is in neutral and the park brake has been applied.

WARNING!
Rolling vehicle

– Make sure that the release screw of the spring brake cylinder is threaded completely in after completing the maintenance and installation work and check the functionality of the parking brake.

1.2.2 Risk of injury

CAUTION!
Hazardous dusts

– Do not clean any soiled areas of the brake with compressed air or other high-pressure devices.

CAUTION!
Heavy load

– A second technician must assist during removal and installation of the brake.

CAUTION! Brake action while working on the brake

– Attach a clearly marked note on the steering wheel saying that work is being performed on the vehicle and that the brake must not be touched.

CAUTION!
Crushing of fingers

– Only grip the brake on the outside with your hands while moving the brake calliper or working on the brake.
– **Do not use motor-driven screw or torque tools!**

CAUTION! Falling brake parts and high tightening and loosening torques

– Use suitable equipment, such as a vice, to clamp the brake when performing repairs on the brake outside the vehicle.

1.3 Repair and maintenance instructions

For good handling and good braking characteristics it is essential that the disc brake is in flawless technical condition.

– If cast parts have been heavily damaged or are severely worn, (cracks for example), replace the entire brake following the instructions.

– Never use the lining retainer (38) as a grab handle or for fastening a lifting device, because the retainer can be damaged in the process.

– **Do not open the brake calliper with the clamping unit, and do not unscrew the fastening screws on the brake calliper cover.**

– Do not apply the brake when brake linings have been removed.

– Do not use compressed air or other high-pressure devices when cleaning the brake or the vehicle. This may result in the risk of personal injury or hazardous dusts. Rubber parts of the brake could also be damaged.

– Only use original WABCO parts and approved brake linings and retaining systems for brake linings and pressure plates. An exploded view of replacement parts is found in the annex of this document (see chapter 8.3 „Exploded view of the replacement parts“, page36).

– Only use grease contained in the repair kits.

– Perform the repair work using only the recommended tools (see chapter 8.1 „WABCO tools“, page33). **Do not use motor-driven screw or torque tools!**

– Tighten screws and nuts only with the specified spanners, applying only the specified tightening torque; refer to the table in Annex (see chapter 8.2 „Widths across flats and tightening torques“, page34) for the corresponding positions.

– Perform a concluding roller test stand test having completed the repairs. If no roller test stand is available, conduct a test drive with brake action tests.

– Do not perform full braking, with the exception of emergency braking, during the first 50 km after new brake linings have been fitted. Also avoid continuous braking over longer periods. Ensure that the driver of the vehicle is informed.

2 Description of the mechanical sliding calliper disc brake

The PAN®19 brake is a pneumatic one-piston brake. It is designed for use in commercial vehicles and trailers on front and rear axle as service, auxiliary and parking brakes for 19.5" and 22.5" wheel rims. It is actuated mechanically via a diaphragm brake cylinder or a spring brake actuator. The latter is fitted directly onto the brake calliper, thereby reducing the overall axial length of the brake. This enables optimal utilisation of the installation situations.

The entire disc brake consists of brake cylinder, brake calliper (1), and brake anchor plate (2).

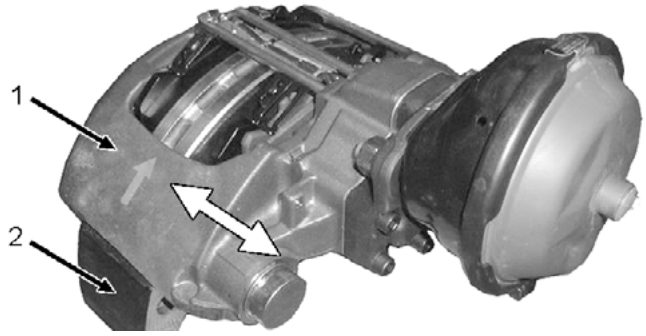


Fig. Entire disc brake

1 Brake calliper

2 Brake anchor plate

Arrow Brake calliper shifting directions

Functional description

More information is provided in the illustrations below.

Axial movement of the brake calliper (1) occurs on the guide pins (8, 9) of the brake carrier (2). The brake linings (35, 36) are guided and supported axially movable in the brake carrier. The brake lining support is implemented by means of a retainer (38) and hold-down springs (37).

The radially open design of the brake calliper enables simple and quick brake lining replacements. Linings with a large wear volume are used in order to prolong the replacement intervals.

For compensating the pad wear the actuating mechanism of the brake is equipped with a force-dependent, stageless, automatic adjuster mechanism. This mechanism maintains a preset clearance regardless of load and operating conditions. This, together with the stable and stiff construction of the brake calliper, results in safe control of the pedal travel and increases the reserve of travel for emergency braking.

All rubber parts and the grease fillings are maintenance-free except when damaged.

The disc brake is optionally equipped with an electrical wear indicator (threshold indicator).

When the indicator in the vehicle lights up, the residual lining thickness has been reached. It is necessary to drive the vehicle to a workshop for the brake linings to be replaced.

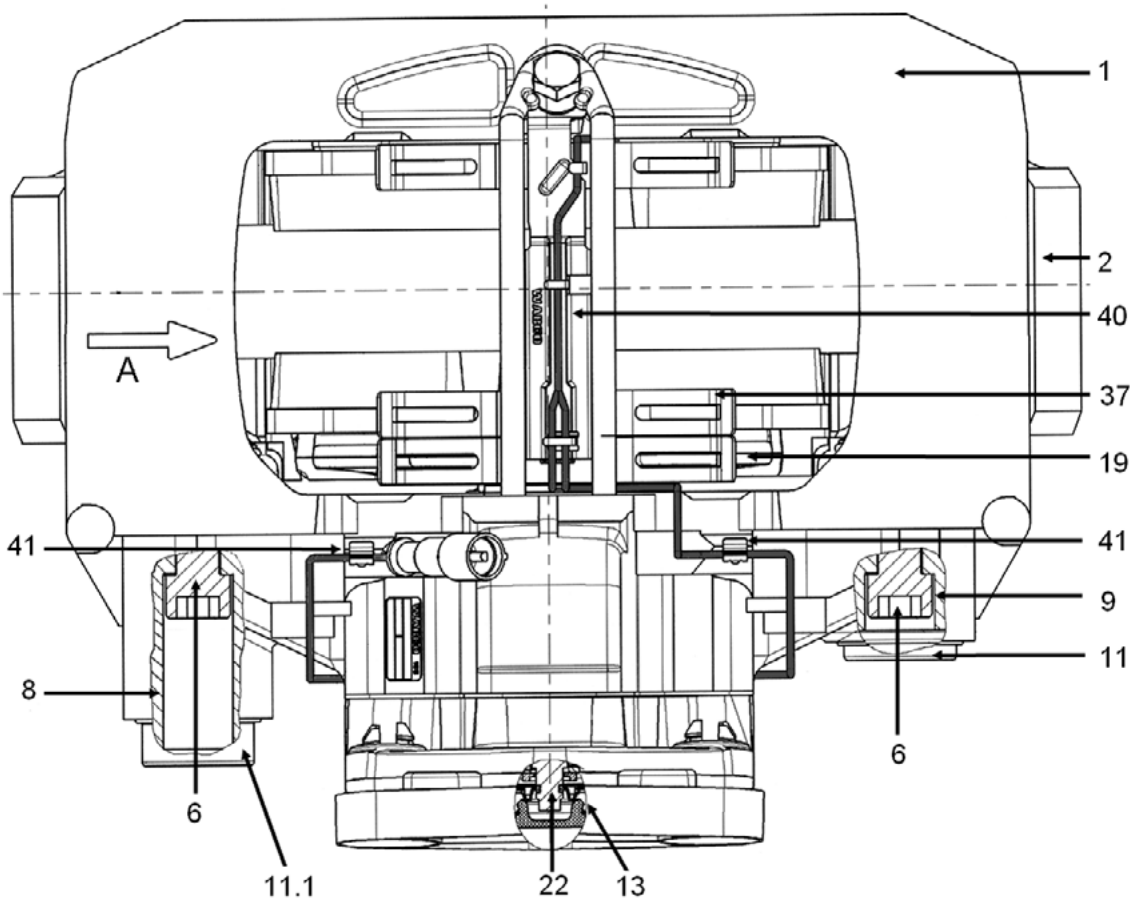


Fig. Top view and sectional view (left brake)

1	Brake calliper
2	Brake anchor plate
6	Hexagon socket screw
8	Guide pin (long)
9	Guide pin (short)
11	Closing cover (short)
11.1	Closing cover (long)
13	Protection cap of the adjuster
19	Spreader plate
22	Hexagon of the adjuster
37	Hold-down spring
40	Cable guide with wear indicator
41	Retaining clip
A	Forward driving, direction of rotation

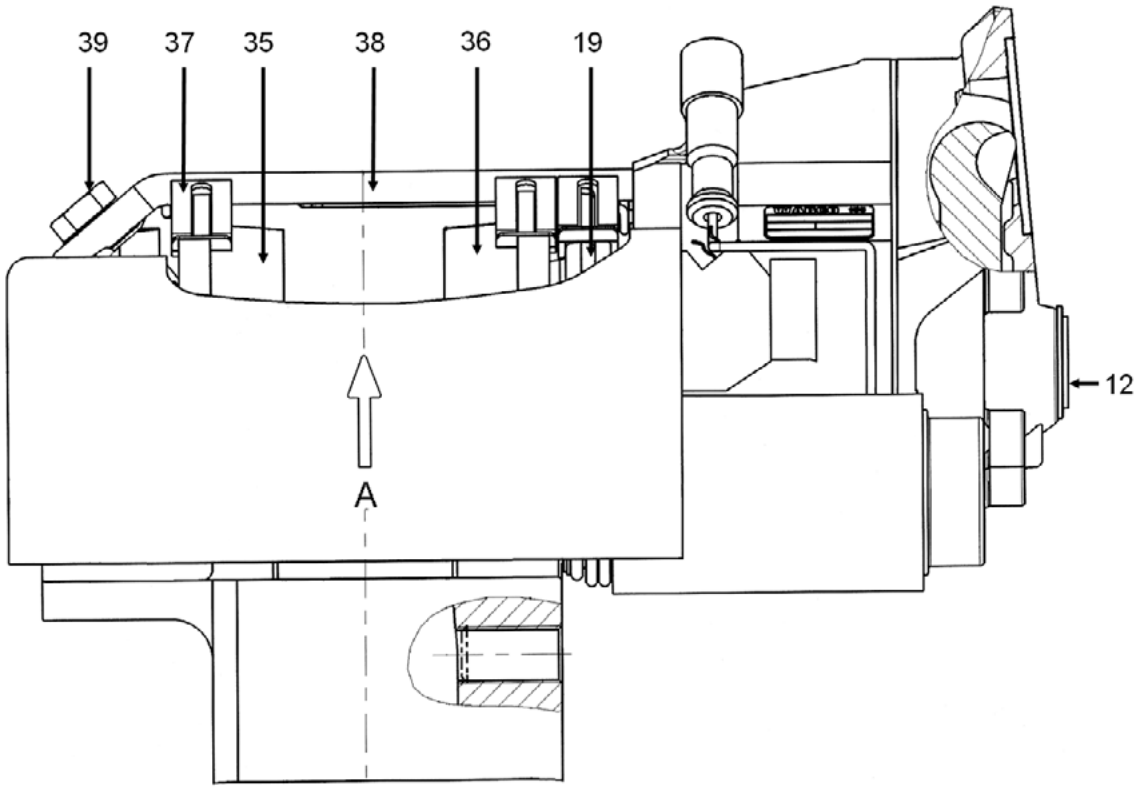


Fig. Side view and sectional view (left brake)

12 Sealing plug for adjustment
19 Spreader plate
35 Brake lining rim side
36 Brake lining cylinder side
37 Hold-down spring
38 Lining retainer
39 Hexagon screw
A Forward driving, direction of rotation

3 Checking the brake

CAUTION!
Risk of injury

– Observe all safety, repair and maintenance instructions (see chapter 1 „Important instructions and safety instructions“, page3).
– These instructions must be observed to avoid personal injury or material damage.

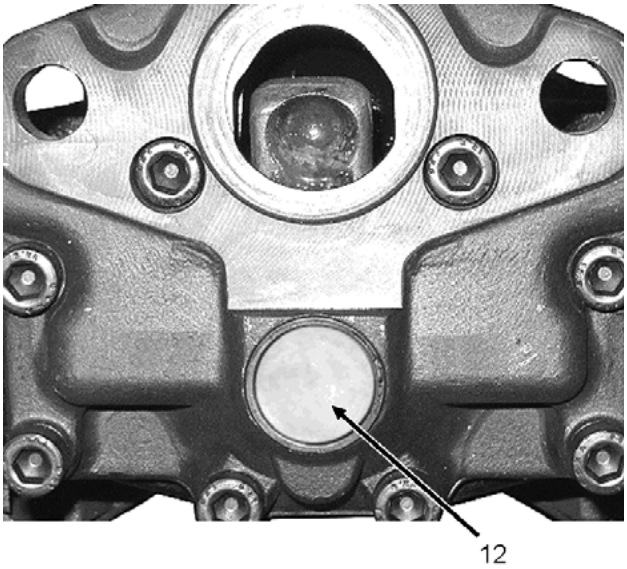
! The brake cylinder does not need to be dismantled in order to check the brake. The brake is shown without the brake cylinder for illustration purposes only.

3.1 Checking the adjuster

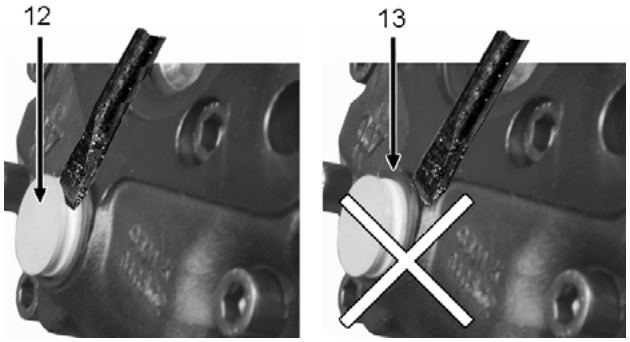
! Directions of rotation and torques of the hexagon nut of the adjuster are listed in the table in the annex (see chapter 8.2 „Widths across flats and tightening torques“, page34, item I).

Brake linings and pressure plate must be fitted in order to check the adjuster.

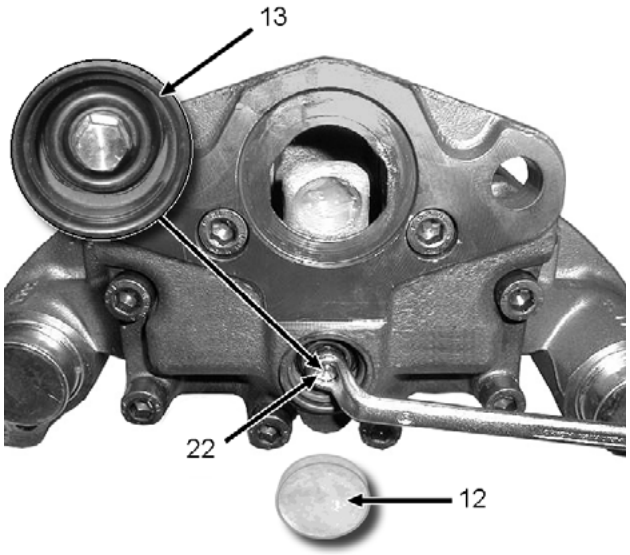
– Remove the sealing plug (12) of the adjuster.



! When removing the sealing plug, apply the respective tool (such as a screwdriver) only to the sealing plug and do not damage the closing cover (13) or the brake calliper.



– Check the protection cap (13) for wear and damage.
– If the protection cap (13) of the adjuster is damaged, renew it (see chapter 6.3 „Renewing the protection cap on the adjuster screw hexagon“, page28).
– Use the ring spanner (tools **12** and **13**) to turn the hexagon (22) of the adjuster a ½ turn in clockwise direction (see chapter 8.2 „Widths across flats and tightening torques“, page34, item I).



! The adjuster can only be checked with increased clearance.

There must be sufficient space for the engaged ring spanner; it must not be obstructed when it is turned during adjustment.

Do not use an open-end spanner for the hexagon (22) of the adjuster and never overstrain the hexagon nut. Otherwise the hexagon will be damaged.

– Gently apply the brake 5 times (braking pressure approx. 1 bar).

  If the adjuster functions correctly, the ring spanner will turn anticlockwise incrementally.

With increasing adjustment the angle of rotation of the engaged ring spanner becomes smaller. The adjuster is working correctly if the ring spanner rotates anticlockwise as described above.

Faults that might occur:

The engaged ring spanner

- not
- rotate with the initial brake action
- rotate forward and backward with every brake action

In these cases the adjuster is faulty and the brake must be replaced (see chapter 5 „Renewing the brake“, page20).

– Reset the clearance to 1 mm having completed the adjuster test (see chapter 4.3 „Fitting the brake linings“, page16).

– Remove the ring spanner (tools **12** and **13**) from the hexagon nut of the adjuster (22).

– Insert the sealing plug (12) into the adjuster and ensure that the plug has a tight seat.

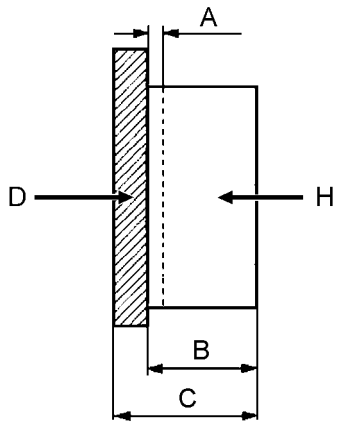
3.2 Checking the brake linings

The brake lining thickness must be checked at regular intervals, in relation to vehicle use, during maintenance intervals, as well as in the context of applicable local laws and regulations.

Burned, glazed or oil contaminated brake linings must be replaced immediately.

Always replace all brake linings by axle, using a new retaining system for brake linings and pressure plates.

To avoid damaging the brake disc replace the brake linings no later than at the point when they reach the wear limit at their weakest spot. The residual lining thickness must not be allowed to become less than 2 mm above the backing.

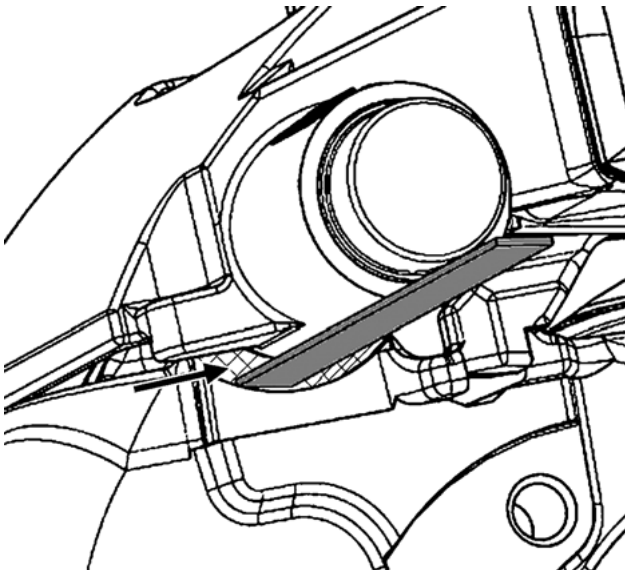


A Lining thickness without backing (limit value 2 mm residual thickness)
B Lining thickness new without backing (21 mm)
C Total thickness new lining with backing (30 mm)
D Backing
H Brake lining

3.2.1 Optical indication of the wear limit

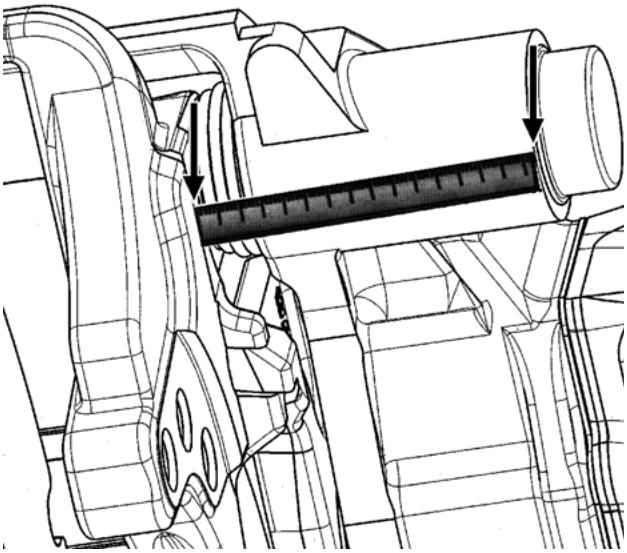
Wear on the middle of the lining can be measured with a tape measure or a ruler either at the fit bolt (long guide pin near the disc run in) or at the play bolt (short guide pin near the disc run out).

– Place the ruler onto the surface (hatched area in the picture, arrow) of the brake anchor plate.



The measuring point on the brake anchor plate is the machined bearing surface of the screwed joint of the respective guide pin (arrow on the hatched area).

– Measure the distance from the area on the brake anchor plate (left arrow) to the edge of the guide pin (right arrow) on the brake calliper.



If the distance measured

- at the short guide pin is greater than **96 mm**,
- at the long guide pin is greater than **122 mm**,

the wear limit has been reached.

– Replace the brake linings if the wear limit has been reached or it has been exceeded (see chapter 4 „Replacing the brake linings“, page13).

3.3 Inspecting the brake discs

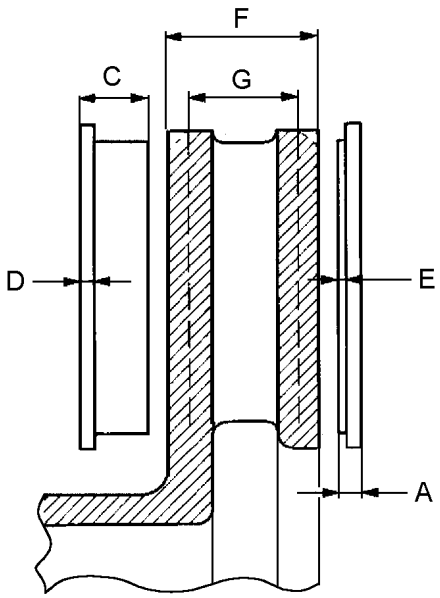
! Regularly check the wear limits of brake linings and brake discs.

When brake linings and/or brake discs are worn, the braking effect is reduced and there is a risk of brake failure. Replace brake discs and brake linings.

Always replace all brake discs by axle.

The brake discs must be clean and free from grease!

Having installed new brake discs, it is recommended that new brake linings be fitted as well.



A Lining thickness with lining support (limit value 11 mm residual lining thickness)

C Total thickness new lining with backing (30 mm)

D brake lining supporting plate (9 mm)

E Residual brake lining thickness (2 mm)

F Overall thickness new brake disc (45 mm)

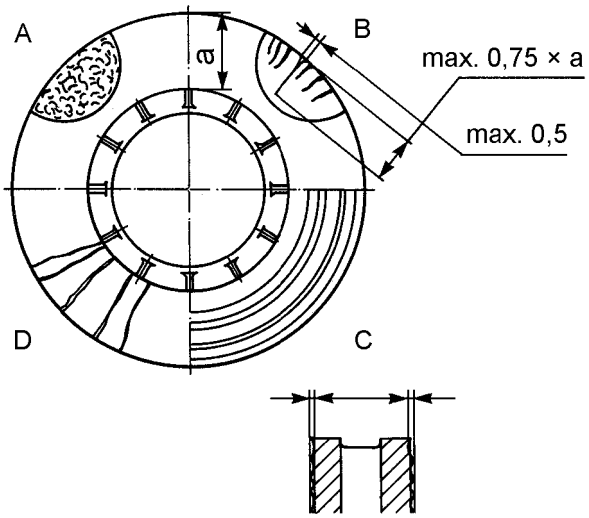
G Wear measurement limit (at least 37 mm)

– Remove the brake linings (see chapter 4.1 „Removing the brake linings“, page13).

– Measure the brake disc thickness at the contact area of the brake linings.

– Replace the brake disc if the wear measurement limit of 37 mm has been reached at the thinnest point.

3.3.1 Checking the condition of the brake disc



A Web-like crack formation: permissible

B Radial cracks up to max. 0.5 mm width: permissible

C Unevenness of the disc surfaces up to max. 1.5 mm deep: permissible

D Continuous cracks: not permissible

a Width of the braking area

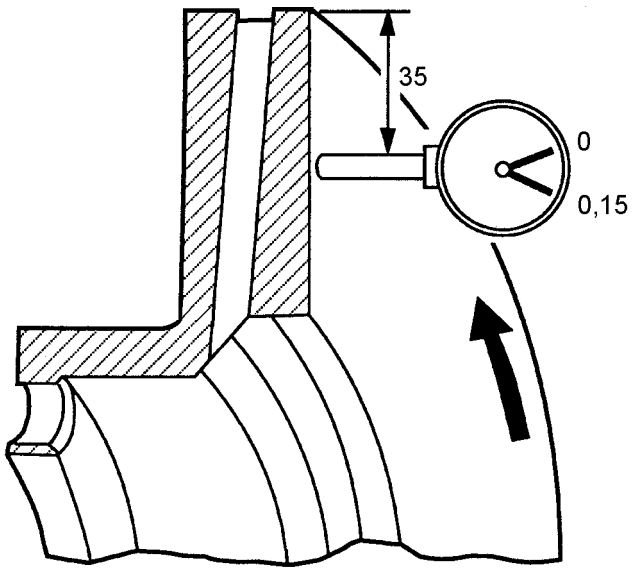
– Check the brake disc for cracks and the condition of the surface.

– Replace the brake disc if the brake disc has continuous cracks or cracks or unevenness in excess of the permissible max. dimensions.

3.3.2 Checking the disc runout

– Fasten the dial indicator to the brake calliper.

– With the brake disc installed, check the disc runout by rotating the wheel hub. Limit value: 0.15 mm



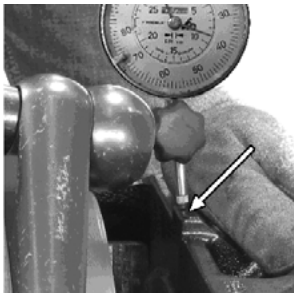
– Replace the brake disc or have it properly reworked if the brake disc runout is more than 0.15 mm.

– Install the brake linings, and adjust the clearance (see chapter 4.3 „Fitting the brake linings“, page16).

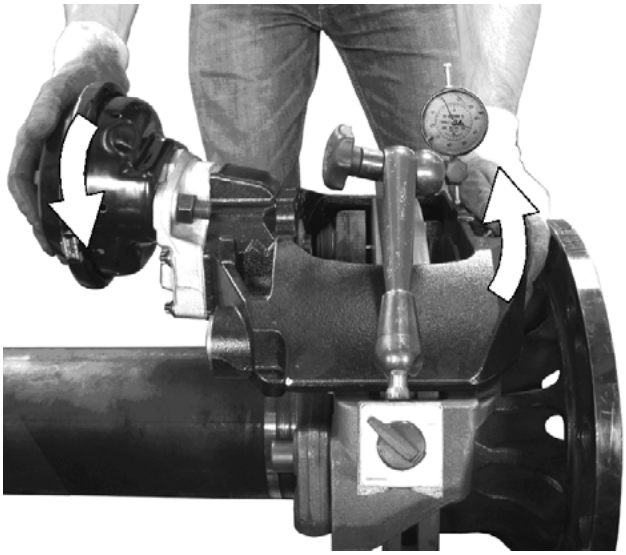
3.4 Checking the bearing play of the guide pin

– Remove the vehicle wheel and then the brake linings and the pressure plate (see chapter 4.1 „Removing the brake linings“, page13).
– Push the calliper completely to the rim side by hand.
– Fasten the magnetic dial indicator support to the brake carrier or the axle.
– Clean the measuring point. The measuring point is the moulded edge on the brake calliper on the rim side.
– Press the dial indicator against the measuring point (arrow) on the brake calliper.

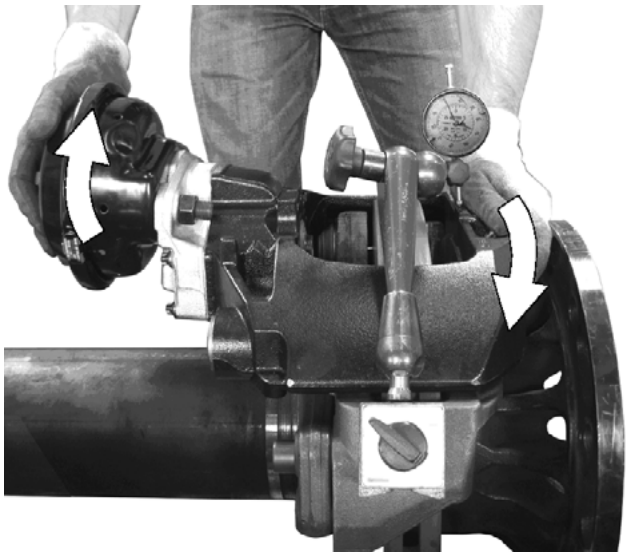




– Applying little force, tilt the brake calliper as far as possible (direction as illustrated in picture) and set the dial indicator to the value zero.



– Now, and again applying little force, tilt the brake calliper as far as possible in the opposite direction.



– Read the dial indicator. **The bearing play must not be greater than 2 mm.**
– Remove the measurement device.
– Renew the bushings of the guide pins if the measured bearing play is greater than 2 mm (see chapter 6.1 „Renewing the protection caps and the bushings of the guide pins“, page22).
– Fit the pressure plate and the brake linings, adjust the clearance and mount the vehicle wheel (see chapter 4.3 „Fitting the brake linings“, page16).

4 Replacing the brake linings

CAUTION!
Risk of injury

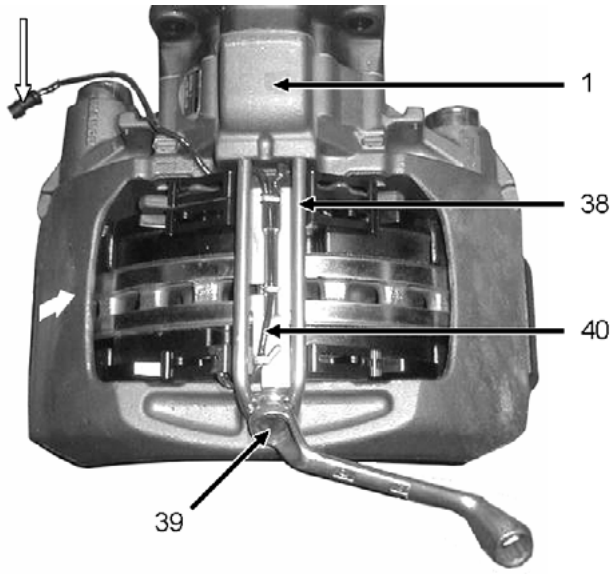
– Observe all safety, repair and maintenance instructions (see chapter 1 „Important instructions and safety instructions“, page3).
– These instructions must be observed to avoid personal injury or material damage.

! The brake cylinder does not need to be dismantled in order to replace the brake linings. The brake is shown without the brake cylinder for illustration purposes only.

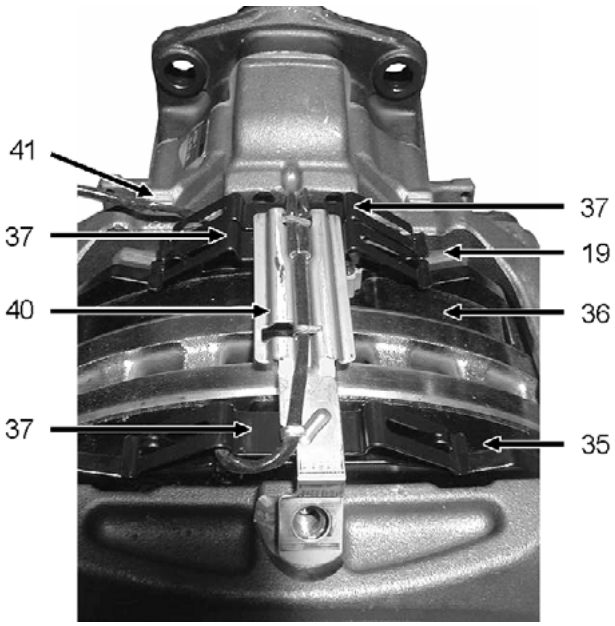
Always replace the brake linings by axle and use a new retaining system for brake linings and pressure plates.

4.1 Removing the brake linings

– Remove the vehicle wheel in accordance with the instructions of the axle or vehicle manufacturer.
– Disconnect the plug connection (arrow) of the wear indicators (40).
– Remove the hexagon head screw (39) from the lining retainer (38) (see chapter 8.2 „Widths across flats and tightening torques“, page34, item II).
– The lining retainer (38) has to be withdrawn from the calliper (1).

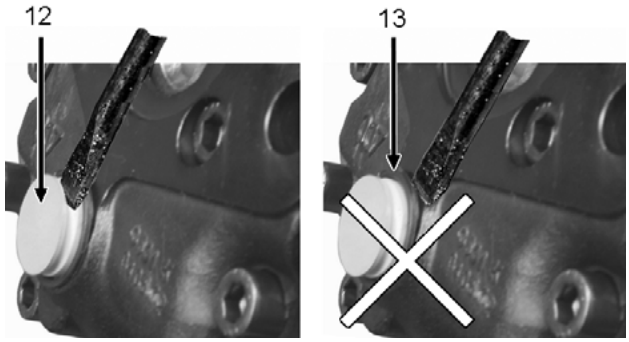


– Remove the cable guide (40) with the wear indicators.
– Remove three hold-down springs (37) from the brake linings (35 and 36) and the pressure plate (19).
– Remove the cable clips (41) from the calliper.



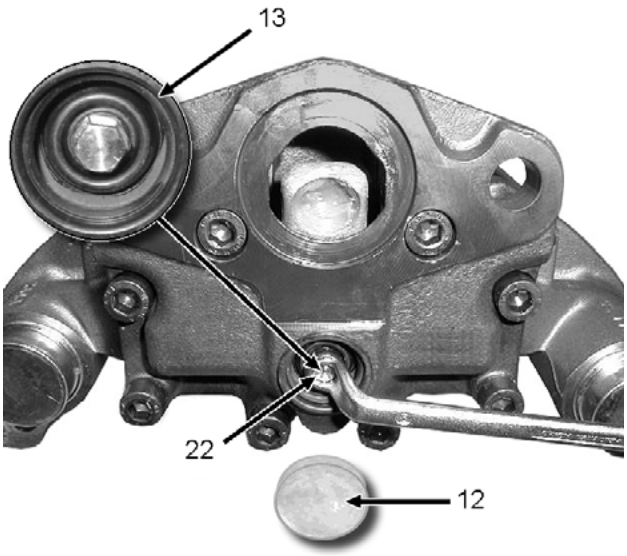
– Remove the sealing plug (12) of the adjuster.

! When removing the sealing plug, apply the respective tool (such as a screwdriver) only to the sealing plug and do not damage the closing cover (13) or the brake calliper.



– Check the protection cap (13) for wear and damage.
– If the protection cap (13) of the adjuster is defective, renew it (see chapter 6.3 „Renewing the protection cap on the adjuster screw hexagon“, page28).
– Use a ring spanner (tools **12** and **13**) to turn the hexagon (22) of the adjuster clockwise to the stop

position and then turn the hexagon back in anticlockwise direction by 90°.

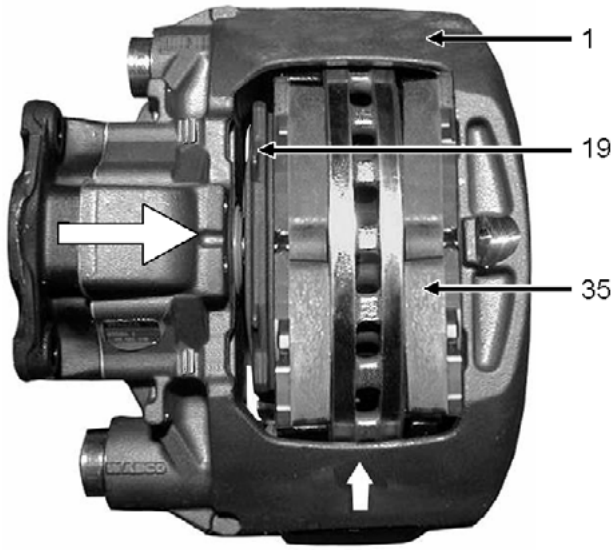


– While turning the hexagon (22), use your hand to push the pressure plate (19) towards the cylinder side to ensure that the pin as an antirotation lock for the adjuster screw (21) does not slip out of the retaining groove of the pressure plate.

  Otherwise there is a risk of the adjuster screw turning simultaneously, which could damage the protection cap (10).

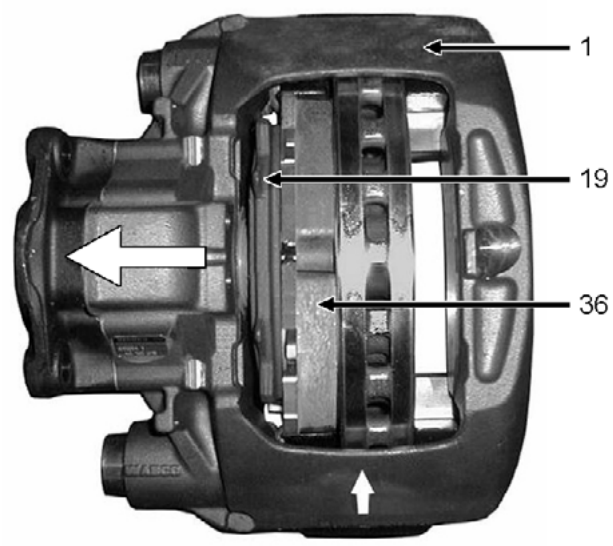
– Push the calliper (1) towards the rim side by hand (arrow).

– Remove the brake lining (35) on the rim side.



– Push the calliper (1) towards the cylinder side by hand (arrow).

– Remove the brake lining (36) and pressure plate (19) on the cylinder side.

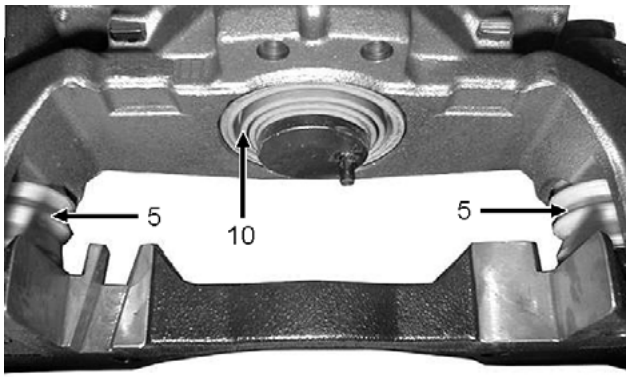


! Do not apply the brake when brake linings have been removed. There is the risk of injury and the risk of damaging the brake!

– Check the pressure plate (19) for corrosion and damage. **Renew the pressure plate if you have identified damage. Always replace the pressure plate axle by axle.**

– Use a wire brush to clean pressure plate, lining slots and pressure plate guide, and remove any corrosion on these components.

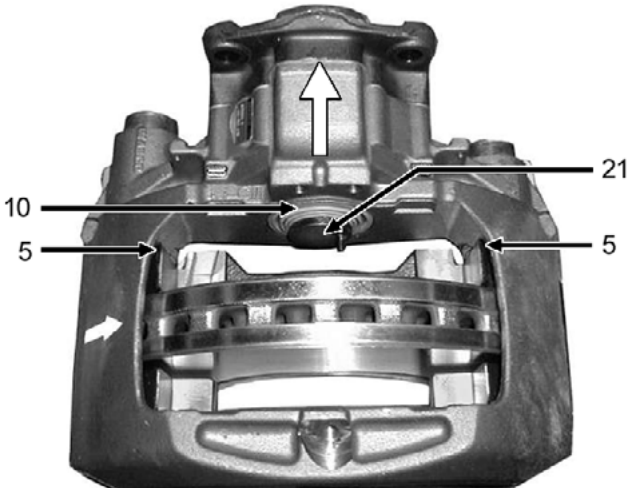
  Take care not to damage the protection caps (5, 10) while cleaning.



! The guide surfaces of the lining slots on the brake carrier must be **clean and free of grease**!

4.2 Checking the protection caps and the ability of the brake calliper to move

– Push the calliper (1) towards the cylinder side (arrow).
– Check the protection caps (5, 10) for the guide pins (8, 9) and the adjuster screw (21) for wear and damage.
– Renew any defective protection caps (see chapter 6.1 „Renewing the protection caps and the bushings of the guide pins“, page22 and see chapter 6.2 „Renewing the protection cap of the adjuster screw“, page26).



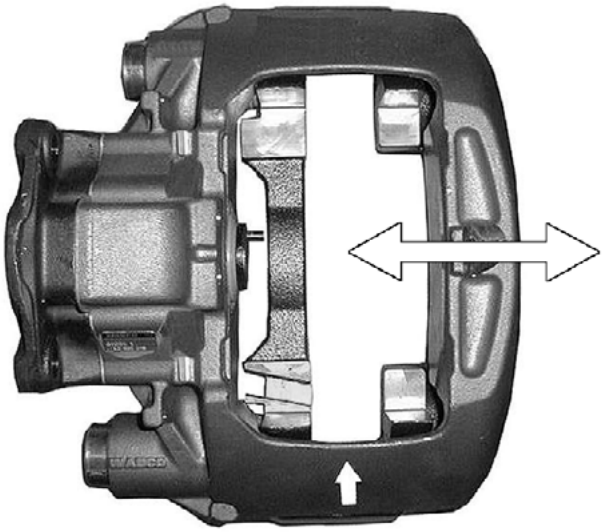
! If the protection cap (10) is damaged, check whether dirt or moisture has penetrated into the brake's interior parts or have damaged the calliper due to corrosion.

Renew the brake if you have identified damage or corrosion (see chapter 5 „Renewing the brake“, page20).

– Renew the protection caps if they are damaged during service work on the brake.
Drehen Sie mit dem Ringschlüssel (Werkzeuge **12** und **13**) den Sechskant (22) der Nachstellung im Uhrzeigersinn bis die Nachstellschraube (21) ca. 30 mm herausgeschraubt ist.

Prüfen Sie dabei die Leichtgängigkeit der Bewegung

– Manually move the brake calliper on the guide pins across the entire displacement path and check for ease of movement.



! Do not squeeze the guide pin protection caps against the brake carrier while moving the calliper.

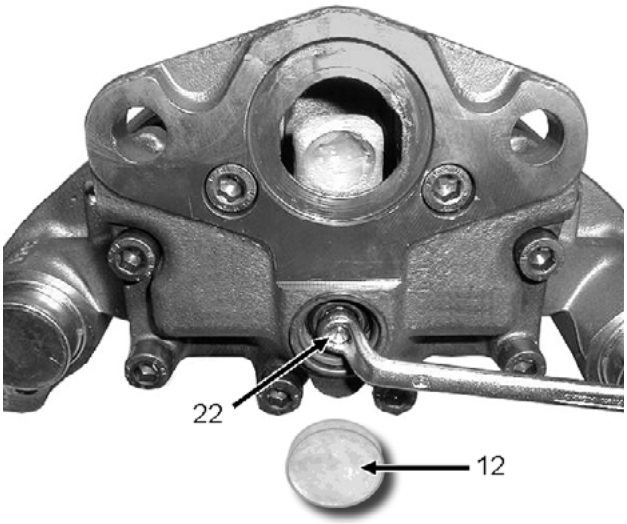
– Replace the bushings, guide pins and protection caps if the calliper moves sluggishly (see chapter 6.1 „Renewing the protection caps and the bushings of the guide pins“, page22).
– Manually check the adjuster.

! Secure the adjuster screw (21) against twisting when performing the test and when turning the hexagon (22) by arresting the pin (arrow) of the adjuster screw.



– Use the ring spanner (tools **12** and **13**) to turn the hexagon (22) of the adjuster clockwise until the adjuster screw (21) is unscrewed about 30 mm.

– Check for ease of movement.



! Do not use an open-end spanner for the hexagon (22) of the adjuster and never overstrain the hexagon nut. Otherwise the hexagon will be damaged.

– Use the ring spanner to turn the hexagon (22) clockwise back to the stop.

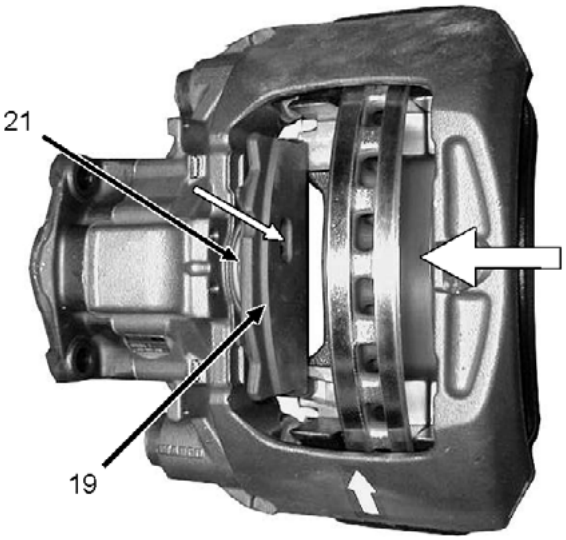
  When turning back (clockwise) the torque is greater than when turning anticlockwise.

– If appropriate, check the adjuster for correct function (see chapter 3.1 „Checking the adjuster“, page8).

4.3 Fitting the brake linings

– To insert the pressure plate and the brake linings on the cylinder side, push the calliper towards the cylinder side until there is sufficient distance to the brake disc.

– Insert the pressure plate (19) into the brake carrier and push the pressure plate against the adjuster screw (21).

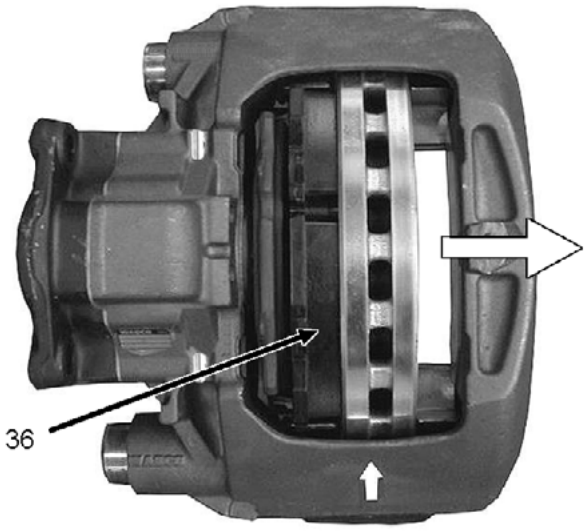


! Ensure that the pressure plate is seated in the guide groove of the brake anchor plate and that it rests with the entire surface on the guide strips of the brake anchor plate. Otherwise the pressure plate could slide out of the guiding.

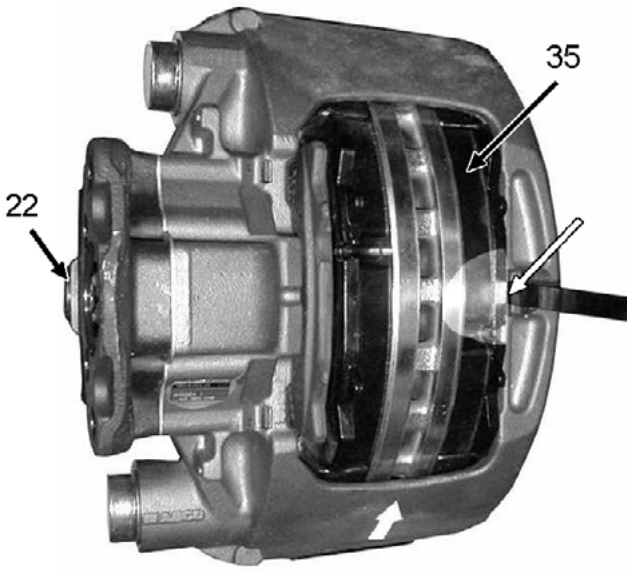
  If required, push the calliper a little towards the rim side.

  The pin of the adjuster screw must mesh with the groove (arrow) of the pressure plate, otherwise the adjustment will not function. Turn the adjuster screw until the pin meshes with the groove of the pressure plate. Ensure that the protection cap is not twisted.

– Fit a **new** brake lining (36) on the cylinder side.
– Push the calliper towards the rim side until the brake lining (36) of the cylinder side bears against the brake disc.



– Fit a **new** brake lining (35) on the rim side.
– Adjust the clearance by means of a 1 mm feeler gauge (arrow). For this purpose insert the feeler gauge between the brake lining of the rim side and the calliper. Turn the hexagon (22) of the adjuster anticlockwise with a ring spanner (tools **12** and **13**) until both brake linings bear on the brake disc.

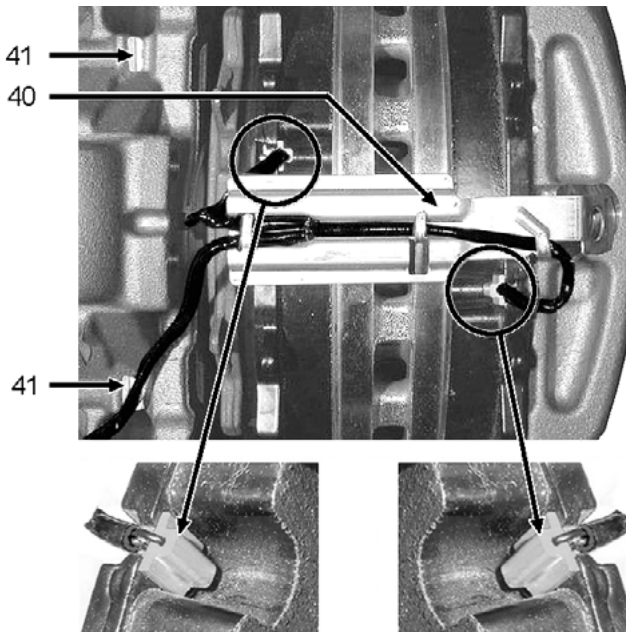


Always insert the feeler gauge into the centre between brake calliper (1) and brake lining support plate (35).

Do not use an open-end spanner for the hexagon (22) of the adjuster and never overstrain the hexagon nut. Otherwise the hexagon will be damaged.

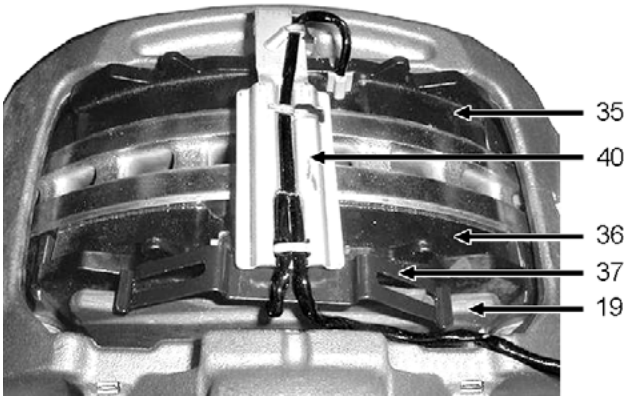
Mount the lining retainer pin only **after** you have adjusted the clearance.

– Remove the sensor gauge and insert two **new** cable clips (41) into the brake calliper.
– Place the **new** cable guide plate (40) with **new**preassembled wear indicators onto the brake calliper and insert the indicators (circles) into the brake linings.



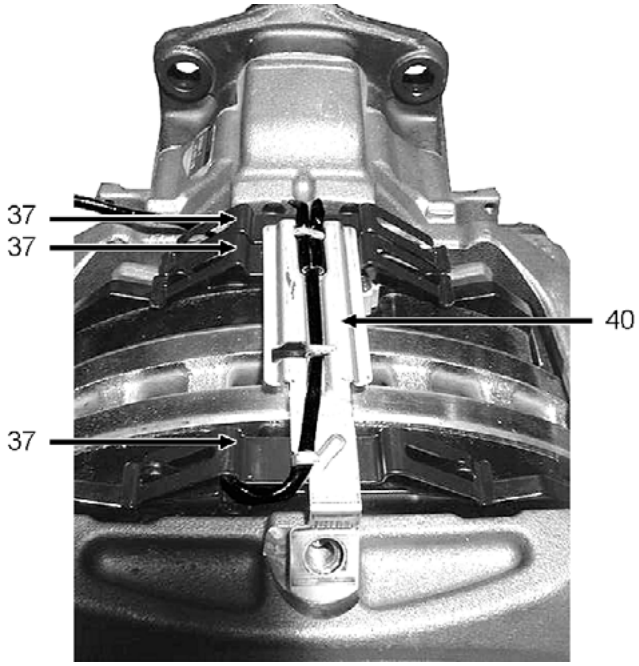
Ensure that each wear side of the indicators points towards the brake disc and that the indicators are inserted completely into the brake lining.

– Lift the cable guide plate (40) a little and push **three new** hold-down springs (37) under the cable guide plate onto the brake linings (35, 36) and the pressure plate (19).

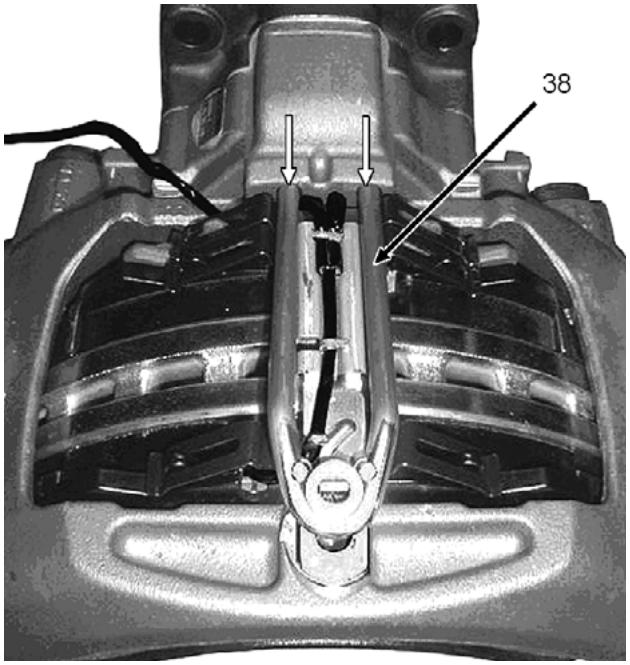


! When laying the cable, ensure that the cable does not touch the brake lining.

– Press the cable guide plate (40) against the hold-down springs and position it on the brake calliper.

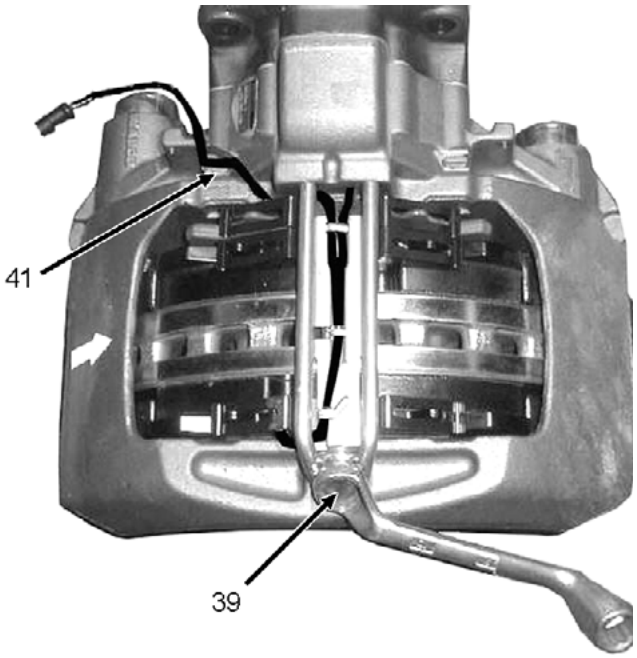


– Push a **new** lining retainer (38) into the openings (white arrows) of the brake calliper and press the lining retainer so that the bracket meshes between the radial lugs of the hold-down springs.



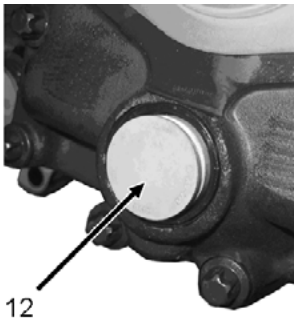
! Make sure that the lining retainer (38) is above the wear indicator cables.

– Fasten a **new** hexagon screw (39) to the brake calliper (see chapter 8.2 „Widths across flats and tightening torques“, page34, item II).
– Remove the transport protection cap from the wear indicator connector if in place.
– Connect the connectors of the wear indicators to the plug socket of the vehicle or the axle.
– Fasten the cable to the **new** cable clip (41).



– Ensure that the cable has been laid correctly and fix the cable in position using cable ties.
– Push a **new** sealing plug (12) into the opening of the brake calliper. Make sure that the plug has a tight seat.





– Check the wheel hub for ease of movement.
– Mount the vehicle wheel in accordance with the instructions of the axle or vehicle manufacturer.

! Having completed the work, test the brake on a roller test stand.

5 Renewing the brake

CAUTION!
Risk of injury

– Observe all safety, repair and maintenance instructions (see chapter 1 „Important instructions and safety instructions“, page3).
– These instructions must be observed to avoid personal injury or material damage.

! Never use the lining retainer (38) as a grab handle or for fastening the brake to a lifting device, because the retainer can be damaged in the process.

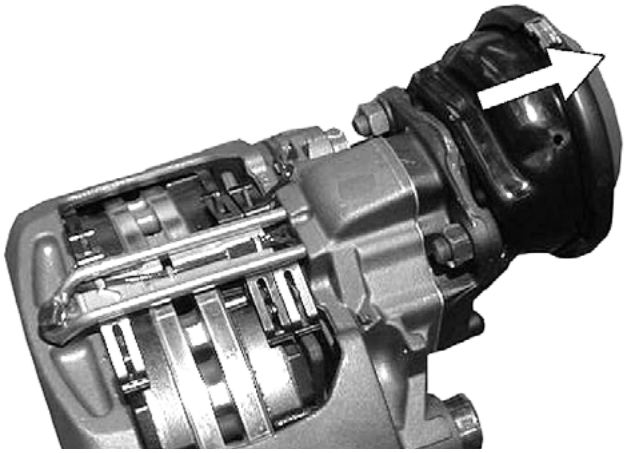
The **new** brake without brake lining is supplied as a pre-assembled unit and may be mounted to the vehicle's axle via the brake carrier.

Left and right brake must not be interchanged when they are installed on the axle. An arrow on the brake calliper indicates which brake is correct for the left and which for the right axle side. This arrow indicates the brake disc's direction of rotation during forward driving.

5.1 Removing the brake

! The illustrations of the brake anchor plate are for example only and may deviate from the actual brake design.

– Remove the vehicle wheel in accordance with the instructions of the axle or vehicle manufacturer.
– Remove the brake linings (see chapter 4.1 „Removing the brake linings“, page13).
– Remove the brake cylinder from the calliper (see chapter 7.1 „Removing the brake cylinder“, page31).



– Disconnect the plug connection of the wear indicators.
– Remove the brake calliper with brake anchor plate from the axle (see chapter 8.2 „Widths across flats and tightening torques“, page34, item III).
– Check the brake disc (see chapter 3.3 „Inspecting the brake discs“, page10).
– Check the dismantled brake linings and replace if necessary (see chapter 3.2 „Checking the brake linings“, page9).
– Check the fastening flange on the axle for wear and damage.
– Clean the fastening flange on the axle and remove any dirt, rust and grease.

5.2 Installing the brake

! When fitting the brake follow the mounting instructions of the axle or vehicle manufacturer, and make sure you do not mismatch the right and left brake.

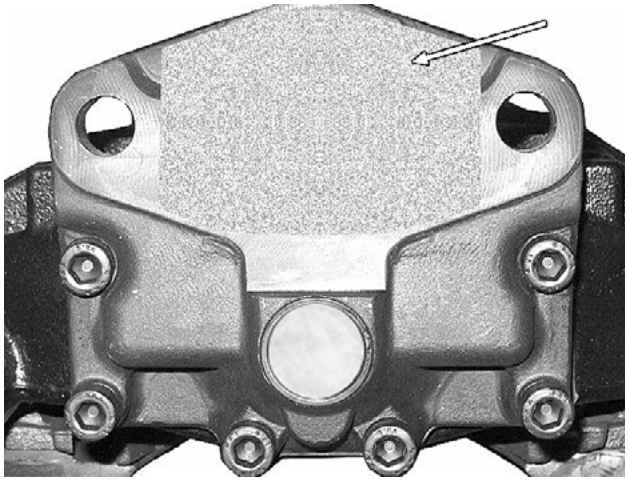
– Place the brake with brake anchor plate on top of the brake disc and mount the brake to the axle.



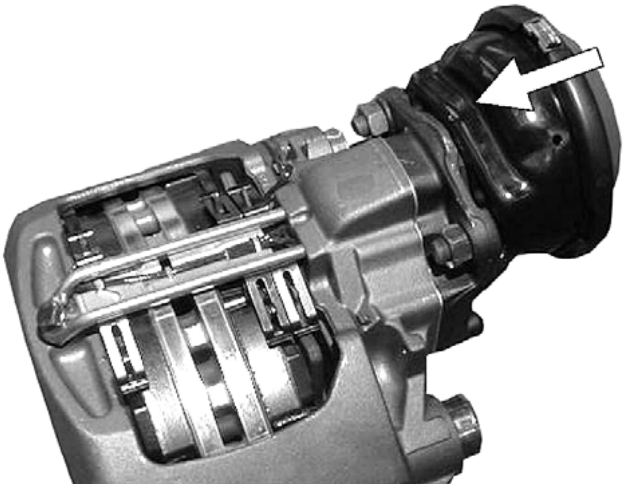
– Tighten the hexagon screw (see chapter 8.2 „Widths across flats and tightening torques“, page34, item III).

  Always observe the assembly instructions of the axle or vehicle manufacture.

– Remove **all** transport locks from the **new** brake. The protection film (arrow) or the transport protector cap must be fully removed from the brake calliper in the area of the cylinder fastening.



– Install pressure plate, brake linings, and wear indicators, and adjust the clearance (see chapter 4.3 „Fitting the brake linings“, page16).
– Connect the wear indicator connector to the socket on the vehicle or the axle and fasten the cable to the cable clip (41) of the brake calliper.
– Ensure that the cable has been laid correctly and fix the cable in position using cable ties.
– Inspect the brake cylinder for damage, particularly at the inner area of the piston-rod seal. **Renew the brake cylinder if you have identified damage.** (see chapter 7 „Replacing the brake cylinder“, page31). **A defective brake cylinder must not be fitted again.**
– Clean the sealing surface and the flange area of the brake cylinder.
– Mount the brake cylinder on the calliper(see chapter 7.2 „Installing the brake cylinder“, page31).



! Depending on the installation position of the brake, ensure that the lower drainage aperture of the brake cylinder facing the ground is open.

Depending on the actuator type, the other drainage openings can either remain open or they must be sealed with a plug. Observe the respective instructions of the brake cylinder manufacturer.

– Check whether the wheel hub moves freely.
– Mount the vehicle wheel in accordance with the instructions of the axle or vehicle manufacturer.

! Having completed the work, test the brake on a roller test stand.

6 Renewing the seals

CAUTION!
Risk of injury

– Observe all safety, repair and maintenance instructions (see chapter 1 „Important instructions and safety instructions“, page3).
– These instructions must be observed to avoid personal injury or material damage.

! Never use the lining retainer (38) as a grab handle or for fastening the brake to a lifting device, because the retainer can be damaged in the process.

If all seals of the brake calliper are replaced, the work sequences for renewing the protection caps and bushings of the guide pins, as well as the protection cap of the adjuster screw can be performed together.

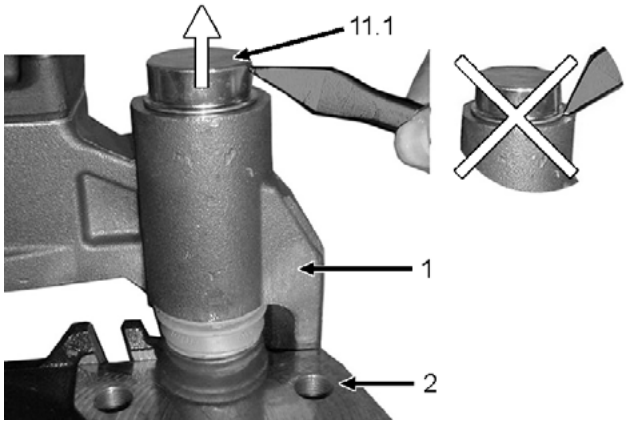
If the seals were individually replaced however, the step sequences are to be performed individually as described in the respective sections (Kapitel 6.1 and Kapitel 6.2).

The illustrations are for example only and may deviate from the actual design.

6.1 Renewing the protection caps and the bushings of the guide pins

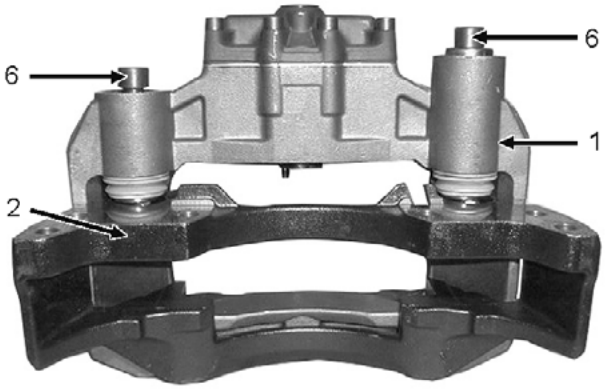
6.1.1 Disassembly

– Remove the vehicle wheel in accordance with the instructions of the axle or vehicle manufacturer.
– Remove brake linings, the brake cylinder and the brake calliper with brake anchor plate from the axle (see chapter 5.1 „Removing the brake“, page20).
– Use a suitable fastening device (e.g. a vice) to clamp the brake to the brake carrier.
– Remove the closing covers (11, 11.1) of the pin guide (8, 9) from the brake calliper (1).



! When removing the sealing plug, apply the respective tool (such as a chisel) only to the closing cover and do not damage the seat of the closing cover on the brake calliper.

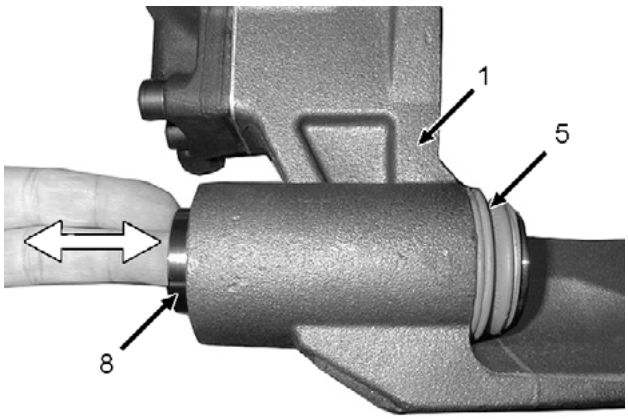
– Unscrew the screws (6) (see chapter 8.2 „Widths across flats and tightening torques“, page34, item IV), and remove the brake calliper (1) from the brake carrier (2).



! **Risk of injury!** Moving brake calliper: risk of injury!

– Clean the contact areas (fitting collars) to the guide pins on the brake carrier (2).
– Remove the guide pins (8, 9) from the brake calliper (1).

– Pull the protection cap (5) out of the ring groove of the brake calliper (1).

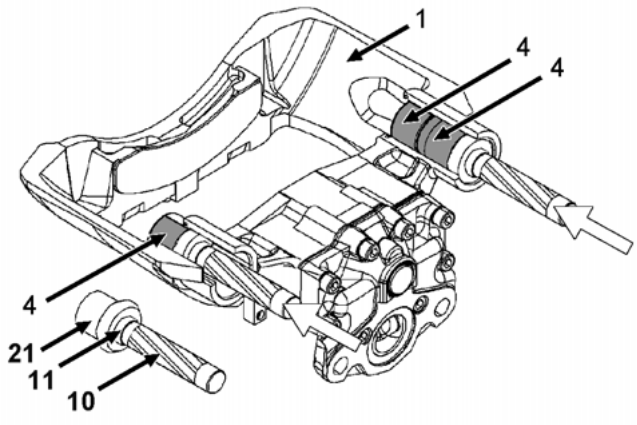


– Place the brake calliper (1) on a firm base for pressing out the bushings (4). The cover opening of the brake calliper must face upwards.



! Use WABCO tools (see chapter 8.1 „WABCO tools“, page33) to replace the bushings.

– Use tools **10**, **11** and **21** to press the bushings (4) out of the brake calliper (1).

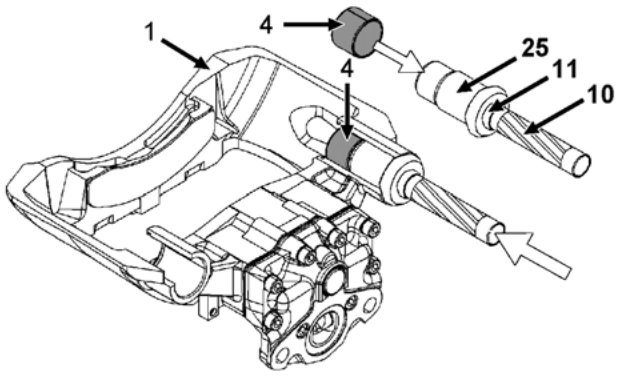


– Clean the bores in the calliper.

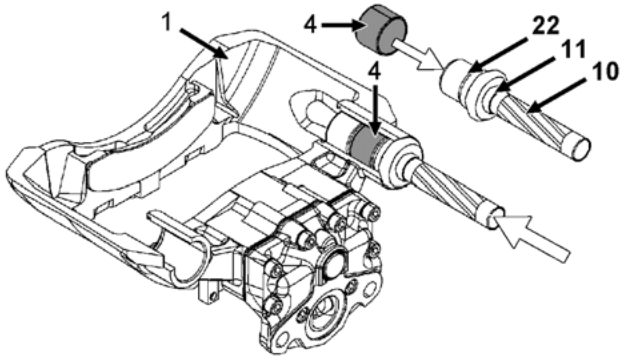
6.1.2 Assembly

Press in two **new** bushings for the long guide pin.

– Use tools **10**, **11** and **25** to press the inner bushing (4) into the bores of the brake calliper (1) on the brake disc entry side right to the end stop of the tool.



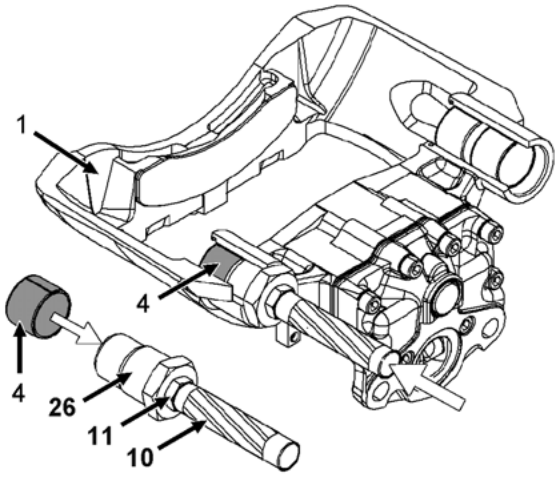
– Use tools **10**, **11** and **22** to press the outer bushing (4) into the same bore right up to end stop of the tool.



– Grease the sliding surfaces of the bushings and the space between them.

– Use tools **10**, **11** and **26** to press a **new** bushing (4) for the short guide pin into the bore of the brake

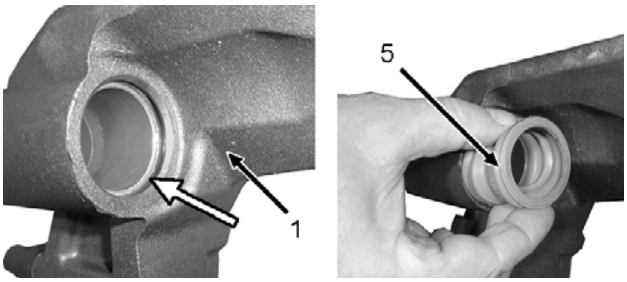
calliper (1) on the brake disc exit side right to the end stop of the tool.



– Grease the sliding surface of the bushing.

– Clean the sealing seats (ring groove) of the brake calliper for the protection caps. The cleaned sealing seats must be **clean and free from grease**.

– Manually push **new** green protection caps (5) into the sealing seats (ring groove, arrow) of the brake calliper (1).



! Ensure that the beaded edge of the protection caps (5) have an even and wrinkle-free seat on the brake calliper (1).

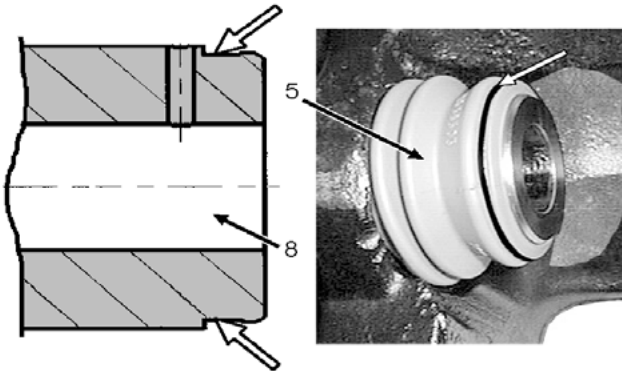
– Grease the bearing surfaces of the guide pins (8, 9) and the beaded edge of the protection caps (5).

– Insert a **new** long guide pin (8) into the brake calliper (disc brake entry side) from the cylinder side.

– Insert a **new** short guide pin (9) into the brake calliper (disc brake exit side) from the cylinder side.

– Slide the protection caps (5) over both WABCO guide pins.

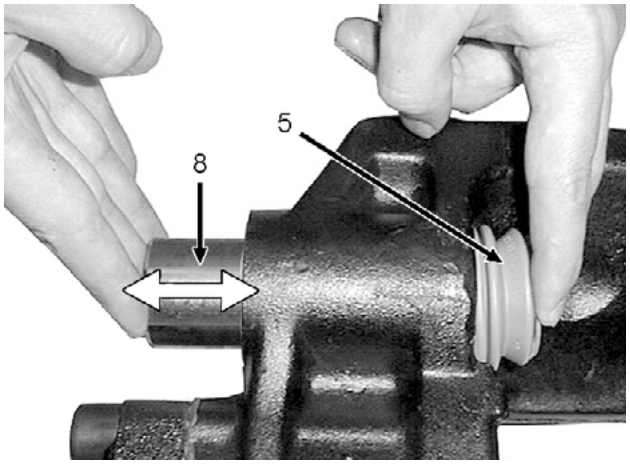
– Position the beaded edge of the protection caps (5) into the sealing seats (ring grooves) of the guide pins (8, 9). Make sure that the metal ring (arrow) does not come off the protection cap in the process.



! Ensure that the beaded edge of the protection caps (5) have an even and wrinkle-free seat in the sealing seats of the guide pins (8, 9).

– Remove any excess grease. **The plane surfaces of the guide pins to the brake carrier and the contact areas of the brake carrier must be clean and free of grease.**

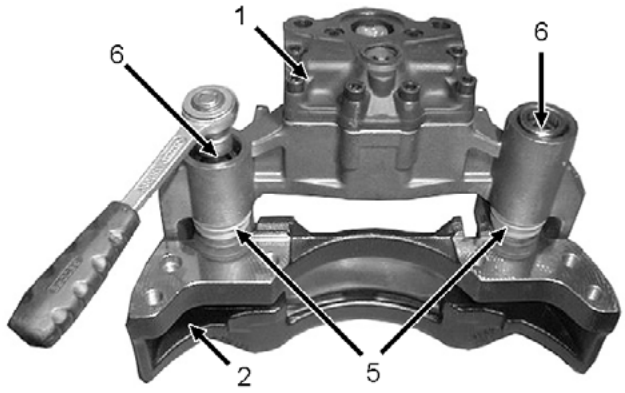
– Manually move the guide pins in the bushings lightly back and forth and check for ease of movement.



– Place the calliper (1) on the brake carrier (2) and the inserted guide pins (8, 9) into the fitting collar.

– Insert two **new** screws (6) through the guide pins inserted in the brake calliper (1).

– Fasten the screws to the brake anchor plate (2) (see chapter 8.2 „Widths across flats and tightening torques“, page34, item IV).



! During assembly, ensure that the protection caps (5) are not damaged or twisted while tightening the screws (6).

Always tighten the longer guide pin (8) with press-fit first and then the shorter guide pin (9) with clearance.

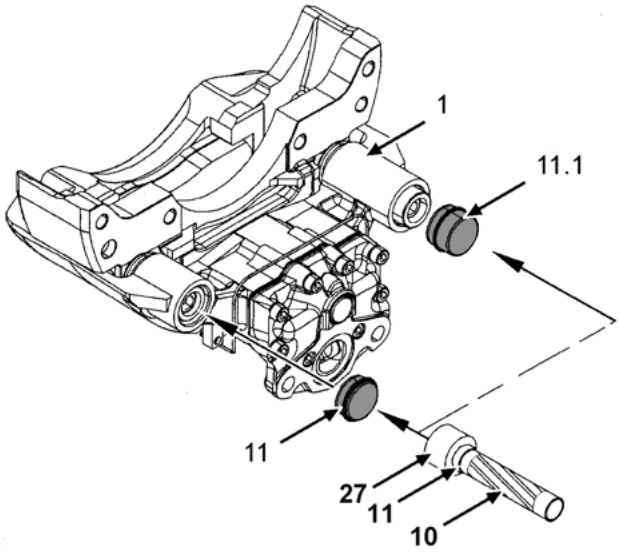
If the guide pins (8, 9) are released from the brake carrier (2) during the maintenance work, **new** screws (6) must be used for reassembly.

– Manually move the brake calliper on the guide pins (8, 9) across the entire displacement path and check for ease of movement; repeat the action a number of times.



! Do not squeeze the guide pin protection caps against the brake carrier while moving the calliper.

– Grease the bores for the closing cover (11, 11.1) in the brake calliper (1).
– Push the brake calliper (1) against the brake carrier.
– Insert the **new** closing covers (11, 11.1) into the bores of the brake calliper (1). Use the long closing cover (11.1) for the long guide pin (8) and the short closing cover (11) for the short guide pin (9).
– Use tools **10**, **11** and **27** to press the closing cover down to the stop position.



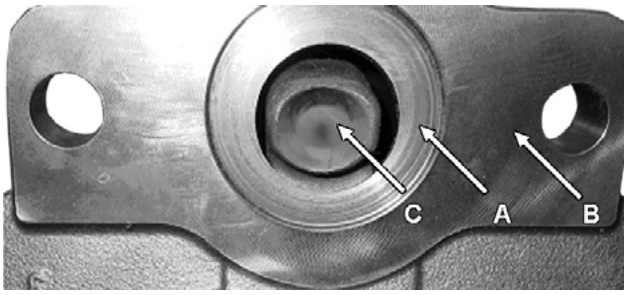
! Avoid damaging the lids while pressing them in.

– Check the connecting surface on the fastening flange of the axle and the brake carrier and remove any dirt, rust or oil.
– Place the brake with brake anchor plate on top of the brake disc and mount the brake to the axle.(see chapter 5.2 „Installing the brake“, page20).

Always observe the assembly instructions of the axle or vehicle manufacture.

– Install pressure plate, brake linings, and wear indicators, and adjust the clearance (see chapter 4.3 „Fitting the brake linings“, page16).

– Clean the sealing area (A) and the flange surface (B) on the brake calliper and grease the calotte in the brake lever (C).



! Ensure that no dirt or moisture enters the brake when cleaning.

– Check the brake cylinder for damage, particularly at the inner area of the piston-rod seal. **Renew the brake cylinder if you have identified damage.** (see chapter 7 „Replacing the brake cylinder“, page31). **A defective brake cylinder must not be fitted again.**
– Clean the sealing surface and the flange area of the brake cylinder.
– Mount the brake cylinder on the calliper(see chapter 7.2 „Installing the brake cylinder“, page31).

  Always note the relevant specifications of the axle or vehicle manufacturer during this procedure and strictly adhere to them.

! Depending on the installation position of the brake, ensure that the lower drainage aperture of the brake cylinder facing the ground is open.

  Depending on the actuator type, the other drainage openings can either remain open or they must be sealed with a plug. Observe the respective instructions of the brake cylinder manufacturer.

– Check whether the wheel hub moves freely.
– Mount the wheel in accordance with the instructions of the axle or vehicle manufacturer.

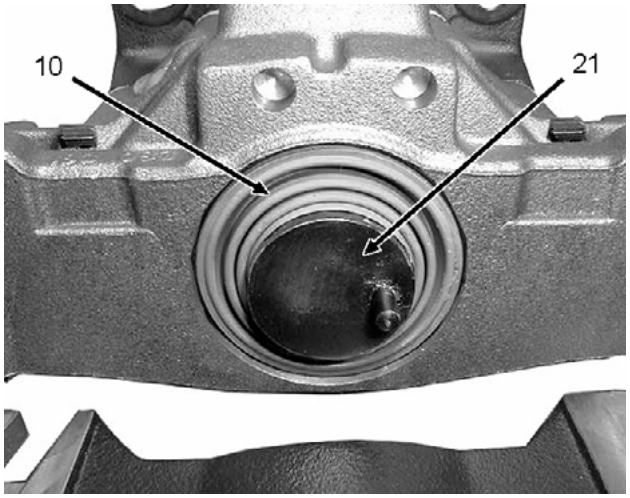
! Having completed the work, test the brake on a roller test stand.

6.2 Renewing the protection cap of the adjuster screw

! If the protection caps are removed individually, brake calliper and brake cylinder need not be dismantled.

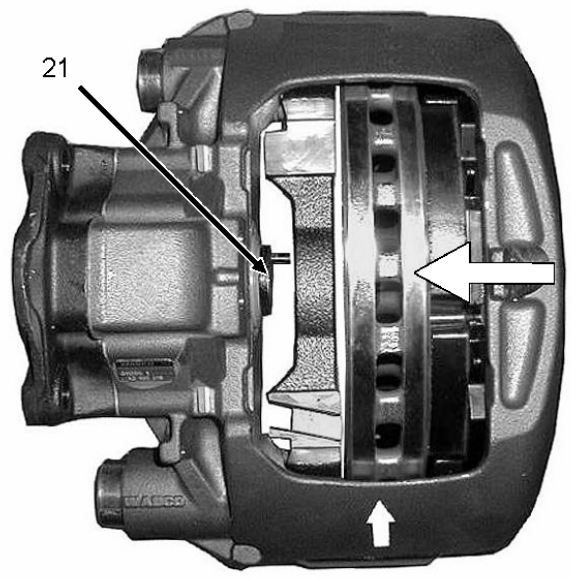
6.2.1 Removing the protection cap

– Remove the brake linings and the pressure plate (see chapter 4.1 „Removing the brake linings“, page13).
– Push the calliper completely to the cylinder side by hand.
– Pull the protection cap (10) from the sealing seat (ring groove) of the adjuster screw (21).

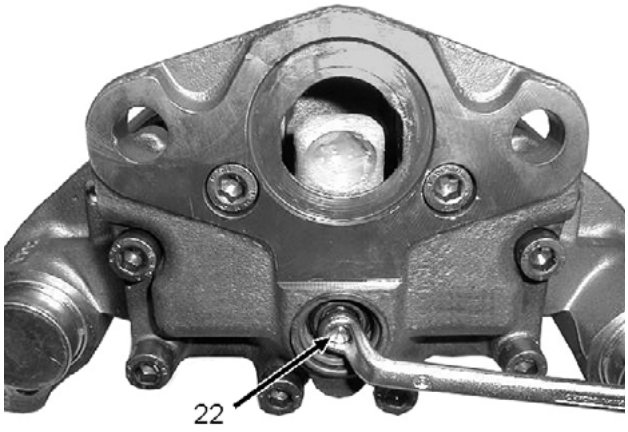


– Remove the protection cap (10) from the sealing seat of the brake calliper with a screwdriver. Make sure you do not damage the sealing seat of the protection cap in the brake calliper in the process.
– Check the brake calliper. If dirt or moisture has entered the brake, or if the sealing seat in the brake calliper or the thread of the adjuster screw (21) is damaged, replace the brake (see chapter 5 „Renewing the brake“, page20).

– Fit the rim side brake lining into the lining slot so that the adjuster screw cannot be screwed out of the adjuster completely.



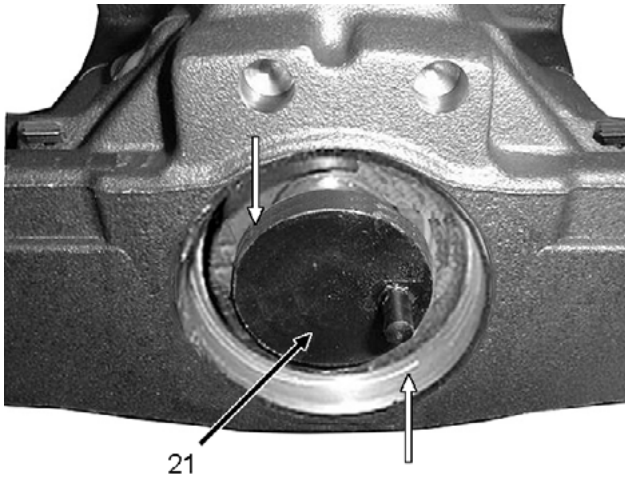
– Secure the adjuster screw (21) on the pin against twisting.
– Use tools **12** and **13** to turn the hexagon (22) anticlockwise until the adjuster screw has been screwed outwards approx. 30 mm by this action (see chapter 8.2 „Widths across flats and tightening torques“, page34, item I).



– While threading it out, check the thread of the adjuster screw (21) for corrosion and damage. If the thread and/or visible internal brake parts are damaged or corroded, replace the brake (see chapter 5 „Renewing the brake“, page20).

! The protection cap (10) can be renewed if it is certain that no dirt or water has penetrated into the brake calliper, or if the protection cap has been damaged during maintenance work.

– Clean the sealing seats (arrows) of the protection cap (10) in the brake calliper and the ring groove of the adjuster screw (21).



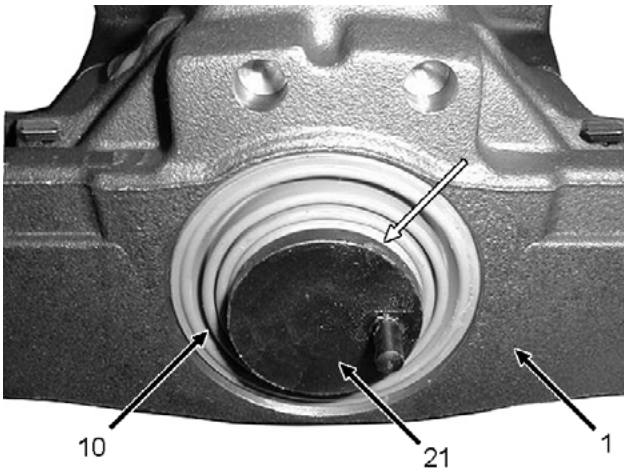
! Ensure that no dirt or moisture enters the brake when cleaning. **The sealing seat for protection cap (10) in the brake calliper must be clean and free from grease.**

– Grease the thread of the adjuster screw (21).
– Use a ring spanner to turn the hexagon (22) anticlockwise until the adjuster screw has been partially turned inwards through this action. The adjuster screw pin must be in the same position as it was before it was screwed out.
– Remove the brake lining from the lining slot on the rim side.

6.2.2 Fitting the protection cap

– Slide a **new and grease-free** protection cap (10) over the adjuster screw.
– Centre the protection cap and it into the sealing seat of the brake calliper (1) by hand.
– Lightly grease the inner beaded edge of the protection cap (10).

– Insert the beaded edge of the protection cap (10) into the sealing seat (arrow) of the adjuster screw (21).



! Ensure that the cap has a correct sealing seat in the brake calliper (1) and that the beaded edge of the protection cap (10) has an even and wrinkle-free seat in the ring groove of the adjuster screw (21).

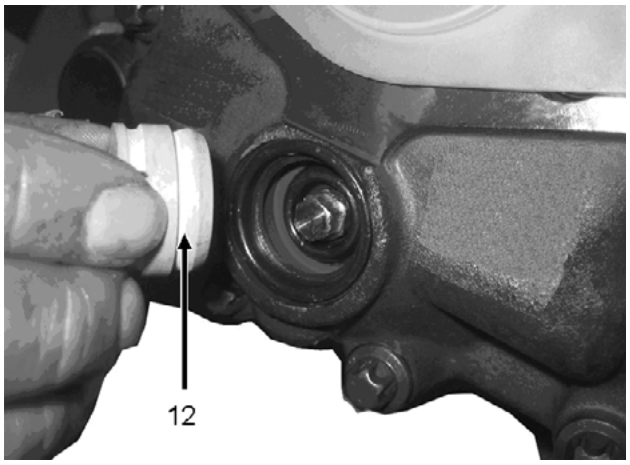
– Install the pressure plate and the brake linings, and set the clearance (see chapter 4.3 „Fitting the brake linings“, page16).

6.3 Renewing the protection cap on the adjuster screw hexagon

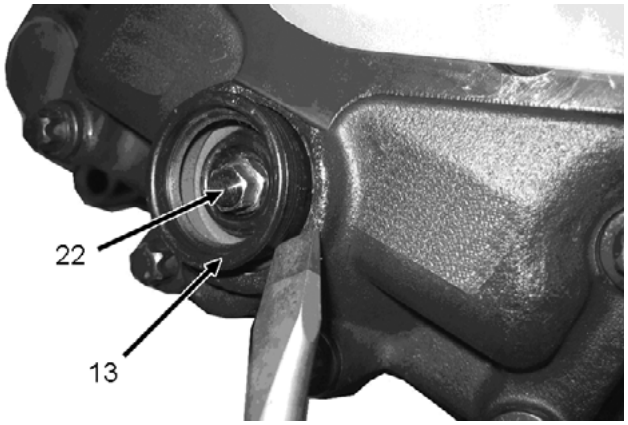
! If the protection caps are removed individually, brake calliper and brake cylinder need not be dismantled.

6.3.1 Removing the protection cap

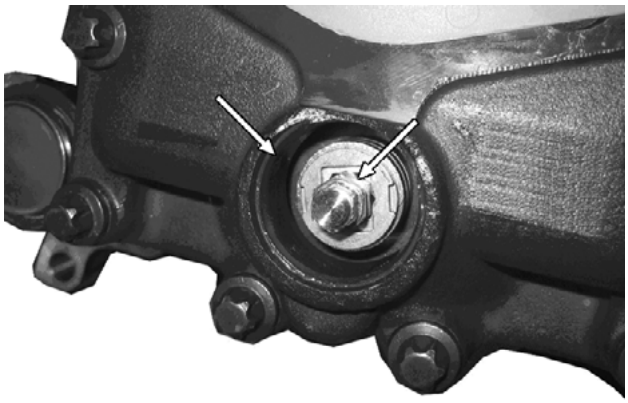
– Remove the sealing plug (12) of the adjuster.



– Use a suitable tool (e.g. screwdriver) to press the protection cap (13) out of the brake calliper seat and remove the protection cap (13) from the hexagon (22) of the adjuster.



– Clean the sealing seats (arrows) of the protection cap (13) in the brake calliper.



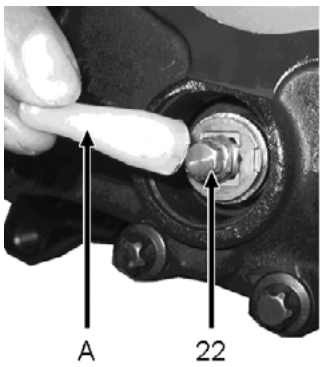
! Ensure that no dirt or moisture enters the brake when cleaning.

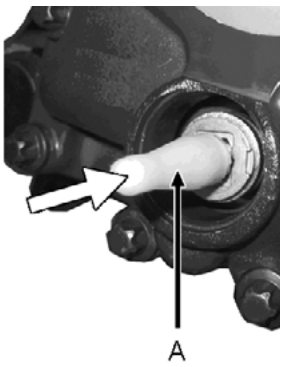
– Check the brake calliper. If dirt or moisture has entered the brake, or if the sealing seat in the brake calliper or the hexagon (22) of the adjuster screw is damaged, replace the brake (see chapter 5 „Renewing the brake“, page20).

! The protection cap (13) can be renewed, if definitely no dirt or water has penetrated into the brake calliper, or if the protection cap has been damaged in the process of servicing the brake.

6.3.2 Fitting the protection cap

– Place the mounting cap (A) onto the hexagon (22) of the adjuster and push the mounting cap right up to the stop position.

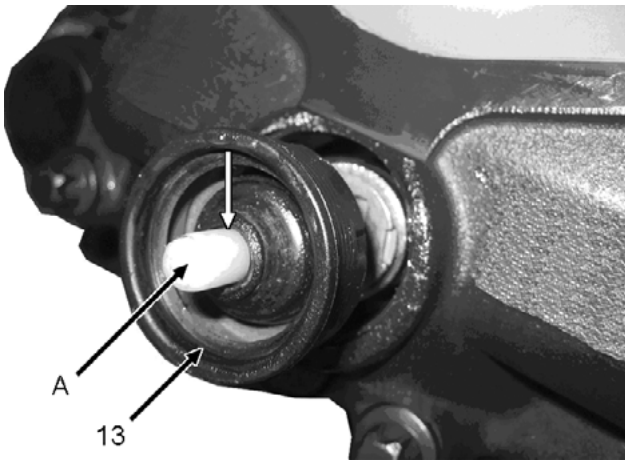




– Grease a **new** protection cap (13) only lightly at the inner sealing bead (arrow).

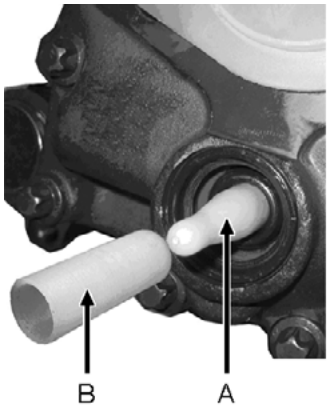
– Place the protection cap (13) onto the mounting cap (A).

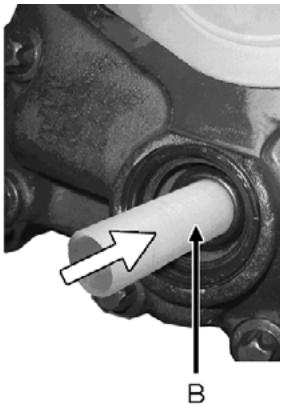
– Manually press the protection cap (13) right to the stop in the brake calliper seat.



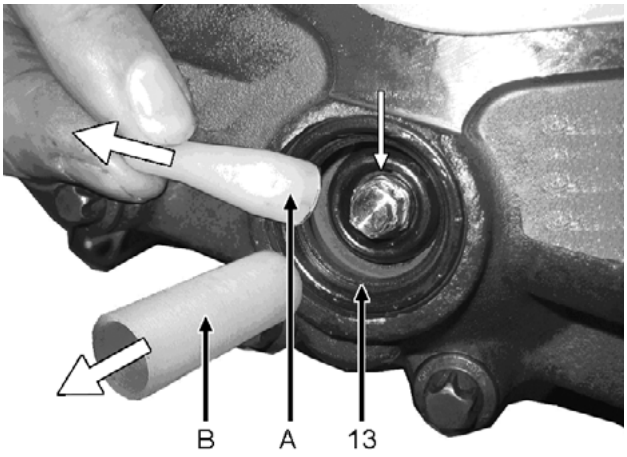
– Place the mounting bushing (B) onto the mounting cap (A).

– Press the mounting bushing (B) against the inner sealing bead of the protection cap (13) until the sealing bead lies in the ring groove of the adjuster.

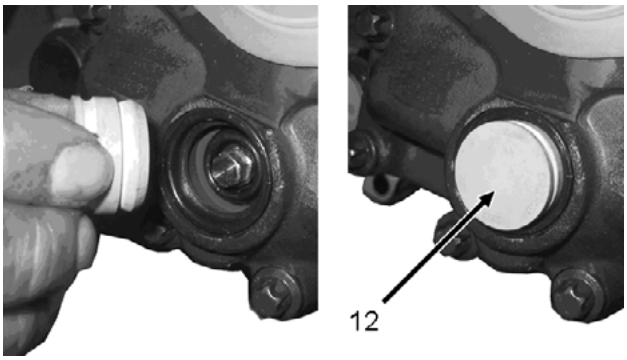




– Remove the mounting bushing (B) and the mounting cap (A).
– Make sure that the protection cap (13) is fully inserted in the sealing seat of the brake calliper and the ring groove (arrow) of the adjuster.



– Push a **new** sealing plug (12) into the protection cap (13) of the adjuster. Ensure that the sealing plug (12) has a tight seat.



7 Replacing the brake cylinder

CAUTION!
Risk of injury

– Observe all safety, repair and maintenance instructions (see chapter 1 „Important instructions and safety instructions“, page3).
– These instructions must be observed to avoid personal injury or material damage.

Only use brake cylinders as specified by the axle or vehicle manufacturer.

The instructions for breaking the brake cylinder in are for general information. Pay attention to the installation specifications and the test and installation instructions of the brake cylinder manufacturer and strictly adhere to them.

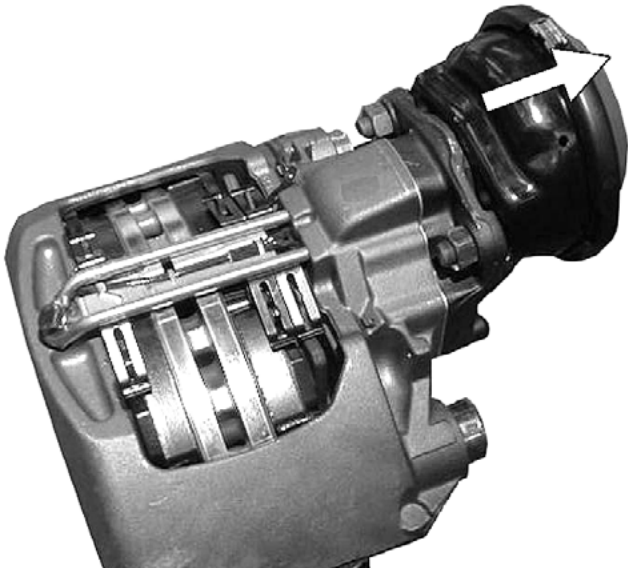
The illustrations are for example only and may deviate from the actual design.

7.1 Removing the brake cylinder

– Unscrew the air connection from the brake cylinder.

Ensure that the air connections of the brake cylinder are not pressurised.

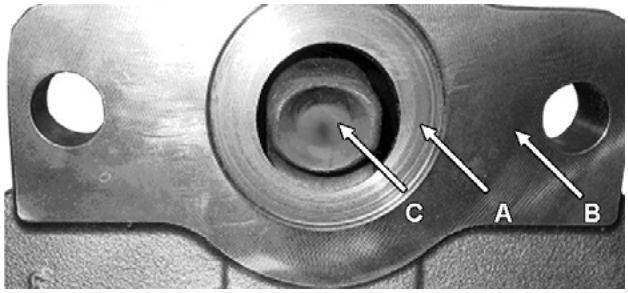
– Unscrew the brake cylinder nuts (see chapter 8.2 „Widths across flats and tightening torques“, page34, item V).
– Remove the brake cylinder from the brake calliper.



Ensure that no dirt or moisture enters the brake when removing the brake cylinder.

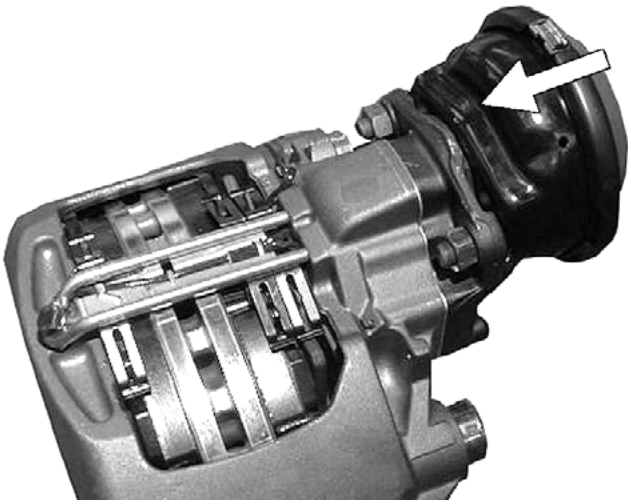
7.2 Installing the brake cylinder

– Clean the sealing area (A) and the flange surface (B) on the brake calliper and grease the calotte in the brake lever (C).



Ensure that no dirt or moisture enters the brake when cleaning.

– Place the brake cylinder onto the brake calliper and manually screw on the brake cylinder using **new** fastening screws until the brake cylinder makes full contact with the brake calliper.



– Tighten the brake cylinder with around 120 Nm.
– Tighten the fastening nuts with approx. 210 – 30 Nm (see chapter 8.2 „Widths across flats and tightening torques“, page34, item V).

Always use new fastening nuts when fitting the brake cylinder.

Depending on the installation position of the brake, ensure that the lower drainage aperture of the brake cylinder facing the ground is open.

Depending on the actuator type, the other drainage openings can either remain open or they must be sealed with a plug. Observe the respective instructions of the brake cylinder manufacturer.

– Screw the air connection onto the brake cylinder.

! Observe the respective instructions of the brake cylinder manufacturer here.

– Ensure that the brake hose is not twisted and routed so that it does not rub against the other parts.
– Ensure that the brake hose does not exert initial stress on the sliding function of the brake calliper and does not obstruct brake calliper movement over the entire displacement path.
– Check the air connection for tightness.
– Perform a function and effectiveness test of the brake.

8 Appendix

8.1 WABCO tools

WABCO Basic Tools (tool kit 640 195 522 2)

Required for all WABCO compressed-air disc brakes

Item	Name	Notation
10	Handle	
11	Adapter	
12	Ring spanner / Ratchet spanner	
13	Renewal	

WABCO tools for PAN®19 (tool kit 640 195 521 2)

The WABCO Basic Tools (tool kit 640 195 522 2) are also required.

Item	Name	Notation
21	Drive-out bushing	
22	Drive-in bushing long 1	
25	Drive-in bushing long 2	
26	Drive-in bushing short	
27	Drive-in bushing cover	
28*	Drive-in bushing short*	

*) This tool is part of the tool kit but is not required for the brake type PAN®19.

8.2 Widths across flats and tightening torques

(Also see drawing on the next page)

! Do not use motor-driven screw or torque tools!

Item	Name	Width across flats Hexagon screw		Tightening torque (Nm) Remarks
		external	inside	
I	Hexagon adjuster	8	–	Direction of rotation on the hexagon: • Adjust, anti-clockwise (left) maximum 3 Nm, clearance decreases. • Restore, clockwise (right), maximum 12 Nm, clearance increases.
II	Screw for lining retainer	17	–	40 + 5 Nm
III	Brake fastening screwed connection	24	–	Recommended: 290 ±20 Nm Always observe the relevant specifications of the axle or vehicle manufacture!
IV	Couplings, guide pins	–	14	130 Nm + 90° (angle controlled tightening) Tightening sequence for guide pins: • 1. Fit bolt, long (with hexagon socket screw) • 2. Play bolt, short (with hexagon socket screw)
V	Couplings, brake cylinder	24	–	210 – 30 Nm[1)] • Screw on the fastening nuts manually till the brake cylinder rests against the surface. • Tighten the fastening nuts with approx. 120 Nm. • Tighten fastening nuts with 210 – 30 Nm. **Only use fastening nuts once!**

[1)] The tightening torques apply for original WABCO cylinders

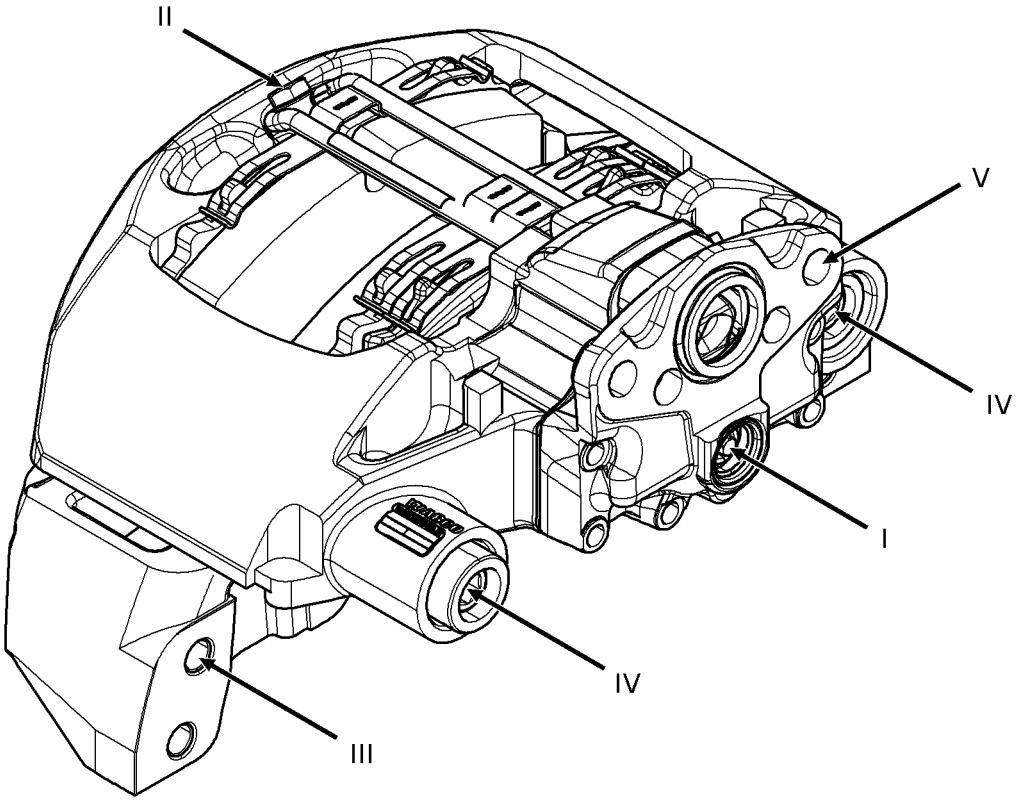


Fig. Illustration of positions for widths across flats and tightening torques

8.3 Exploded view of the replacement parts

Information and publications on WABCO repair kits and service documents can be found in the product catalogue INFORM on the Internet at www.wabco-auto.com

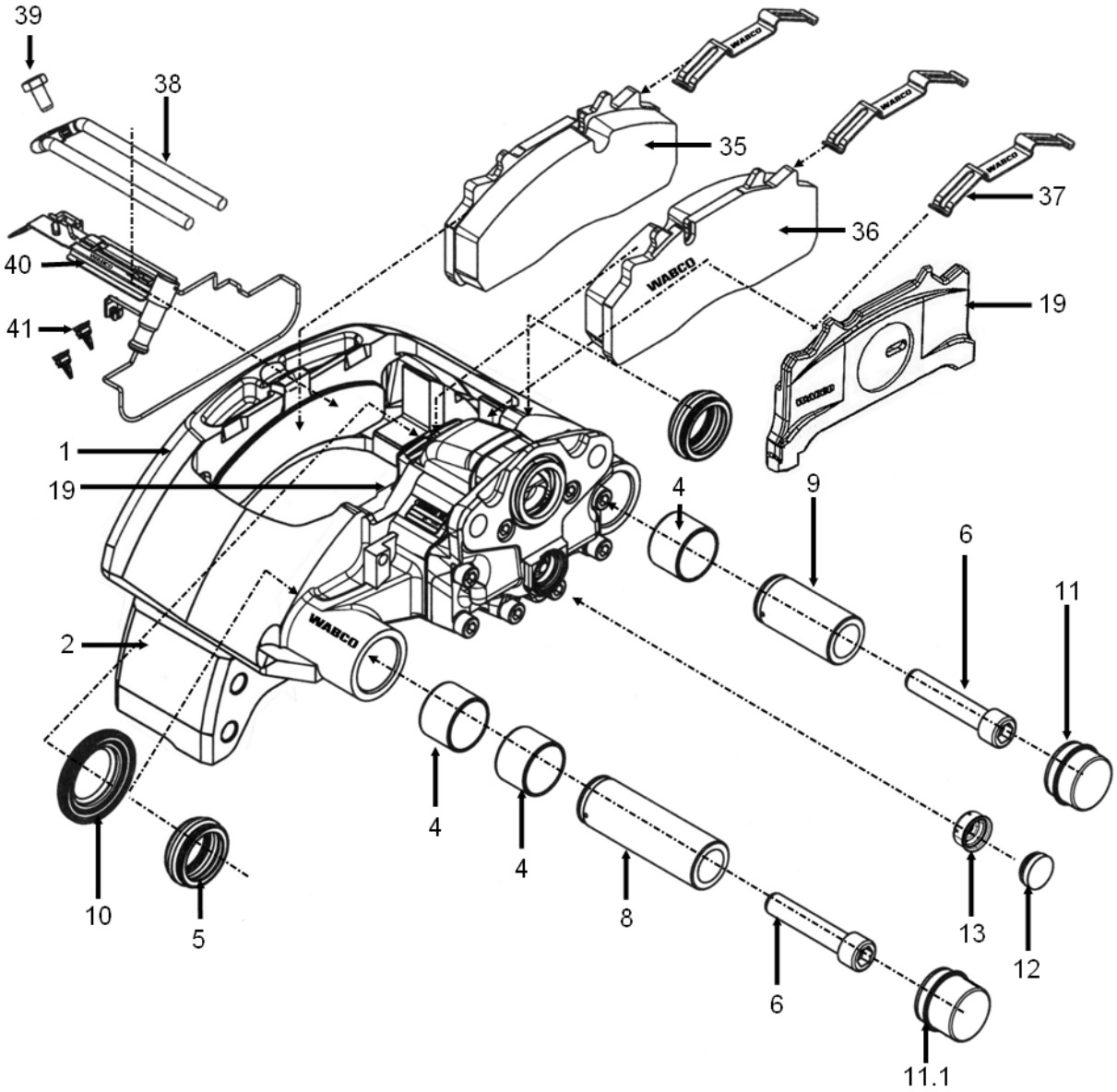


Fig. Illustration of replacement parts for a left brake

1 preassembled brake calliper (1) with actuating unit, with brake anchor plate (2) and pressure plate (19)
4 Bushings for guide pins
5 Protection caps for guide pins
6 Hexagon socket screw
8 Guide pin (long)
9 Guide pin (short)
10 Protection cap for adjuster screw
11 Closing cover (short)
11.1 Closing cover (long)
12 Closing plug of the adjuster
13 Protection cap for the hexagon of the adjuster
19 Spreader plate
35 Brake lining rim side
36 Brake lining cylinder side
37 Hold-down springs
38 Lining retainer
39 Hexagon screw
40 Cable guide with wear indicator
41 Cable clips

8.4 Procurement and disposal of spare parts

8.4.1 Procurement of spare parts

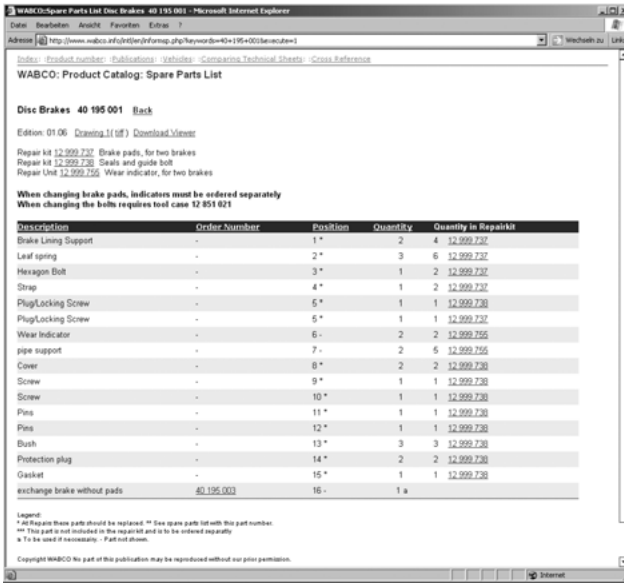
– Identify the brake by means of the WABCO part number.



Fig. WABCO type plate

A Vehicle manufacturer part number
B Date of production
C Assembly number
D WABCO part number

– Open INFORM at www.wabco-auto.com
– Enter the WABCO part number of the brake calliper.
– Click on "Repair".
– Open the spare part sheet.


WABCO: Product Catalog: Spare Parts List

Disc Brakes 40 195 001 Back

Edition: 01.06 Drawing 1 (tif) Download Viewer

Repair kit 12.999.737 Brake pads, for two brakes
Repair kit 12.999.736 Seals and guide bolt
Repair Unit 12.999.755 Wear indicator, for two brakes

When changing brake pads, indicators must be ordered separately
When changing the bolts requires tool case 12 851 021

Description	Order Number	Position	Quantity	Quantity in Repairkit
Brake Lining Support	-	1 *	2	4 12.999.737
Leaf spring	-	2 *	3	6 12.999.737
Hexagon Bolt	-	3 *	1	2 12.999.737
Strap	-	4 *	1	2 12.999.737
Plug/Locking Screw	-	5 *	1	1 12.999.736
Plug/Locking Screw	-	5 *	1	1 12.999.737
Wear Indicator	-	6 -	2	2 12.999.755
pipe support	-	7 -	2	5 12.999.755
Cover	-	8 *	2	2 12.999.736
Screw	-	9 *	1	1 12.999.736
Screw	-	10 *	1	1 12.999.736
Pins	-	11 *	1	1 12.999.736
Pins	-	12 *	1	1 12.999.736
Bush	-	13 *	3	3 12.999.736
Protection plug	-	14 *	2	2 12.999.736
Gasket	-	15 *	1	1 12.999.736
exchange brake without pads	40 195 003	16 -	1 a	

8.4.2 Disposing of the brake components

– Dispose of used and replaced parts in accordance with the national and regional regulations regarding environmental protection.

> ! Generally brake components can be scrapped.

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CITIPORT



WORKSHOP MANUAL

REPAIR

INSTRUCTIONS

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Preface

This documentation was developed for specialized staff trained in the operation of ZF products by ZF Friedrichshafen AG (hereinafter referred to as "ZF").

The work described below may be performed by authorized, trained, and instructed staff only. It is the responsibility of the user's company or service company to ensure that their specialized staff is properly trained and that current documents are made available.

Object of documentation is a volume-produced ZF product. State of design acc. to date of issue.

The images illustrate the work sequence and do not always represent the original. Illustrations and figures are not drawn to scale; no conclusions about size and weight can be drawn.

The repair or assembly of the ZF product available to you may require different work steps as well as different settings and test data as a result of technical further developments. We therefore recommend that work done on your ZF product be carried out only by skilled mechanics and fitters who have had their practical and theoretical knowledge updated on a regular basis at ZF.

The ZF service locations which have been put in place for you worldwide by ZF offer the following services:

- Well-trained specialized personnel
- Specified workshop equipment, e. g. special tools, diagnostic software, etc.
- Genuine ZF spare parts in accordance with the latest volume production specifications

ZF Friedrichshafen AG

Safety Instructions

General safety instructions

Read all safety instructions. Failure to comply with safety instructions may lead to material damage, serious injury, possibly even to death.

Intended use / liability / guarantee / warranty

The ZF product is exclusively designed for the purpose specified in the contract and agreed on at the time of delivery. Any other or extended form of use does not comply with this definition of intended use. ZF Friedrichshafen AG is not liable for any damage resulting from this. Instead, the user is fully liable for this risk. The intended use includes compliance with this documentation and other applicable documents in order to avoid malfunctions and damage in operation.

The ZF product is designed and produced in line with state-of-the-art technology and is safe to operate. However, this product may cause hazardous situations if used incorrectly by unauthorized, untrained, and uninstructed specialized staff or if not used for its intended purpose.

This version of the document complies with the relevant standards and regulations as well as with European product liability law.

We offer guarantee for the ZF product in accordance with our Terms and Conditions. Warranty claims cease to apply if damage and secondary damage result from incorrect and unprofessionally performed work. Work that is performed by unauthorized, untrained, and uninstructed specialized staff leads to ceasing of all warranty claims.

We offer warranty for the ZF product in accordance with our Terms and Conditions.
Damage, secondary damage, defects, and possibly resulting costs are excluded from contractual liability or warranty in the event of non-compliance with one of the following points:

- All work must be performed in a professional manner.
- Work must only be performed by trained, instructed and authorized specialized staff.
- Only genuine ZF spare parts may be used which have been tested and released by ZF.
- Only genuine ZF accessories may be used which have been tested and released by ZF.
- Only genuine ZF special tools may be used which have been tested and released by ZF.
- Revisions and modifications on the ZF product must be approved by ZF.

In case of damage, immediate action is mandatory in order to restore full functionality and safety / operational safety of the ZF product and to minimize the extent of damage. In the event of non-compliance, ZF will not accept liability or warranty claims.

In case of damage, contact ZF Services and have the following data available:

- Product type, product parts list number, and serial number
- Total mileage
- Damage history
- Damage pattern

Specialized staff

Work must only be performed by trained and instructed specialized staff. As a result of specialized training and practical experience, the specialized staff must be capable of detecting risks and avoiding possible dangers which may be caused by the operation, maintenance, and repair of the ZF product.

To avoid injury to personnel and damage to ZF products, all safety regulations and legal requirements must be adhered to. The specialized staff must have read and understood these regulations prior to beginning work.

Country-specific safety, accident prevention, and environmental regulations apply irrespective of the instructions provided in this document.

Safety-relevant workwear is to be used for all work. Depending on the type of work, additional protection, e. g. protective goggles, protective gloves, a hard hat, and a skirt, is to be used. The workwear must fit properly and be tight so that it cannot get caught in turning or protruding parts.

After completion of repair work and inspections, the specialized staff must ensure that the ZF product is again functioning perfectly and is safe to operate.

The user/operator is responsible for assigning the corresponding section of the documentation to the correct target group. The former must ensure that the respective section of the documentation is stored in the immediate vicinity of the ZF product and that the relevant target group has access to it.

Handling of ZF products

Impermissible superstructures, add-ons, modifications, and changes to the ZF product may affect the ZF product's operational safety and are only permitted with the approval of ZF Friedrichshafen AG.

Unless explicitly permitted, no work may be performed while the engine is running.
Secure the engine against unintentional setting off and the vehicle against moving.
Attach a "Do not operate" sign which is visible for everyone!
Keep uninvolved parties away.

Always secure the ZF product before starting work according to specification and using suitable means.
Do not work on ZF products which are only held by a lifting device or a hoist.
Risk of injury from tilting or falling parts and/or tools.

- Do not walk under suspended loads.
- Keep distance.

Lifting and moving heavy parts without tools may lead to health damage or serious injury.

- Only use permitted means of transport, lifting equipment with sufficient load capacity, and suitable chain hoist.
- Observe safety regulations.

Increased risk of injury at contact with cooled down or heated parts. Only touch parts when wearing suitable protective gloves.

Noise

Wear suitable ear protection at all workplaces with a sound pressure level above 85 dB(A).
Country-specific safety and accident prevention regulations apply regardless of this.
Noise can mean a higher risk of accidents if the noise affects the perception of acoustic signals, warning calls, or other sounds alerting to danger.

Handling operating fluids and consumables

Increased risk of injury at contact with heated, cooled down, or caustic operating fluids and consumables (e. g. lubricants, cleaning agents, nitrogen).

- Prevent skin contact.
- Do not drink.
- Do not inhale vapors.
- Keep away from ignition sources, do not smoke.

Store operating fluids and consumables in suitable and correctly labeled containers.
Use suitable protective clothing, protective gloves, and protective goggles/face protection.
Pay attention to manufacturer's and accident prevention regulations.
Immediately seek medical assistance after contact with heated, cooled down, or caustic operating fluids and consumables.

Environment

Operating fluids and consumables must not be allowed to enter the soil, groundwater, or sewage system.

- Ask your local environmental protection agency for the safety data sheets of the relevant ZF products and observe these requirements.
- Collect operating fluids and consumables in a sufficiently large container.
- Dispose of operating fluids and consumables, waste, containers, soaked cleaning cloths, contaminated filters etc. in accordance with the regulations of the environmental protection laws.
- Pay attention to manufacturer's and accident prevention regulations.

When selecting operating fluids and consumables, bear in mind health risks, environmental compatibility, disposal regulations, and country-specific possibilities for approved disposal.

Signal words and symbols

This document contains particularly highlighted safety instructions which start with one of the following signal words depending on the danger's severity.

NOTE
Refers to special working procedures, methods, information, use of auxiliary equipment, etc.

CAUTION
Is used when the instructions are not complied with or not followed precisely and could lead to the product being damaged.

⚠ **DANGER!**
Is used when lack of care could result in personal injury or danger to life.

Product-related safety instructions

CAUTION
The transmission must NOT be suspended by the input shaft OR by the output flange/add-on parts.

Instructions for Repair and Assembly

General notes

- Please read carefully through this documentation prior to starting repair or assembly work.
- Prior to starting repair or assembly work, please find out whether ZF Service Information on the ZF product is available. ZF Service Information can contain tests, supplements to the product or to repair processes which may not yet be included in this documentation. The ZF Service Information details are available from all ZF Service Centers or from the ZF-ServiceLine.
- In cases of doubt, always contact the relevant expert departments of the ZF Customer Service.
- All work on the ZF product must be performed expertly and under clean conditions.
- Use the specified special tools and equipment intended for the described working procedures.
- All work must be performed according to the described working procedure.
- Carefully cover opened ZF products to prevent the entry of foreign matter.
- Cover all parts that have been removed and that are reusable and protect them against dirt and damage.
- After completion of work and inspections, the specialized staff must ensure that the ZF product is again functioning perfectly and is safe to operate.

Cleaning the ZF product prior to disassembly

- Use an appropriate cleaning agent to thoroughly clean the ZF product prior to repair or assembly work. Thoroughly clean the angles and recesses of housing and cover.

CAUTION
Be careful when using a high-pressure cleaner on the ZF product.
Penetrating water might lead to operational disruption and damage to the ZF product.

Cleaning parts

- Thoroughly clean all reusable components after disassembly.
- Thoroughly remove sealing compound residue on sealing faces or retaining agent residue, e. g. in tapped holes or on splines.
- Thoroughly clean joining surfaces and check for damage.
- Thoroughly wash out blind holes and blind hole threads and remove contamination.
- Lubricating bores, oil clearance holes, oil ducts, bores for oil press fits, and lubricating grooves must be free from dirt, preservative, and foreign matter. If possible, blow through with compressed air. Check for free passage.
- Hose assemblies, oil tubes, and joining elements must be free from dirt, oil, and chafe marks. Dirty or oily parts must be thoroughly cleaned and, if necessary, blown through with compressed air. Replace damaged parts.
- Thoroughly clean all cavities and reliefs.
- All edges which can cause chip formation during assembly or represent a risk of injury for the fitter must be deburred.
- Carefully remove burrs or other similar rough surfaces using a honing stone.
- Thoroughly remove preservative from new parts (e. g. on bearing).

Reusing parts

Authorized, specialized staff assess whether parts can be reused.

- Replace parts if they are damaged.
- Replace parts if they are worn, e. g. rolling bearings, multidisks, thrust washers, etc.
- Replace parts if they have a permanent deformation.
- Replace parts if they have been overheated during operation or during disassembly.

Always replace:

- Bolts with reduced shank, seals, etc., and parts that are intended for single use only
- Sealing rings
- Safety plates
- Shaft sealing rings

The parts must be replaced with genuine ZF parts or parts released by ZF. Please refer to the spare parts catalog for the ZF product.

Reworking parts

Authorized, specialized staff assess whether parts need to be reworked or replaced.

Minor damage on reusable components can be removed and reworked with suitable special tools if the component's function is not impaired.

Minor damage includes:

- Indentation marks on sealing faces
- Score marks or burrs caused by the disassembly of the ZF product
- Frictional corrosion
- Paint and rust damage

If rework is needed on spacer washers or shims because of clearance settings, ensure that the reworked surface is level with the starting face and has the same surface quality.

Disassembly

- To avoid mixing up parts, the parts must be clearly assigned to the disassembled ZF product. In particular, this applies to gear parts, reusable spacer washers or shims, electronic components, etc.
- Assemblies which must not be disassembled or are only available as spare parts assembly are described accordingly. Please refer to the spare parts catalog for the ZF product.
- Inspect the parts during disassembly in order to find a potential cause of damage.

Assembly

Assemble the ZF product at a clean workplace. The order, settings, and tightening torques must be observed.

Bearings

The bearings' assembly specifications are described in the corresponding work step. After assembly, each mounted bearing must be lubricated with transmission oil.

Sealing

If a sealing agent* is recommended for sealing, then it is essential to adhere to the manufacturer's directions for use. A thin layer of sealing agent should be applied to the surfaces and coat them evenly. Do not allow sealing agent to enter oil ducts and oil bores. In the case of oil transfer channels and/or oil transfer bores in the sealing face areas, the sealing agent should be scraped off around the openings so that no sealing agent gets into the oil supply lines when the parts are pressed together.

Retaining agents

Only use retaining agents* if specified in the work step. Follow the safety instructions and the processing instructions of the manufacturer.

Transmission oil

Prior to initial operation, fill the transmission with transmission oil. For the procedure and approved oil grades, refer to the technical manual, the operating instructions, the type plate, and/or the latest List of Lubricants TE-ML. These documents are available from the ZF Service Centers and at www.zf.com.

* refer to Operating supplies and auxiliary materials

Tightening torques for screws and nuts, extract from ZFN 148

This standard applies to bolts according to DIN 912, DIN 931, DIN 933, DIN 960, DIN 961 as well as ISO 4762, ISO 4014, ISO 4017, ISO 8765, ISO 8676, and for nuts according to DIN 934 and ISO 4032, ISO 8673.

This standard contains data on tightening torques for screws/bolts and nuts of strength categories 8.8, 10.9, and 12.9, as well as nuts of strength categories 8, 10, and 12.

Surface condition of screws/nuts: Heat-treated blackened finish and oiled or galvanized and oiled.

The bolts are tightened using a calibrated torque wrench.

NOTE
Differing tightening torques are listed separately in the repair manual.

Coarse thread

Measurement	Tightening torque in Nm for		
Screw	8.8	10.9	12.9
Nut	8	10	12
M4	2,8	4,1	4,8
M5	5,5	8,1	9,5
M6	9,5	14	16,5
M7	15	23	28
M8	23	34	40
M10	46	68	79
M12	79	115	135
M14	125	185	215
M16	195	280	330
M18	280	390	460
M20	390	560	650
M22	530	750	880
M24	670	960	1100
M27	1000	1400	1650
M30	1350	1900	2250

Fine thread

Measurement	Tightening torque in Nm for		
Screw	8.8	10.9	12.9
Nut	8	10	12
M8x1	24	36	43
M9x1	36	53	62
M10x1	52	76	89
M10x1,25	49	72	84
M12x1,25	87	125	150
M12x1,5	83	120	145
M14x1,5	135	200	235
M16x1,5	205	300	360
M18x1,5	310	440	520
M18x2	290	420	490
M20x1,5	430	620	720
M22x1,5	580	820	960
M24x1,5	760	1100	1250
M24x2	730	1050	1200
M27x1,5	1100	1600	1850
M27x2	1050	1500	1800
M30x1,5	1550	2200	2550
M30x2	1500	2100	2500

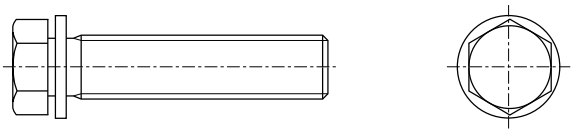
Status: August 1991

Tightening torques for hex head screws according to EN ISO 10644 and DIN EN 1665

CAUTION
Depending on the screw design, different tightening torques for hex head screws arerequired:

Screw with washer assembly according to EN ISO 10644
(hex head screw with washer)

M 8 = Tightening torque: **23 Nm**
M 10 = Tightening torque: **46 Nm**
M 12 = Tightening torque: **79 Nm**



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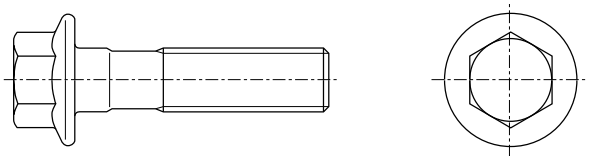
Flange-head screw according to DIN EN 1665
(hex head screw without washer)

M 8 = Tightening torque: **29 Nm**
M 10 = Tightening torque: **60 Nm**
M 12 = Tightening torque: **99 Nm**



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Designation ZF item number	Name	Quantity approx.	Application	Comment
Grease 0750 199 001	For example Spectron FO 20		Assembly aid, general	
Grease 0671 190 016	Techn. Vaseline 8420		Assembly aid, general	
Operating oil	Refer to TE-ML 20 List of Lubricants		Assembly aid, general	

NOTE: Inquire as to size of containers before ordering!

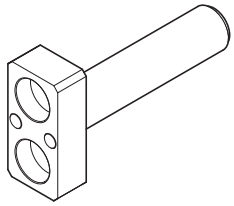
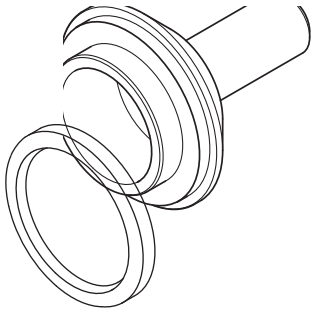
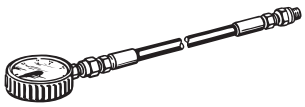
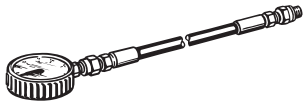
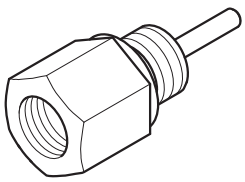
Image no.	Figure	Order no. Application	Quantity	Comment
1		**1X56 137 452** **Adapter** for safety plate at output flange	1	
2		**1X56 138 625** **Adapter** for shaft sealing ring, output **1X56 138 590** **Washer** for the second position of shaft sealing ring, output	1 1	
3		**1P01 136 670** **Test gage** 0 – 25 bar with connection socket M10x1	1	
4		**1P01 137 856** **Test gage** 0 – 10 bar with connection socket M10x1	1	
5		**1P82 139 839** **Adapter** for EcoLife test gage To be used at pressure measuring points PD8, PD6, A8, PHD, PVF	1	Refer to Chapter 2.7 Pressure test

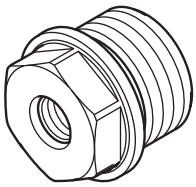
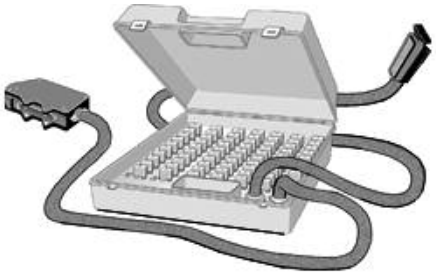
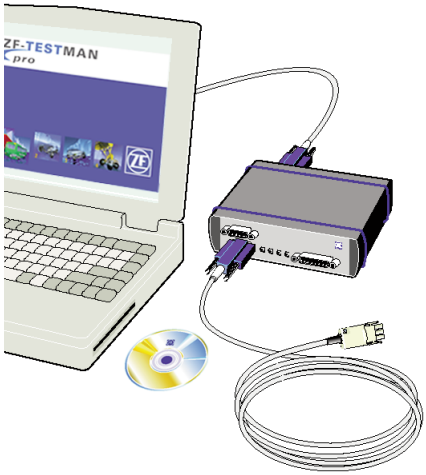
Image no.	Figure	Order no. Application	Quantity	Comment
6		**4181 302 009** **Screw plug** (without valve) for EcoLife test gage in combination with adapter 1P82 139 839 To be used at measuring connection Main pressure – PHD (2) and pressure upstream of filter – PVF (3)	1	Refer to Chapter 2.7 Pressure test
7		**6008 006 002** **68-pin terminal tester** for troubleshooting in electrical part	1	
8		**6008 208 550** **Diagnostic system** **ZF-TESTMAN Service Edition** (full version, only for ZF Service) **Complete system without PC** This includes: ZF-TESTMAN software 6008 208 500 on DVD The diagnostic tool 6008 208 100 comprises various connection cables including the DPA 05 diagnostic adapter	1	System requirements: - WIN. XP SP2 - WIN. Vista (32 & 64 Bit) - WIN. 7 (32 & 64 Bit) - WIN. 8 - IE 5.01 < - WIN. Installer 3.0 <
9		**6008 208 500** **Software** **ZF-TESTMAN Service Edition** (full version, only for ZF Service) on DVD	1	

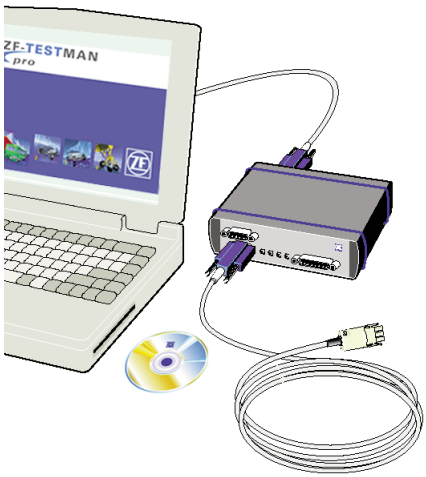
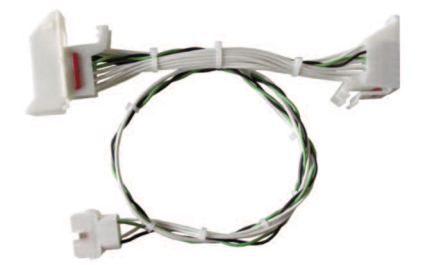
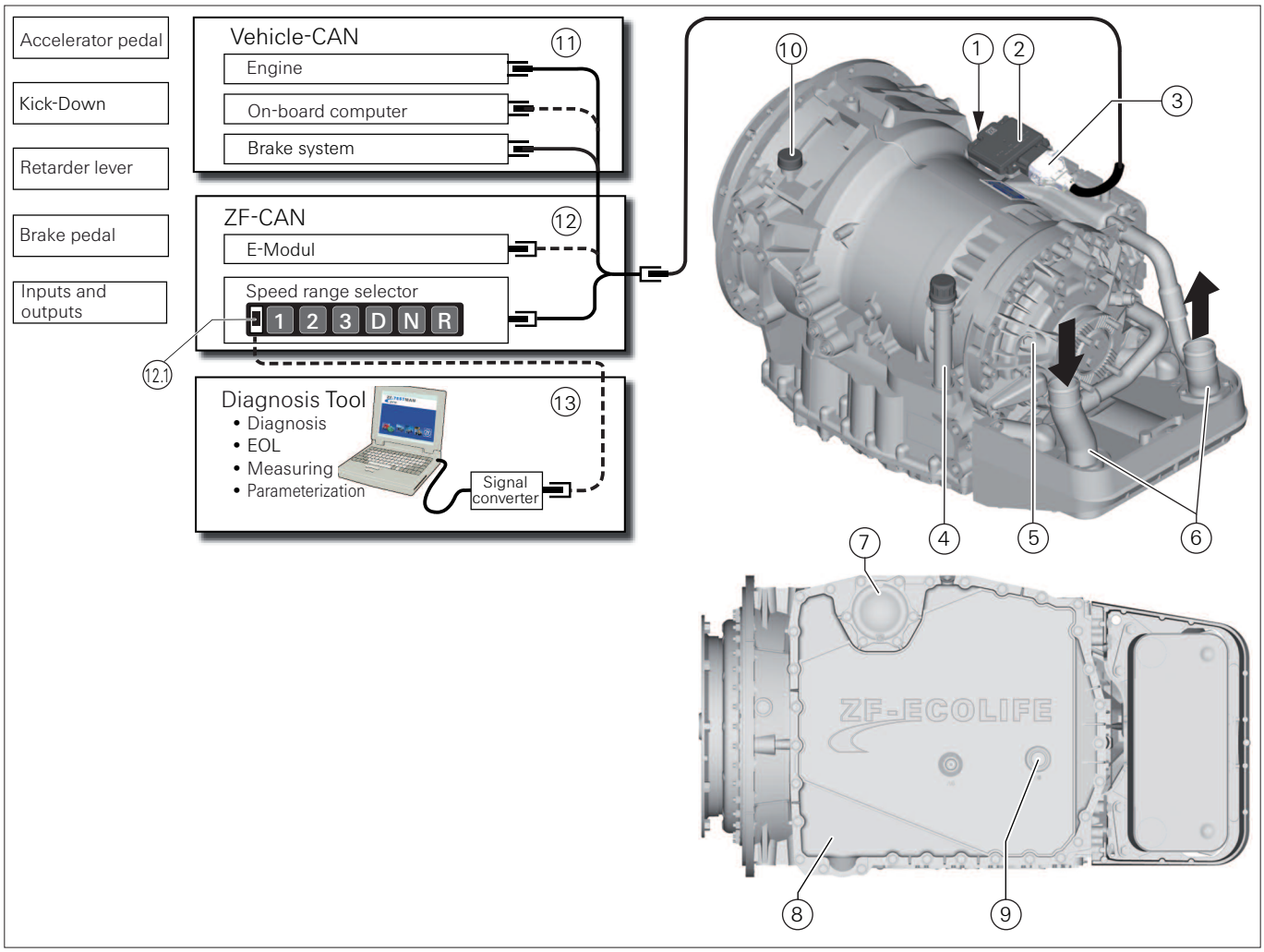
Image no.	Figure	Order no. Application	Quantity	Comment
10		**6008 208 450** **Diagnostic system** **ZF-TESTMAN IAM Edition** (customer version) **Complete system without PC** This includes: ZF-TESTMAN software 6008 208 400 on DVD The diagnostic tool 6008 208 100 comprises various connection cables including the DPA 05 diagnostic adapter	1	System requirements: - WIN. XP SP2 - WIN. Vista (32 & 64 Bit) - WIN. 7 (32 & 64 Bit) - WIN. 8 - IE 5.01 < - WIN. Installer 3.0 <
11		**6008 208 400** **Software** **ZF-TESTMAN IAM Edition** (customer version) on DVD	1	
12		**6008 206 038** **Adapter cable** between transmission control unit and terminal tester	1	
13		**6008 206 039** **Adapter cable** between transmission connector and terminal tester	1	

Image no.	Figure	Order no. Application	Quantity	Comment
14		**6008 206 040** **Adapter kit** contains 6008 206 038 and 6008 206 039	1	
15		**6008 206 042** **T adapter** between transmission control unit and vehicle-side connector with CAN2 interface and power supply	1	
16		**6008 207 038** **TMA table mode adapter** for table mode-based programming of electronics	1	
17		**6008 207 043** **Adapter** Diagnostic connection for ZF speed range selector	1	
18		**6008 207 048** **Adapter** MAN diagnostic connection	1	

Classification of peripheral equipment



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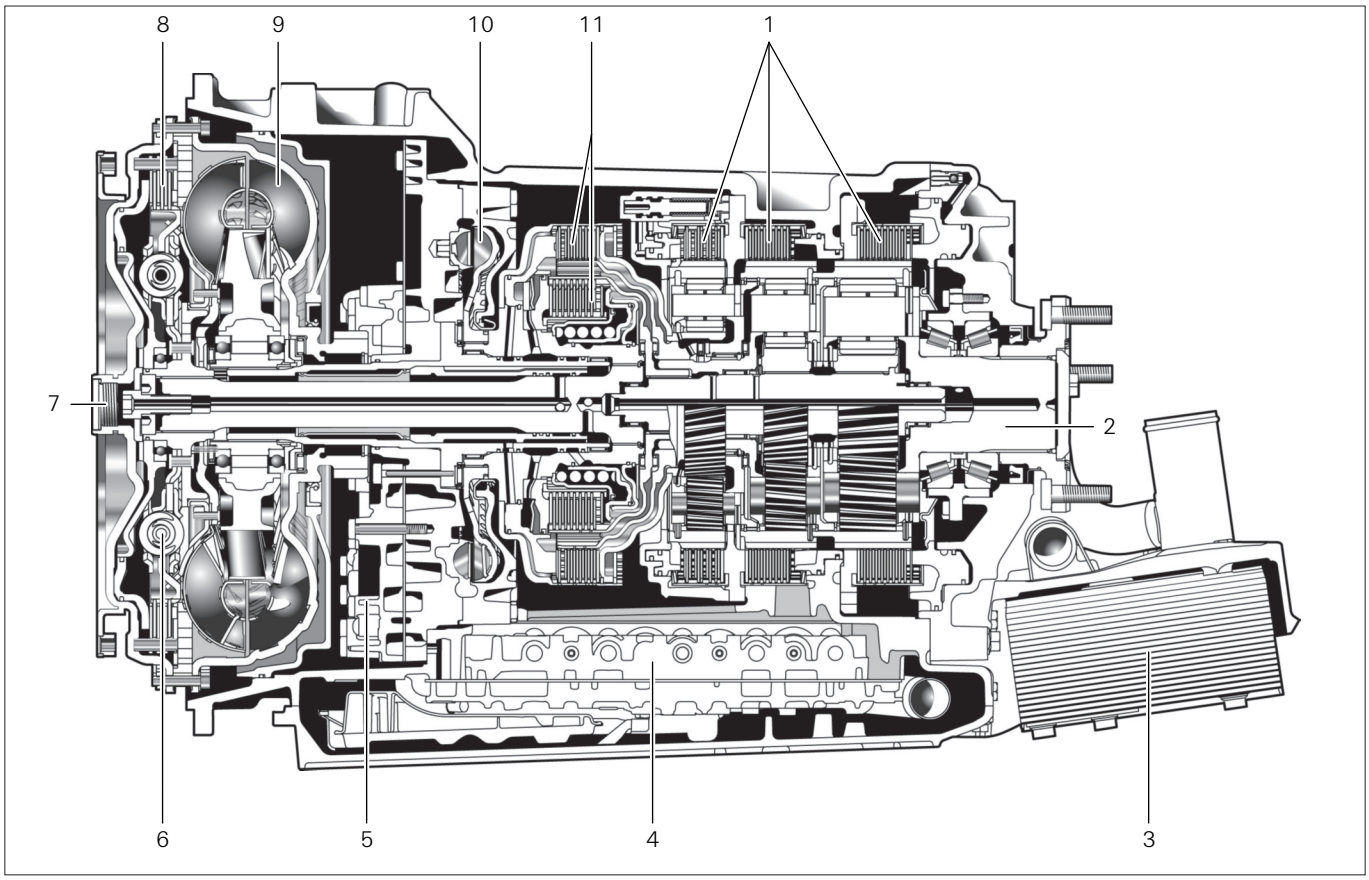
1 Cable connection between electronic control unit and transmission
2 Electronic control unit
3 Electronic control unit's connector
4 Oil filler tube with dipstick
5 Impulse sensor for speedometer (optional at 10 o'clock/2 o'clock)
6 Cooling water connections
7 Pressure filter
8 Oil pan
9 Oil drain plug
10 Breather

11 Vehicle CAN
- Engine/on-board computer/brake system
  - Accelerator pedal
  - Kickdown, retarder lever, step plate

12 ZF-CAN
- E module 2 (optional)
  - Inputs
    - Kickdown, retarder lever, step plate
  - Outputs
- Speed range selector (pushbutton range selector)
  - Inputs
    - Kickdown, retarder lever, step plate
  - Outputs
- ZF diagnostic access (12.1)

13 Diagnostic tool, ZF-Testman
- Diagnosis
- EOL
- Measurement
- Parameterization

6 AP 1000 B, 6 AP 1200 B, 6 AP 1400 B, 6 AP 1700 B and 6 AP 2000 B



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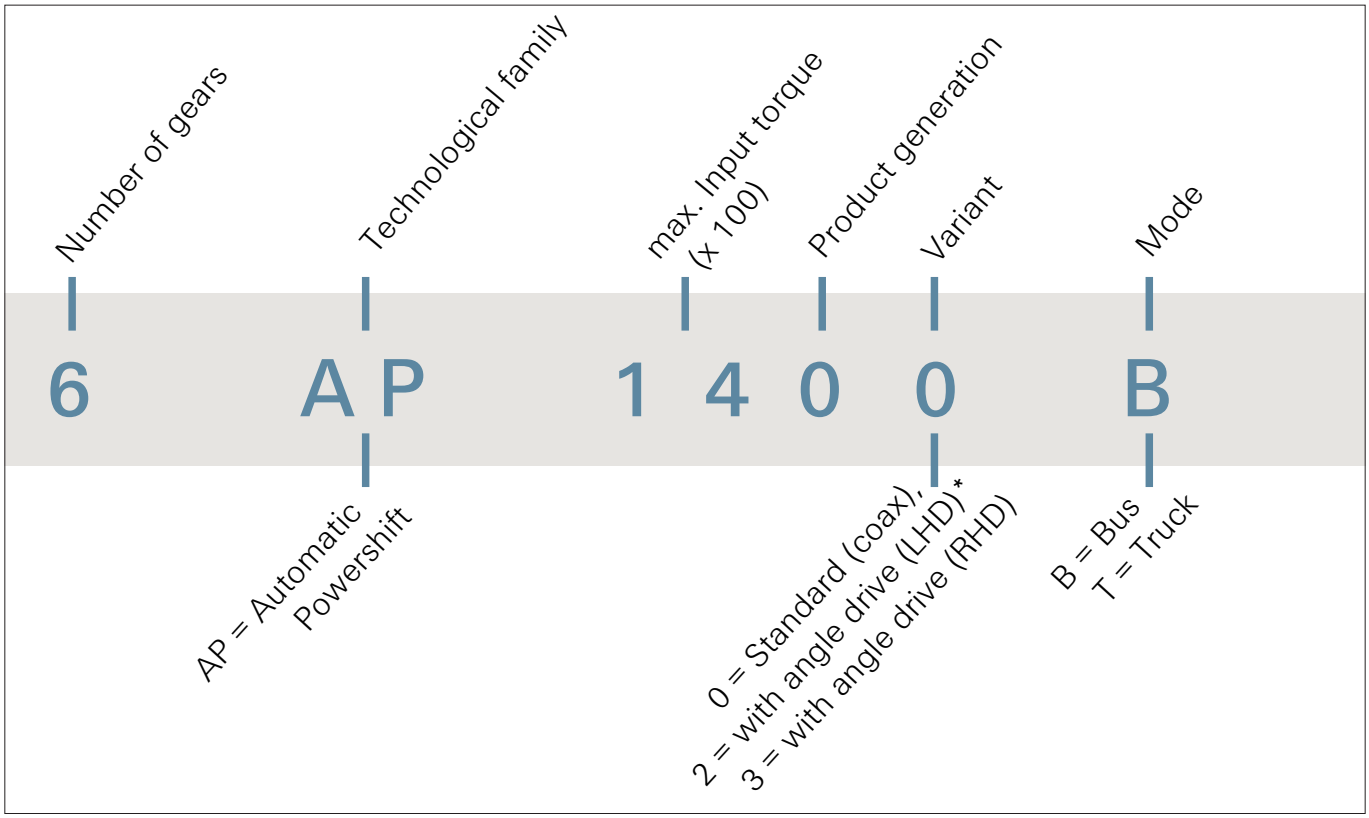
Key to drawing

1 Brakes D, E, F
2 Output
3 Retarder oil cooler (ROC)
4 Hydraulic shift control unit
5 Oil pump
6 Torsional vibration damper
7 Input
8 Torque converter lock-up clutch (LuC)
9 Torque converter
10 Retarder
11 Clutches A, B

ZF-EcoLife - Product designation

The entire ZF-EcoLife transmission family at a glance.

The new nomenclature: Clear and standardized for all ZF model ranges.



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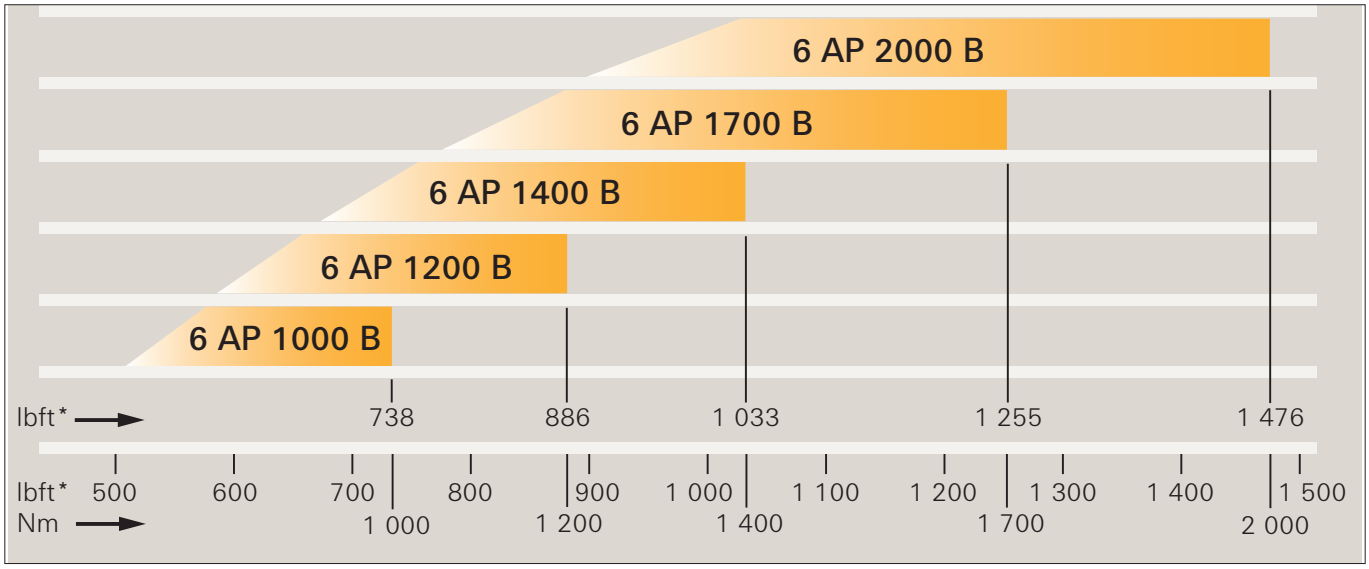
Transmission types



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* 1 Nm ≅ 0,738 lbft

The installation conditions and connection points of all transmission types are identical.

Shift element combinations

The table shows the shift element combinations depending on the gears engaged and the ratios activated.

Clutch/brake combinations/ratios												
Gear	A	B	D	E	F	6 AP xx00 B			6 AP xx02 B; 6 AP xx03 B			
						i Gear	φ	φ total	i Gear	φ	φ total	
1.	●				●	3.364		5.469	3.265		5.469	
							1.762			1.762		
2.	●			●		1.909			1.853			
							1.343			1.343		
3.	●		●			1.421			1.380			
							1.421			1.421		
4.	●	●				1.000			0.971			
							1.389			1.389		
5.		●	●			0.720			0.699			
							1.171			1.171		
6.		●		●		0.615			0.597			
AIS 1.					●							
R			●		●	4.235			4.112			
AIS 2.[1)]				●								
AIS R [1)]					●							

1) AIS special versions

Permissible transmission input speeds*

Transmission type			6 AP 1000 B 6 AP 1200 B 6 AP 1400 B	6 AP 1700 B 6 AP 2000 B	6 AP xx02 B 6 AP xx03 B [2)]
Speeds					
Minimum idling speed	n_{min}	[rpm]	400	400	400
Maximum input speed	n_{max}	[rpm]	2800 (1st to 5th gear) 2100 (6th gear)	2600 (1st to 5th gear) 2100 (6th gear)	2400 (1st to 5th gear) 2100 (6th gear)

2) For increased input speeds at reduced input torques, refer to the technical manual 4181 765 101, Chapter 2.4.2.

* For latest data, reference the technical manual 4181 765 101, Chapter 2.4.2

1 Maintenance

1.1 Oil change intervals

NOTE
The pressure filter must be replaced at each oil change.
Only genuine ZF oil filters may be used.

Transmission oil change	Oil-change interval
List of Lubricants TE-ML 20	
- Vehicle classification TE-ML 20.100, lubricant class 20C	every 120 000 km mileage/km or every 2 years [1)]
- Vehicle classification TE-ML 20.100, lubricant class 20E / 20F	every 240 000 km mileage/km or every 3 years [1)]
- Vehicle classification TE-ML 20.105, lubricant class 20E / 20F	every 180 000 km mileage/km or every 3 years [1)]
- Vehicle classification TE-ML 20.110, lubricant class 20F	every 120 000 km mileage/km or every 3 years [1)]

[1)] Depending on what occurs first.

1.2 Oil quantities

• For oil change with standard oil drain (draining time approx. 10 min.)	approx. 24 liters
• For oil change with VRM special oil drain system	approx. 17 litres
• For initial filling of the empty transmission	
- 6 AP 1000 B / 1200 B / 1400 B	approx. 38 liters
- 6 AP 1700 B / 2000 B	approx. 42 liters
- 6 AP 100x B / 120x B / 6 AP 140x B / 170x B	approx. 43 liters

NOTE
These values are reference values! The oil quantity after the oil level check at operating temperature (90 °C) is definitive.

1.3 Oil grade

- The data in the ZF List of Lubricants TE-ML 20 are binding

Only oil of the 20C/20E/20F lubricant class may be used for filling of EcoLife transmissions.

The current List of Lubricants can be obtained directly from ZF or via the Internet at http://www.zf.com.

1.4 Oil level check

CAUTION
It is absolutely necessary to maintain the correct oil level:

- **Insufficient oil quantities lead to malfunctions and damage of the transmission**
- **Excessive oil quantities lead to overheating of the transmission**

⚠ DANGER
Insufficient oil quantities lead to partial or complete failure of the retarder, i.e. results in reduced braking effect or no braking effect at all.

The following general rules apply:

- Transmission delivered with status 'not oil-filled' must be filled with the specified oil volumes prior to initial operation.
- In order to ensure minimum oil volumes for initial operation or after an oil fill (e.g. oil change, repair), an initial check is to be conducted with cold transmission oil, refer to Chapter 1.4.1.
- The relevant oil level check is to be conducted at operating temperature (90 °C), also refer to Chapter 1.4.2.
- For options to heat up transmission oil, refer to Chapter 1.4.4.
- Oil level check at least quarterly
- Regular visual inspection of the transmission for signs of leakage

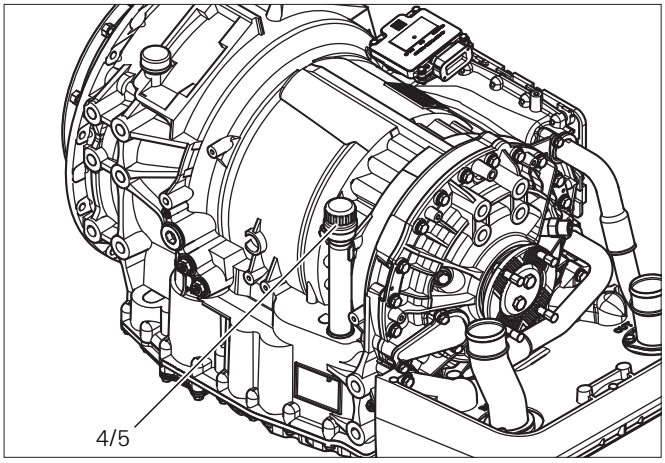

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Fig. 1.1 Coaxial transmission

4 Oil filler tube
5 Oil dipstick

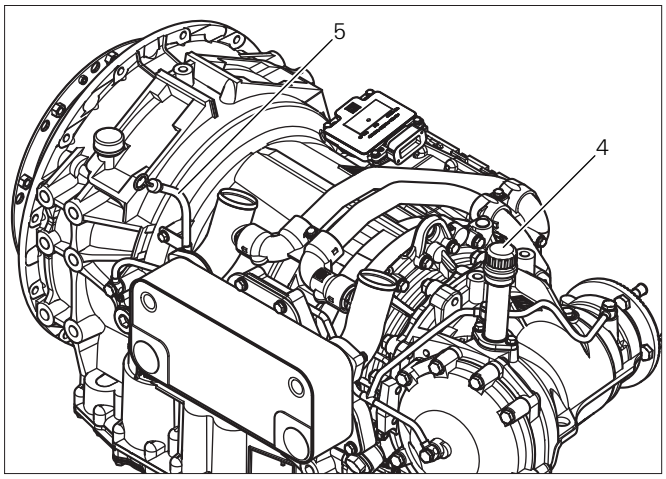

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Fig. 1.2 Transmissions with angle drive of 80°, RHD

4 Oil filler tube
5 Oil dipstick

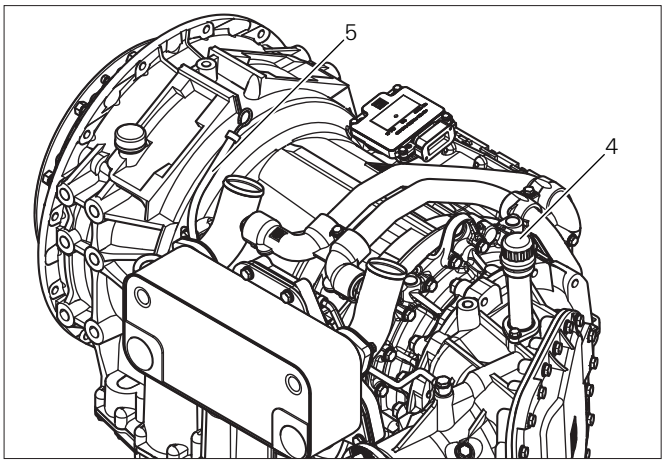

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Fig. 1.3 Transmissions with angle drive of 80°, LHD

4 Oil filler tube
5 Oil dipstick

1.4.1 Initial check of the oil level in order to ensure a minimum oil quantity

NOTE
For commissioning or after an oil filling (e.g. oil change, repair), an initial check of the oil level has to be conducted after engine start to ensure the minimum oil quantity.

Oil level check with cold transmission oil (30 °C):

- Vehicle is parked on level ground
- Shift speed range selector (pushbutton range selector) to “Neutral”
- Let engine run at 1 200 – 1 500 rpm for 15 to 20 seconds
- Let engine run at idle speed

CAUTION
The idle speed should be set to between 500 and 700 rpm. It must never drop below 400 rpm.

- Oil level must be within **“30 °C (cold)”** range

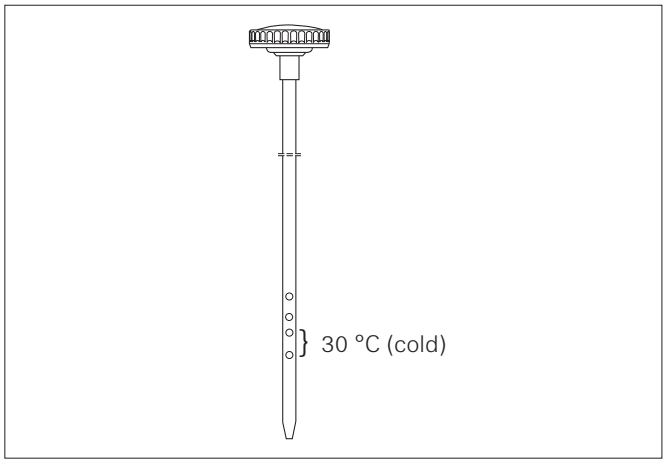

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Fig. 1.4 Oil level in the "30 °C (cold)" range

1.4.2 Check at operating temperature

Oil level check when transmission oil is hot (90 °C):

- Vehicle is parked on level ground
- Shift speed range selector (pushbutton range selector) to “Neutral”
- Let engine run at 1 200 – 1 500 rpm for 15 to 20 seconds
- Let engine run at idle speed

CAUTION
The idle speed should be set to between 500 and 700 rpm. It must never drop below 400 rpm.

- Oil must be within **“90 °C (hot)”** range

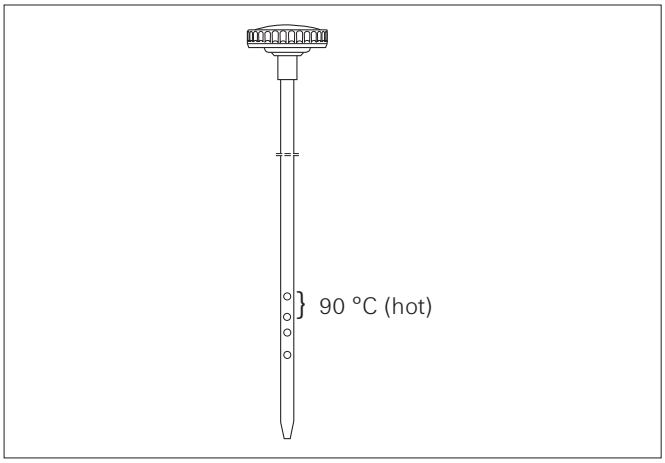

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Fig. 1.5 Oil level in the "90 °C (hot)" range

1.4.3 Electric oil level check

The Technical Customer Information "Electric Oil Level Sensor EcoLife, 4181 761 022" is obligatory.

1.4.4 Option for heating up transmission oil

The transmission oil can be heated up to the specified operating temperature for oil level check purposes by normal driving operation with retarder cycles until the oil sump temperature reaches 90 °C.

CAUTION
Max. permissible continuous oil temperature in oil sump is 120 °C and must not be exceeded.

When the operating temperature is reached carry out **"Check at Operating Temperature"** (Chapter 1.4.2).

1.5 Variant 1 – Oil change with standard oil drain

1.5.1 Oil drain

⚠ **DANGER**
Risk of burns!
Contact with hot transmission or hot transmission oil may result in burns.
Wear suitable protective clothing, protective gloves, and safety goggles/face protection.

⚠ **DANGER**
Environmental hazard!
When draining oil, oil can get into the environment!
Collect oil in a sufficiently large container and dispose of it in accordance with the regulations of the environmental protection laws.

NOTE
Drain oil only at operating temperature and at least for 10 minutes:

- Engine standstill
- Unscrew oil drain plug **(1)** and drain oil
- Change filters according to Chapter 2.1

NOTE
Pressure filter must be replaced when oil is changed.

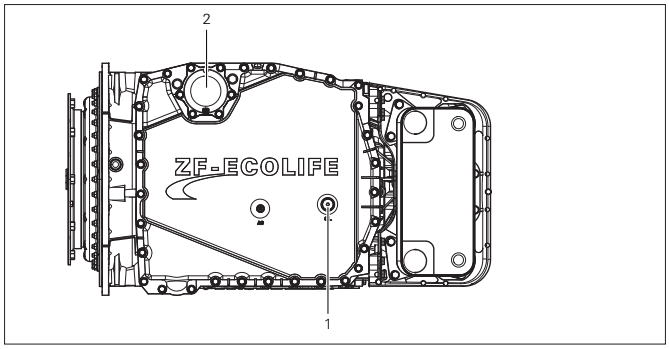


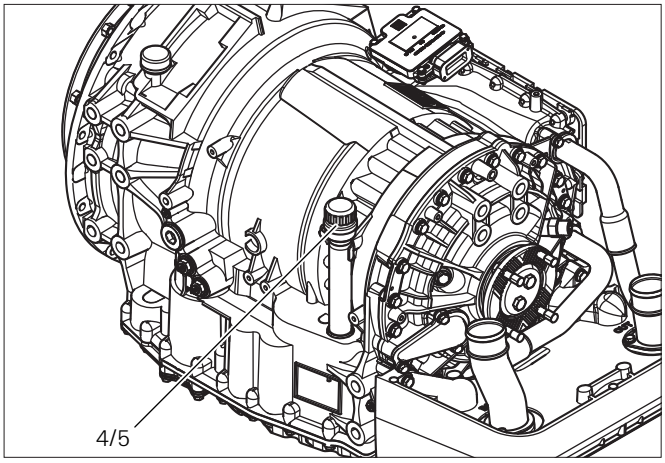
Fig. 1.6 Coaxial transmission with standard oil drain 035580

ZF angle drive 80° RHD / LHD
The angle drive does not have its own oil drain plug. Drain oil via main transmission's oil drain plug according to Chapter 1.5.

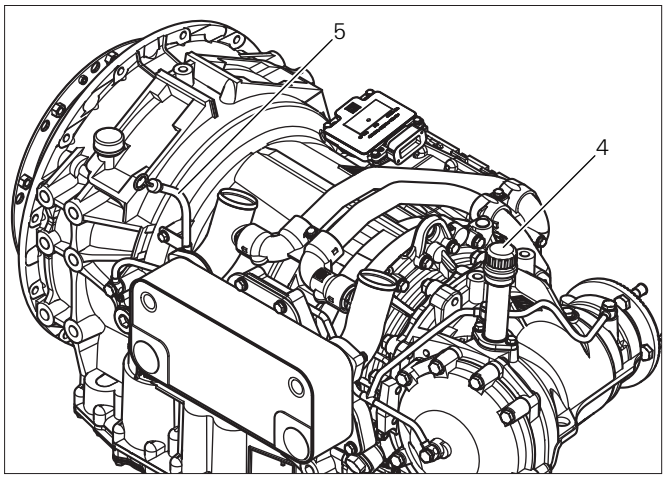
1.5.2 Oil fill

CAUTION
Always use genuine ZF oil drain plugs.
The torque converter drain valve is operated via the oil drain plug.

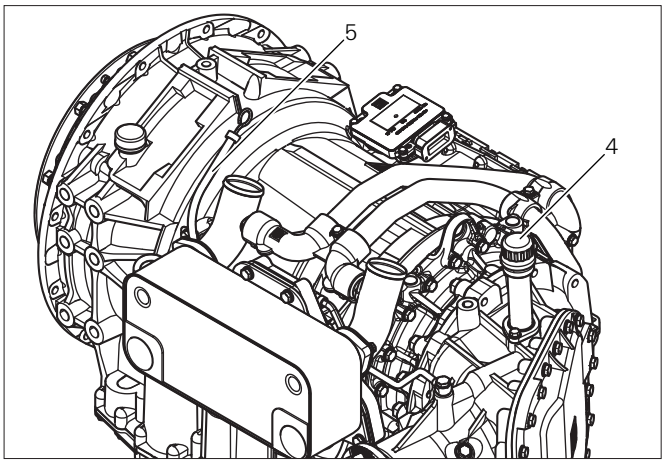
- Screw in oil drain plug **(1)** with new O-ring (refer to Fig. 1.6).
  Tightening torque: **35 Nm**
- Fill in oil at oil filler tube **(4)** according to Chapter 1.2
- Check oil level at oil dipstick **(5)**; refer to Chapter 1.4
- For oil grade, see Chapter 1.3



035559_1
Fig. 1.7 Coaxial transmission



035560_1
Fig. 1.8 Transmissions with angle drive of 80°, RHD



035561_1
Fig. 1.9 Transmissions with angle drive of 80°, LHD

1.6 Variant 2 – Oil change with VRM special oil drain

1.6.1 Oil drain

DANGER
Risk of burns!
Contact with hot transmission or hot transmission oil may result in burns.
Wear suitable protective clothing, protective gloves, and safety goggles/face protection.

DANGER
Environmental hazard!
When draining oil, oil can get into the environment!
Collect oil in a sufficiently large container and dispose of it in accordance with the regulations of the environmental protection laws.

NOTE
- Oil drain only at operating temperature.
- No torque converter draining for oil drain with the VRM special oil drain.
- For VRM special oil drain, harmonization and approval from the "Sales and Application" department is required for the specification of the oil and filter change intervals.

- Engine standstill
- Unscrew special screw plug (**6.1** or **6.2**, depending on installation position) and drain oil via quick plug system.
- Change filters according to Chapter 2.1.

NOTE
Pressure filter must be replaced when oil is changed.

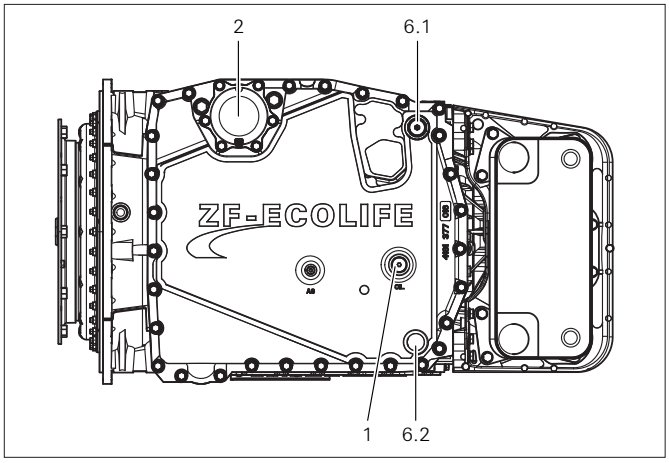


Fig. 1.10 Coaxial transmission with VRM special oil drain

1.6.2 Oil fill

- Screw in special screw plug **(6.1** or **6.2**, depending on installation position); (refer to Fig. 1.10).
  Tightening torque: **10 Nm**
- Fill in oil at oil filler tube **(4)** according to Chapter 1.2 (reference Figs. 1.7 up to 1.9).
- Check oil level at oil dipstick **(5)**; refer to Chapter 1.4 (reference Figs. 1.7. up to 1.9).
- For oil grade, see Chapter 1.3.

2 Repair

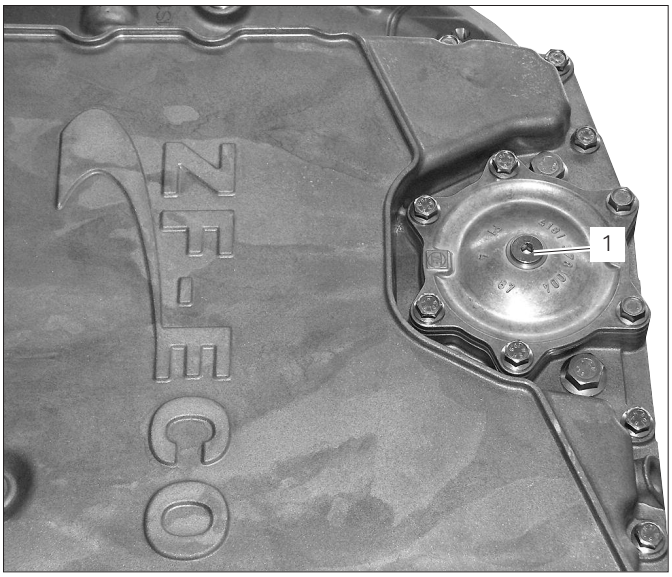
2.1 Filter change

⚠ DANGER
Environmental hazard!
Oil can leak out and contaminate the environment!
Collect oil in a sufficiently large container and dispose of it in accordance with regulation of environmental protection laws.
Dispose of contaminated filters in accordance with regulations of environmental protection laws.

1 Switch off engine.

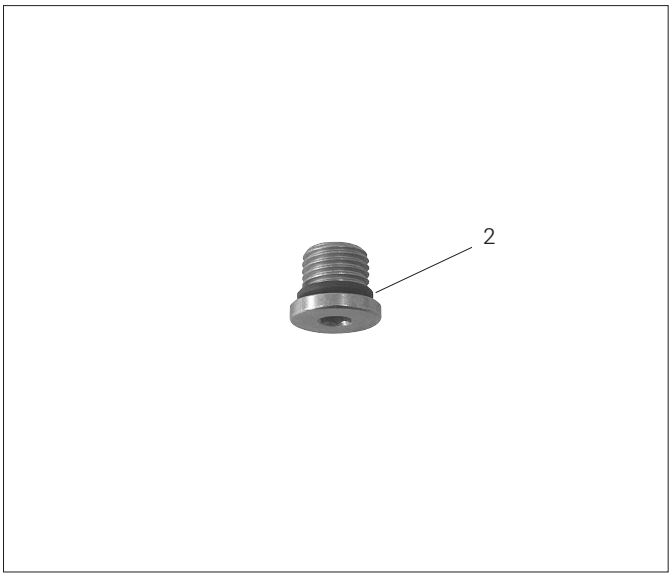
⚠ DANGER
Risk of burns!
Contact with hot transmission or hot transmission oil may result in burns.
Wear suitable protective clothing, protective gloves, and safety goggles/face protection.

2 If available, unscrew screw plug **(1)** and drain oil from filter chamber. No screw plugs used anymore as of serial number 344696.



032293

3 Remove O-ring **(2)**.



032263

⚠ DANGER
Risk of burns!
Contact with hot transmission or hot transmission oil may result in burns.
Wear suitable protective clothing, protective gloves, and safety goggles/face protection.

4 Unscrew six hex head screws **(1)** from the filter cover **(2)**.

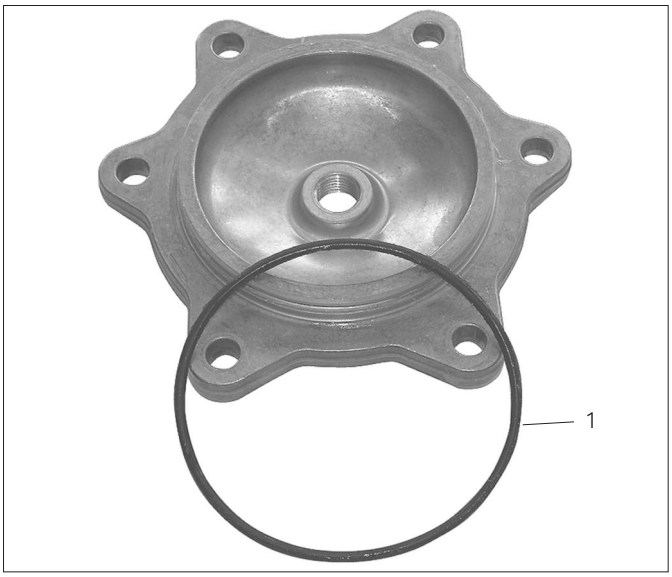
NOTE
Watch for possibly leaking residual oil when removing the filter cover.



032292

5 Remove filter cover **(2)**.

6 Remove O-ring **(1)** of filter cover.



032265

7 Take out filter **(1)**.

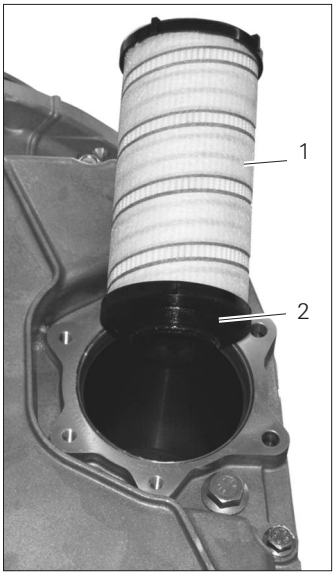
NOTE
Check filter for contamination.



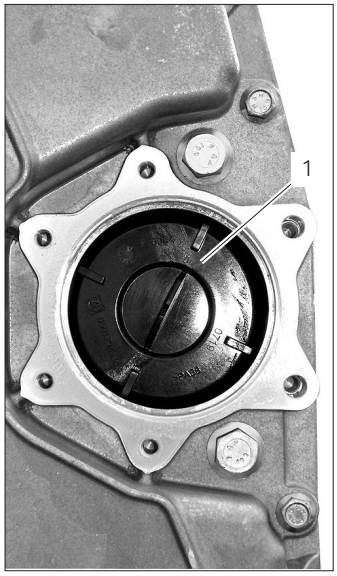
032291

CAUTION
Use new filter. Ensure correct position of O-ring (2) on the filter.

8 Coat the O-ring **(2)** with technical Vaseline and insert new filter **(1)**.



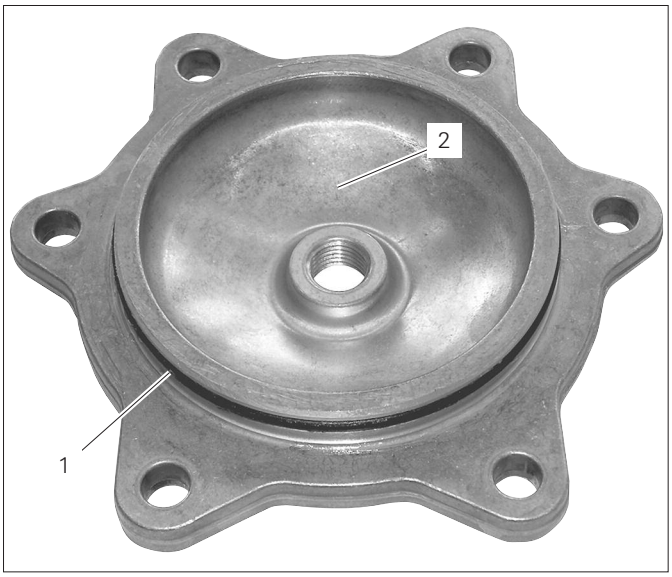
032721



032266

9 Coat new O-ring **(1)** with technical Vaseline.

10 Insert O-ring **(1)** into filter cover **(2)**.

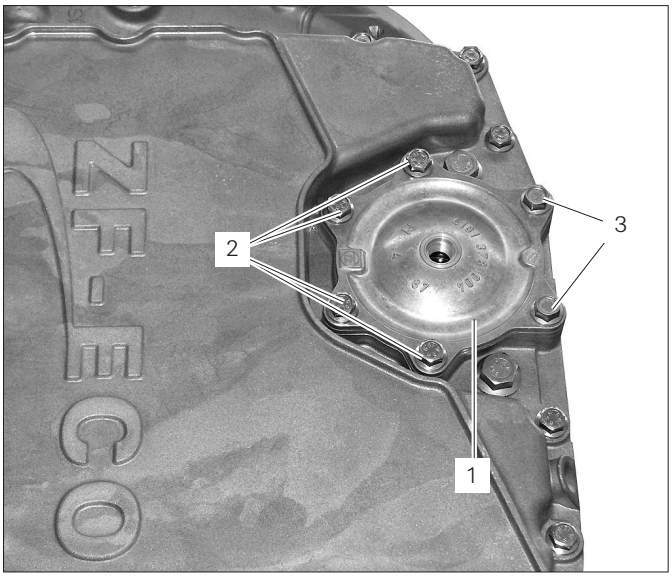


032264

11 Insert filter cover **(1)**.

12 Screw in four M8x30 hex head screws **(2)** and tighten.
Tightening torque:
Screw with washer assembly: **23 Nm**
Flange-head screw: **29 Nm**

13 Screw in two M8x55 hex head screws **(3)** and tighten.
Tightening torque:
Screw with washer assembly: **23 Nm**
Flange-head screw: **29 Nm**

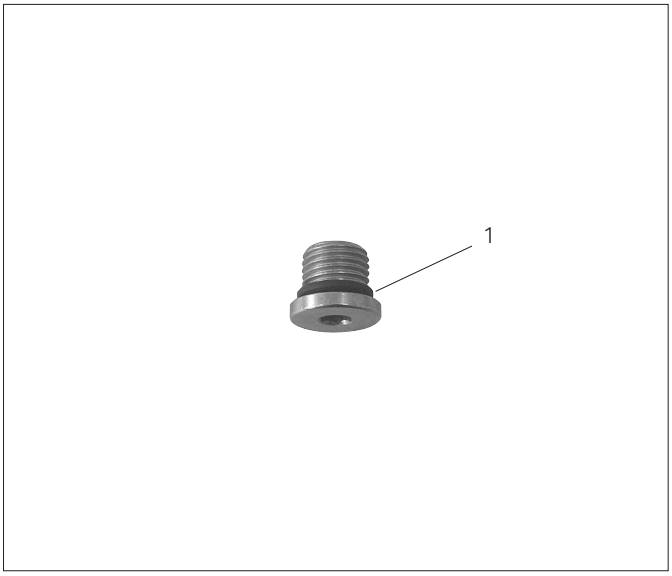


032292

14 Coat new O-ring **(1)** with technical Vaseline.

15 Fit new O-ring **(1)** to screw plug.

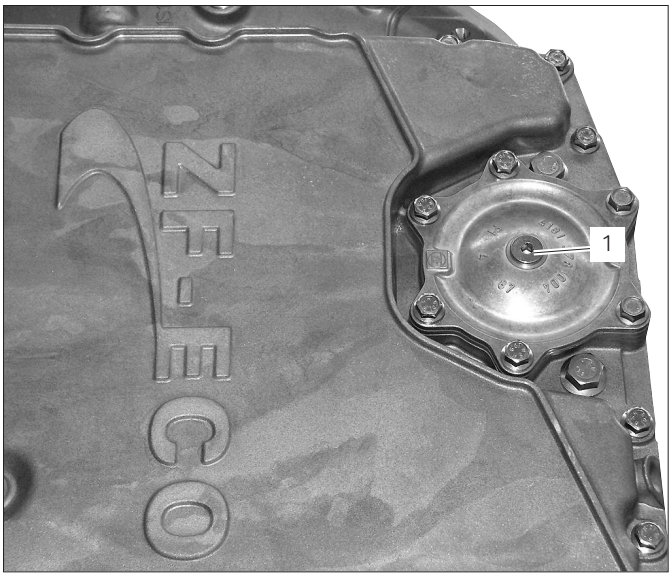
NOTE
No screw plugs used anymore as of serial number 344696.



032263

16 Screw M14x1.5 screw plug **(1)** into filter cover and tighten.
Tightening torque: **25 Nm**

NOTE
No screw plugs used anymore as of serial number 344696.

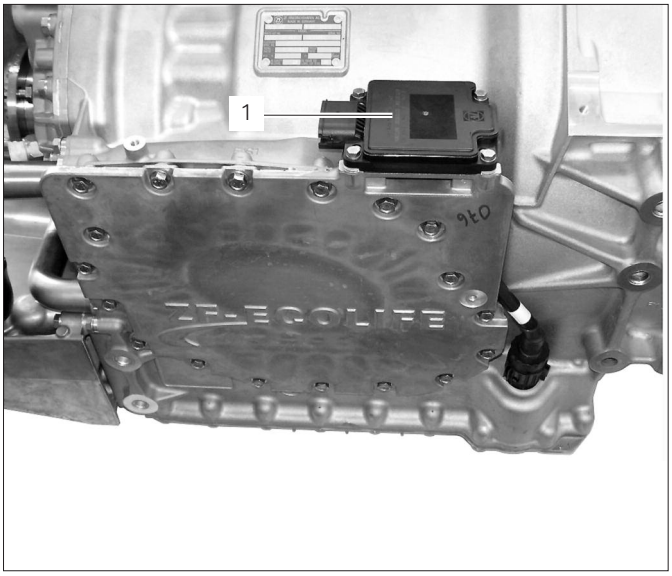


032293

2.2 Replacing electronic control unit

2.2.1 Removing electronic control unit

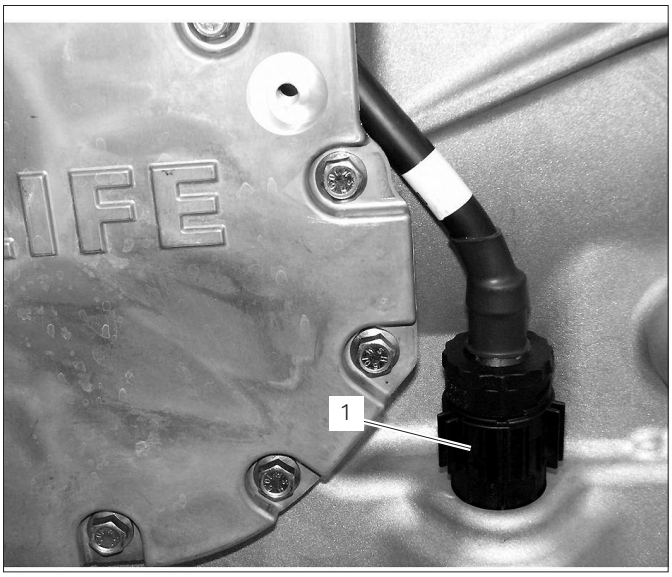
1 Unscrew the four hexagon screws **(1)** of the electronic control unit.



032314

2 Loosen securing device **(1)** and disconnect the connector.

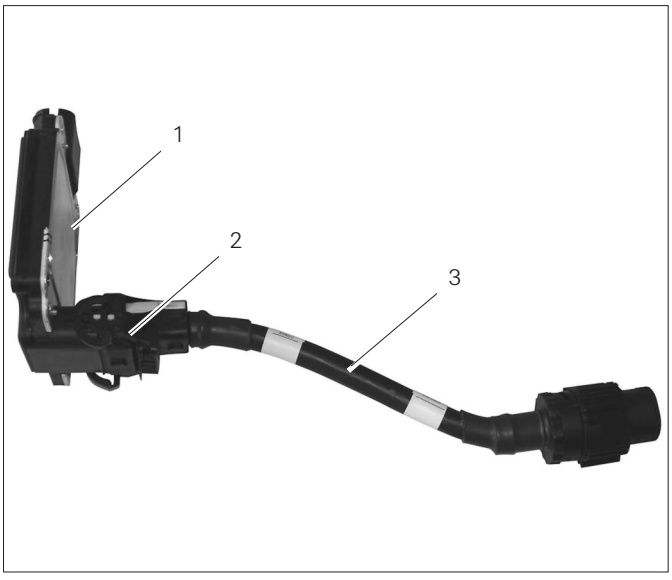
NOTE
The connector comes lose when turning the securing device counterclockwise.



032315

3 Take off the electronic control unit **(1)** together with the wiring harness **(3)**.

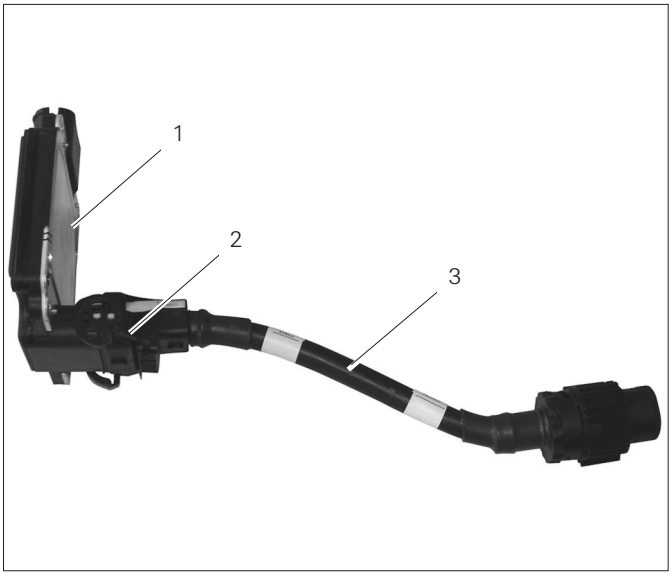
4 Open the connector's **(2)** safeguard and separate the connector **(2)** from the electronic control unit.



032294

2.2.2 Installing electronic control unit

1 Plug wiring harness **(3)** with connector **(2)** into the new electronic control unit **(1)** and close lock **(2)**.



032294

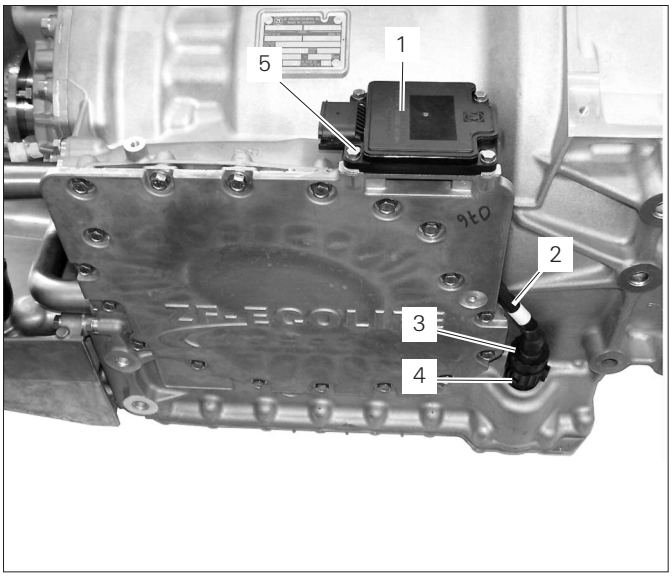
CAUTION
The contact faces of the electronic control unit and the transmission must be even and clean; otherwise, electronic control unit might be damaged.

2 Position electronic control unit **(1)** with wiring harness **(2)** on the transmission.

3 Insert connector **(3)**.

4 Turn in the securing device **(4)** in clockwise direction and snap it in.

5 Screw in four M6x26 hex head screws **(5)** and tighten.
Tightening torque: **9.5 Nm**

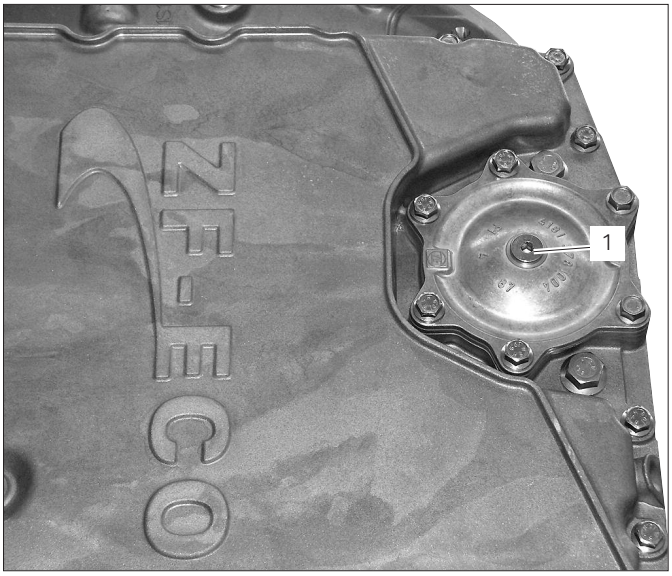


032314

2.3 Completely replacing the hydraulic shift control unit

2.3.1 Removing oil pan

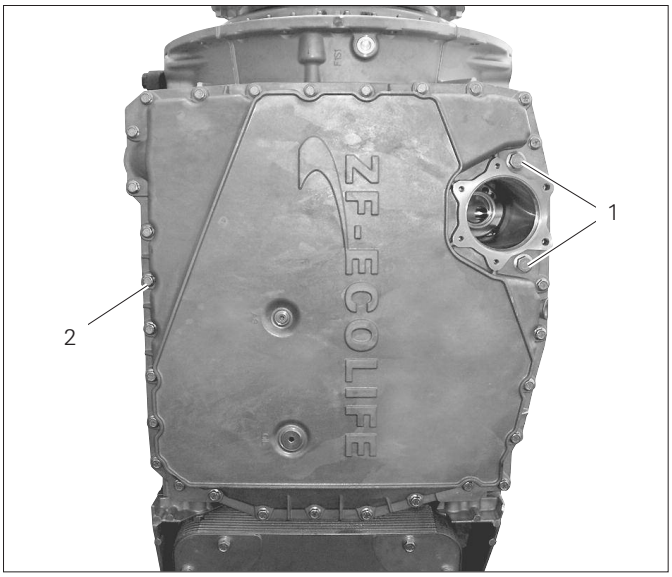
1 Remove cover **(1)** and filter according to Chapter 2.1 “Filter change”.



032293

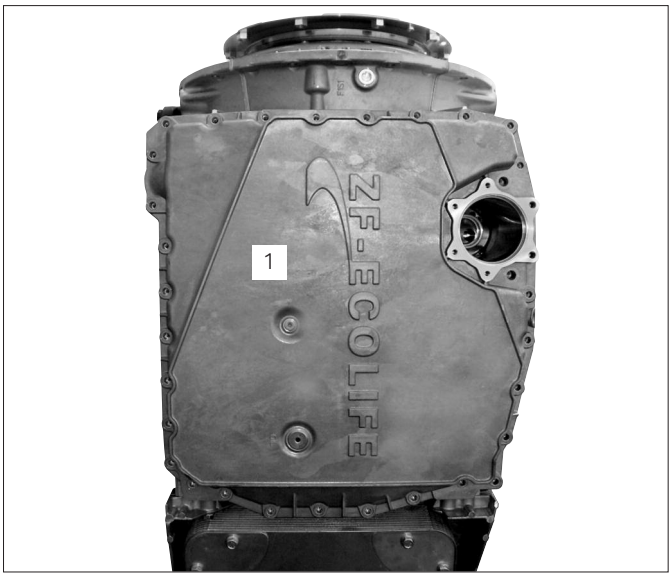
2 Unscrew two hex head screws **(1)**.

3 Unscrew 29 hex head screws **(2)** from circumference of oil pan.



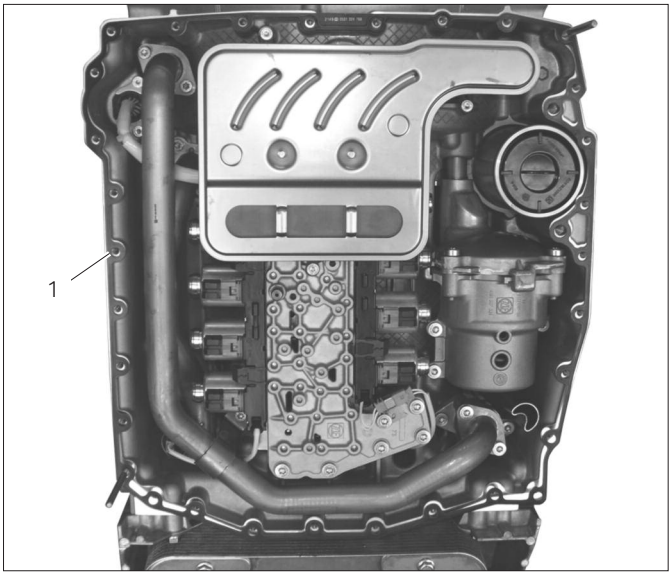
032267

4 Remove oil pan **(1)**.



032268

5 Remove gasket **(1)** from oil pan.

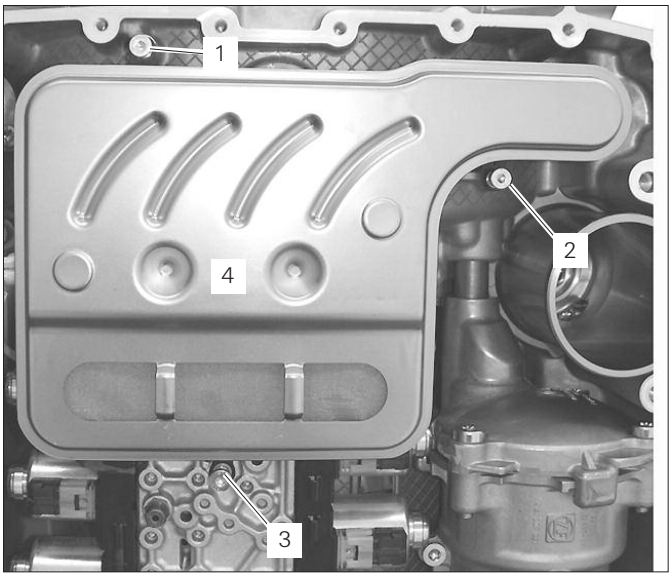


032984

2.3.2 Removing suction filter

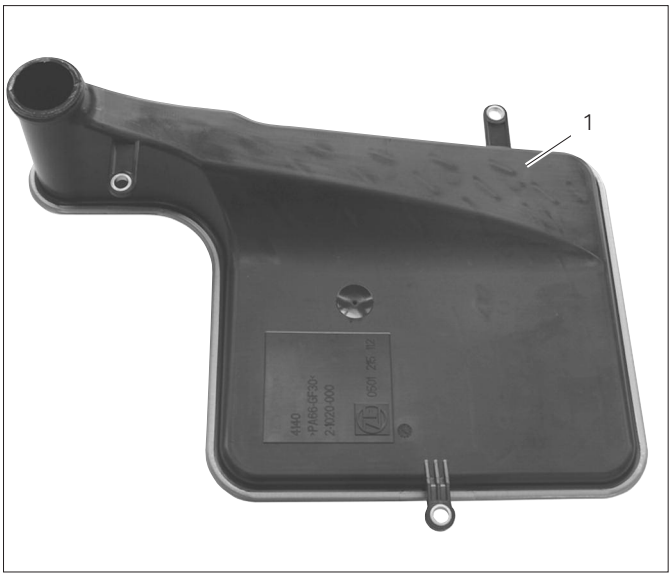
1 Unscrew three torx screws **(1, 2, 3)** from the suction filter **(4)**.

NOTE
If available, remove washer from underneath the torx screw **(3)**. No washers used anymore as of serial number 300214.



032270

2 Remove suction filter **(1)**.



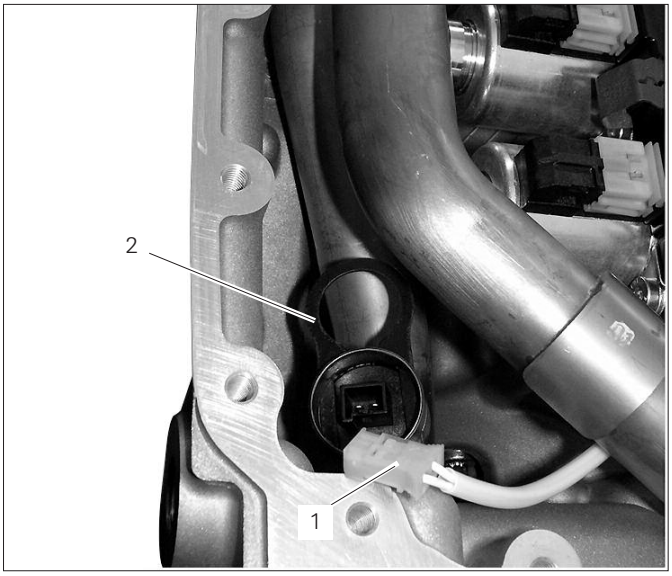
032271

2.3.3 Removing temperature sensor

CAUTION
Do not pull on the cable. This could lead to damage of the connector.

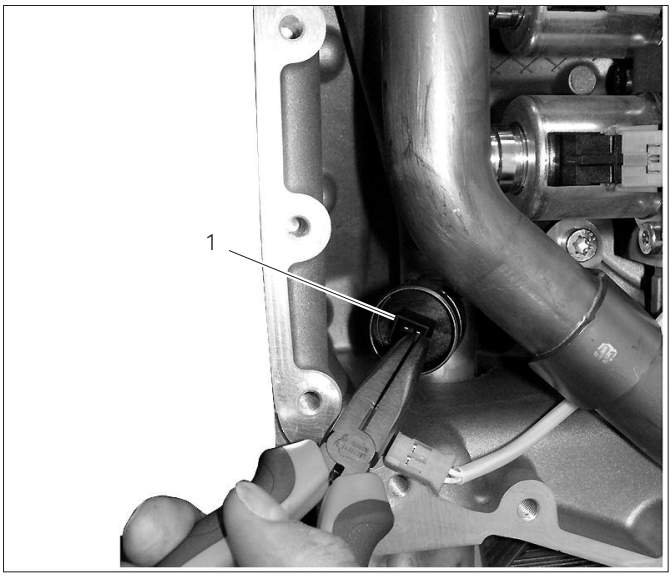
1 Remove the temperature sensor's connector **(1)**.

2 Remove retaining clamp **(2)**.



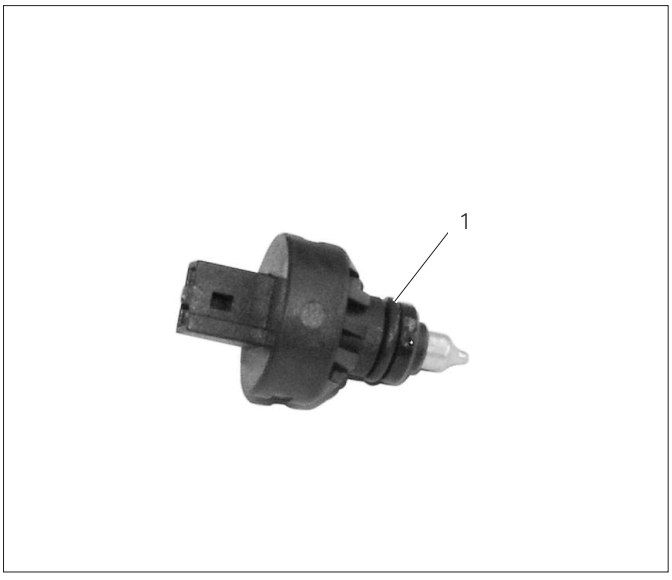
032273

3 Take out the temperature sensor **(1)**.



032274

4 Remove the temperature sensor's O-ring **(1)**.

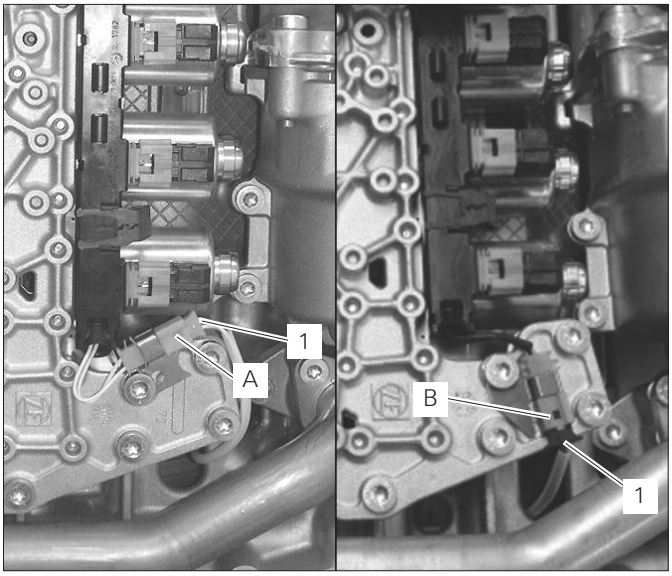


02198

2.3.4 Removing the hydraulic shift control unit

1 Pull out the speed sensor's output connector **(1)**.

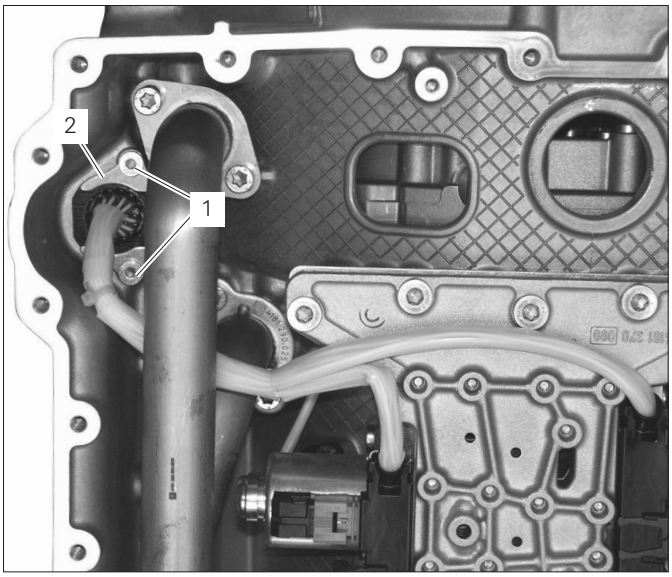
NOTE
Depending on the version, variant **A** or **B** (molded hose) is possible.



032276/035456

2 Unscrew two torx screws **(1)** from transmission connector mounting plate.

3 Remove the mounting plate **(2)**.



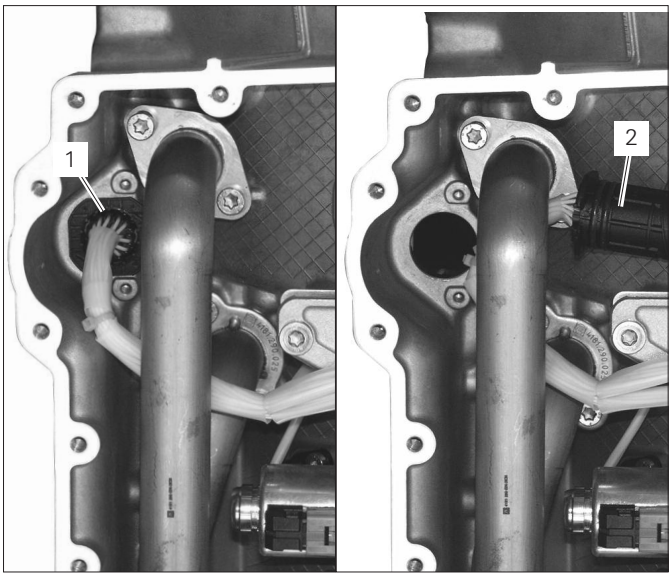
032990

CAUTION
Do not pull on the cable. This could lead to damage of the connector.

4 Push out transmission connector **(1)** from behind.

5 Pass through the transmission connector **(2)** underneath oil pipe.

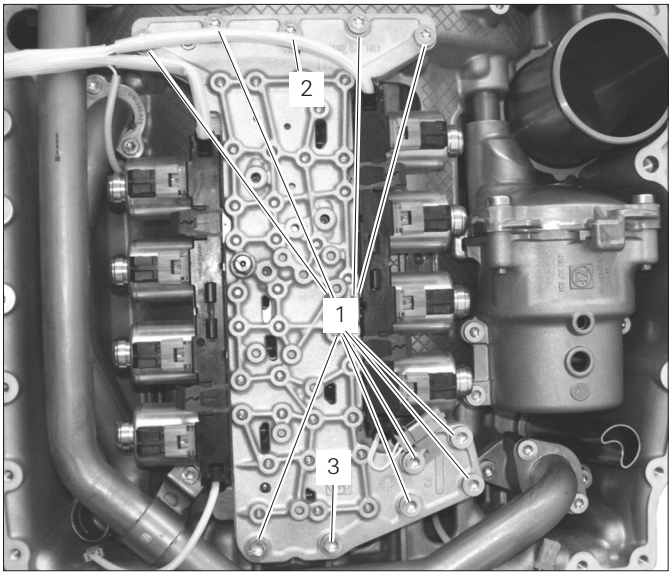
NOTE
In the case of a sand cast version, the transmission connector is routed through the oil tube.



032989/032988

CAUTION
In the event of overhead work with the transmission still installed, the hydraulic shift control unit must be prevented from falling down by means of two M8x100 auxiliary screws at position 2 and 3 before all torx screws (1) are removed.

6 Unscrew all torx screws **(1)** at the hydraulic shift control unit.

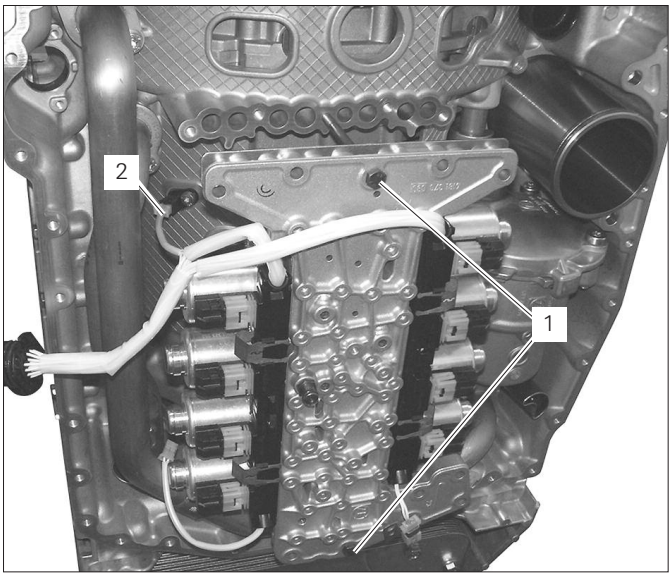


0032281

7 Place hydraulic shift control unit on screw heads of M8x100 auxiliary screws **(1)**.

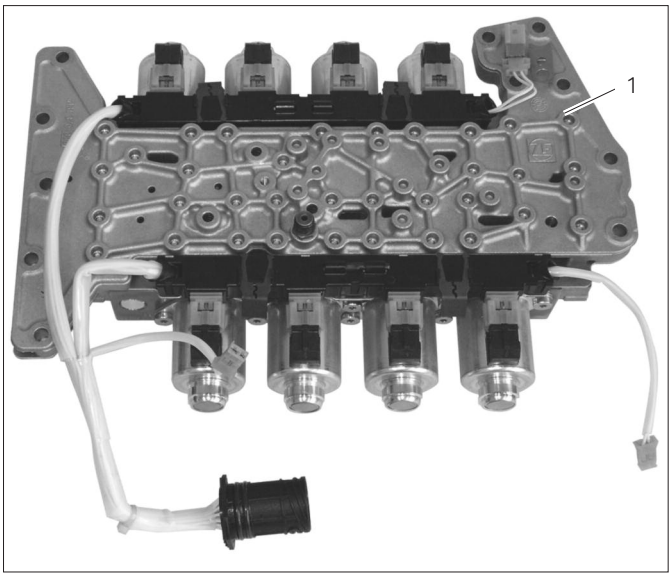
CAUTION
Do not pull on the cable. This could lead to damage of the connector.

8 Pull out the speed sensor's turbine connector **(2)**.



032282

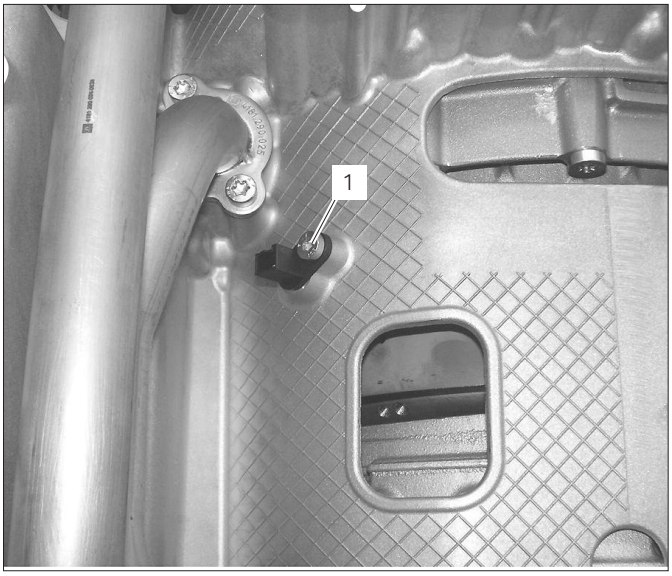
9 Unscrew M8x100 auxiliary screws and take out hydraulic shift control unit **(1)**.



032995

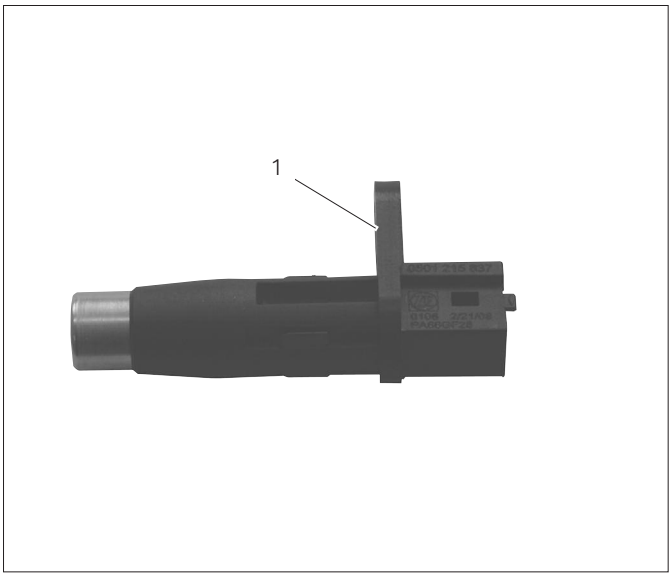
2.3.5 Removing speed sensor, turbine

1 Unscrew torx screw **(1)**.



032285

2 Take out the speed sensor, turbine **(1)**.

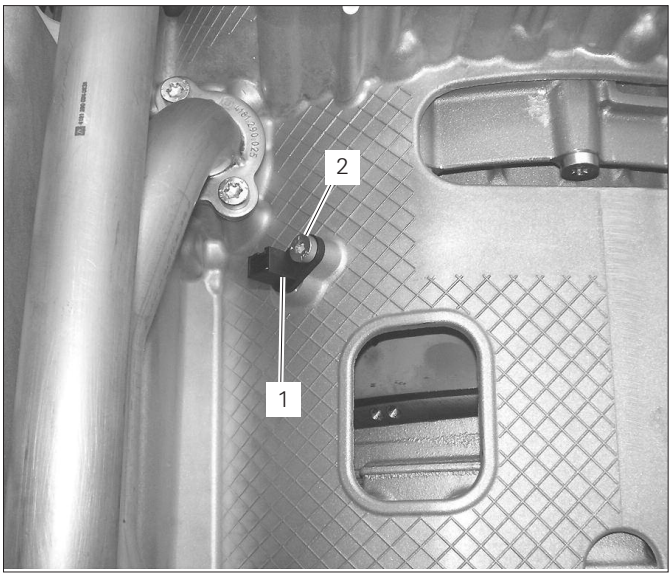


032286

2.3.6 Installing speed sensor, turbine

1 1 Insert the speed sensor **(1)** in the transmission housing.

2 Screw in M6x17 torx screw **(2)** and tighten. Tightening torque: **9.5 Nm**

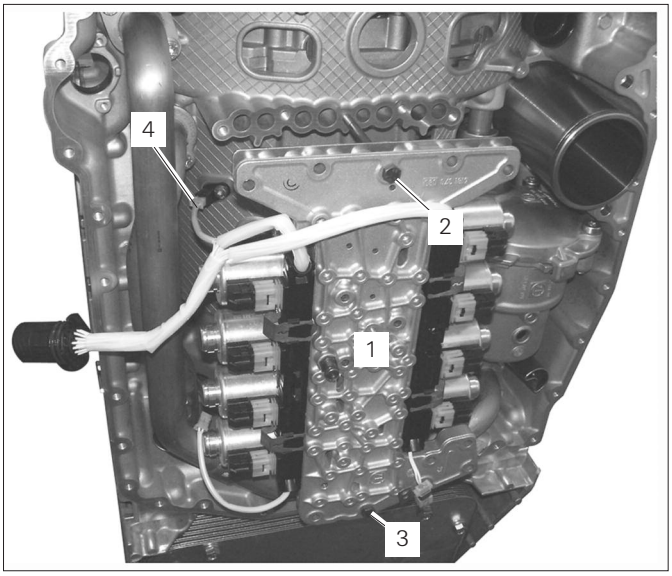


032285

2.3.7 Installing the hydraulic shift control unit

1 Insert the hydraulic shift control unit **(1)** into the transmission housing and prevent it from falling down by means of two auxiliary screws **(2/3)**.

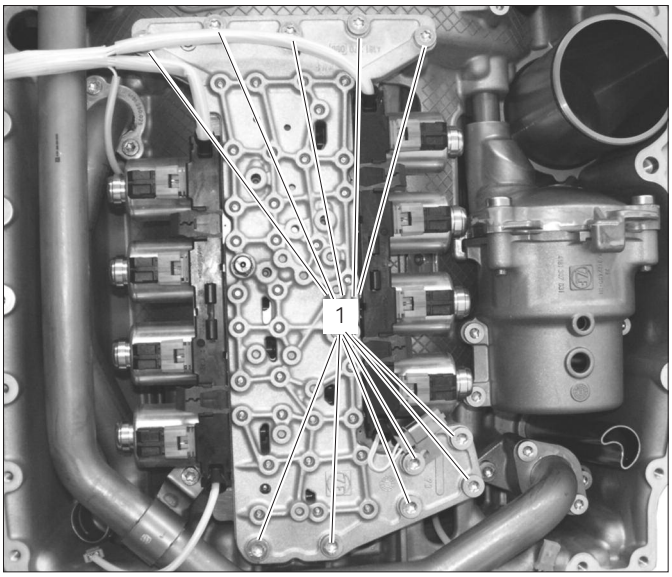
2 Insert the speed sensor's turbine connector **(4)**.



032282

NOTE
After screwing in first torx screws, auxiliary screws are removed again.

3 Screw eleven torx screws **(1)** into the hydraulic shift control unit and tighten. Tightening torque: **20 Nm**

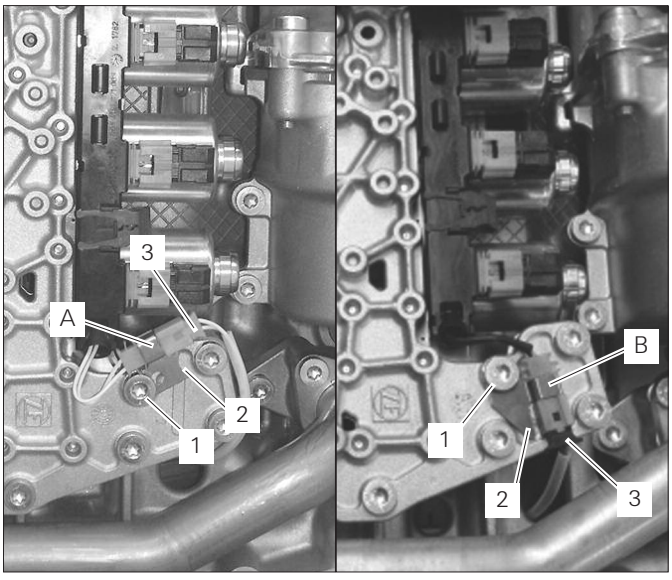


0032281

NOTE
When tightening the torx screw **(1)**, make sure position of retaining plate **(2)** (**A** or **B**) is correct.

4 Insert the speed sensor's output connector **(3)**.

NOTE
Depending on the version, variant **A** or **B** (molded hose) is possible.



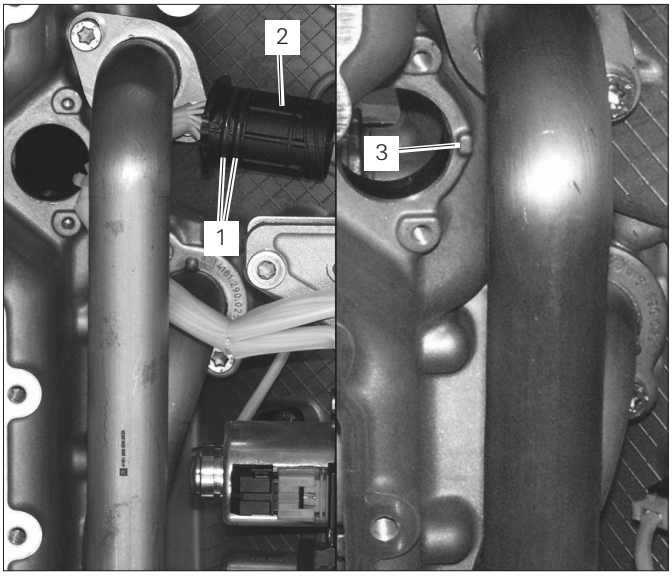
032276/035456

5 Fit two new O-rings **(1)** to the transmission connector **(2)**. O-ring part number: 0501 325 589

NOTE
Mind anti-twist protection **(3)** for transmission connector.

6 Pass through the wiring harness with transmission connector **(2)** underneath oil pipe.

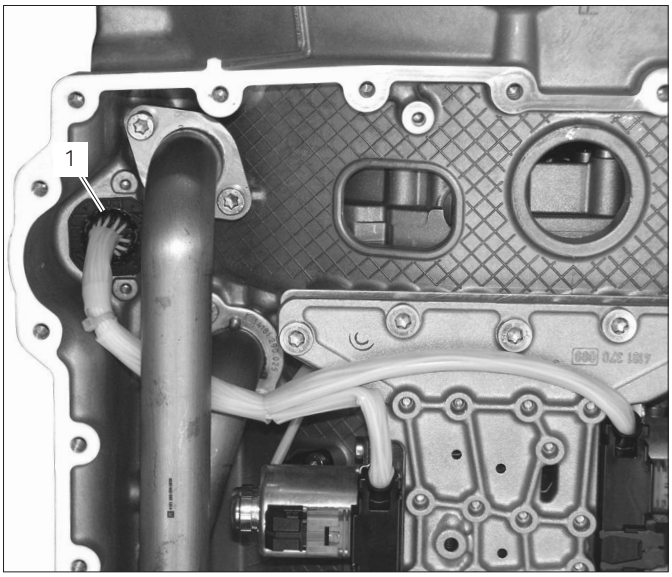
NOTE
In the case of a sand cast version, the transmission connector is routed through the oil tube.



032988032987/

7 Insert transmission connector **(1)**.

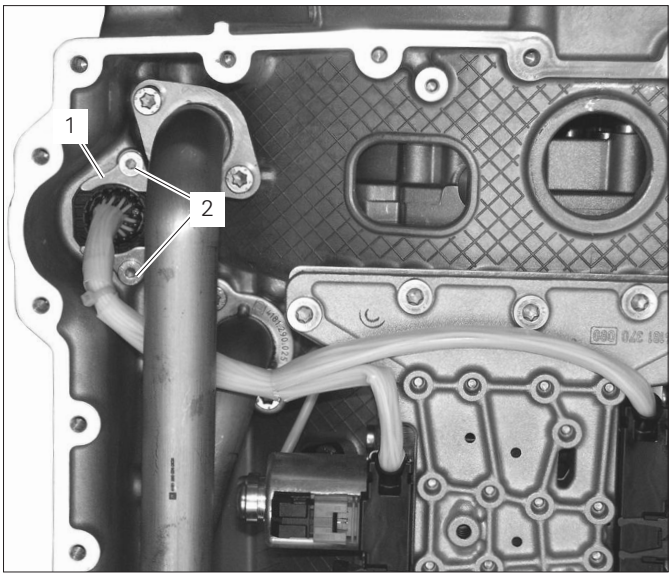
NOTE
Mind anti-twist protection for transmission connector.



032989

8 Put on the mounting plate **(1)**.

9 Screw in two M6x17 torx screws **(2)** and tighten.
Tightening torque: **9.5 Nm**

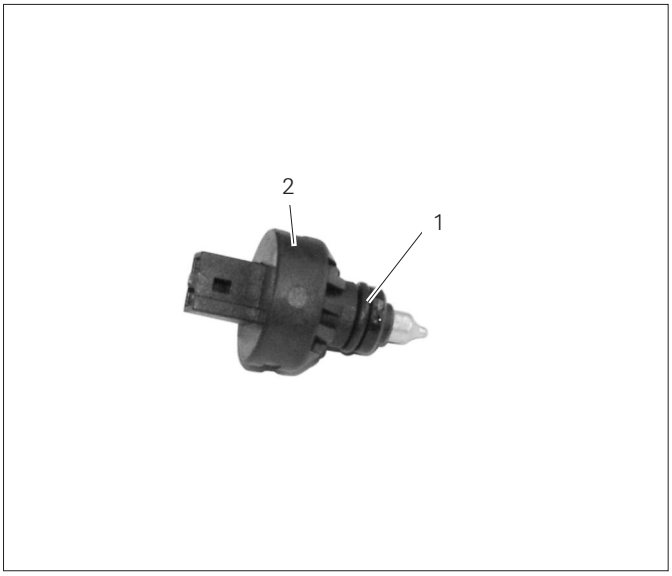


032990

2.3.8 Installing temperature sensor

1 Coat new O-ring **(1)** of temperature sensor **(2)** with technical Vaseline.

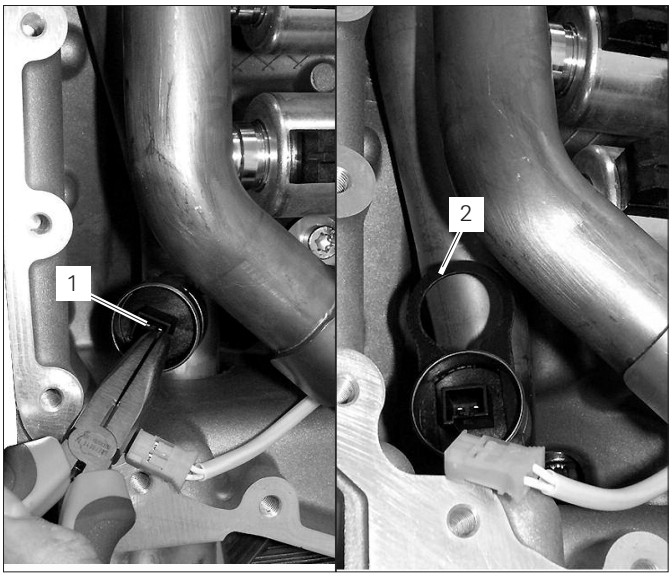
2 Mount O-ring **(1)** on temperature sensor **(2)**.



024198

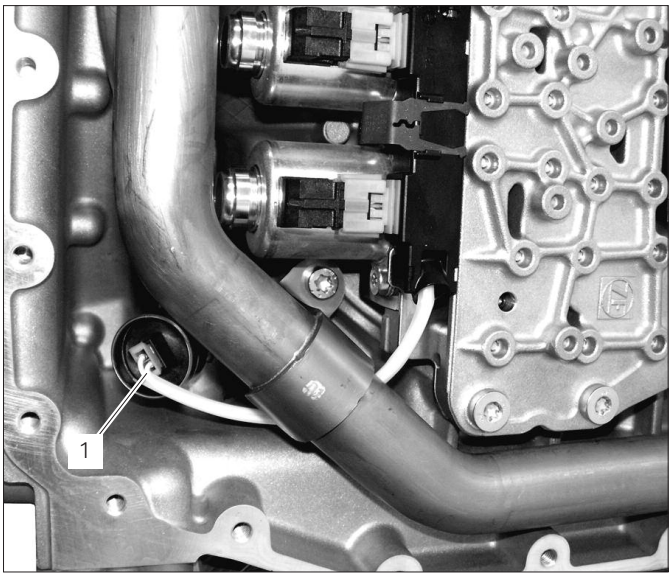
3 Insert the temperature sensor **(1)**.

4 Fit retaining clip **(2)**.



032274 / 032273

5 Plug in the temperature sensor's **(1)** connector.

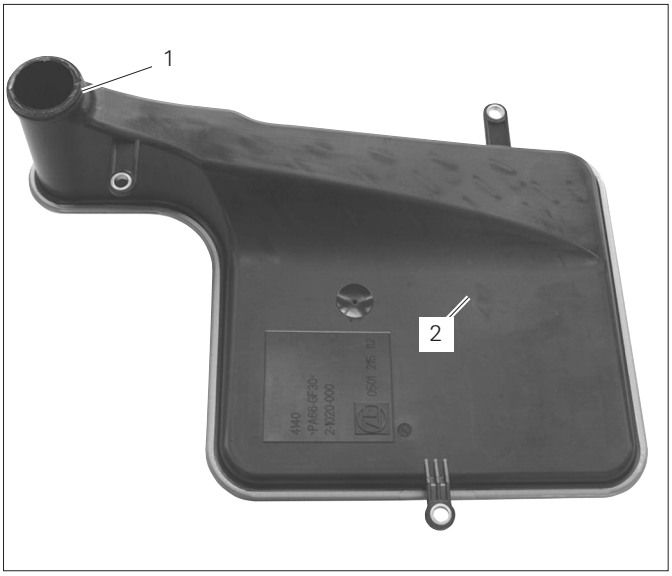


032272

2.3.9 Installing the suction filter

1 Coat new O-ring **(1)** with technical Vaseline.

2 Fit O-ring **(1)** to suction filter **(2)**.



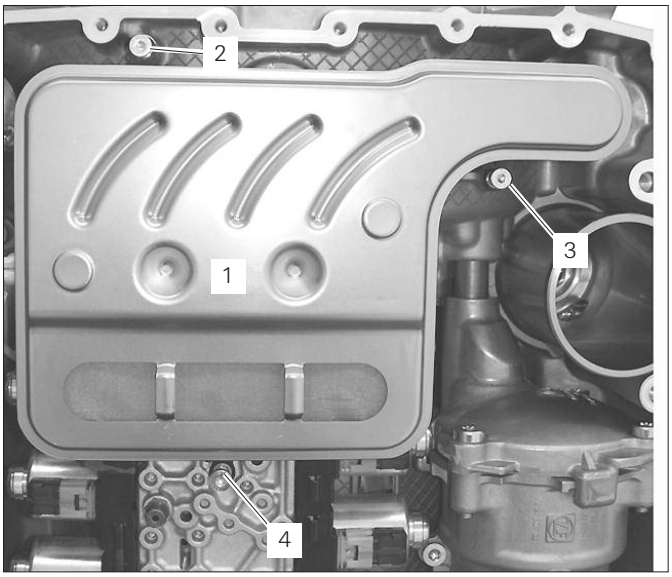
032271

CAUTION
When inserting the suction filter, the wiring harness must not be pinched.

3 Insert suction filter (1).

4 Screw in two M6x25 torx screws **(2 and 3)**.

5 Screw in M6x25 torx screw **(4)** with washer and tighten all three screws.
Tightening torque: **9.5 Nm**

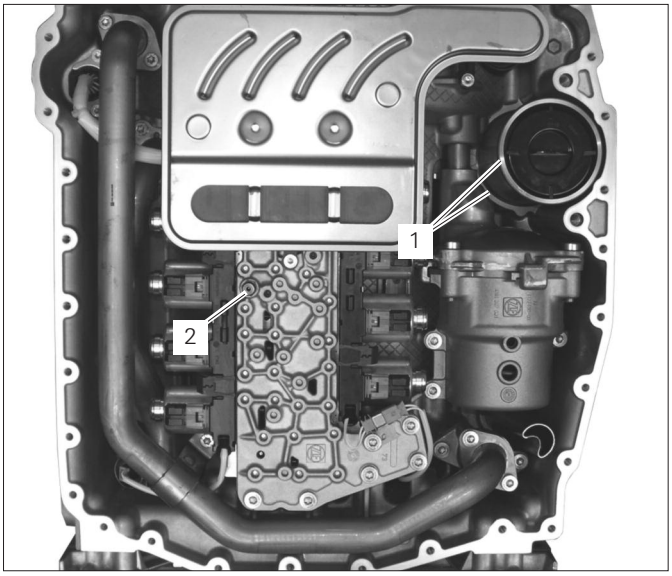


032270

NOTE
There must be a washer underneath the torx screw **(4)**. No washers used anymore as of serial number 300214.

2.3.10 Attaching the oil pan

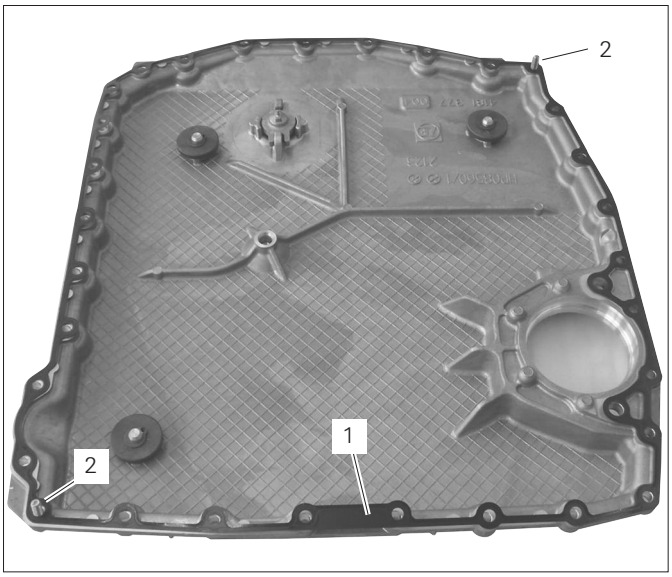
1 Check O-rings on oil tube **(1)** and at the valve **(2)**, replace if necessary. Coat O-rings with technical Vaseline.



032991

2 Place new seal **(1)** on the oil pan.

3 Insert two M8x30 hex head screws **(2)** into oil pan.

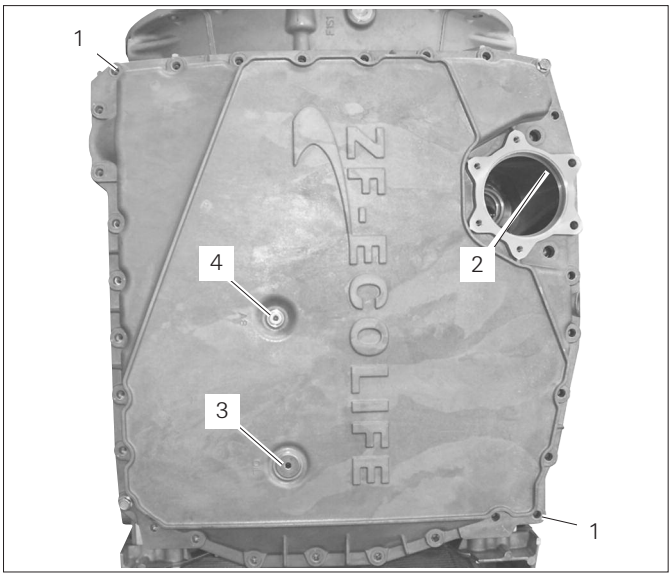


032288

CAUTION
When putting on oil pan, ensure that O-ring of oil pipe (2) is positioned correctly and is not damaged.

4 Carefully put on oil pan and screw in two hex head screws **(1)**.

NOTE
In terms of the torque converter counter-pressure, the ball-and-socket bearing must correctly snap into place, namely the bore for the pressure measurement point **(3)**.

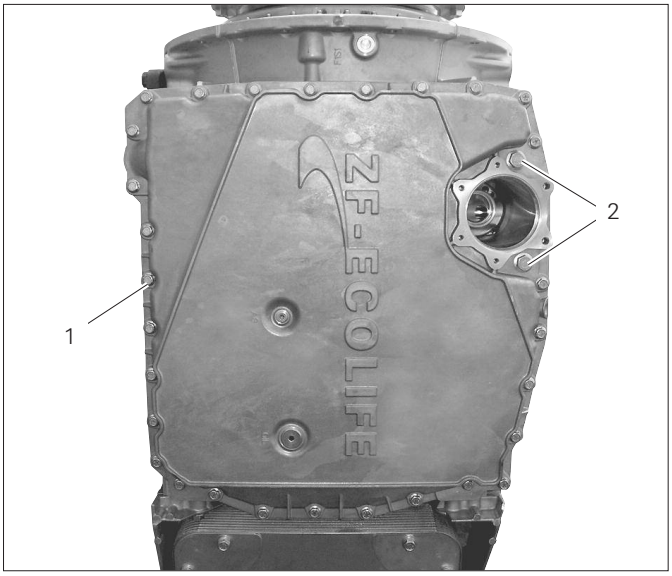


032290

5 Screw in remaining 27 M8x30 hex head screws **(1)** at circumference of oil pan – do not tighten yet.

6 Screw in two M12x55 hexagon screws **(2)** and tighten.
Tightening torque:
Screw with washer assembly: **79 Nm**
Flange head screw: **99 Nm**

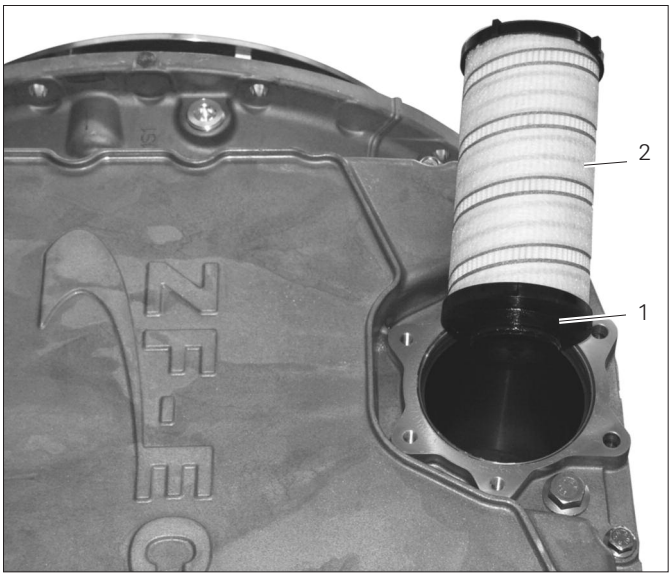
7 Tighten all 29 M8x30 hex head screws **(1)** at circumference of oil pan.
Tightening torque:
Screw with washer assembly: **23 Nm**
Flange-head screw: **29 Nm**



032267

CAUTION
Use new filter. Ensure correct position of O-ring (1) on the filter.

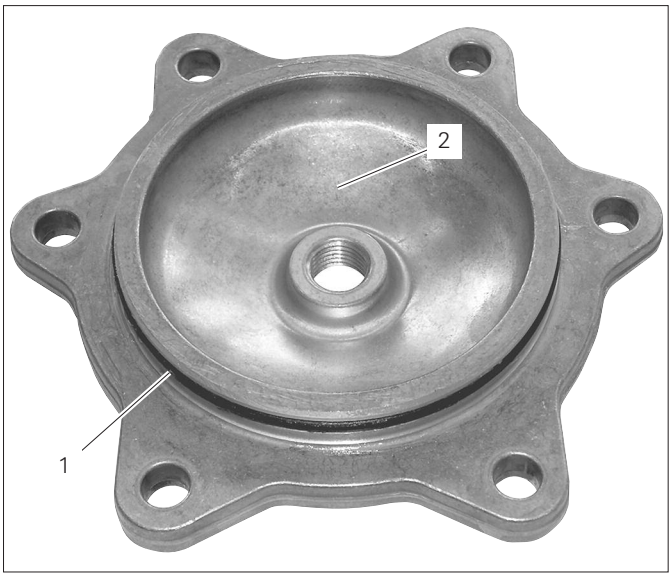
8 Coat O-ring **(1)** with technical Vaseline and insert new filter **(2)**.



32721

9 Coat O-ring **(1)** with technical Vaseline.

10 Insert new O-ring **(1)** in the filter cover **(2)**.

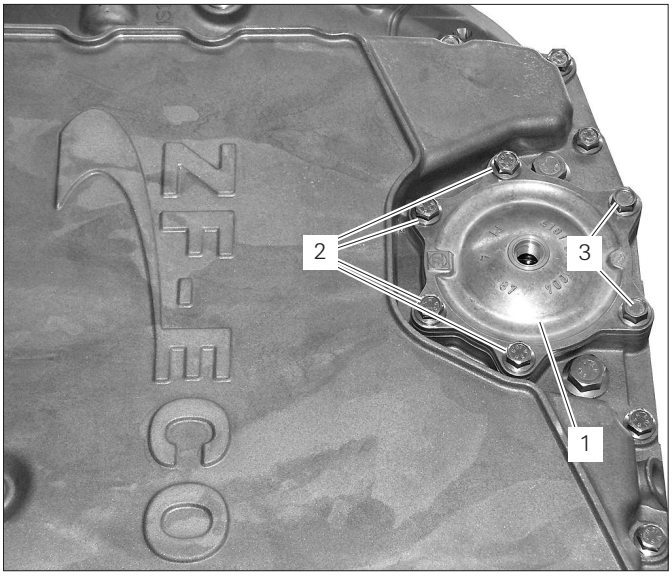


032264

11 Insert filter cover **(1)**.

12 Screw in four M8x30 hex head screws **(2)** and tighten.
Tightening torque:
Screw with washer assembly: **23 Nm**
Flange-head screw: **29 Nm**

13 Screw in two M8x55 hex head screws **(3)** and tighten.
Tightening torque:
Screw with washer assembly: **23 Nm**
Flange-head screw: **29 Nm**

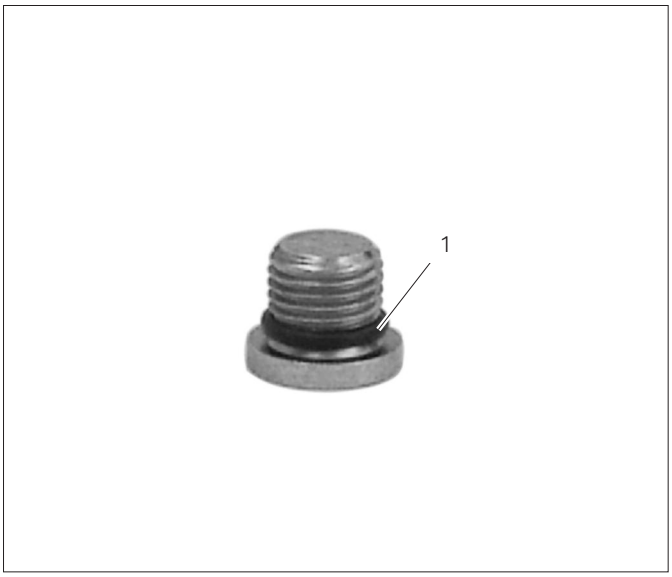


025016

14 Coat O-ring **(1)** with technical Vaseline.

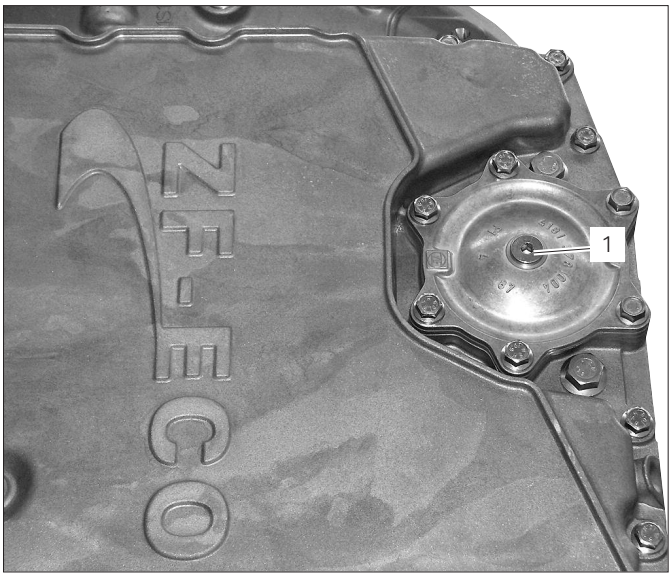
15 Fit new O-ring **(1)** to screw plug.

NOTE
No screw plugs used anymore as of serial number 344696.



16 Screw in M14x1.5 screw plug **(1)** and tighten.
Tightening torque: **25 Nm**

NOTE
No screw plugs used anymore as of serial number 344696.

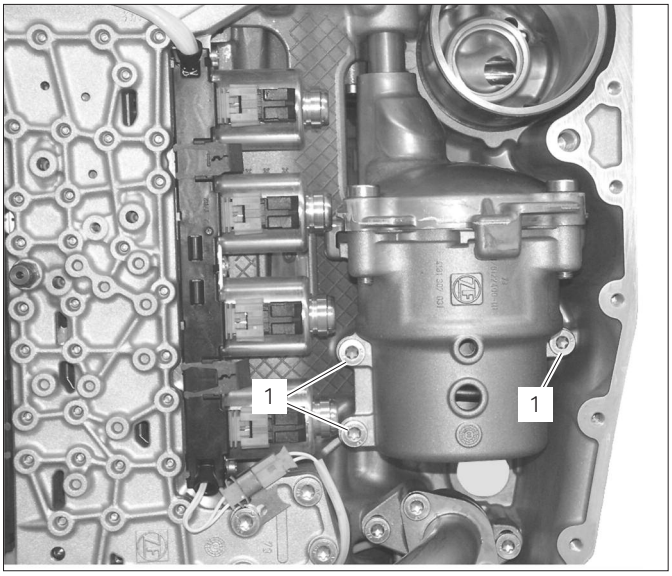


032293

2.4 Replacing retarder accumulator

2.4.1 Removing retarder accumulator

1 Unscrew three torx screws **(1)**.

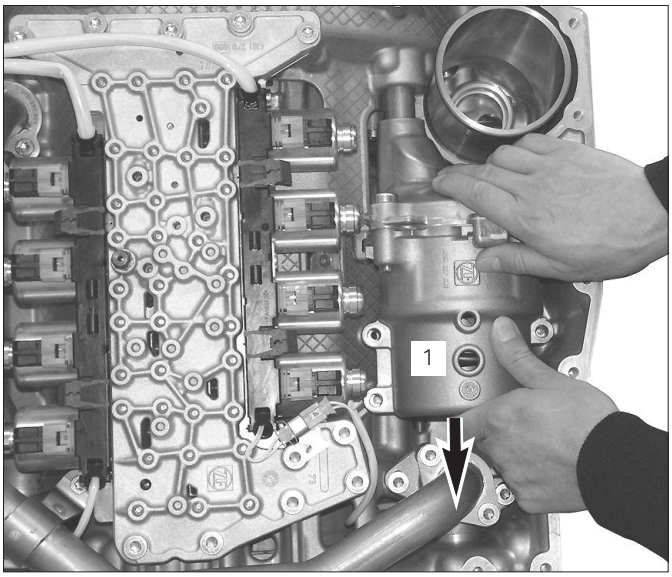


032316

2 Pull retarder accumulator **(1)** towards output (see arrow) and take out.

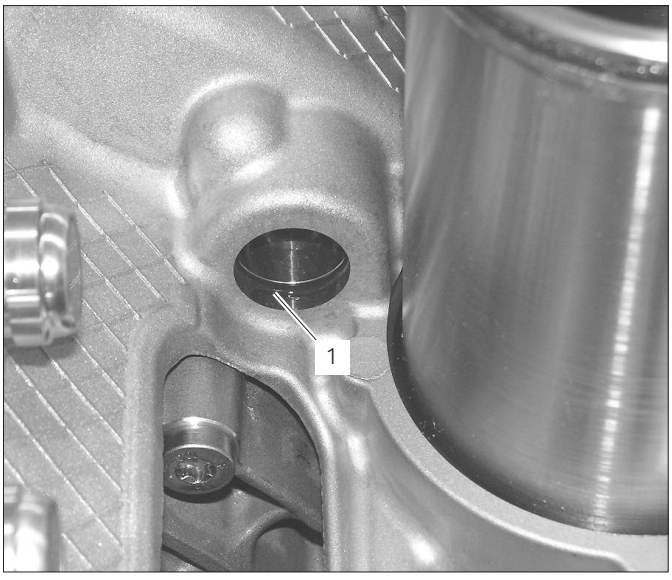
⚠ DANGER

Failure to do so could cause major injury!
Do not dismantle the retarder accumulator without the special tools specified.
Failure to do so could cause major injury.



032317

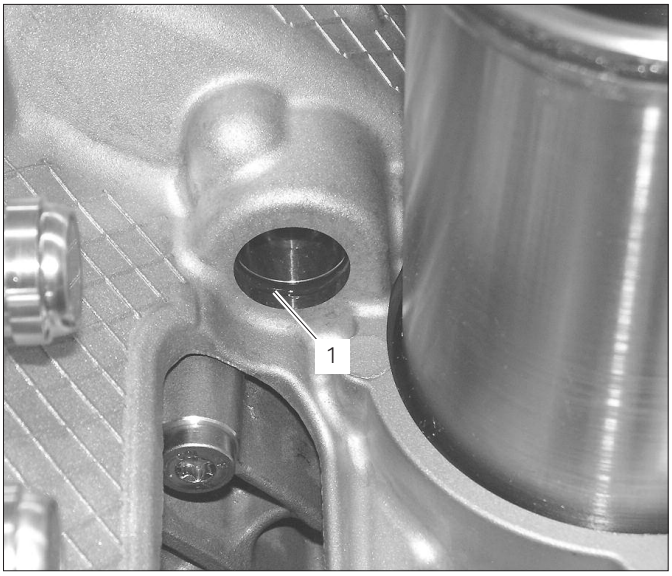
3 Remove O-ring **(1)**.



032318

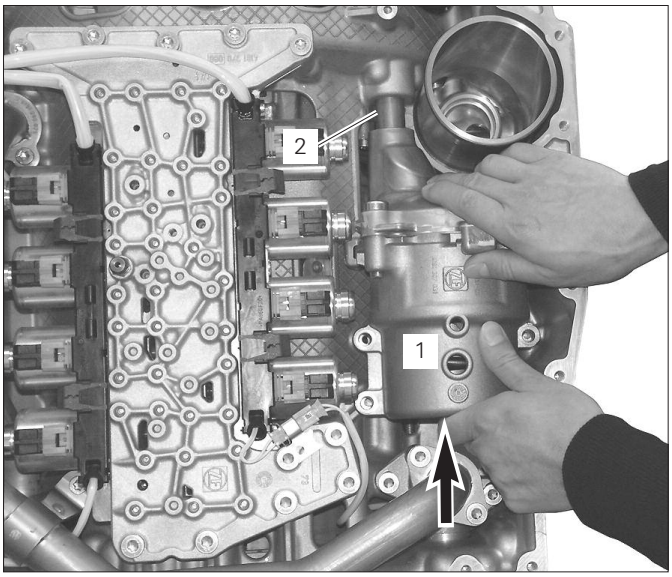
2.4.2 Installing the retarder accumulator

1 Coat new O-ring **(1)** with technical Vaseline and insert it.



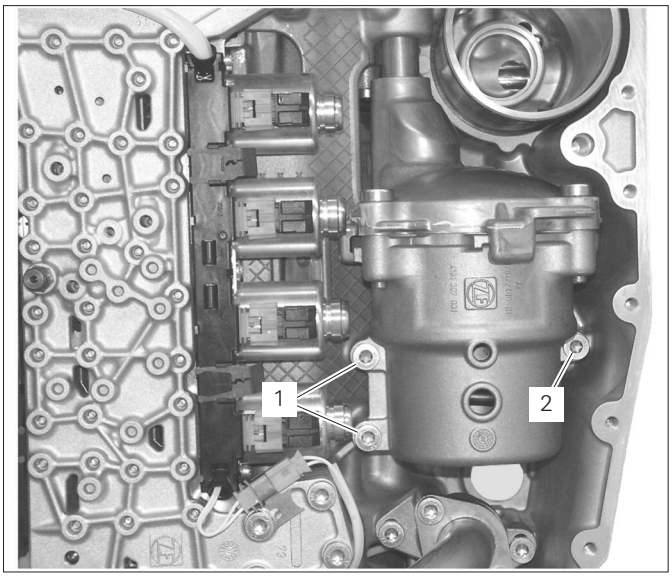
032318

2 Insert retarder accumulator **(1)** with tube **(2)** in housing bore.



032317

3 Screw in three M8x36 **(1, 2)** torx screws. Tightening torque: **20 Nm**



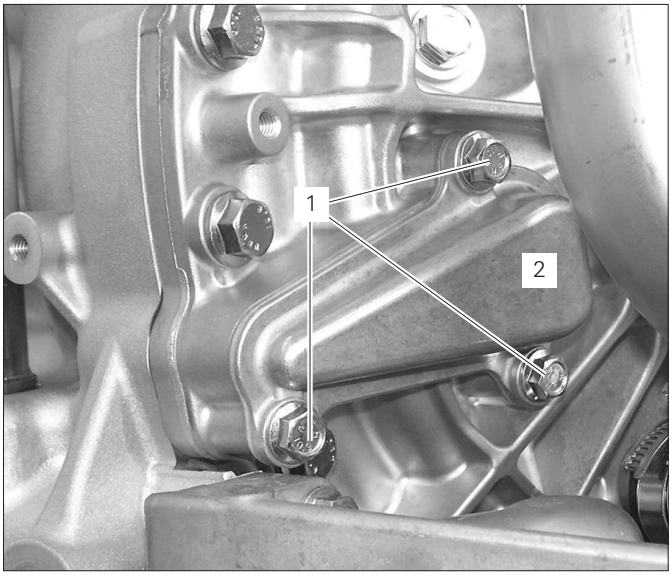
032316

2.5 Replacing speed sensor, output

2.5.1 Removing speed sensor, output (coaxial transmission)

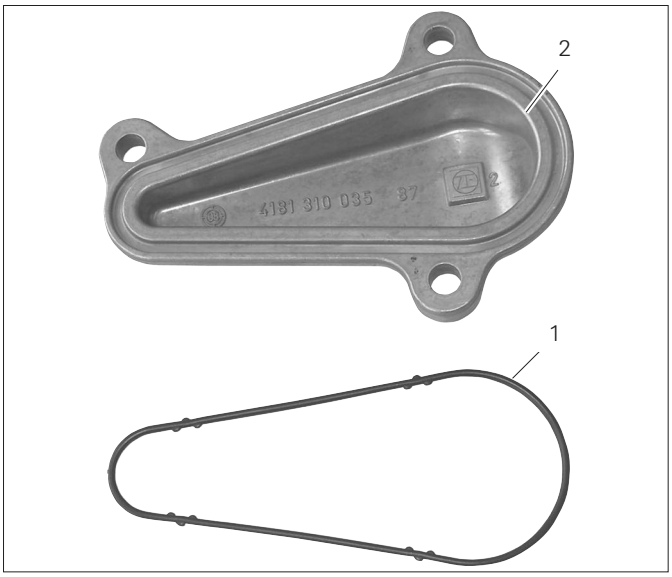
1 Remove three M8 hex head screws **(1)**.

2 Take off cover **(2)**.



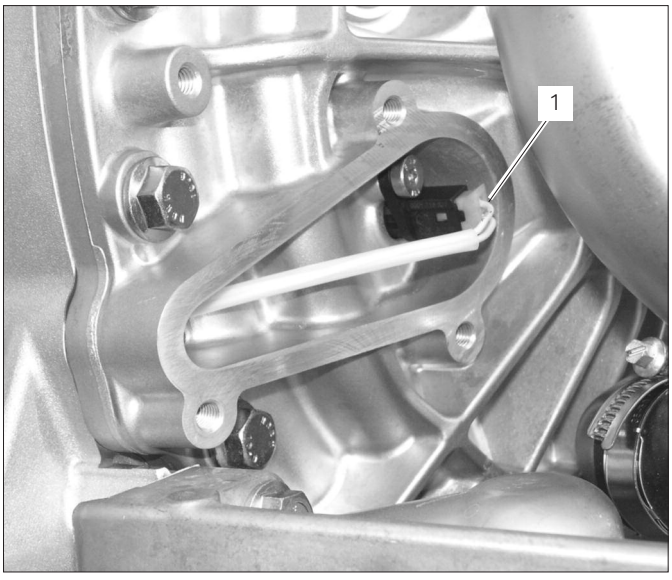
032309

3 Take out seal **(1)** from the speed sensor's **(2)** cover.



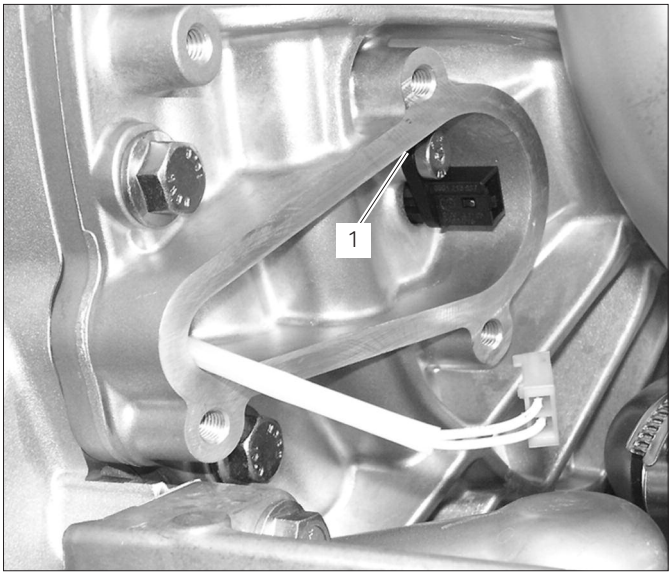
032311

4 Disconnect connector **(1)**.



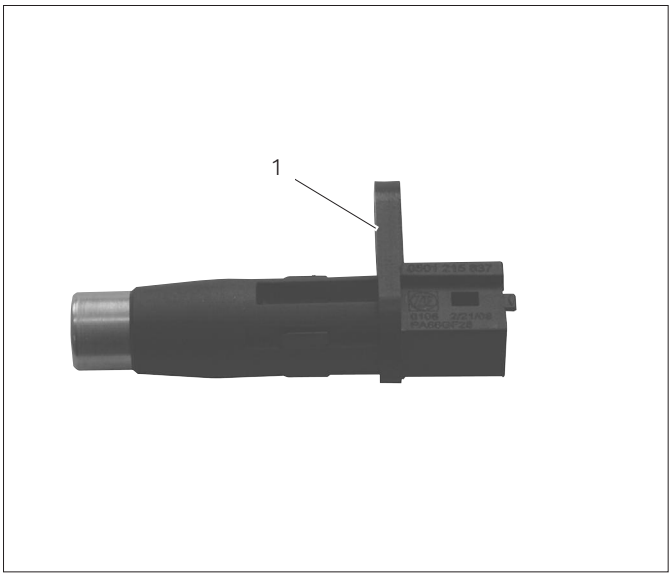
032312

5 Screw out one M6 torx screw **(1)**.



032313

6 Take out the speed sensor, output **(1)**.

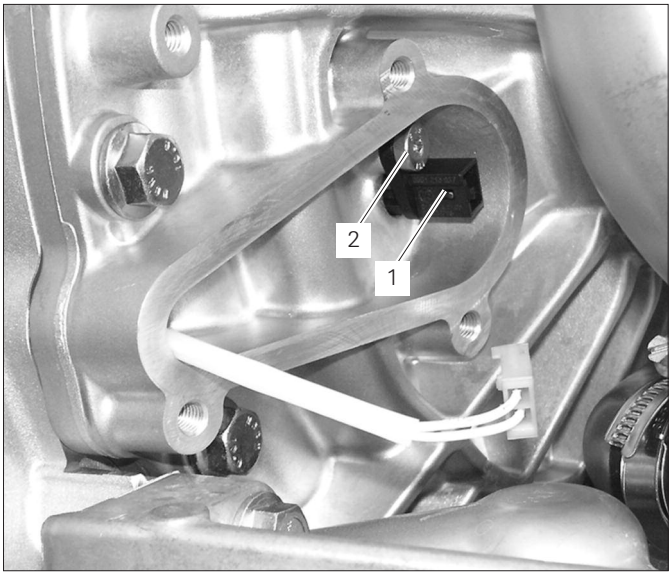


032286

2.5.2 Installing speed sensor, output (coaxial transmission)

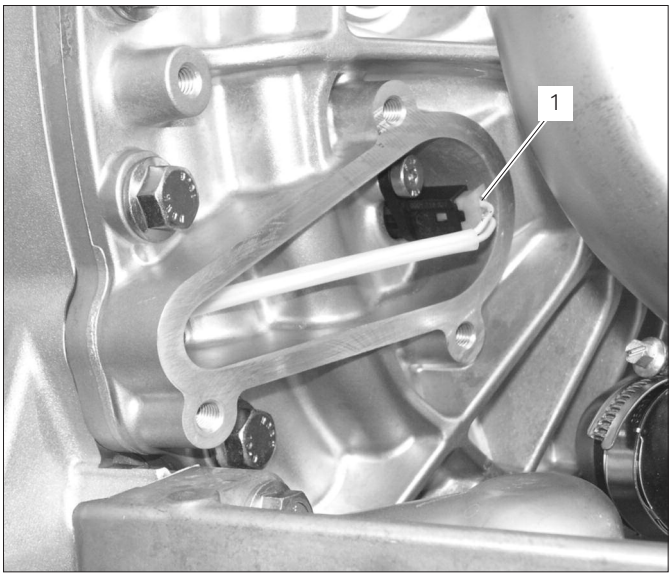
1 Insert the new speed sensor, output **(1)**.

2 Screw in M6x17 torx screw **(2)** and tighten.
Tightening torque: **9.5 Nm**



032313

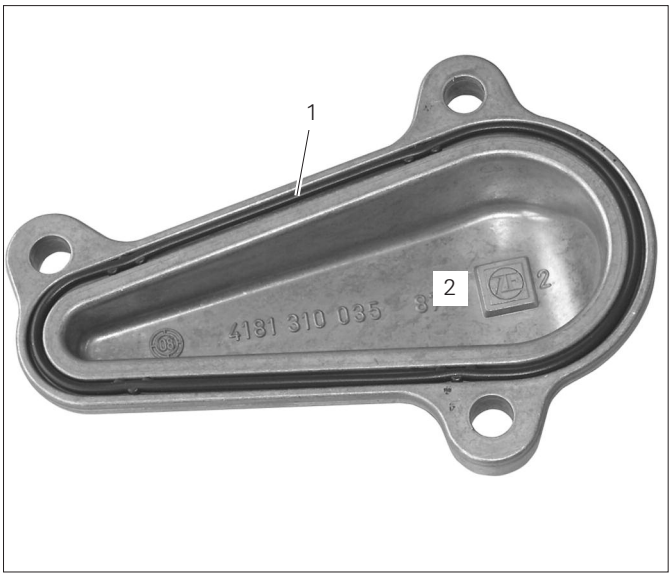
3 Fit connector **(1)**.



032312

4 Coat new seal **(1)** with technical Vaseline.

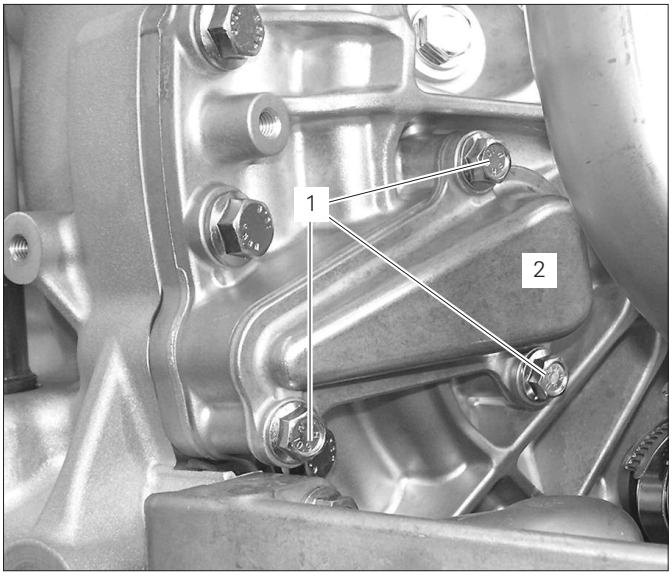
5 Insert seal **(1)** in the speed sensor's **(2)** cover.



032310

6 Fit cover **(1)**.

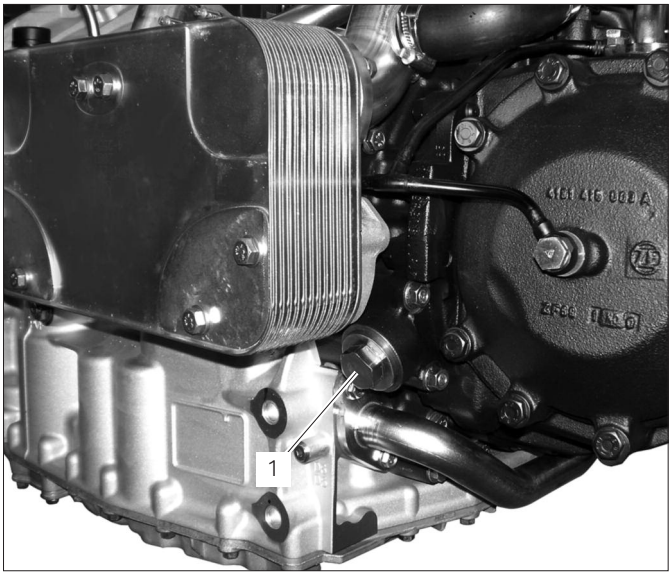
7 Screw in three M8x30 hex head screws **(2)** and tighten.
Tightening torque:
Screw with washer assembly: **23 Nm**
Flange-head screw: **29 Nm**



032309

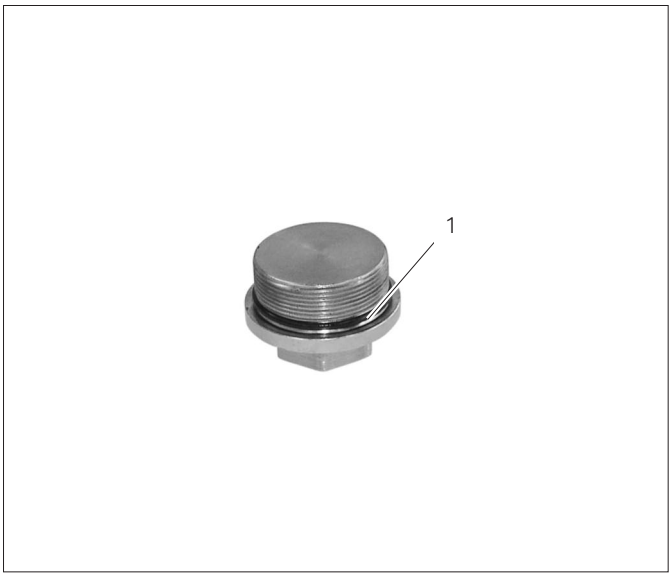
2.5.3 Removing speed sensor, output (RHD / LHD angle drive)

1 Screw out screw plug **(1)**.



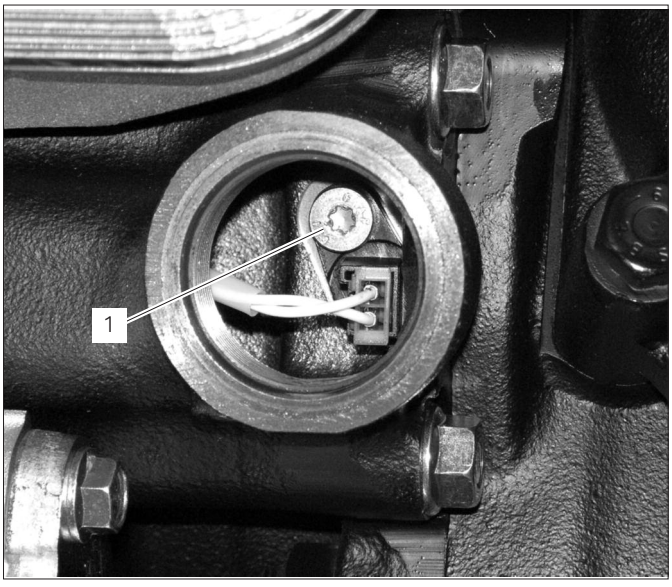
033063

2 Remove O-ring **(1)**.



025042

3 Screw out one M6 torx screw **(1)**.

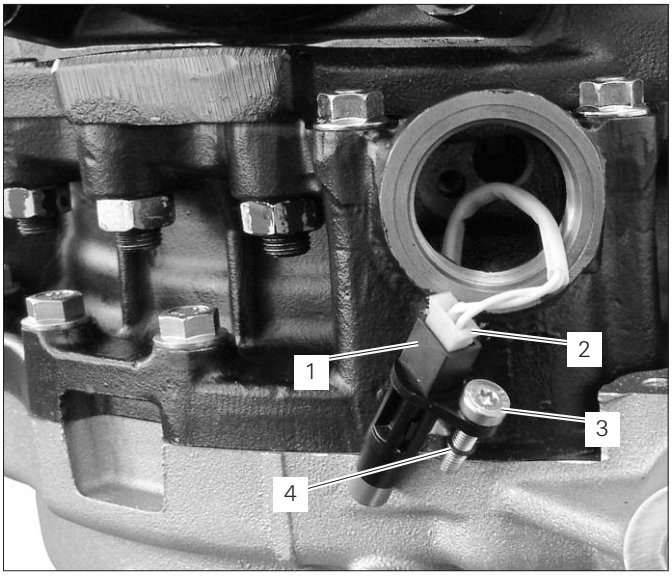


033064

4 Take out the speed sensor, output **(1)** with the cable.

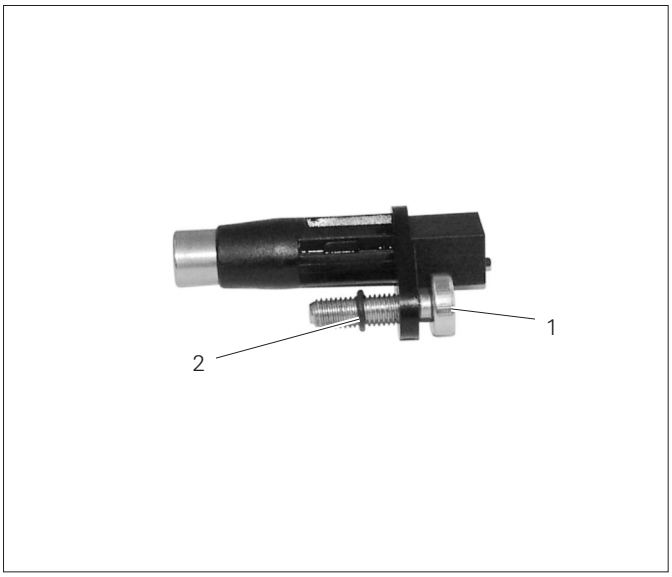
5 Unplug connector **(2)** and remove speed sensor with screw **(3)** and O-ring **(4)**.

NOTE
The O-ring **(4)** serves as loss protection for the screw **(3)**.



030148

6 Remove screw **(1)** and O-ring **(2)**.

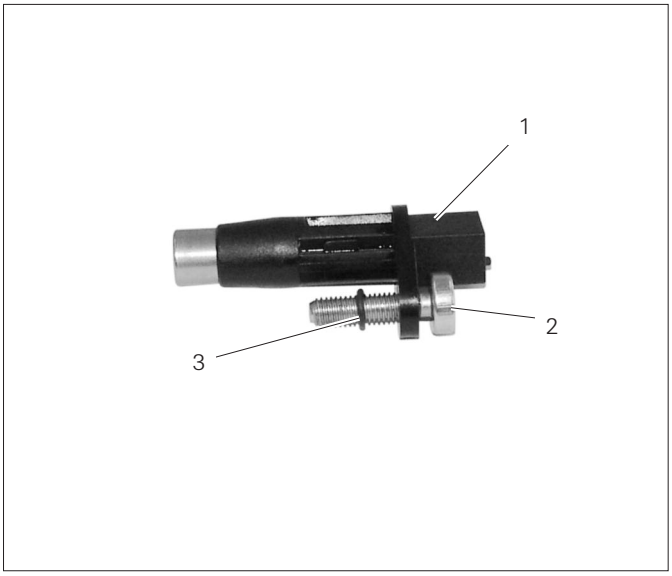


025043

2.5.4 Installing speed sensor, output (RHD / LHD angle drive)

1 Assemble speed sensor, output **(1)** with screw **(2)** and O-ring **(3)**.

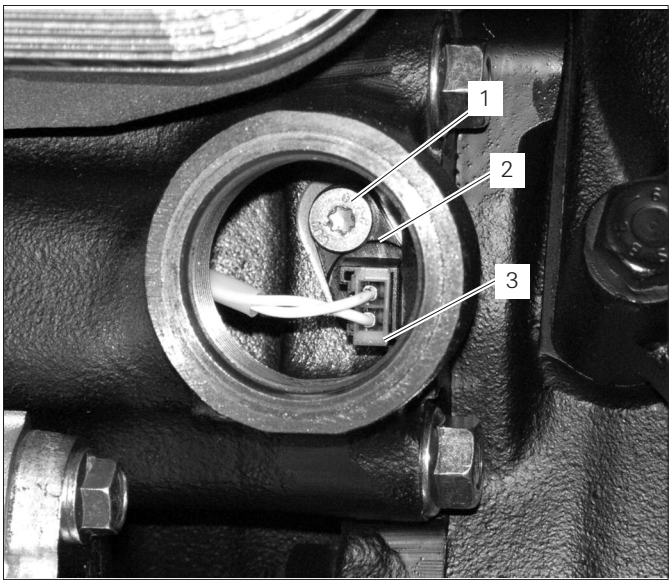
NOTE
The O-ring **(3)** serves as loss protection for the screw **(2)**.



025043

2 Install inductive sensor, output **(2)** with M6x17 torx screw **(1)** and O-ring.
Tightening torque: **9.5 Nm**

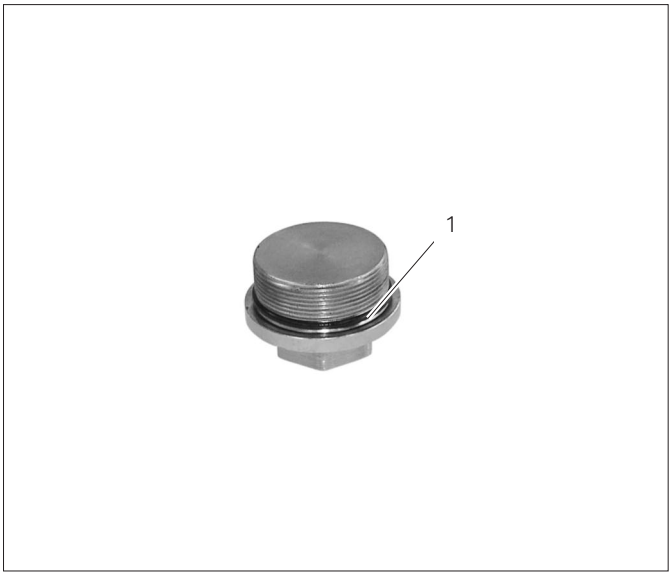
3 Fit connector **(3)**.



033064

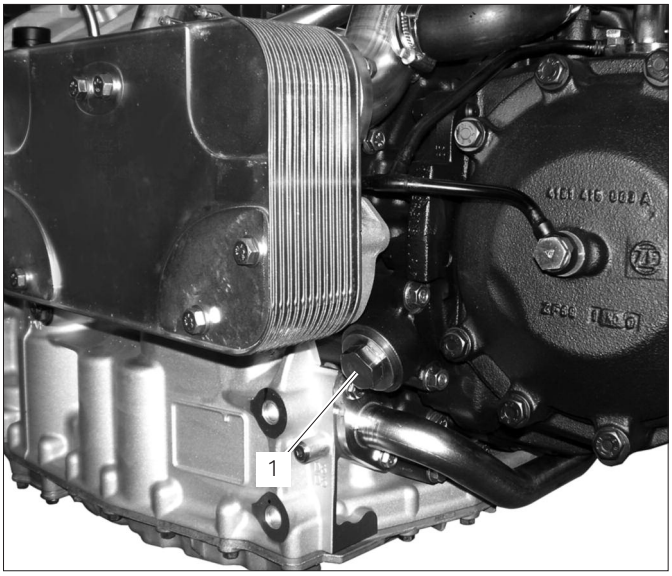
4 Coat O-ring **(1)** with technical Vaseline.

5 Fit O-ring **(1)** to screw plug.



025042

6 Screw in M42x1.5 screw plug **(1)**.
Tightening torque: **120 Nm**



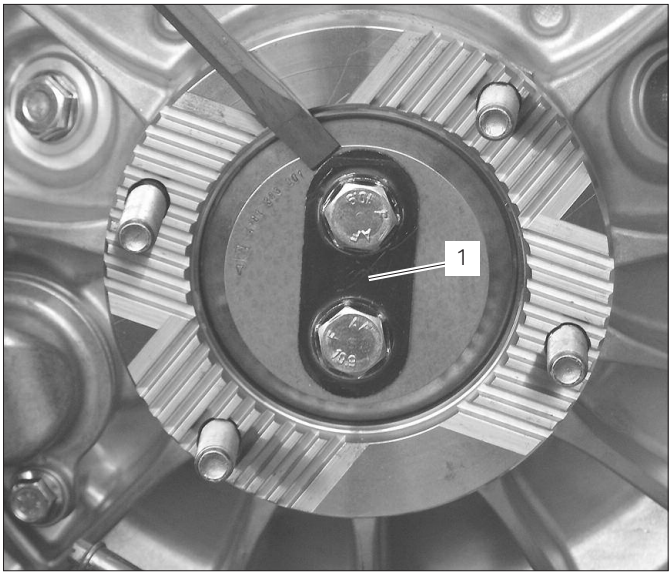
033063

2.6 Replacing output shaft sealing ring

2.6.1 Removing shaft sealing ring

NOTE
The procedure is identical for transmissions with angle drive.

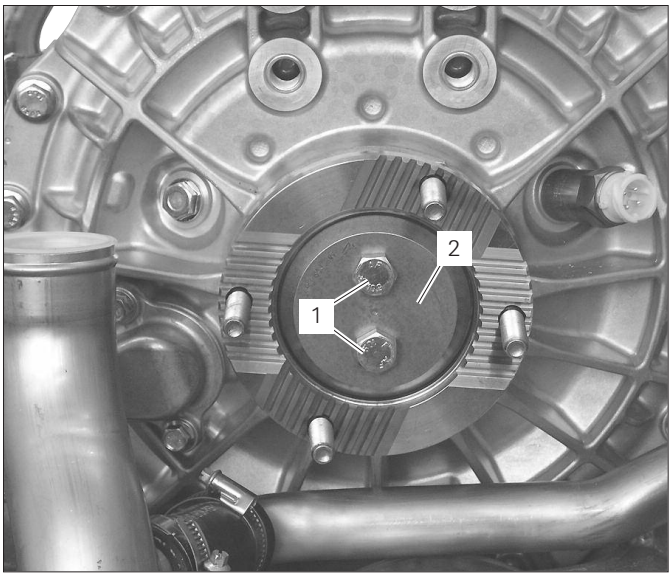
1 If needed, remove the safety plate **(1)** by means of a small flat chisel.



032307

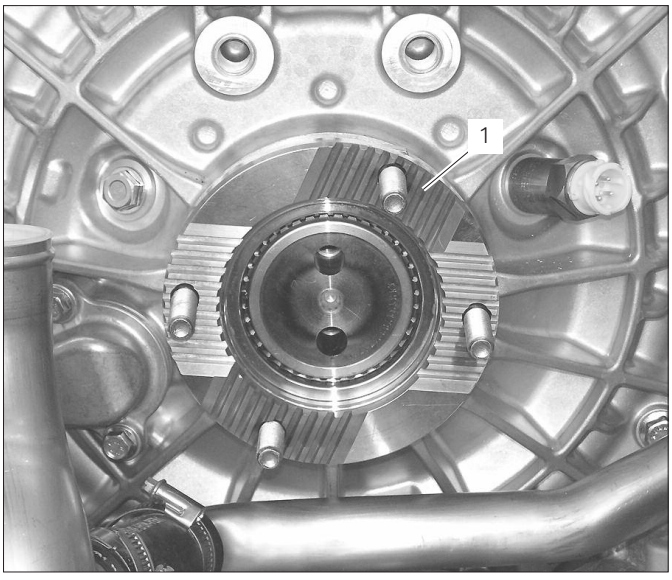
2 Unscrew two hex head screws **(1)** from flange.

3 Remove fixing plate **(2)**.



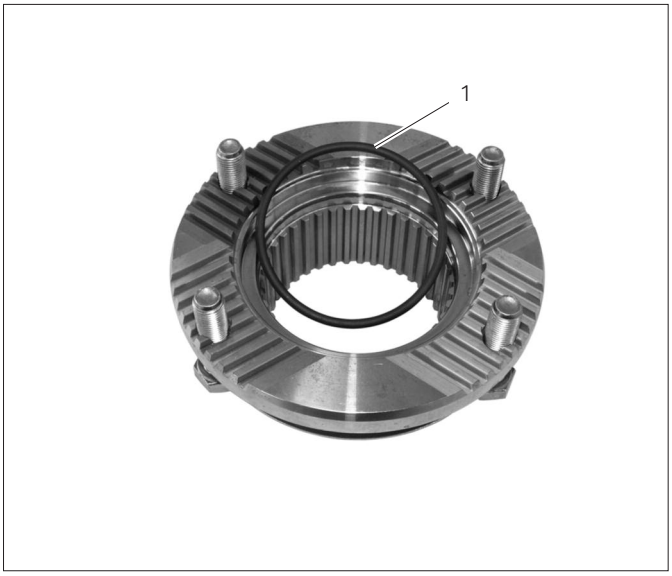
032295

4 Manually pull off output flange **(1)**.



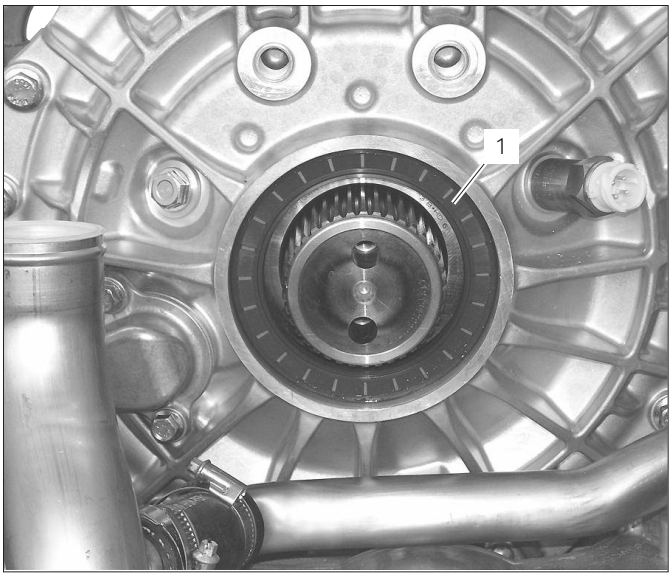
032297

5 Remove O-ring **(1)**.



034078

6 Remove shaft sealing ring **(1)** using a suitable tool.



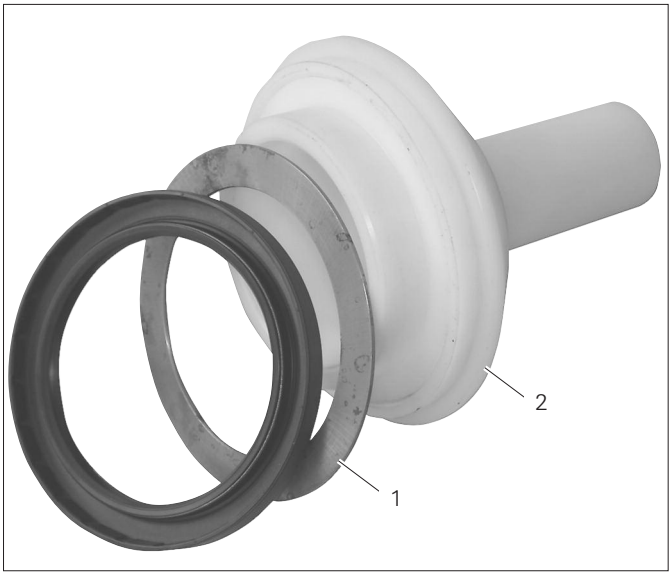
032298

2.6.2 Installing shaft sealing ring

NOTE
The procedure is identical for transmissions with angle drive.

CAUTION
If the output flange shows running-in wear from the shaft sealing ring, the shaft sealing ring must be installed in the output housing in a new position.

1 If required, fit washer **1X56 138 590 (1)** onto tool **1X56 138 625 (2)**.



032303

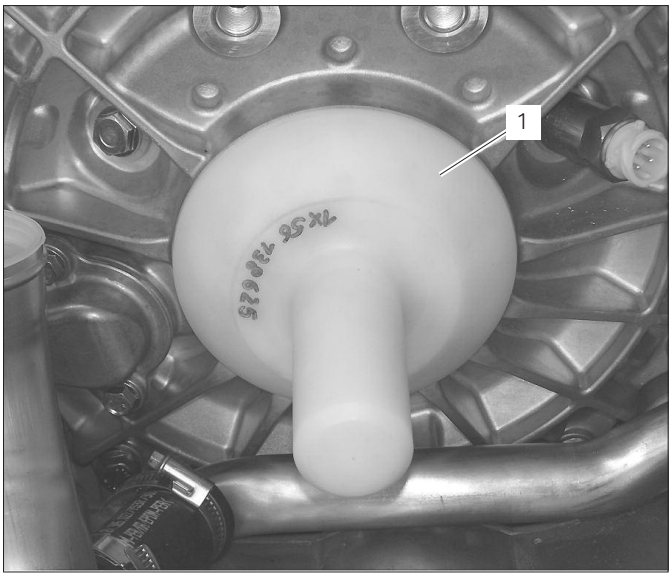
2 Sprinkle shaft sealing ring's outside diameter with spirit (ethanol).

3 Position new shaft sealing ring **(1)** onto tool **1X56 138 625**.



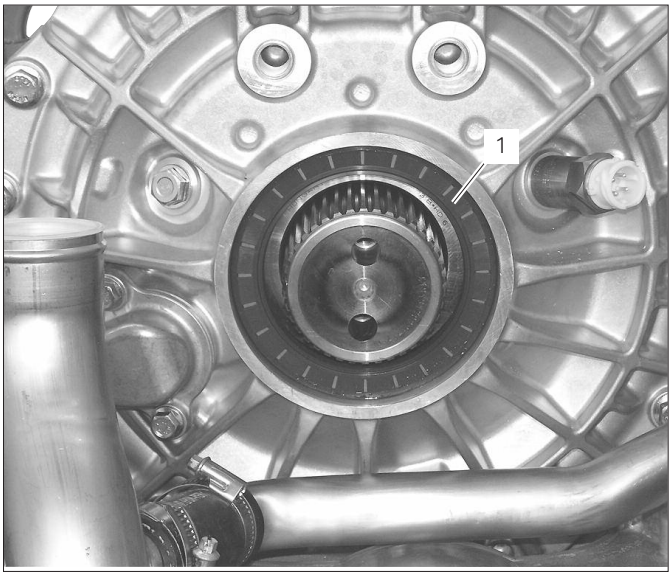
032302

4 Drive shaft sealing ring in until firmly home using tool **1X56 138 625 (1)**.



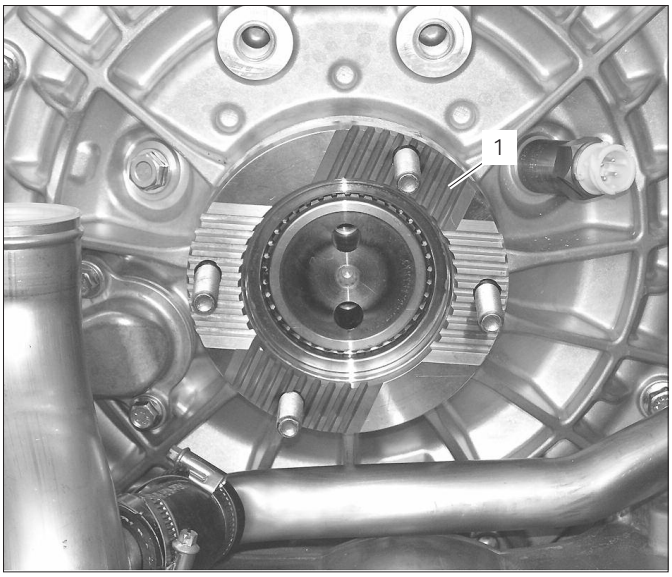
032301

NOTE
The shaft sealing ring's **(1)** installation dimension is predetermined by the tool.



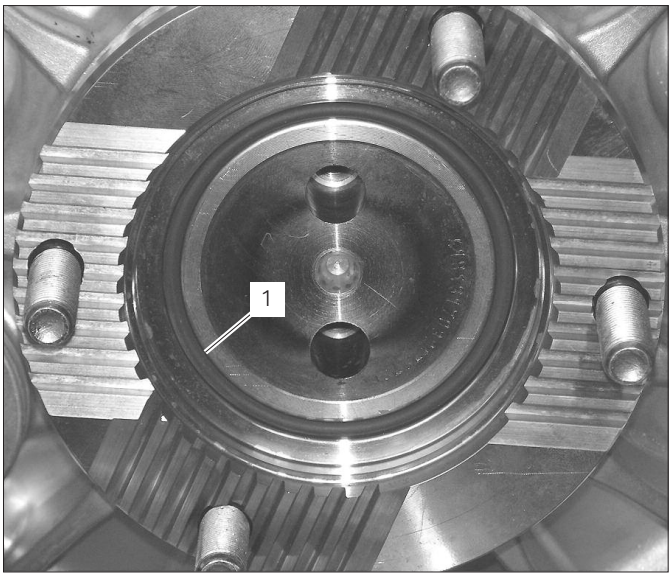
032298

5 Slide on output flange **(1)**.



032297

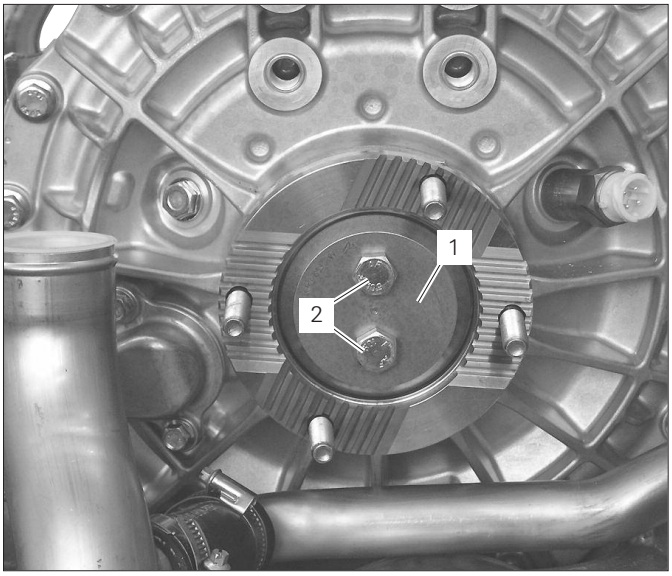
6 Insert new O-ring **(1)** and press into groove.



032296

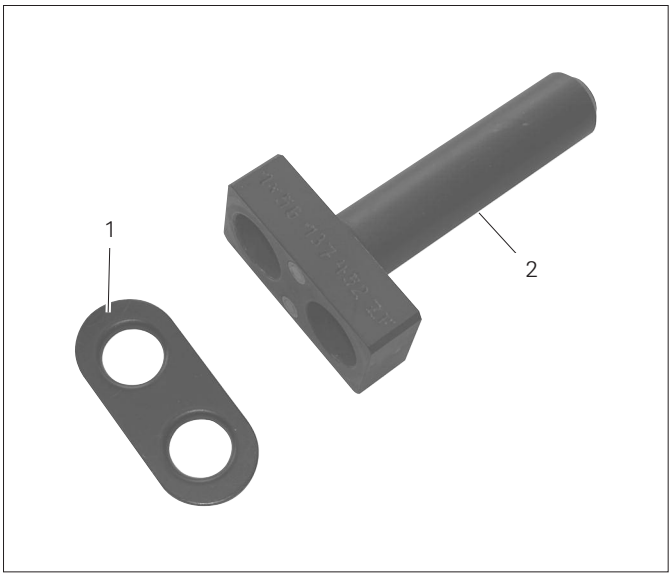
7 Position fixing plate **(1)**.

8 Screw in two new M12x60 hex head screws **(2)** and tighten.
Tightening torque: **80 Nm**



032295

9 Place safety plate **(1)**, part no. 4132 304 015, onto tool **1X56 137 452 (2)**.

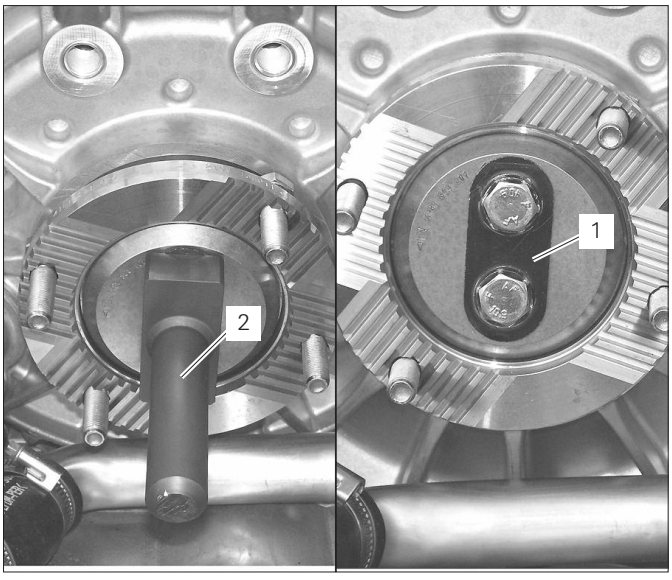


032304

⚠ **DANGER**
Risk of injury!
Pushing on the safety plate (1) might produce a sharp-edged bur!
Carefully remove bur with a suitable tool.

10 Push safety plate **(1)** onto M12 hex head screws until firmly home with pressure plate by using tool **(2)**.

CAUTION
Ensure cleanliness! Carefully remove chips and other abraded material.



032305/032306

2.7 Pressure test

Pressure test with the transmission installed in the vehicle:

Pressure measuring connections:

1 = **PD8** Lubricating pressure

2 = **PHD** Main pressure

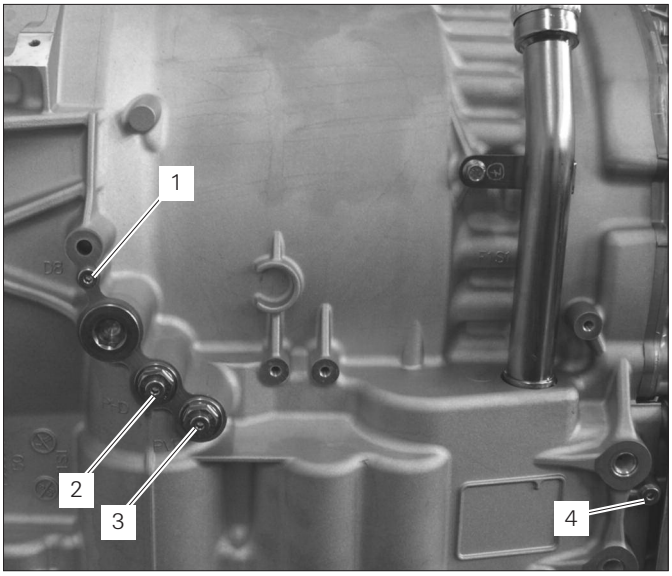
3 = **PVF** Pressure upstream of filter

4 = **PD6** Measuring connection for pressure **downstream of** retarder oil cooler (ROC) is mounted at output end on all sand-cast and die-cast transmissions with ROC.

4 = **PD5** Measuring connection for pressure **upstream of** retarder oil cooler (ROC) is flange-mounted laterally on all die-cast transmissions with ROC.

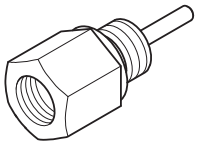
5 = **A8** Torque converter counter-pressure

Test gage **1P01 136 670** (up to 25 bar)
Test gage **1P01 137 856** (up to 10 bar)



032994

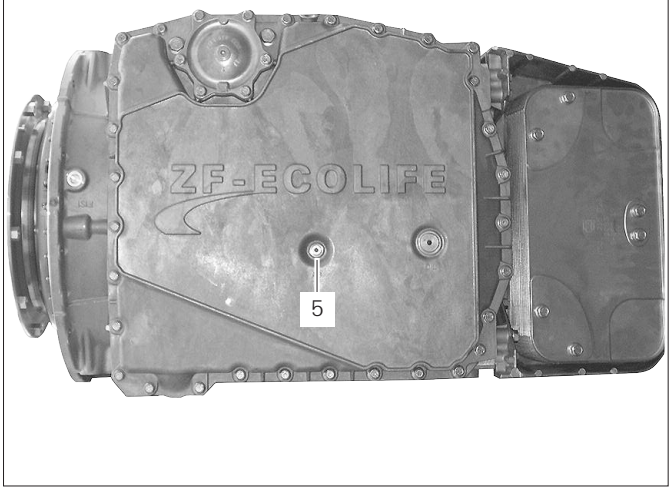
NOTE
The method for pressure testing at pressure measuring connections **PD8 (1)** and **PD5/6 (4)** described under work step 1 must be applied to all transmission housings prior to introduction of standard transmission housings 4181 302 025, starting from transmission no: 1020 (approx.). After that number, continuous testing is possible without removing non-return valves with adapter **1P82 139 839**.



Adapter 1P82 139 839

1 Unscrew M10x1 screw plug at pressure measuring point **PD8 (1)** and depending on cooler mounting **PD5/6 (4)**, screw out non-return valves using a screwdriver, screw in adapter **1P82 139 839** with O-ring and connect test gage.

2 Unscrew M10x1 screw plug at pressure measuring point **A8 (5)**, screw in adapter **1P82 139 839** with O-ring and connect test gage.



032262

NOTE
The method for pressure testing at pressure measuring point **PHD (2)** and **PVF (3)** described under work step 3 must be applied to all screw plugs prior to introduction of standard screw plug **4181 302 029**, or prior to introduction of die-cast transmissions.
After that, continuous testing is possible without changing screw plugs with adapters **1P82 139 839.**

3 Unscrew SW 22 and/or SW 24 at pressure measuring point **PHD (2)** and/or **PVF (3)** and replace by screw plug **4181 302 009** (without valve).
Screw in adapter **1P82 139 839** with O-ring and connect test gage.

4 Carry out pressure test.

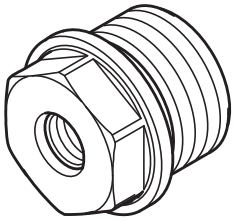
5 Remove test gage and adapter after completed pressure measurement.

6 Re-insert original SW 22 or SW 24 screw plug at **PHD (2)** or **PVF (3)**, respectively.
Tightening torque: **65 Nm**
Screw in M10x1 screw plug with new O-rings.
Tightening torque: **12 Nm**

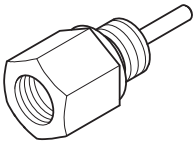
7 Non-return valves do not have to be inserted anymore in pressure measuring point **PD8 (1)** and depending on cooler mounting **PD5/6 (4)**.
Screw in M10x1 screw plug with new O-rings.
Tightening torque: **12 Nm**

8 At pressure measuring point **A8 (5)**, screw in M10x1 screw plug with new O-ring.
Tightening torque: **12 Nm**

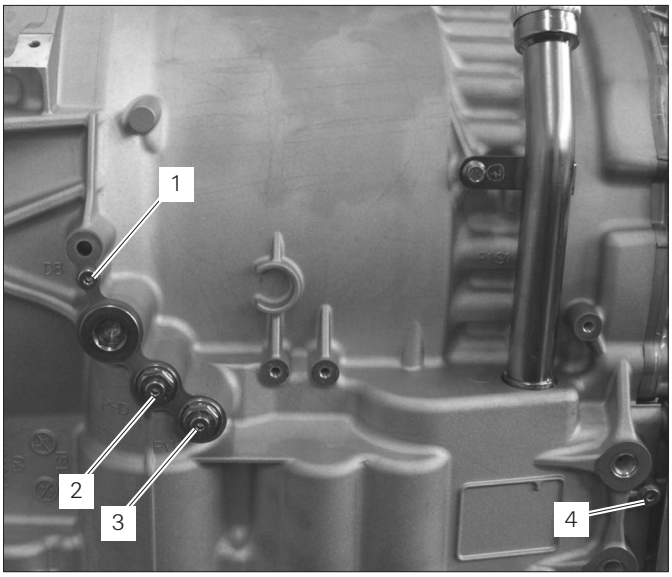
NOTE
In the following, you will find an excerpt of the test record for KD functional tests. The **latest** test record for the EcoLife KD functional test can be ordered under print number 4181 754 103 or accessed on the ZF-ServiceLine.



Screw plug 4181 302 009 (without valve)



Adapter 1P82 139 839



032994



032262

2.7.1 System check at idling speed (turbine speed 620 rpm)

UG = lower limit
OG = upper limit

Gear	PHD (bar) UG – OG 8.0 – 12.0 ACTUAL	PA 8 (bar) UG – OG 5.0 – 6.5 ACTUAL	PD 5 / PD 6 (bar) UG – OG 1.0 – 2.0 ACTUAL	PD 8 (bar) UG – OG 0.4 – 1.5 ACTUAL	Psch. WTR* (bar) UG – OG 0.1 – 1.0 ACTUAL
N WK open**					

2.7.2 System check at high speed (turbine speed 2 200 rpm)

UG = lower limit
OG = upper limit

Gear	PHD (bar) UG – OG 10.0 – 12.0 ACTUAL	PA 8 (bar) UG – OG 5.0 – 6.5 ACTUAL	PD 5 / PD 6 (bar) UG – OG 3.0 – 5.0 ACTUAL	PD 8 (bar) UG – OG 1.8 – 3.0 ACTUAL	Psch. WTR* (bar) UG – OG 0.6 – 3.0 ACTUAL
N WK open**					

* Psch.WTR = Lubricating pressure angle drive
** WK = Torque converter lock-up clutch

3 Troubleshooting

3.1 Electronic control unit

CAUTION
Disconnecting the battery while the engine is running might destroy the electronic control unit!

Checking the ground and supply wires (ZF requirement):

- Ground (−), cable cross-section: 2.5 mm^2
- Supply (+), cable cross-section: 2.5 mm^2

CAUTION
Battery master switch in the vehicle:
When master switch is OFF, battery and generator must both be disconnected from vehicle electric system!
Otherwise, power supply to the electronic control unit needs to be assured via terminal 30/battery, even when master switch is OFF (power consumption < 1 mA, non-critical!).
The electronic control unit must not be operated without battery. Risk of destruction through overvoltage!

3.2 Test with terminal tester 6008 006 002

Use of terminal tester 6008 006 002 with adapter kit 6008 206 040.

For troubleshooting purposes, the terminal tester 6008 006 002 together with the adapter kit 6008 206 040 can be connected as follows: Either between the transmission cable and the electronic control unit or between the electronic control unit and the vehicle connector.

⚠ **DANGER**
Driving with terminal tester and adapter cable is only permitted for test purpose and is not allowed on public roads!

CAUTION
Do not supply voltage to the emergency switch, the inductive sensor, and the proportional valves (gear clutches, main pressure, and retarder), because this would cause short circuit and failure of affected components. The proportional valves can be supplied with a current of max. 900 mA.

Carry out resistance measurements according to “Pin assignment with measured values at EcoLife transmission”.

NOTE
Resistance values can change with increasing and decreasing temperature.
The resistance value of solenoid valves **increases** with rising temperature.

Pin assignment with measured values at EcoLife transmission

Pin at transmission plug	EcoLife	Comment	EcoLife measured value (target value)
1	n_Tu	Turbine speed Resistance value cannot be measured, signal check with TestmanLife	-
2	n_Ab	Output speed Resistance value cannot be measured, signal check with TestmanLife	-
3	VPS1	Positive supply of control valves	-
4	TG_Sumpf	Sump temperature sensor	approx. 62 kohm between pin 4 and 15 at (°C, refer to page 3-3)
5	VPS2	Positive supply of control valves	-
6	-	-	-
7	-	-	-
8	RR3	Retarder control valve	10-15 ohm between pin 8 and 5 at 20 °C
9	WK	Torque converter lock-up clutch control valve	10-15 ohm between pin 9 and 5 at 20 °C
10	RHD	Main pressure control valve	10-15 ohm between pin 10 and 5 at 20 °C
11	-	-	-
12	B	Clutch B control valve	10-15 ohm between pin 12 and 5 at 20 °C
13	A	Clutch A control valve	10-15 ohm between pin 13 and 5 at 20 °C
14	-	-	-
15	GM1	Ground connection of sump temperature sensor	
16	-	-	-
17	GM2	Ground connection of retarder temperature sensor	-
18	TG_Ret	Retarder temperature sensor	approx. 124 kohm between pin 18 and 17 at (°C, refer to page 3-3)
19	F	Brake F control valve	10-15 ohm between pin 19 and 5 at 20 °C
20	-	-	-
21	AU +5V	Positive supply of output speed sensor	-
22	D	Brake D control valve	10-15 ohm between pin 22 and 5 at 20 °C
23	AU +5V	Positive supply of turbine speed sensor	-
24	E	Brake E control valve	10-15 ohm between pin 24 and 5 at 20 °C

Notes: Do not supply voltage of 24 V to control valves!

Tolerance table for sump temperature sensor

NTC temperature sensor
DKS 4261 thermometrics
Tolerance table −40 °C to 150 °C

Temperature °C	R/R25	R nominal ohm	R minimum ohm	R maximum ohm
-40	33.0042179	1650061.2	1524759.4	1784945.9
-35	23.8370981	1191746.8	1104837.5	1284978.4
-30	17.4083136	870336.7	809406.5	935479.3
-25	12.8483939	642361.4	599208.4	688346.7
-20	9.5788331	478898.2	448040.3	511676.7
-15	7.2101341	360474.0	338206.1	384054.3
-10	5.4770683	273828.6	257620.4	290940.1
-5	4.1970599	209834.0	197939.9	222353.8
0	3.2431186	162141.2	153345.4	171373.0
5	2.5260344	126290.3	119738.1	133147.7
10	1.9825385	99117.9	94203.5	104247.0
15	1.5673486	78360.3	74650.3	82221.8
20	1.2477705	62382.9	59565.0	65307.9
25	1.0000000	49995.5	47842.9	52224.0
30	0.8065651	40324.6	38671.5	42031.6
35	0.6545420	32724.1	31448.2	34038.2
40	0.5342997	26712.6	25723.2	27728.9
45	0.4386094	21928.5	21158.0	22717.9
50	0.3620081	18098.8	17496.4	18714.4
55	0.3003397	15015.6	14543.0	15497.4
60	0.2504222	12520.0	12148.0	12898.2
65	0.2098044	10489.3	10195.6	10787.0
70	0.1765668	8828.5	8596.2	9063.5
75	0.1492890	7463.8	7279.6	7649.6
80	0.1267509	6337.0	6190.7	6484.1
85	0.1080586	5402.4	5286.2	5519.1
90	0.0924884	4624.0	4531.5	4716.5
95	0.0794644	3972.9	3887.5	4058.5
100	0.0685260	3426.0	3347.4	3505.0
105	0.0593035	2964.9	2892.7	3037.7
110	0.0514982	2574.7	2508.5	2641.6
115	0.0448682	2243.2	2182.5	2304.7
120	0.0392169	1960.7	1905.0	2017.1
125	0.0343832	1719.0	1668.0	1770.8
130	0.0302352	1511.6	1464.9	1559.2
135	0.0266644	1333.1	1290.3	1376.8
140	0.0235809	1178.9	1139.7	1219.1
145	0.0209103	1045.4	1009.4	1082.3
150	0.0185906	929.4	896.4	963.4

Retarder temperature sensor

Resistance value in kohm
Measured current: < 1.2 mA

°C	Min	Nominal	Max
-40	-	-	-
-20	830.7	1000.2	1203.7
0	281.3	329.4	385.6
20	108.3	123.8	141.4
40	46.39	51.88	57.98
60	21.73	23.83	26.12
80	10.98	11.84	12.75
100	5.9231	6.283	6.661
120	3.3786	3.533	3.692
140	2.0234	2.088	2.154
160	1.2498	1.289	1.329
180	0.7932	0.8275	0.8627

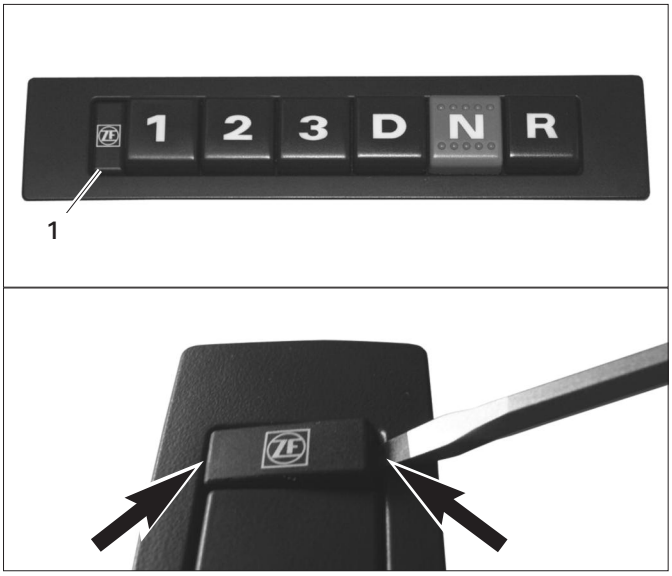
Adjusted at 150 °C 1.633 kohm

Tau 63:	< 3 s
Operating current:	< 2.5 mA
U_B:	5 V
Temperature range:	−40 °C to +160 °C (short-term +180 °C
Measurement range:	−20 °C to +180 °C
Housing material:	Ultramid TKR 4355 G7
Color:	black

3.3 Connect ZF-TESTMAN to diagnostic connector

Carefully take off diagnostic connector's protective cap to connect ZF-TESTMAN via the diagnostic connector (USB) on the speed range selector.

NOTE
Carefully lift protective cap on both sides (see arrows) by using a small slotted screwdriver.



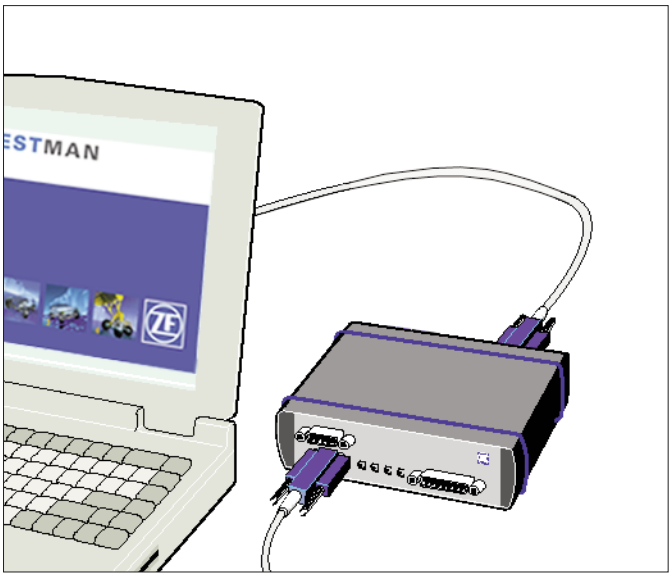
029415 / 032719

Connect adapter cable 6008 207 043 to diagnostic connector (USB).



6008 207 043 / 029417

Connect adapter cable 6008 207 043 to ZF-TESTMAN.



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3.4 ZF-TESTMAN diagnosis system

The ZF-TESTMAN diagnosis system can be used universally, i.e. on all diagnosable ZF vehicle systems.

All necessary, transmission-specific data required for a rapid and comprehensive diagnosis can be retrieved using the ZF-TESTMAN diagnosis system. Data are supplied on DVD and saved on the hard disk using an installation routine.

Targeted troubleshooting allows staff trained by ZF to rapidly find the error in the transmission system. After having identified the fault, the diagnosis system will propose remedial measures.

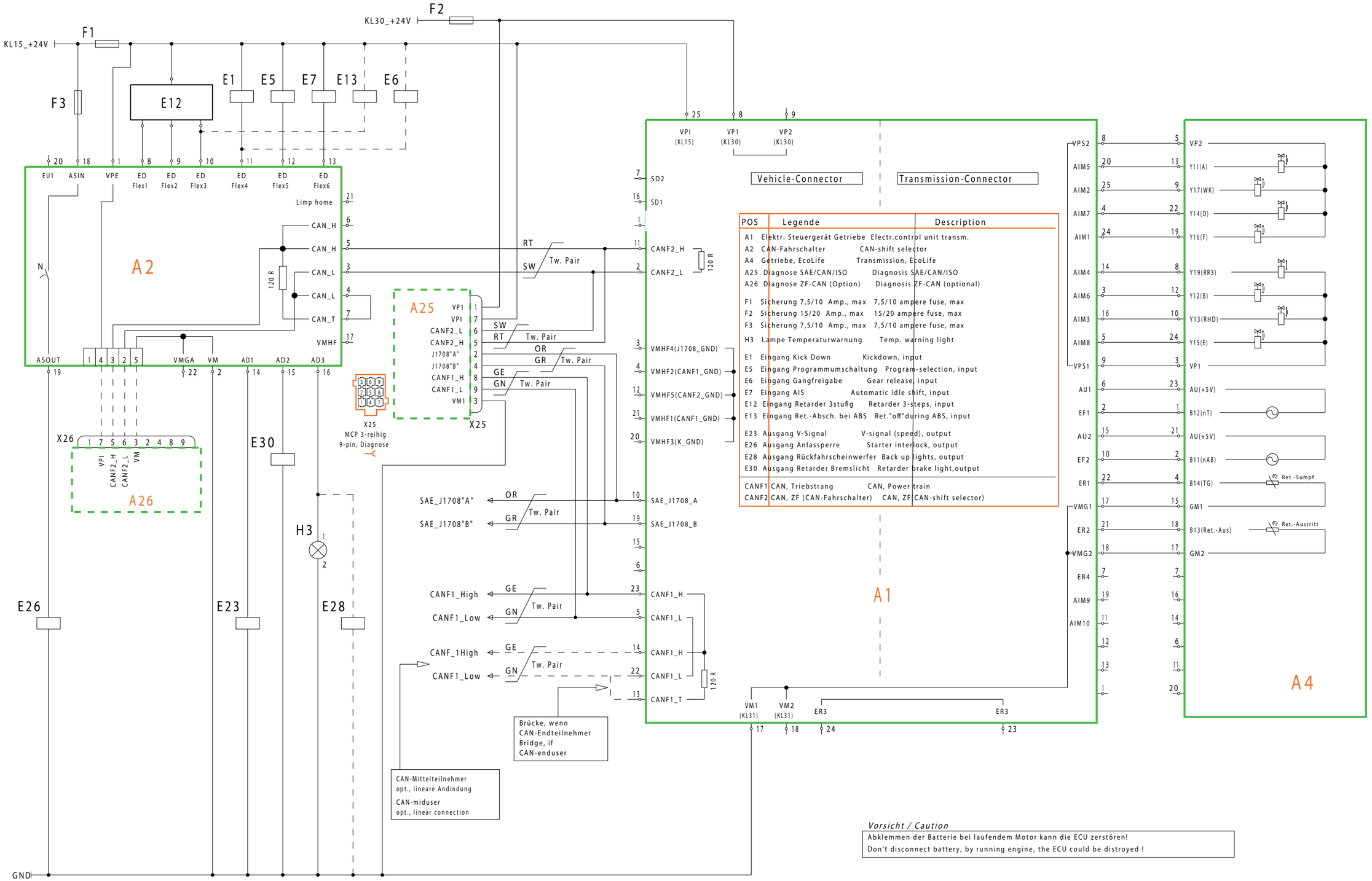
Communication between the transmission electronics and the interface adapter (DPA 05) is performed via CAN. Communication between interface adapter and PC is performed via USB, serial line, or online using mobile telephony. Each screen page can be printed out or saved for error documentation. The diagnosis software is available in different languages.

Scope of functions

- **Statistics data**
  All the statistics data which is saved on the control unit is displayed.
- **Diagnosis**
  Current fault display; read error memory; delete error memory; read identification data
- **Monitoring**
  Tester (displays all digital inputs and outputs); display of digital and analog parameters, e.g. speeds, amperages, and voltages
- **Repair aids**
  Tightening torques; setting data; special tools; test equipment.
  Maintenance; servicing.
  Pressures; circuit diagrams; electr. measured values.
  As PDF file.
- **ZF telephone directory**
  Telephone directory of all ZF service centers.
- **Vehicle configuration**
  Depending on the product, all vehicle-specific data can be set here and/or driving programs can be selected and adapted.
- **Programming (Flashing)**
  Available programming files can be installed.

System requirements and scope of supply

Refer to Operating Instructions: ZF-TESTMAN 6008.758.004 (DE) or 6008.758.104 (EN).



POS	Legende	Description
A1	Elektr. Steuergerät Getriebe	Electr.control unit transm.
A2	CAN-Fahrschalter	CAN-shift selector
A4	Getriebe, EcoLife	Transmission, EcoLife
A25	Diagnose SAE/CAN/ISO	Diagnosis SAE/CAN/ISO
A26	Diagnose ZF-CAN (Option)	Diagnosis ZF-CAN (optional)
F1	Sicherung 7,5/10 Amp., max	7,5/10 ampere fuse, max
F2	Sicherung 15/20 Amp., max	15/20 ampere fuse, max
F3	Sicherung 7,5/10 Amp., max	7,5/10 ampere fuse, max
H3	Lampe Temperaturwarnung	Temp. warning light
E1	Eingang Kick Down	Kickdown, input
E5	Eingang Programmumschaltung	Program-selection, input
E6	Eingang Gangfreigabe	Gear release, input
E7	Eingang AIS	Automatic idle shift, input
E12	Eingang Retarder 3stufig	Retarder 3-steps, input
E13	Eingang Ret.-Absch. bei ABS	Ret."off"during ABS, input
E23	Ausgang V-Signal	V-signal (speed), output
E26	Ausgang Anlassperre	Starter interlock, output
E28	Ausgang Rückfahrscheinwerfer	Back up lights, output
E30	Ausgang Retarder Bremslicht	Retarder brake light,output
CANF1	CAN, Triebstrang	CAN, Power train
CANF2	CAN, ZF (CAN-Fahrschalter)	CAN, ZF (CAN-shift selector)

Vorsicht / Caution

Abklemmen der Batterie bei laufendem Motor kann die ECU zerstören!
Don't disconnect battery, by running engine, the ECU could be distroyed !

Verkabelung-Anforderungen

Stecker, ECU, fahrzeugseitig
Typ: 25pol, Kostal, Buchse (SLK/MLK)
ZF-Best-Nr.: 6029 199 156
Hersteller: Fa. Kostal
Hersteller Best-Nr.: siehe TKI 0000 702 303
ZF-Verarbeitungspezifikation: 0501 700 453
ZF-Spezifikation: 6029 705 028
Kostal-Verarbeitungspez: DOK 000 860 29 (verbindlich)
Achtung:
Der Kabelabgang am ECU-Stecker muss nach ca. 100mm befestigt werden !
Hierzu ist eine Gewindebohrung (M8) am Getriebe-Wärmetauscher vorgesehen

Stecker, CAN-Fahrschalter
Typ: 22pol, Tyco, Buchse, Jun.P.T., 2reihig
ZF-Best-Nr.: 6029 199 132
Hersteller: Fa. Tyco
Hesteller Best-Nr.: 929504-7 (Stecker-Gehäuse)
Herteller Best-Nr.: 927771-3 (Kontaktbuchse)

Stecker, Diagnose
Typ: 9pol, Tyco, Buchse, MCP, 3reihig
ZF-Best-Nr.: 6029 199 157
Hersteller: Fa. Tyco
Hesteller Best-Nr.: 8-968971-1 (Stecker-Gehäuse)
Herteller Best-Nr.: 1-968849-1 (Kontaktbuchse)

Stecker, Bordnetz (Vorschlag-ZF)
Typ: 15pol, Tyco, Buchse, MCP, 3reihig
ZF-Best-Nr.: 6029 199 161
Hersteller: Fa. Tyco
Hesteller Best-Nr.: 8-968973-1 (Stecker-Gehäuse)
Herteller Best-Nr.: 1-968849-1 (Kontaktbuchse, 1,0qmm)
Herteller Best-Nr.: 1-968851-1 (Kontaktbuchse, 2,5qmm)

Leitungen, CAN-Schnittstellen
Schnittstellen nach: SAE J1939 / SAE J 1708
Verdrilltes Leitungspaar: Schläge 32mm (32 S/m)
Empfohlener Leiterquerschnitt: 1,0qmm

Leitungen, BN(+)Kl.30, BN(-)Kl.31
Empfohlener Leiterquerschnitt: 2,50qmm
Kl.30 (VPE1/VPE2), Pin 8 / 9
Kl.31 (VM1/VM2), Pin 17 / 18

Leitungen, BN(+)Kl.15 und sonstige
Empfohlener Leiterquerschnitt: 1,00qmm
Kl.15 (VPI), Pin 25 und alle sonstigen Leitungen

Hinweis:
Der Fahrzeughersteller (OEM) ist verantwortlich für die Auslegung der Verkabelung.

Harness-requirements

Plug, ECU, vehicle-part
Type: 25pin, Kostal, female (SLK/MLK)
ZF-Order-no.: 6029 199 156
Manufacturer: Co. Kostal
Manufacturer order-no: See TCI 0000 702 303
ZF-processing-specification: 0501 700 453
ZF-specification: 6029 705 028
Kostal-processing-specific: DOK 000 860 29 (binding)
Attention:
The cable must be fixed ca. 100mm after cable-out from the ECU-plug !
For this is designed a threaded hole (M8) at the transmission heat-exchanger

Plug, CAN shift-seletor
Type: 22pin, Tyco, female, jun.p.t., 2-array
ZF-Order-no.: 6029 199 132
Manufacturer: Co. Tyco
Manufacturer order-no: 929504-7 (plug-housing)
Manufacturer order-no: 927771-3 (female terminal)

Plug, diagnoses
Type: 9pin, Tyco, female, MCP, 3-array
ZF-Order-no.: 6029 199 157
Manufacturer: Co. Tyco
Manufacturer order-no: 8-968971-1 (plug-housing)
Manufacturer order-no: 1-968849-1 (female terminal)

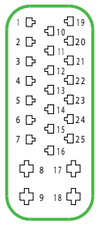
Plug, vehicle interface (ZF proposel)
Type: 15pin, Tyco, female, MCP, 3-array
ZF-Order-no.: 6029 199 161
Manufacturer: Co. Tyco
Manufacturer order-no: 8-968973-1 (plug-housing)
Manufacturer order-no: 1-968849-1 (female terminal, 1,0qmm)
Manufacturer order-no: 1-968851-1 (female terminal, 2,5qmm)

Wires, CAN-interface
Interfaces according: SAE J1939 / SAE J 1708
Twisted pair wires: Twisted 32mm (32 S/m)
Recommended wire cross-section: 1,0qmm

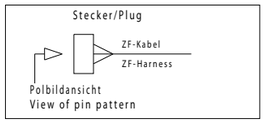
Wires, power supply, Kl.30, Kl.31
Recommended wire cross-section: 2,5qmm
Kl.30 (VPE1/VPE2), pin 8 / 9
Kl.31 (VM1/VM2), pin 17 / 18

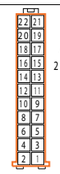
Wires, power(+)Kl.15 and miscellaneous
Recommended wire cross-section: 1,0qmm
Kl.15 (VPI), pin 25 and all other wires

Notice
The Vehicle manufacturer (OEM) is responsible for the construction of the harness.



Kostal
25-pin, ECU





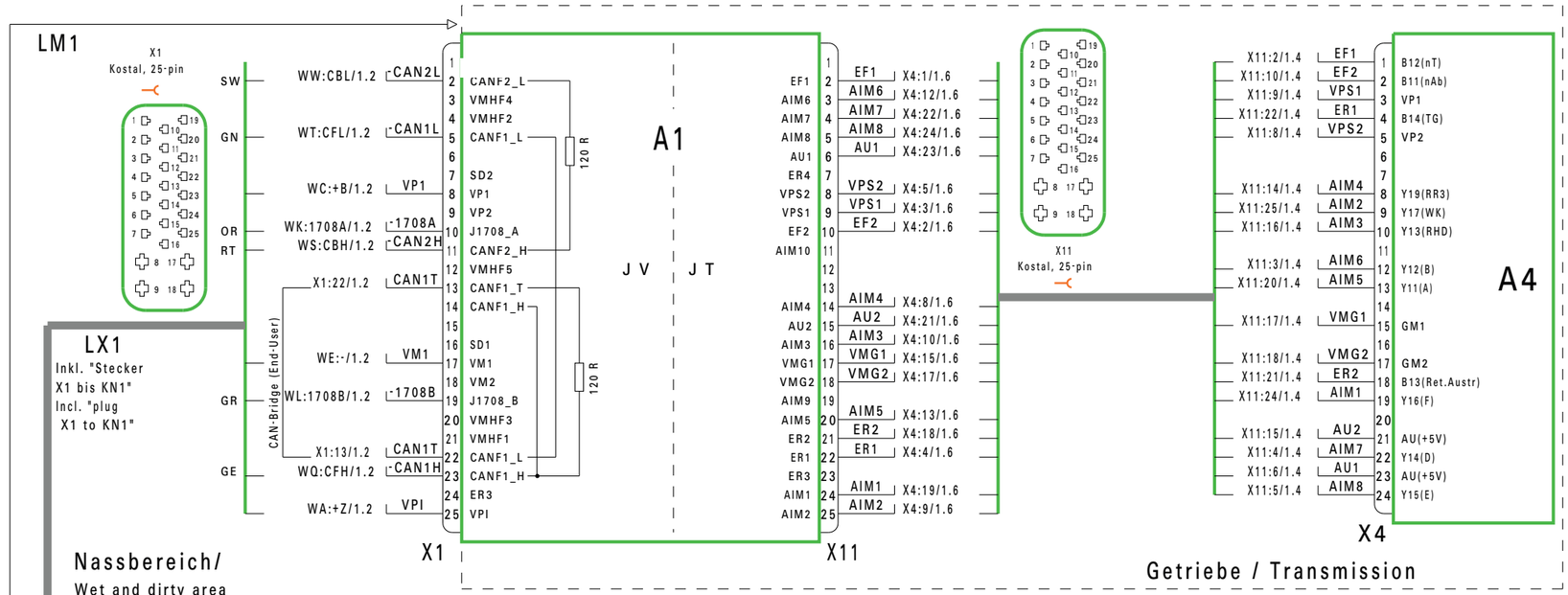
AMP JPT
22-pin, FS

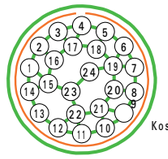


X25
MCP 3-reihig
9-pin, Diagnose



MCP, 3-reihig
15-pin, Bordnetz

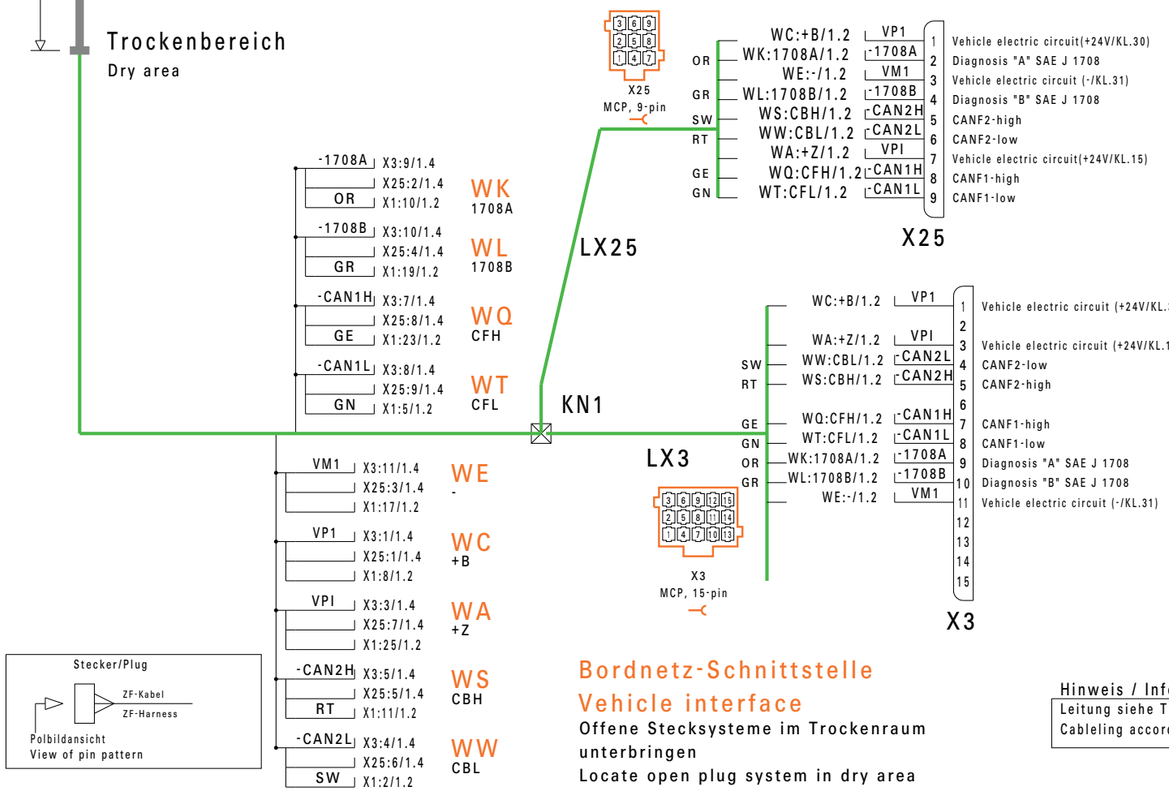


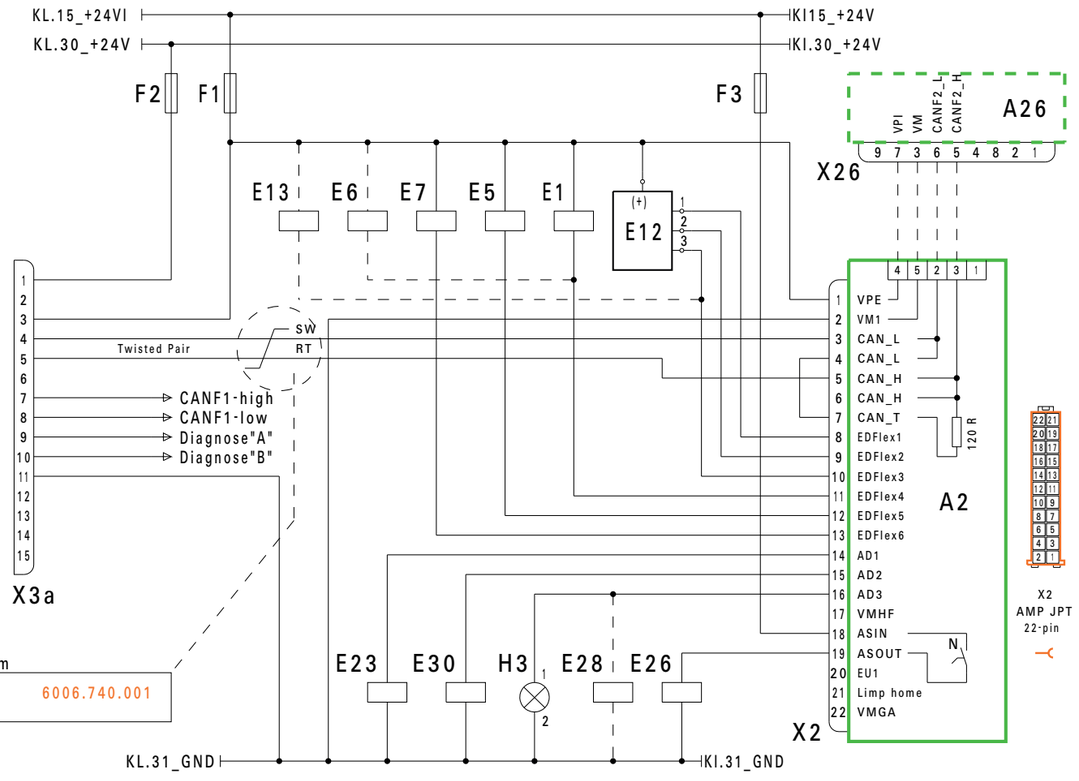


Stromlaufplan: 6029.739.017
Circuit diagram:

X4
Kostal, 24-pin

POS. ITEM	Legende	Description
A1	Elektr. Steuergerät Getriebe	Control unit transmission
A2	CAN-Fahrschalter	CAN-shift selector
A4	Getriebe	Transmission
A26	Diagnose ZF-CAN (Option)	Diagnosis ZF-CAN (optional)
F1	Sicherung 7,5/10 Amp, max	7,5/10 ampere fuse, max
F2	Sicherung 15/20 Amp, max	15/20 ampere fuse, max
F3	Sicherung 7,5/10 Amp, max	7,5/10 ampere fuse, max
H3	Lampe Temperaturwarnung	Temperature warning light
E1	Eingang Kick Down	Kickdown, intput
E5	Eingang Programmumschaltung	Program-selection, input
E6	Eingang Gangfreigabe	Gear release, input
E7	Eingang AIS	Automatic idle shift, input
E12	Eingang Retarder 3stufig	Retarder 3-steps, input
E13	Eingang Ret.-Abschtl. bei ABS	Retarder "off" durning ABS, input
E23	Ausgang V-Signal	Speed-signal, output
E26	Ausgang Relais Anlassperre	Starter interlock, output
E28	Ausgang Rückfahrscheinwerfer	Back up lihgts, output
E30	Ausgang Retarder Bremslicht	Retarder brake light, output
CANF1	CAN, Triebstrang	CAN, power train
CANF2	CAN, ZF (CAN-Fahrschalter)	CAN, ZF (CAN-shift selector





Hinweis / Informatiom
Leitung siehe TKI: 6006.740.001
Cableing according TCI:

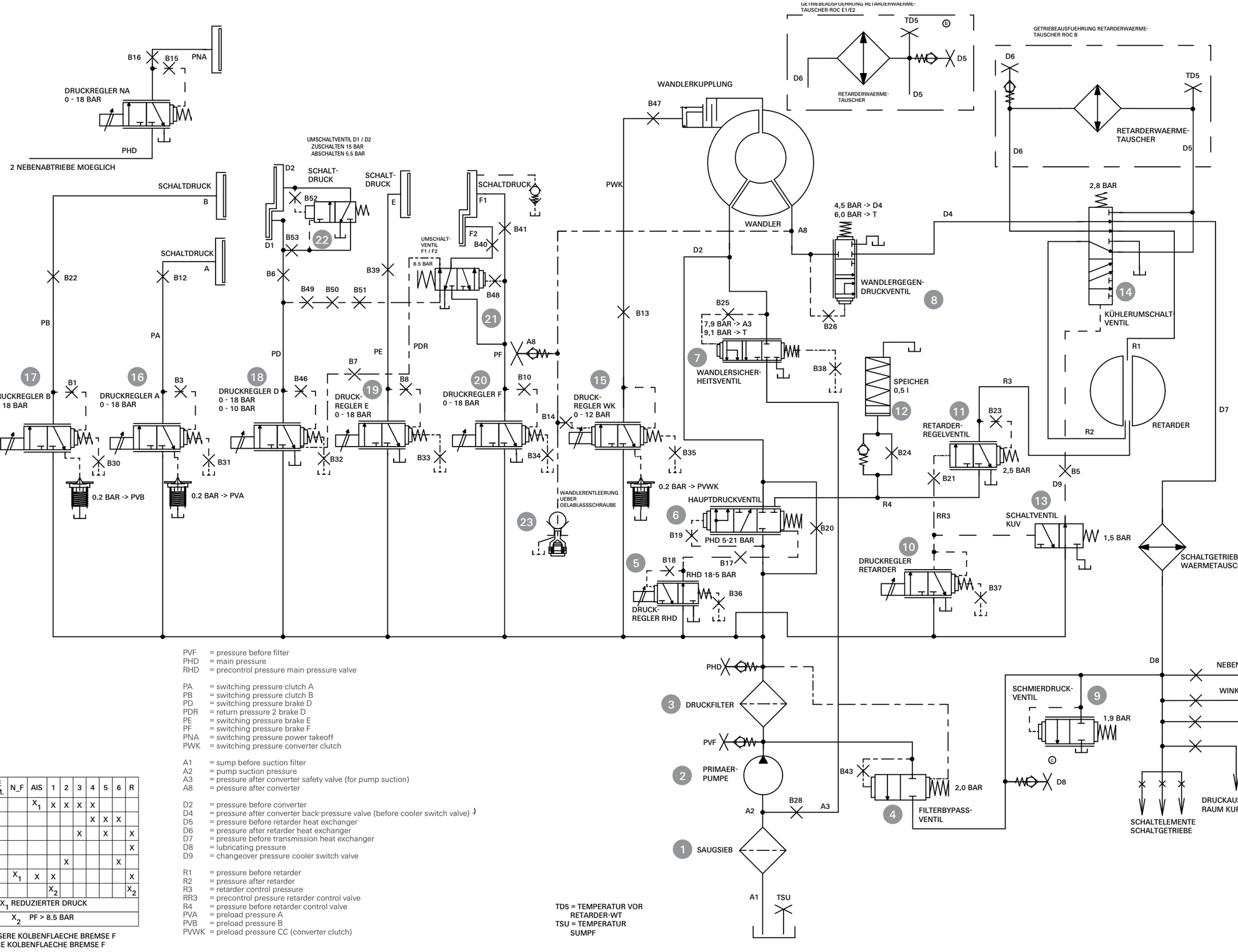
Stromlaufplan: 6029.739.017
Circuit diagram:

POS ITEM	Legende	Description
A1	Elektr. Steuergerät Getriebe	Control unit transmission
A2	CAN-Fahrschalter	CAN-shift selector
A4	Getriebe	Transmission
A26	Diagnose ZF-CAN (Option)	Diagnosis ZF-CAN (optional)
F1	Sicherung 7,5/10 Amp, max	7,5/10 ampere fuse, max
F2	Sicherung 15/20 Amp, max	15/20 ampere fuse, max
F3	Sicherung 7,5/10 Amp, max	7,5/10 ampere fuse, max
H3	Lampe Temperaturwarnung	Temperature warning light
E1	Eingang Kick Down	Kickdown, intput
E5	Eingang Programmumschaltung	Program-selection, input
E6	Eingang Gangfreigabe	Gear release, input
E7	Eingang AIS	Automatic idle shift, input
E12	Eingang Retarder 3stufig	Retarder 3-steps, input
E13	Eingang Ret.-Abschtl. bei ABS	Retarder "off" durning ABS, input
E23	Ausgang V-Signal	Speed-signal, output
E26	Ausgang Relais Anlassperre	Starter interlock, output
E28	Ausgang Rückfahrscheinwerfer	Back up lihgts, output
E30	Ausgang Retarder Bremslicht	Retarder brake light, output
CANF1	CAN, Triebstrang	CAN, power train
CANF2	CAN, ZF (CAN-Fahrschalter)	CAN, ZF (CAN-shift selector

Getriebe / Transmission

Bordnetz-Schnittstelle
Vehicle interface
Offene Stecksysteme im Trockenraum unterbringen
Locate open plug system in dry area

Hinweis / Informatiom
Leitung siehe TKI: 6006.740.001
Cableing according TCI:



PVF = pressure before filter
PHD = main pressure
RHD = precontrol pressure main pressure valve

PA = switching pressure clutch A
PB = switching pressure clutch B
PD = switching pressure brake D
PDR = return pressure 2 brake D
PE = switching pressure brake E
PF = switching pressure brake F
PNA = switching pressure power takeoff
PWK = switching pressure converter clutch

A1 = sump before suction filter
A2 = pump suction pressure
A3 = pressure after converter safety valve (for pump suction)
A8 = pressure after converter

D2 = pressure before converter
D4 = pressure after converter back-pressure valve (before cooler switch valve) -)
D5 = pressure before retarder heat exchanger
D6 = pressure after retarder heat exchanger
D7 = pressure before transmission heat exchanger
D8 = lubricating pressure
D9 = changeover pressure cooler switch valve

R1 = pressure before retarder
R2 = pressure after retarder
R3 = retarder control pressure
RR3 = precontrol pressure retarder control valve
R4 = pressure before retarder control valve
PVA = preload pressure A
PVB = preload pressure B
PVWK = preload pressure CC (converter clutch)

GANGSTUFE SCHALTELEM.	N_F	AIS	1	2	3	4	5	6	R
A		X_1	X	X	X	X			
B						X	X	X	
D1					X		X		X
D2									X
E				X				X	
F1	X_1	X	X						X
F2			X_2						X_2
X_1 REDUZIERTER DRUCK									
X_2 PF > 8.5 BAR									

F1 = AEUSSERE KOLBENFLAECHE BREMSE F
F2 = INNERE KOLBENFLAECHE BREMSE F

TD5 = TEMPERATUR VOR RETARDER-WT
TSU = TEMPERATUR SUMPF

The hydraulic system converts electronic signals (commands) into the required hydraulic variables and ensures oil pressures/volumetric flows.

- Suction strainer **1**, pump **2**, and pressure filter **3**
  Pump **2** sucks oil from the oil pan through the suction strainer **1** (only when the engine is running). The pressure filter **3** filters the oil supplied by the pump **2**.

- Pump charging **A3**
  The effluent oil quantity **A3** at the converter safety valve **7** is directly fed into the pump suction port **A2** and increases the pressure level in the suction port. Pump charging is needed to reduce the suction vacuum and thus to raise the cavitation limit and efficiency of the pump **3**.

- Filter by-pass valve **4**
  The filter by-pass valve **4** limits pressure loss in the pressure filter **3** to a specified value. When reaching the specified value, oil is fed into the lubricating system.

- RHD pressure regulator **5** and main pressure valve **6**
  The proportional solenoid actuates the RHD pressure regulator **5** where pump pressure is applied. The proportional valve sets the pRHD pilot pressure depending on the control current of the transmission electronics. The pRHD pilot pressure acts on the controlled surface of the main pressure valve **6** and thus determines the main pressure level pHD. There is a by-pass bore between pHD and **D2** at the main pressure valve **6** to prevent torque converter internal pressure drop and to guarantee a minimum quantity of lubricating oil for the transmission.

- Torque converter safety valve **7**
  The torque converter safety valve **7** limits pressure **D2** towards the torque converter to a specified value. The effluent oil quantity **A3** is directly fed to the pump suction port **A2** for charging the pump.

- Converter counter-pressure valve **8**
  Pressure from the torque converter flows to the converter counter-pressure valve **8**. There, the torque converter internal pressure **A8** is set to a specified value. The A8 pressure is directed to the control surface of the lock-up clutch (WK) pressure regulator.

- Accumulator **12**
  To reduce the retarder's response time, the accumulator oil quantity is fed into the retarder circuit by spring force. It is connected to **R4** and is charged during traction operation. When engaging the retarder, the pressure of the retarder pilot control increases and the cooler change-over control valve **13** switches. Now, the retarder control valve **11** charges the retarder; thus, R4 pressure drops below a specified limit. The accumulator **12** is activated and supports retarder filling. An orifice is installed in the filler line to make sure that the accumulator **12** does not immediately suck oil once the pressure rises again.

- Lock-up clutch pressure regulator **15**
  The proportional solenoid actuates the lock-up clutch pressure regulator **15** where main pressure **pHD** is applied. The proportional solenoid is assisted by the torque converter's internal pressure **A8** acting on the controlled surface. The proportional valve sets the switching pressure **pWK** depending on the control current of the transmission electronics. Switching pressure acts on the pressure return surface supporting the return spring. This limits the maximum switching pressure **pWK** to a specified value. In an inactive condition, a preload valve prevents the switching element from running empty.

- Pressure regulator A **16**
  The proportional solenoid actuates pressure regulator A **16** where main pressure **pHD** is applied. The proportional valve sets the switching pressure **pA** depending on the control current of the transmission electronics. Switching pressure **pA** acts on the pressure return surface supporting the return spring. This limits the maximum switching pressure **pA** to a specified value. In an inactive condition, a preload valve prevents the switching element from running empty.

- Pressure regulator B **17**
  The proportional solenoid actuates pressure regulator B **17** where main pressure **pHD** is applied. The proportional valve sets the switching pressure **pB** depending on the transmission electronics. Switching pressure **pB** acts on the pressure return surface supporting the return spring. This limits the maximum switching pressure **pB** to a specified value. In an inactive condition, a preload valve prevents the switching element from running empty.

- Pressure regulator D **18**
  The proportional solenoid actuates pressure regulator D **18** where main pressure **pHD** is applied. The proportional valve sets the switching pressure **pD** depending on the control current of the transmission electronics. Switching pressure **pFD** acts on the first pressure return surface supporting the return spring. This limits the maximum switching pressure **pD** to a specified value.

- Pressure regulator E **19**
  The proportional solenoid actuates pressure regulator E **19** where main pressure **pHD** is applied. The proportional valve sets the switching pressure **pE** depending on the transmission electronics. Switching pressure **pE** acts on the pressure return surface supporting the return spring. This limits the maximum switching pressure **pE** to a specified value by feeding the excess oil into the sump. A by-pass at the main pressure valve 6 prevents pressure drop in the torque converter and guarantees the minimum oil quantity required for lubrication at the same time.

- Pressure regulator F **20**
  The proportional solenoid actuates pressure regulator F **20** where main pressure **pHD** is applied. The proportional valve sets the switching pressure **pF** depending on the transmission electronics. Switching pressure **pF** acts on the pressure return surface supporting the return spring. This limits the maximum switching pressure **pF** to a specified value.

- Change-over valve F/D **21**
  Switching pressure pF acts on the activating face of the change-over valve F/D **21**. Starting with a specified switching pressure **pF**, the change-over valve F/D **21** switches. Thus, piston surface F2 is switched on in the switching element F. Pressure regulator D **18** is switched to a higher control range.

- Change-over valve D1/D2 **22**
  Switching pressure **pD** acts on the activating face of the change-over valve D1/D2 **22**. Starting with a specified switching pressure **pD**, the change-over valve D1/D2 **22** switches. Thus, the piston surface **D2** is activated in the switching element **D**.

- Torque converter drain valve **23**
  The drain valve **23** is activated by removing the oil drain plug at the oil pan. Thus, a part of the oil in the torque converter is also drained when draining the transmission oil.

- Retarder pressure regulator **10**, retarder control valve **11**
  The proportional solenoid actuates the retarder pressure regulator **10** where main pressure **pHD** is applied. The proportional valve sets the pilot pressure **pRR3** depending on the control current of the transmission electronics. The pilot pressure **pRR3** acts on the ruled surface of the retarder control valve **11** and thus determines the **pR3** main pressure level. The level of the retarder control pressure **pR3** determines the retarder effect.
  The retarder control pressure acts on the pressure return surface supporting the return spring. This limits the maximum retarder control pressure **pR3** to a specified value.

- Lubrication pressure valve **9**, cooler change-over switching valve **13**, cooler change-over valve **14**
  (in the case of inactive retarder)
  The retarder pressure regulator **10**, the retarder control valve **11**, and the cooler-change over switching valve **13** are non-pressurized. Via the cooler change-over switching valve **13**, main pressure **pHD** is transferred to the controlled surface of the cooler change-over valve **14**. The cooler change-over valve **14** is connected through. Coming from the converter back-pressure valve **8**, the oil **D4** reaches the retarder heat exchanger **27** via the cooler switch valve **14**. Coming from the retarder heat exchanger **27**, the oil reaches the transmission heat exchanger **26** via the cooler switch valve **14**. Subsequently, the cooled oil flows into the transmission for lubrication. Lubricating pressure is limited to a specified value by the lubricating pressure valve **9** by feeding the excess oil into the sump. A by-pass at the main pressure valve **6** helps prevent a pressure drop in the torque converter and guarantees the minimum oil quantity required for lubrication at the same time.

- Lubricating pressure valve **9**, cooler change-over switching valve **13**, cooler change-over valve **14**
  (in the case of inactive retarder)
  Retarder pilot pressure **pRR3** acts on the activating face of the cooler change-over switching valve **13**, which is deactivated when main pressure **pHD** on the activating face of the cooler change-over valve **14** reaches a specified value. The cooler change-over valve **14** is switched by spring force. From the converter counter-pressure valve **8**, the oil **D4** flows through the cooler change-over valve **14** to the transmission heat exchanger. Subsequently, the cooled oil flows into the transmission for lubrication.
  Lubricating pressure is limited to a specified value by the lubricating pressure valve **9** by feeding the excess oil into the sump. A by-pass at the main pressure valve **6** helps prevent a pressure drop in the torque converter and guarantees the minimum oil quantity required for lubrication at the same time.

5 Annex

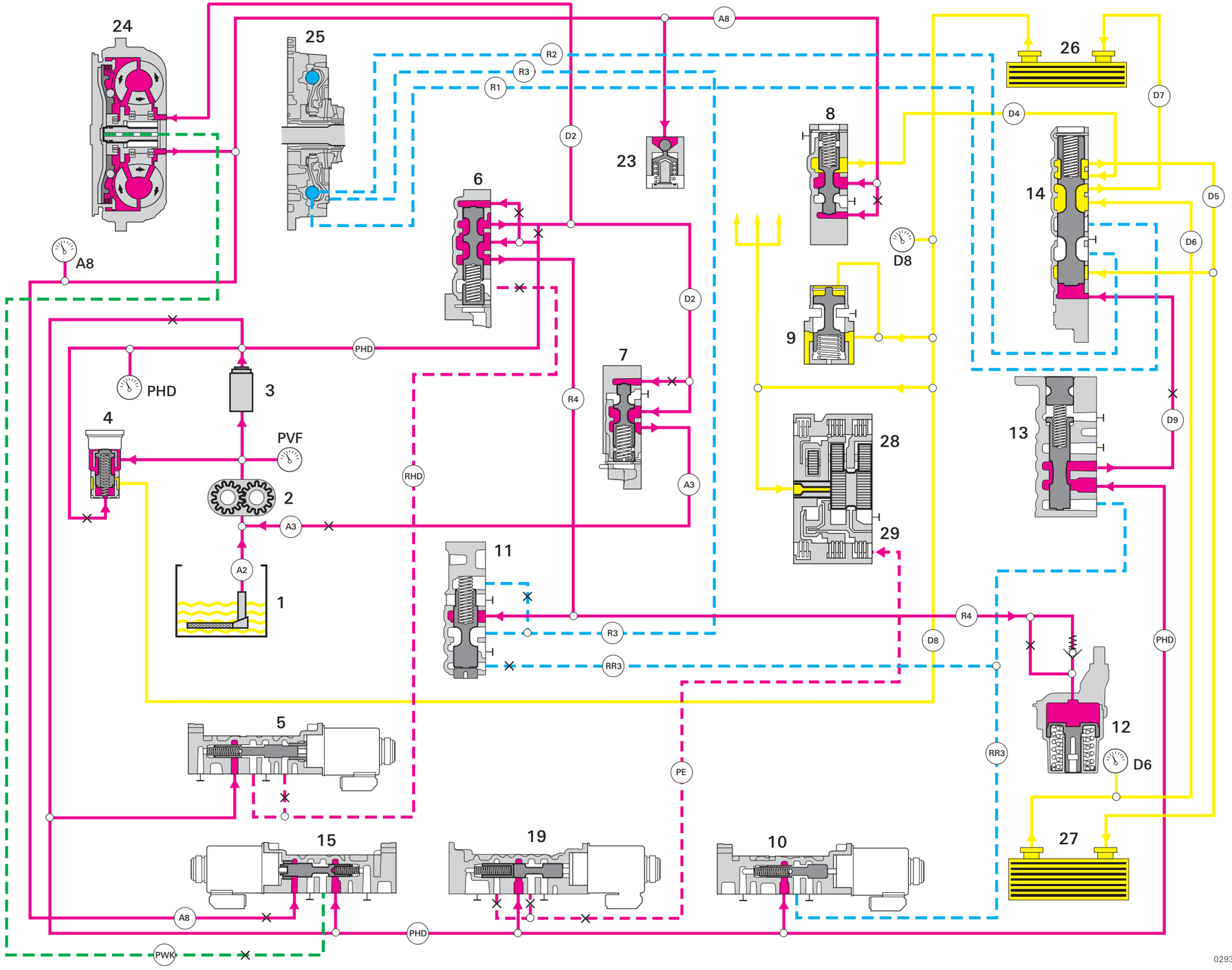
5.1 Overview of revisions

Index	Date of issue	Initiator	Chapter	Comments
a	2010-06	BKS-T	All chapters	complete revision
b	2011-10	TBCI	Preface	Tightening torques flanged hexagon bolt/screw with washer assembly
			1	Oil quantities
			2	Tightening torques flanged hexagon bolt/screw with washer assembly
		TMCC	4	Circuit diagram
c	2014-02	TUCI		CI cover page, CI back page, Copyright, Preface, Safety Instructions, Repair and Assembly Instructions Special tools: ZF-TESTMAN amended, 6008 001 021 omitted Ratios table: Added values for WTR [angle drive] Input speeds table: Added values for LHD
			1.1 / 1.3	Added lubricant class 20C
			1.2	Oil quantities (added special oil drain, VRM; updated WTR [angle drive])
			1.4	Added LHD; added electric
			1.4.4	Alternatives for normal vehicle operation omitted
			1.5 / 1.6	Added special oil drain, VRM
			2.1 / 2.3.10	Screw plug as of serial no. 344696 omitted
			2.3.2 / 2.3.9	Washer as of serial no. 300214 omitted
			2.3.4 / 2.3.7	Added molded hose variant Amended note on transmission connector cable routing
			2.5.3 / 2.5.4	Changed work step sequence (added screw loss protection section)
			2.6.1	Amended work steps
			2.6.2	Added a work step
			3.4	Complete revision
			4	Updated circuit diagram, connection diagram, and hydraulic diagram
			5 / 6	Added

6 Enclosed Documents

The documents enclosed are not subject to change management; they are for informational purposes only. Please turn to your contact if you need binding documents and drawings.

Document no.	Designation	Technical information
4181.753.101a	SD PDI EcoLife	Hydraulic 1 - Position opened
4181.753.102a	SD PDI EcoLife	Hydraulic 2 - Position locked



029309_1

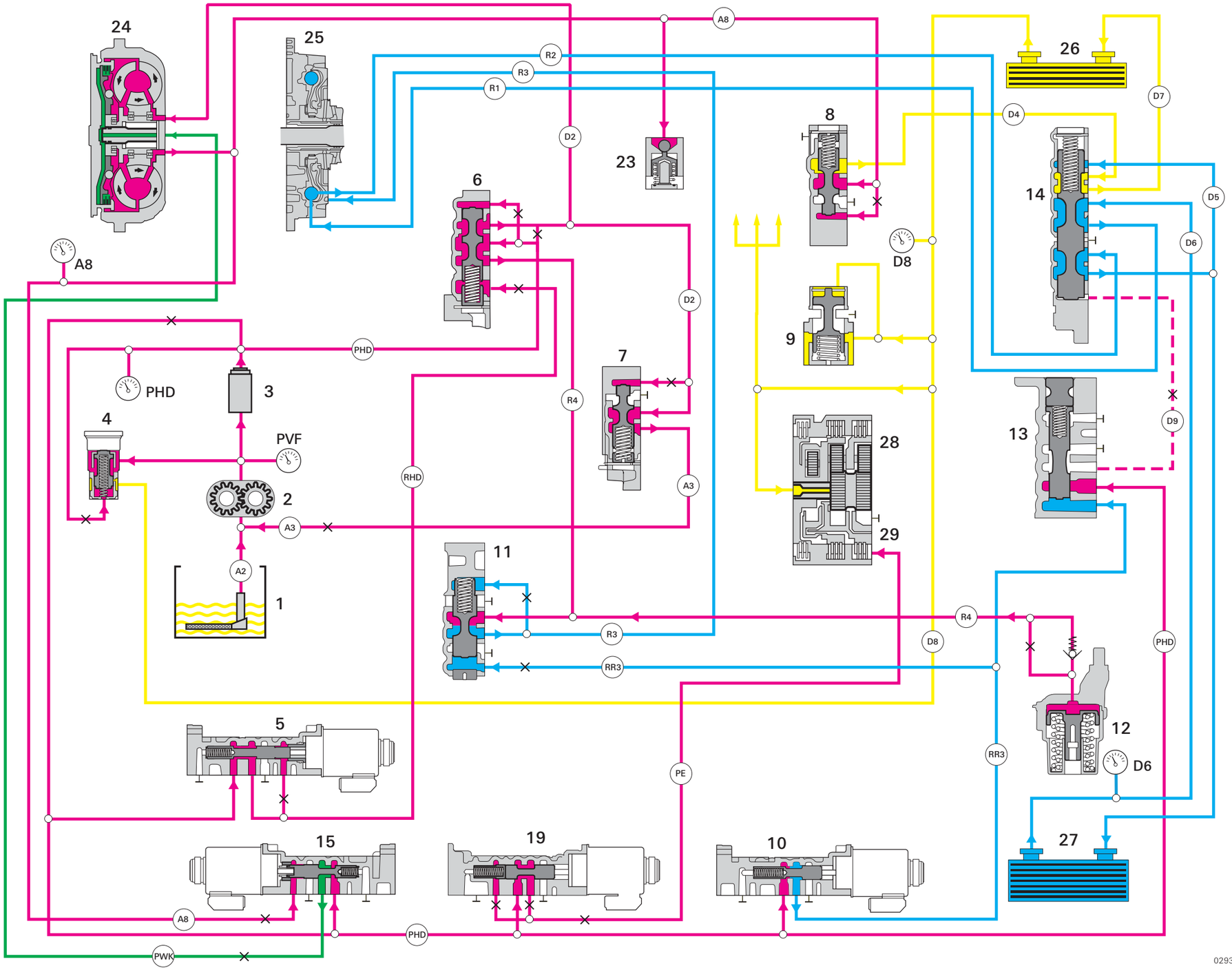
1 Suction strainer insert
2 Pump
3 Pressure filter
4 Filter bypass valve
5 Pressure regulator (RHD)
6 Main pressure valve (PHD)
7 Converter safety valve
8 Converter counter-pressure valve
9 Lubrication pressure
10 Pressure regulator retarder
11 Retarder control valve
12 Accumulator
13 Shift valve (KUV)
14 Cooler change-over valve (KUV)
15 Pressure regulator (WK)
16-20 Pressure regulator A, B, D, E, F
23 Torque converter drain valve
24 Torque converter
25 Retarder
26 Heat exchanger (TOC)
27 Heat exchanger (ROC)
28 Planet gear train
29 Clutches/Brakes A, B, D, E, F

Subject to technical change without notice

ZF-ECOLIFE

HYDRAULIC 1 - POSITION OPENED

ZF Friedrichshafen AG
4181 753 101a • MC-C • 2009-12



029310_1

1 Suction strainer insert
2 Pump
3 Pressure filter
4 Filter bypass valve
5 Pressure regulator (RHD)
6 Main pressure valve (PHD)
7 Converter safety valve
8 Converter counter-pressure valve
9 Lubrication pressure
10 Pressure regulator retarder
11 Retarder control valve
12 Accumulator
13 Shift valve (KUV)
14 Cooler change-over valve (KUV)
15 Pressure regulator (WK)
16-20 Pressure regulator A, B, D, E, F
23 Torque converter drain valve
24 Torque converter
25 Retarder
26 Heat exchanger (TOC)
27 Heat exchanger (ROC)
28 Planet gear train
29 Clutches/Brakes A, B, D, E, F

Subject to technical change without notice

ZF-ECOLIFE

HYDRAULIC 2 - POSITION LOCKED

ZF Friedrichshafen AG
4181 753 102a • MC-C • 2009-12

CITIPORT



WORKSHOP MANUAL

Error Description

001

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Pressure regulator A (DR_A) short circuit to plus (VPS) of proportional valves

Internal designation:
DR_A_Kurzschluss VPS (DR_A_short circuit VPS)

Error description:
TCU detects short circuit fault VPS, if current output (AIM) is active and the current is higher than allowed. E.g. proportional valve = 0 ohm

Error detection by:
- Sum current detection (I_Summe_ist > I_Summe_Soll [I_Sum_is > I_Sum_Nominal]);
- Control frequency is greater than maximum allowable control frequency (f_ist > f_max [f_is > f_max]);
- Output stage of TCU (TREX);

System response:
- All current outputs are switched off (ZAE open)
- Neutral / Loss of a gear
- No retarder

Cancellation condition:
- No short circuit of the AIM on VPS
- Ignition off/on

System check:
1. Switch ignition off
2. Unplug electronic system incl. transmission cable
3. Connect transmission test cable
4. Measure resistance of proportional valve (pin 5 to pin 13) Setpoint value: 10 – 15 ohm
5. TCU cable -> test transmission

In the event of deviations from the nominal value, check the wiring and the component.

002

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Pressure regulator B (DR_B) has a short circuit on the positive supply pin (VPS) of the proportional valves

Internal designation:
DR_B_Kurzschluss VPS (DR_B_short circuit VPS)

Error description:
TCU detects short circuit fault VPS, if current output (AIM) is active and the current is higher than allowed. E.g. proportional valve = 0 ohm

Error detection by:
- Sum current detection (I_Summe_ist > I_Summe_Soll [I_Sum_is > I_Sum_Nominal]);
- Control frequency is greater than maximum allowable control frequency (f_ist > f_max [f_is > f_max]);
- Output stage of TCU (TREX);

System response:
- All current outputs are switched off (ZAE open)
- Neutral / Loss of a gear
- No retarder

Cancellation condition:
- No short circuit of the AIM on VPS
- Ignition off/on

System check:
1. Switch ignition off
2. Unplug electronic system incl. transmission cable
3. Connect transmission test cable
4. Measure resistance of proportional valve (pin 5 to pin 12) Setpoint value: 10 – 15 ohm
5. TCU cable -> test transmission

In the event of deviations from the nominal value, check the wiring and the component.

003

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Pressure regulator D (DR_D) has a short circuit on the positive supply pin (VPS) of the proportional valves

Internal designation:
DR_D_Kurzschluss VPS (DR_D_short circuit VPS)

Error description:
TCU detects short circuit fault VPS, if current output (AIM) is active and the current is higher than allowed. E.g. proportional valve = 0 ohm

Error detection by:
- Sum current detection (I_Summe_ist > I_Summe_Soll [I_Sum_is > I_Sum_Nominal]);
- Control frequency is greater than maximum allowable control frequency (f_ist > f_max [f_is > f_max]);
- Output stage of TCU (TREX);

System response:
- All current outputs are switched off (ZAE open)
- Neutral / Loss of a gear
- No retarder

Cancellation condition:
- No short circuit of the AIM on VPS
- Ignition off/on

System check:
1. Switch ignition off
2. Unplug electronic system incl. transmission cable
3. Connect transmission test cable
4. Measure resistance of proportional valve (pin 5 to pin 22) Setpoint value: 10 – 15 ohm
5. TCU cable -> test transmission

In the event of deviations from the nominal value, check the wiring and the component.

004

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Pressure regulator E (DR_E) has a short circuit on the positive supply pin (VPS) of the proportional valves

Internal designation:
DR_E_Kurzschluss VPS (DR_E_short circuit VPS)

Error description:
TCU detects short circuit fault VPS, if current output (AIM) is active and the current is higher than allowed. E.g. proportional valve = 0 ohm

Error detection by:
- Sum current detection (I_Summe_ist > I_Summe_Soll [I_Sum_is > I_Sum_Nominal]);
- Control frequency is greater than maximum allowable control frequency (f_ist > f_max [f_is > f_max]);
- Output stage of TCU (TREX);

System response:
- All current outputs are switched off (ZAE open)
- Neutral / Loss of a gear
- No retarder

Cancellation condition:
- No short circuit of the AIM on VPS
- Ignition off/on

System check:
1. Switch ignition off
2. Unplug electronic system incl. transmission cable
3. Connect transmission test cable
4. Measure resistance of proportional valve (pin 5 to pin 24) Setpoint value: 10 – 15 ohm
5. TCU cable -> test transmission

In the event of deviations from the nominal value, check the wiring and the component.

005

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Pressure regulator F (DR_F) has a short circuit on the positive supply pin (VPS) of the proportional valves

Internal designation:
DR_F_Kurzschluss VPS (DR_F_short circuit VPS)

Error description:
TCU detects short circuit fault VPS, if current output (AIM) is active and the current is higher than allowed. E.g. proportional valve = 0 ohm

Error detection by:
- Sum current detection (I_Summe_ist > I_Summe_Soll [I_Sum_is > I_Sum_Nominal]);
- Control frequency is greater than maximum allowable control frequency (f_ist > f_max [f_is > f_max]);
- Output stage of TCU (TREX);

System response:
- All current outputs are switched off (ZAE open)
- Neutral / Loss of a gear
- No retarder

Cancellation condition:
- No short circuit of the AIM on VPS
- Ignition off/on

System check:
1. Switch ignition off
2. Unplug electronic system incl. transmission cable
3. Connect transmission test cable
4. Measure resistance of proportional valve (pin 5 to pin 19) Setpoint value: 10 – 15 ohm
5. TCU cable -> test transmission

In the event of deviations from the nominal value, check the wiring and the component.

006

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Pressure regulator WK [torque converter lock-up clutch] (DR_WK) has a short circuit on the positive supply pin (VPS) of the proportional valves

Internal designation:
DR_WK_Kurzschluss VPS (DR_WK_short circuit VPS)

Error description:
TCU detects short circuit fault VPS, if current output (AIM) is active and the current is higher than allowed. E.g. proportional valve = 0 ohm

Error detection by:
- Sum current detection (I_Summe_ist > I_Summe_Soll [I_Sum_is > I_Sum_Nominal]);
- Control frequency is greater than maximum allowable control frequency (f_ist > f_max [f_is > f_max]);
- Output stage of TCU (TREX);

System response:
- All current outputs are switched off (ZAE open)
- Neutral / Loss of a gear
- No retarder

Cancellation condition:
- No short circuit of the AIM on VPS
- Ignition off/on

System check:
1. Switch ignition off
2. Unplug electronic system incl. transmission cable
3. Connect transmission test cable
4. Measure resistance of proportional valve (pin 5 to pin 9) Setpoint value: 10 – 15 ohm
5. TCU cable -> test transmission

In the event of deviations from the nominal value, check the wiring and the component.

007

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Main pressure regulator (DR_HD) has a short circuit on the positive supply pin (VPS) of the proportional valves

Internal designation:
DR_HD_Kurzschluss VPS (DR_HD_short circuit VPS)

Error description:
TCU detects short circuit fault VPS, if current output (AIM) is active and the current is higher than allowed. E.g. proportional valve = 0 ohm

Error detection by:
- Sum current detection (I_Summe_ist > I_Summe_Soll [I_Sum_is > I_Sum_Nominal]);
- Control frequency is greater than maximum allowable control frequency (f_ist > f_max [f_is > f_max]);
- Output stage of TCU (TREX);

System response:
- All current outputs are switched off (ZAE open)
- Neutral / Loss of a gear
- No retarder

Cancellation condition:
- No short circuit of the AIM on VPS
- Ignition off/on

System check:
1. Switch ignition off
2. Unplug electronic system incl. transmission cable
3. Connect transmission test cable
4. Measure resistance of proportional valve (pin 5 to pin 10) Setpoint value: 10 – 15 ohm
5. TCU cable -> test transmission

In the event of deviations from the nominal value, check the wiring and the component.

008

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Pressure regulator of retarder (DR_Ret) has a short circuit on the positive supply pin (VPS) of the proportional valves

Internal designation:
DR_Ret_Kurzschluss VPS (DR_Ret_short circuit VPS)

Error description:
TCU detects short circuit fault VPS, if current output (AIM) is active and the current is higher than allowed. E.g. proportional valve = 0 ohm

Error detection by:
- Sum current detection (I_Summe_ist > I_Summe_Soll [I_Sum_is > I_Sum_Nominal]);
- Control frequency is greater than maximum allowable control frequency (f_ist > f_max [f_is > f_max]);
- Output stage of TCU (TREX);

System response:
- All current outputs are switched off (ZAE open)
- Neutral / Loss of a gear
- No retarder

Cancellation condition:
- No short circuit of the AIM on VPS
- Ignition off/on

System check:
1. Switch ignition off
2. Unplug electronic system incl. transmission cable
3. Connect transmission test cable
4. Measure resistance of proportional valve (pin 5 to pin 8) Setpoint value: 10 – 15 ohm
5. TCU cable -> test transmission

In the event of deviations from the nominal value, check the wiring and the component.

009

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Pressure regulator of PTO (DR_NA) has a short circuit on the positive supply pin (VPS) of the proportional valves

Internal designation:
DR_NA_Kurzschluss VPS (DR_NA_short circuit VPS)

Error description:
TCU detects short circuit fault VPS, if current output (AIM) is active and the current is higher than allowed. E.g. proportional valve = 0 ohm

Error detection by:
- Sum current detection (I_Summe_ist > I_Summe_Soll [I_Sum_is > I_Sum_Nominal]);
- Control frequency is greater than maximum allowable control frequency (f_ist > f_max [f_is > f_max]);
- Output stage of TCU (TREX);

System response:
- All current outputs are switched off (ZAE open)
- Neutral / Loss of a gear
- No retarder

Cancellation condition:
- No short circuit of the AIM on VPS
- Ignition off/on

System check:
None yet, as applications with a PTO are not feasible at this point.

010

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Pressure regulator G (DR_G) has a short circuit on the positive supply pin (VPS) of the proportional valves

Internal designation:
DR_G_Kurzschluss VPS (DR_G_short circuit VPS)

Error description:
TCU detects short circuit fault VPS, if current output (AIM) is active and the current is higher than allowed. E.g. proportional valve = 0 ohm

Error detection by:
- Sum current detection (I_Summe_ist > I_Summe_Soll [I_Sum_is > I_Sum_Nominal]);
- Control frequency is greater than maximum allowable control frequency (f_ist > f_max [f_is > f_max]);
- Output stage of TCU (TREX);

System response:
- All current outputs are switched off (ZAE open)
- Neutral / Loss of a gear
- No retarder

Cancellation condition:
- No short circuit of the AIM on VPS
- Ignition off/on

System check:
None yet, as a version with G-valve is not feasible at this point.

011

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
A fault occurred in pressure regulator A (DR_A). Active diagnostics was not able to uniquely identify the fault.

Internal designation:
DR_A_ Fehlertyp_unbekannt (temporary fault)

Error description:
The TCU detects the fault in pressure regulator A, but cannot uniquely identify the fault during subsequent active diagnostics.

Error detection by:
- Sum current detection
  (I_Summe_ist > I_Summe_Soll [I_Sum_is > I_Sum_Nominal]);
- Return read voltage (U_AIM) faulty
- Control frequency is greater than maximum allowable control frequency (f_ist > f_max [f_is > f_max]);
- Output stage of TCU (TREX)

System response:
- All current outputs are switched off (ZAE open)
- Neutral / Loss of a gear
- No retarder

Cancellation condition:
- No pressure regulator fault
- Ignition off/on

System check:
1. Switch ignition off
2. Unplug electronic system incl. transmission cable
3. Connect transmission test cable
4. Measure resistance of proportional valve (pin 5 to pin 13) Setpoint value: 10 – 15 ohm
5. Measure resistance of proportional valve to ground/housing (pin 13 to KL31) Setpoint value: >10 mohm
6. Measure resistance of proportional valve to ground/housing (pin 13 to pin 9/22/19/8/12/10/24) Setpoint value: 20 – 30 ohm
7. TCU cable -> test transmission

In the event of deviations from the nominal value, check the wiring and the component.

012

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
A fault occurred in pressure regulator B (DR_B). Active diagnostics was not able to uniquely identify the fault.

Internal designation:
DR_B_ Fehlertyp_unbekannt (temporary fault)

Error description:
The TCU detects the fault in pressure regulator B, but cannot uniquely identify the fault during subsequent active diagnostics.

Error detection by:
- Sum current detection
  (I_Summe_ist > I_Summe_Soll [I_Sum_is > I_Sum_Nominal]);
- Return read voltage (U_AIM) faulty
- Control frequency is greater than maximum allowable control frequency (f_ist > f_max [f_is > f_max]);
- Output stage of TCU (TREX)

System response:
- All current outputs are switched off (ZAE open)
- Neutral / Loss of a gear
- No retarder

Cancellation condition:
- No pressure regulator fault
- Ignition off/on

System check:
1. Switch ignition off
2. Unplug electronic system incl. transmission cable
3. Connect transmission test cable
4. Measure resistance of proportional valve (pin 5 to pin 12) Setpoint value: 10 - 15 ohm
5. Measure resistance of proportional valve to ground/housing (pin 12 to KL31) Setpoint value: >10 mohm
6. Measure resistance of proportional valve to other proportional valves (pin 12 to pin 9/22/19/8/13/10/24) Setpoint value: 20 - 30 ohm
7. TCU cable -> test transmission

In the event of deviations from the nominal value, check the wiring and the component.

013

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
A fault occurred in pressure regulator D (DR_D). Active diagnostics was not able to uniquely identify the fault.

Internal designation:
DR_D_ Fehlertyp_unbekannt (temporary fault)

Error description:
The TCU detects the fault in pressure regulator D, but cannot uniquely identify the fault during subsequent active diagnostics.

Error detection by:
- Sum current detection
  (I_Summe_ist > I_Summe_Soll [I_Sum_is > I_Sum_Nominal]);
- Return read voltage (U_AIM) faulty
- Control frequency is greater than maximum allowable control frequency (f_ist > f_max [f_is > f_max]);
- Output stage of TCU (TREX)

System response:
- All current outputs are switched off (ZAE open)
- Neutral / Loss of a gear
- No retarder

Cancellation condition:
- No pressure regulator fault
- Ignition off/on

System check:
1. Switch ignition off
2. Unplug electronic system incl. transmission cable
3. Connect transmission test cable
4. Measure resistance of proportional valve (pin 5 to pin 22) Setpoint value: 10 – 15 ohm
5. Measure resistance of proportional valve to ground/housing (pin 22 to KL31) Setpoint value: >10 mohm
6. Measure resistance of proportional valve to other proportional valves (pin 22 to pin 9/12/19/8/13/10/24) Setpoint value: 20 – 30 ohm
7. TCU cable -> test transmission

In the event of deviations from the nominal value, check the wiring and the component.

014

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
A fault occurred in pressure regulator E (DR_E). Active diagnostics was not able to uniquely identify the fault.

Internal designation:
DR_E_ Fehlertyp_unbekannt (temporary fault)

Error description:
The TCU detects the fault in pressure regulator E, but cannot uniquely identify the fault during subsequent active diagnostics.

Error detection by:
- Sum current detection
  (I_Summe_ist > I_Summe_Soll [I_Sum_is > I_Sum_Nominal]);
- Return read voltage (U_AIM) faulty
- Control frequency is greater than maximum allowable control frequency (f_ist > f_max [f_is > f_max]);
- Output stage of TCU (TREX)

System response:
- All current outputs are switched off (ZAE open)
- Neutral / Loss of a gear
- No retarder

Cancellation condition:
- No pressure regulator fault
- Ignition off/on

System check:
1. Switch ignition off
2. Unplug electronic system incl. transmission cable
3. Connect transmission test cable
4. Measure resistance of proportional valve (pin 5 to pin 24) Setpoint value: 10 – 15 ohm
5. Measure resistance of proportional valve to ground/housing (pin 24 to KL31) Setpoint value: >10 mohm
6. Measure resistance of proportional valve to other proportional valves (pin 24 to pin 9/22/19/8/13/10/12) Setpoint value: 20 - 30 ohm
7. TCU cable -> test transmission

In the event of deviations from the nominal value, check the wiring and the component.

015

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
A fault occurred in pressure regulator F (DR_F). Active diagnostics was not able to uniquely identify the fault.

Internal designation:
DR_F_ Fehlertyp_unbekannt (temporary fault)

Error description:
The TCU identifies the fault in pressure regulator F, but cannot uniquely identify the fault during subsequent active diagnostics.

Error detection by:
- Sum current detection
  (I_Summe_ist > I_Summe_Soll [I_Sum_is > I_Sum_Nominal]);
- Return read voltage (U_AIM) faulty
- Control frequency is greater than maximum allowable control frequency (f_ist > f_max [f_is > f_max]);
- Output stage of TCU (TREX)

System response:
- All current outputs are switched off (ZAE open)
- Neutral / Loss of a gear
- No retarder

Cancellation condition:
- No pressure regulator fault
- Ignition off/on

System check:
1. Switch ignition off
2. Unplug electronic system incl. transmission cable
3. Connect transmission test cable
4. Measure resistance of proportional valve (pin 5 to pin 19) Setpoint value: 10 – 15 ohm
5. Measure resistance of proportional valve to ground/housing (pin 19 to KL31) Setpoint value: >10 mohm
6. Measure resistance of proportional valve to other proportional valves (pin 19 to pin 9/22/12/8/13/10/24) Setpoint value: 20 - 30 ohm
7. TCU cable -> test transmission

In the event of deviations from the nominal value, check the wiring and the component.

016

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
A fault occurred in pressure regulator WK [torque converter lock-up clutch] (DR_WK). Active diagnostics was not able to uniquely identify the fault.

Internal designation:
DR_WK_ Fehlertyp_unbekannt (temporary fault)

Error description:
The TCU identifies the fault in pressure regulator WK, but cannot uniquely identify the fault during subsequent active diagnostics.

Error detection by:
- Sum current detection
  (I_Summe_ist > I_Summe_Soll [I_Sum_is > I_Sum_Nominal]);
- Return read voltage (U_AIM) faulty
- Control frequency is greater than maximum allowable control frequency (f_ist > f_max [f_is > f_max]);
- Output stage of TCU (TREX)

System response:
- All current outputs are switched off (ZAE open)
- Neutral / Loss of a gear
- No retarder

Cancellation condition:
- No pressure regulator fault
- Ignition off/on

System check:
1. Switch ignition off
2. Unplug electronic system incl. transmission cable
3. Connect transmission test cable
4. Measure resistance of proportional valve (pin 5 to pin 9) Setpoint value: 10 – 15 ohm
5. Measure resistance of proportional valve to ground/housing
   (pin 9 to KL31)
   Setpoint value: >10 mohm
6. Measure resistance of proportional valve to other proportional valves (pin 9 to pin 12/22/19/8/13/10/24) Setpoint value: 20 - 30 ohm
7. TCU cable -> test transmission

In the event of deviations from the nominal value, check the wiring and the component.

017

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
A fault occurred in main pressure regulator (DR_HD). Active diagnostics was not able to uniquely identify the fault.

Internal designation:
DR_HD_ Fehlertyp_unbekannt (temporary fault)

Error description:
The TCU identifies the fault in the main pressure regulator, but cannot uniquely identify the fault during subsequent active diagnostics.

Error detection by:
- Sum current detection
  (I_Summe_ist > I_Summe_Soll [I_Sum_is > I_Sum_Nominal]);
- Return read voltage (U_AIM) faulty
- Control frequency is greater than maximum allowable control frequency (f_ist > f_max [f_is > f_max]);
- Output stage of TCU (TREX)

System response:
- All current outputs are switched off (ZAE open)
- Neutral / Loss of a gear
- No retarder

Cancellation condition:
- No pressure regulator fault
- Ignition off/on

System check:
1. Switch ignition off
2. Unplug electronic system incl. transmission cable
3. Connect transmission test cable
4. Measure resistance of proportional valve (pin 5 to pin 10) Setpoint value: 10 - 15 ohm
5. Measure resistance of proportional valve to ground/housing (pin 10 to KL31) Setpoint value: >10 mohm
6. Measure resistance of proportional valve to other proportional valves (pin 10 to pin 9/22/19/8/13/12/24) Setpoint value: 20 - 30 ohm
7. TCU cable -> test transmission

In the event of deviations from the nominal value, check the wiring and the component.

018

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
A fault occurred in pressure regulator of retarder (DR_Ref). Active diagnostics was not able to uniquely identify the fault.

Internal designation:
DR_Ret_Fehlertyp_unbekannt (temporary fault)

Error description:
The TCU identifies the fault in the retarder pressure regulator, but cannot uniquely identify the fault during subsequent active diagnostics.

Error detection by:
- Sum current detection
  (I_Summe_ist > I_Summe_Soll [I_Sum_is > I_Sum_Nominal]);
- Return read voltage (U_AIM) faulty
- Control frequency is greater than maximum allowable control frequency (f_ist > f_max [f_is > f_max]);
- Output stage of TCU (TREX)

System response:
- All current outputs are switched off (ZAE open)
- Neutral / Loss of a gear
- No retarder

Cancellation condition:
- No pressure regulator fault
- Ignition off/on

System check:
1. Switch ignition off
2. Unplug electronic system incl. transmission cable
3. Connect transmission test cable
4. Measure resistance of proportional valve (pin 5 to pin 8) Setpoint value: 10 - 15 ohm
5. Measure resistance of proportional valve to ground/housing (pin 8 to KL31) Setpoint value: >10 mohm
6. Measure resistance of proportional valve to other proportional valves (pin 8 to pin 9/22/19/12/13/10/24) Setpoint value: 20 - 30 ohm
7. TCU cable -> test transmission

In the event of deviations from the nominal value, check the wiring and the component.

019

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
A fault occurred in pressure regulator of PTO (DR_NA). Active diagnostics was not able to uniquely identify the fault.

Internal designation:
DR_NA_Fehlertyp_ unbekannt (temporary fault)

Error description:
The TCU identifies the fault in the pressure regulator of the PTO, but cannot uniquely identify the fault during subsequent active diagnostics.

Error detection by:
- Sum current detection (I_Summe_ist > I_Summe_Soll [I_Sum_is > I_Sum_Nominal]);
- Return read voltage (U_AIM) faulty
- Control frequency is greater than maximum allowable control frequency (f_ist > f_max [f_is > f_max]);
- Output stage of TCU (TREX)

System response:
- All current outputs are switched off (ZAE open)
- Neutral / Loss of a gear
- No retarder

Cancellation condition:
- No pressure regulator fault
- Ignition off/on

System check:
None yet, as applications with a PTO are not feasible at this point.

020

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
A fault occurred in pressure regulator G (DR_G). Active diagnostics was not able to uniquely identify the fault.

Internal designation:
DR_G_Fehlertyp_ unbekannt (temporary fault)

Error description:
The TCU identifies the fault in pressure regulator G, but cannot uniquely identify the fault during subsequent active diagnostics.

Error detection by:
- Sum current detection
  (I_Summe_ist > I_Summe_Soll [I_Sum_is > I_Sum_Nominal]);
- Return read voltage (U_AIM) faulty
- Control frequency is greater than maximum allowable control frequency (f_ist > f_max [f_is > f_max]);
- Output stage of TCU (TREX)

System response:
- All current outputs are switched off (ZAE open)
- Neutral / Loss of a gear
- No retarder

Cancellation condition:
- No pressure regulator fault
- Ignition off/on

System check:
None yet, as a version with G-valve is not feasible at this point

021

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Pressure regulator A (DR_A) has a short circuit on ground

Internal designation:
DR_A_ Kurzschluss GND

Error description:
TCU detects short circuit error AIM on ground.
E.g. chafe point of internal wiring harness.

Error detection by:
- Sum current detection
  (I_Summe_ist > I_Summe_Soll [I_Sum_is > I_Sum_Nominal]);
- Readback voltage (U_AIM) faulty (U_AIM<<U_VPS);
- Control frequency is greater than maximum allowable control frequency (f_ist > f_max [f_is > f_max]);
- Output stage of TCU (TREX)

System response:
- All current outputs are switched off (ZAE open)
- Neutral / Loss of a gear
- No retarder

Cancellation condition:
- No pressure regulator fault
- Ignition off/on

System check:
1. Switch ignition off
2. Unplug electronic system incl. transmission cable
3. Connect transmission test cable
4. Measure resistance of proportional valve to ground/housing (pin 13 to ground (KL31)/housing) Setpoint value: > 10 mohm
5. TCU cable -> test transmission

In the event of deviations from the nominal value, check the wiring and the component.

022

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Pressure regulator B (DR_B) has a short circuit on ground

Internal designation:
DR_B_ Kurzschluss GND

Error description:
TCU detects short circuit error AIM on ground.
E.g. chafe point of internal wiring harness.

Error detection by:
- Sum current detection
  (I_Summe_ist > I_Summe_Soll [I_Sum_is > I_Sum_Nominal]);
- Readback voltage (U_AIM) faulty (U_AIM<<U_VPS);
- Control frequency is greater than maximum allowable control frequency (f_ist > f_max [f_is > f_max]);
- Output stage of TCU (TREX)

System response:
- All current outputs are switched off (ZAE open)
- Neutral / Loss of a gear
- No retarder

Cancellation condition:
- No pressure regulator fault
- Ignition off/on

System check:
1. Switch ignition off
2. Unplug electronic system incl. transmission cable
3. Connect transmission test cable
4. Measure resistance of proportional valve to ground/housing (pin 12 to ground (KL31)/housing) Setpoint value: > 10 mohm
5. TCU cable -> test transmission

In the event of deviations from the nominal value, check the wiring and the component

023

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Pressure regulator D (DR_D) has a short circuit on ground

Internal designation:
DR_D_ Kurzschluss GND

Error description:
TCU detects short circuit error AIM on ground.
E.g. chafe point of internal wiring harness.

Error detection by:
- Sum current detection
  (I_Summe_ist > I_Summe_Soll [I_Sum_is > I_Sum_Nominal]);
- Readback voltage (U_AIM) faulty (U_AIM<<U_VPS);
- Control frequency is greater than maximum allowable control frequency (f_ist > f_max [f_is > f_max]);
- Output stage of TCU (TREX)

System response:
- All current outputs are switched off (ZAE open)
- Neutral / Loss of a gear
- No retarder

Cancellation condition:
- No pressure regulator fault
- Ignition off/on

System check:
1. Switch ignition off
2. Unplug electronic system incl. transmission cable
3. Connect transmission test cable
4. Measure resistance of proportional valve to ground/housing (pin 22 to ground (KL31)/housing) Setpoint value: > 10 mohm
5. TCU cable -> test transmission

In the event of deviations from the nominal value, check the wiring and the component.

024

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Pressure regulator E (DR_E) has a short circuit on ground

Internal designation:
DR_E_ Kurzschluss GND

Error description:
TCU detects short circuit error AIM on ground.
E.g. chafe point of internal wiring harness.

Error detection by:
- Sum current detection
  (I_Summe_ist > I_Summe_Soll [I_Sum_is > I_Sum_Nominal]);
- Readback voltage (U_AIM) faulty (U_AIM<<U_VPS);
- Control frequency is greater than maximum allowable control frequency (f_ist > f_max [f_is > f_max]);
- Output stage of TCU (TREX)

System response:
- All current outputs are switched off (ZAE open)
- Neutral / Loss of a gear
- No retarder

Cancellation condition:
- No pressure regulator fault
- Ignition off/on

System check:
1. Switch ignition off
2. Unplug electronic system incl. transmission cable
3. Connect transmission test cable
4. Measure resistance of proportional valve to ground/housing (pin 24 to ground (KL31)/housing) Setpoint value: > 10 mohm
5. TCU cable -> test transmission

In the event of deviations from the nominal value, check the wiring and the component.

025

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Pressure regulator F (DR_F) has a short circuit on ground

Internal designation:
DR_F_ Kurzschluss GND

Error description:
TCU detects short circuit error AIM on ground.
E.g. chafe point of internal wiring harness.

Error detection by:
- Sum current detection
  (I_Summe_ist > I_Summe_Soll [I_Sum_is > I_Sum_Nominal]);
- Readback voltage (U_AIM) faulty (U_AIM<<U_VPS);
- Control frequency is greater than maximum allowable control frequency (f_ist > f_max [f_is > f_max]);
- Output stage of TCU (TREX)

System response:
- All current outputs are switched off (ZAE open)
- Neutral / Loss of a gear
- No retarder

Cancellation condition:
- No pressure regulator fault
- Ignition off/on

System check:
1. Switch ignition off
2. Unplug electronic system incl. transmission cable
3. Connect transmission test cable
4. Measure resistance of proportional valve to ground/housing (pin 19 to ground (KL31)/housing) Setpoint value: > 10 mohm
5. TCU cable -> test transmission

In the event of deviations from the nominal value, check the wiring and the component.

026

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Pressure regulator WK [torque converter lock-up clutch] (DR_WK) has a short circuit on ground

Internal designation:
DR_WK_ Kurzschluss GND

Error description:
TCU detects short circuit error AIM on ground.
E.g. chafe point of internal wiring harness.

Error detection by:
- Sum current detection
  (I_Summe_ist > I_Summe_Soll [I_Sum_is > I_Sum_Nominal]);
- Readback voltage (U_AIM) faulty (U_AIM<<U_VPS);
- Control frequency is greater than maximum allowable control frequency (f_ist > f_max [f_is > f_max]);
- Output stage of TCU (TREX)

System response:
- All current outputs are switched off (ZAE open)
- Neutral / Loss of a gear
- No retarder

Cancellation condition:
- No pressure regulator fault
- Ignition off/on

System check:
1. Switch ignition off
2. Unplug electronic system incl. transmission cable
3. Connect transmission test cable
4. Measure resistance of proportional valve to ground/housing (pin 9 to ground (KL31)/housing) Setpoint value: > 10 mohm
5. TCU cable -> test transmission

In the event of deviations from the nominal value, check the wiring and the component

027

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Main pressure regulator (DR_HD) has a short circuit on ground

Internal designation:
DR_HD_ Kurzschluss GND

Error description:
TCU detects short circuit error AIM on ground.
E.g. chafe point of internal wiring harness.

Error detection by:
- Sum current detection
  (I_Summe_ist > I_Summe_Soll [I_Sum_is > I_Sum_Nominal]);
- Readback voltage (U_AIM) faulty (U_AIM<<U_VPS);
- Control frequency is greater than maximum allowable control frequency (f_ist > f_max [f_is > f_max]);
- Output stage of TCU (TREX)

System response:
- All current outputs are switched off (ZAE open)
- Neutral / Loss of a gear
- No retarder

Cancellation condition:
- No pressure regulator fault
- Ignition off/on

System check:
1. Switch ignition off
2. Unplug electronic system incl. transmission cable
3. Connect transmission test cable
4. Measure resistance of proportional valve to ground/housing (pin 10 to ground (KL31)/housing) Setpoint value: > 10 mohm
5. TCU cable -> test transmission

In the event of deviations from the nominal value, check the wiring and the component.

028

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Pressure regulator of retarder (DR_Ret) has a short circuit on ground

Internal designation:
DR_Ret_ Kurzschluss GND

Error description:
TCU detects short circuit error AIM on ground.
E.g. chafe point of internal wiring harness.

Error detection by:
- Sum current detection
  (I_Summe_ist > I_Summe_Soll [I_Sum_is > I_Sum_Nominal]);
- Readback voltage (U_AIM) faulty (U_AIM<<U_VPS);
- Control frequency is greater than maximum allowable control frequency (f_ist > f_max [f_is > f_max]);
- Output stage of TCU (TREX)

System response:
- All current outputs are switched off (ZAE open)
- Neutral / Loss of a gear
- No retarder

Cancellation condition:
- No pressure regulator fault
- Ignition off/on

System check:
1. Switch ignition off
2. Unplug electronic system incl. transmission cable
3. Connect transmission test cable
4. Measure resistance of proportional valve to ground/housing (pin 8 to ground (KL31)/housing) Setpoint value: > 10 mohm
5. TCU cable -> test transmission

In the event of deviations from the nominal value, check the wiring and the component.

029

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Pressure regulator of PTO (DR_NA) has a short circuit on ground

Internal designation:
DR_NA_ Kurzschluss GND

Error description:
TCU detects short circuit error AIM on ground.
E.g. chafe point of internal wiring harness.

Error detection by:
- Sum current detection
  (I_Summe_ist > I_Summe_Soll [I_Sum_is > I_Sum_Nominal]);
- Readback voltage (U_AIM) faulty (U_AIM<<U_VPS);
- Control frequency is greater than maximum allowable control frequency (f_ist > f_max [f_is > f_max]);
- Output stage of TCU (TREX)

System response:
- All current outputs are switched off (ZAE open)
- Neutral / Loss of a gear
- No retarder

Cancellation condition:
- No pressure regulator fault
- Ignition off/on

System check:
None yet, as applications with a PTO are not feasible at this point.

030

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Pressure regulator G (DR_G) has a short circuit on ground

Internal designation:
DR_G_ Kurzschluss GND

Error description:
TCU detects short circuit error AIM on ground.
E.g. chafe point of internal wiring harness.

Error detection by:
- Sum current detection
  (I_Summe_ist > I_Summe_Soll [I_Sum_is > I_Sum_Nominal]);
- Readback voltage (U_AIM) faulty (U_AIM<<U_VPS);
- Control frequency is greater than maximum allowable control frequency (f_ist > f_max [f_is > f_max]);
- Output stage of TCU (TREX)

System response:
- All current outputs are switched off (ZAE open)
- Neutral / Loss of a gear
- No retarder

Cancellation condition:
- No pressure regulator fault
- Ignition off/on

System check:
None yet, as applications with a G-valve are not feasible at this point.

031

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Circuit of pressure regulator A (DR_A) is interrupted.

Internal designation:
DR_A_Unterbrechung (DR_A_interruption)

Error description:
TCU detects an interruption in the circuit of pressure regulator A.
E.g. cable breakage / proportional valve not connected.

Error detection by:
- Sum current detection
  (I_Summe_ist < I_Summe_Soll [I_Sum_is < I_Sum_Nominal]);
- Readback voltage (U_AIM) faulty
  (U_AIM -> 0V);
- Control frequency is less than minimum allowable control frequency (f_ist -> 0Hz [f_is -> 0Hz]);
- Output stage of TCU (TREX)

System response:
- All current outputs are switched off (ZAE open)
- Neutral / Loss of a gear
- No retarder

Cancellation condition:
- No pressure regulator fault
- Ignition off/on

System check:
1. Switch ignition off
2. Unplug electronic system incl. transmission cable
3. Connect transmission test cable
4. Measure resistance of proportional valve (pin 5 to pin 13) Setpoint value: 10 – 15 ohm
5. Measure resistance of proportional valve to ground (pin 13 to ground (KL31) / housing) Setpoint value: > 10 mohm
6. TCU cable -> test transmission

In the event of deviations from the nominal value, check the wiring and the component.

032

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Circuit of pressure regulator B (DR_B) is interrupted.

Internal designation:
DR_B_Unterbrechung (DR_B_interruption)

Error description:
TCU detects an interruption in the circuit of pressure regulator B. E.g. cable breakage / proportional valve not connected

Error detection by:
- Sum current detection
  (I_Summe_ist < I_Summe_Soll [I_Sum_is < I_Sum_Nominal]);
- Readback voltage (U_AIM) faulty
  (U_AIM -> 0V);
- Control frequency is less than minimum allowable control frequency (f_ist -> 0Hz [f_is -> 0Hz]);
- Output stage of TCU (TREX)

System response:
- All current outputs are switched off (ZAE open)
- Neutral / Loss of a gear
- No retarder

Cancellation condition:
- No pressure regulator fault
- Ignition off/on

System check:
1. Switch ignition off
2. Unplug electronic system incl. transmission cable
3. Connect transmission test cable
4. Measure resistance of proportional valve (pin 5 to pin 12) Setpoint value: 10 - 15 ohm
5. Measure resistance of proportional valve to ground (pin 12 to ground (KL31) / housing) Setpoint value: > 10 mohm
6. TCU cable -> test transmission

In the event of deviations from the nominal value, check the wiring and the component.

033

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Circuit of pressure regulator D (DR_D) is interrupted.

Internal designation:
DR_D_Unterbrechung (DR_D_interruption)

Error description:
TCU detects an interruption in the circuit of pressure regulator D.
E.g. cable breakage / proportional valve not connected

Error detection by:
- Sum current detection
  (I_Summe_ist < I_Summe_Soll [I_Sum_is < I_Sum_Nominal]);
- Readback voltage (U_AIM) faulty
  (U_AIM -> 0V);
- Control frequency is less than minimum allowable control frequency (f_ist -> 0Hz [f_is -> 0Hz]);
- Output stage of TCU (TREX)

System response:
- All current outputs are switched off (ZAE open)
- Neutral / Loss of a gear
- No retarder

Cancellation condition:
- No pressure regulator fault
- Ignition off/on

System check:
1. Switch ignition off
2. Unplug electronic system incl. transmission cable
3. Connect transmission test cable
4. Measure resistance of proportional valve (pin 5 to pin 22) Setpoint value: 10 - 15 ohm
5. Measure resistance of proportional valve to ground (pin 22 to ground (KL31) / housing) Setpoint value: > 10 mohm
6. TCU cable -> test transmission

In the event of deviations from the nominal value, check the wiring and the component.

034

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Circuit of pressure regulator E (DR_E) is interrupted.

Internal designation:
DR_E_Unterbrechung (DR_E_interruption)

Error description:
TCU detects an interruption in the circuit of pressure regulator E.
E.g. cable breakage / proportional valve not connected

Error detection by:
- Sum current detection
  (I_Summe_ist < I_Summe_Soll [I_Sum_is < I_Sum_Nominal]);
- Readback voltage (U_AIM) faulty
  (U_AIM -> 0V);
- Control frequency is less than minimum allowable control frequency (f_ist -> 0Hz [f_is -> 0Hz]);
- Output stage of TCU (TREX)

System response:
- All current outputs are switched off (ZAE open)
- Neutral / Loss of a gear
- No retarder

Cancellation condition:
- No pressure regulator fault
- Ignition off/on

System check:
1. Switch ignition off
2. Unplug electronic system incl. transmission cable
3. Connect transmission test cable
4. Measure resistance of proportional valve (pin 5 to pin 24) Setpoint value: 10 - 15 ohm
5. Measure resistance of proportional valve to ground (pin 24 to ground (KL31) / housing) Setpoint value: > 10 mohm
6. TCU cable -> test transmission

In the event of deviations from the nominal value, check the wiring and the component.

035

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Circuit of pressure regulator F (DR_F) is interrupted.

Internal designation:
DR_F_Unterbrechung (DR_F_interruption)

Error description:
TCU detects an interruption in the circuit of pressure regulator F.
E.g. cable breakage / proportional valve not connected

Error detection by:
- Sum current detection
  (I_Summe_ist < I_Summe_Soll [I_Sum_is < I_Sum_Nominal]);
- Readback voltage (U_AIM) faulty
  (U_AIM -> 0V);
- Control frequency is less than minimum allowable control frequency (f_ist -> 0Hz [f_is -> 0Hz]);
- Output stage of TCU (TREX)

System response:
- All current outputs are switched off (ZAE open)
- Neutral / Loss of a gear
- No retarder

Cancellation condition:
- No pressure regulator fault
- Ignition off/on

System check:
1. Switch ignition off
2. Unplug electronic system incl. transmission cable
3. Connect transmission test cable
4. Measure resistance of proportional valve (pin 5 to pin 19) Setpoint value: 10 - 15 ohm
5. Measure resistance of proportional valve to ground (pin 19 to ground (KL31) / housing) Setpoint value: > 10 mohm
6. TCU cable -> test transmission

In the event of deviations from the nominal value, check the wiring and the component.

036

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Circuit of pressure regulator WK [torque converter lock-up clutch] (DR_WK) is interrupted.

Internal designation:
DR_WK_Unterbrechung (DR_WK_interruption)

Error description:
TCU detects an interruption in the circuit of pressure regulator WK.
E.g. cable breakage / proportional valve not connected

Error detection by:
- Sum current detection
  (I_Summe_ist < I_Summe_Soll [I_Sum_is < I_Sum_Nominal]);
- Readback voltage (U_AIM) faulty
  (U_AIM -> 0V);
- Control frequency is less than minimum allowable control frequency (f_ist -> 0Hz [f_is -> 0Hz]);
- Output stage of TCU (TREX)

System response:
- Disable WK (LuC)

Cancellation condition:
- No pressure regulator fault
- New request WK (LuC)

System check:
1. Switch ignition off
2. Unplug electronic system incl. transmission cable
3. Connect transmission test cable
4. Measure resistance of proportional valve (pin 5 to pin 9) Setpoint value: 10 - 15 ohm
5. Measure resistance of proportional valve to ground (pin 9 to ground (KL31) / housing) Setpoint value: > 10 mohm
6. TCU cable -> test transmission

In the event of deviations from the nominal value, check the wiring and the component.

037

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Circuit of main pressure regulator (DR_HD) is interrupted.

Internal designation:
DR_HD_Unterbrechung (DR_HD_interruption)

Error description:
TCU detects an interruption in the circuit of main pressure regulator.
E.g. cable breakage / proportional valve not connected

Error detection by:
- Sum current detection
  (I_Summe_ist < I_Summe_Soll [I_Sum_is < I_Sum_Nominal]);
- Readback voltage (U_AIM) faulty
  (U_AIM -> 0V);
- Control frequency is less than minimum allowable control frequency (f_ist -> 0Hz [f_is -> 0Hz]);
- Output stage of TCU (TREX)

System response:
- Main pressure is increased to the applied value

Cancellation condition:
- No pressure regulator fault
- Ignition off/on

System check:
1. Switch ignition off
2. Unplug electronic system incl. transmission cable
3. Connect transmission test cable
4. Measure resistance of proportional valve (pin 5 to pin 10) Setpoint value: 10 - 15 ohm
5. Measure resistance of proportional valve to ground (pin 10 to ground (KL31) / housing) Setpoint value: > 10 mohm
6. TCU cable -> test transmission

In the event of deviations from the nominal value, check the wiring and the component.

038

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Circuit of pressure regulator of retarder (DR_Ret) is interrupted.

Internal designation:
DR_Ret_Unterbrechung

Error description:
TCU detects an interruption in the circuit of pressure regulator Retarder.
E.g. cable breakage / proportional valve not connected

Error detection by:
- Sum current detection
  (I_Summe_ist < I_Summe_Soll [I_Sum_is < I_Sum_Nominal]);
- Readback voltage (U_AIM) faulty
  (U_AIM -> 0V);
- Control frequency is less than minimum allowable control frequency (f_ist -> 0Hz [f_is -> 0Hz]);
- Output stage of TCU (TREX)

System response:
- Retarder request and current output of retarder (AIM) will be switched off.

Cancellation condition:
- No pressure regulator fault
- New retarder request

System check:
1. Switch ignition off
2. Unplug electronic system incl. transmission cable
3. Connect transmission test cable
4. Measure resistance of proportional valve (pin 5 to pin 8) Setpoint value: 10 - 15 ohm
5. Measure resistance of proportional valve to ground (pin 8 to ground (KL31) / housing) Setpoint value: > 10 mohm
6. TCU cable -> test transmission

In the event of deviations from the nominal value, check the wiring and the component.

039

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Circuit of pressure regulator for PTO (DR_NA) is interrupted.

Internal designation:
DR_NA_Unterbrechung (DR_NA_interruption)

Error description:
TCU detects an interruption in the circuit of pressure regulator PTO.
E.g. cable breakage / proportional valve not connected

Error detection by:
- Sum current detection
  (I_Summe_ist < I_Summe_Soll [I_Sum_is < I_Sum_Nominal]);
- Readback voltage (U_AIM) faulty
  (U_AIM -> 0V);
- Control frequency is less than minimum allowable control frequency (f_ist -> 0Hz [f_is -> 0Hz]);
- Output stage of TCU (TREX)

System response:
- All current outputs are switched off (ZAE open)
- Neutral / Loss of a gear
- No retarder

Cancellation condition:
- No pressure regulator fault
- Ignition off/on

System check:
None yet, as applications with a PTO are not feasible at this point.

040

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Circuit of pressure regulator G (DR_G) is interrupted.

Internal designation:
DR_G_Unterbrechung (DR_G_interruption)

Error description:
TCU detects an interruption in the circuit of pressure regulator G.
E.g. cable breakage / proportional valve not connected

Error detection by:
- Sum current detection
  (I_Summe_ist < I_Summe_Soll [I_Sum_is < I_Sum_Nominal]);
- Readback voltage (U_AIM) faulty
  (U_AIM -> 0V);
- Control frequency is less than minimum allowable control frequency (f_ist -> 0Hz [f_is -> 0Hz]);
- Output stage of TCU (TREX)

System response:
- All current outputs are switched off (ZAE open)
- Neutral / Loss of a gear
- No retarder

Cancellation condition:
- No pressure regulator fault
- Ignition off/on

System check:
None yet, as applications with a G-valve are not feasible at this point.

041

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Pressure regulator A (DR_A) has a short circuit on another output (AIM).

Internal designation:
DR_A_ Kurzschluss AIM

Error description:
The circuit of pressure regulator A (DR_A) has a short on the circuit and/or output (AIM) of another pressure regulator.

Error detection by:
- Sum current detection
  (I_Summe_ist > I_Summe_Soll [I_Sum_is > I_Sum_Nominal]);
- Control frequency is greater than maximum allowable control frequency (f_ist > f_soll [f_is > f_nominal]);

System response:
- All current outputs are switched off (ZAE open)
- Neutral / Loss of a gear
- No retarder

Cancellation condition:
- No fault in the circuit of the pressure regulator
- Ignition off/on

System check:
1. Switch ignition off
2. Unplug electronic system incl. transmission cable
3. Connect transmission test cable
4. Measure resistance of proportional valve to other proportional valves (pin 13 to pin 9/12/19/8/22/10/24) Setpoint value: 20 - 30 ohm
5. TCU cable -> test transmission

In the event of deviations from the nominal value, check the wiring and the component.

042

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Pressure regulator B (DR_B) has a short circuit on another output (AIM).

Internal designation:
DR_B_ Kurzschluss AIM

Error description:
The circuit of pressure regulator B (DR_B) has a short on the circuit and/or output (AIM) of another pressure regulator.

Error detection by:
- Sum current detection
  (I_Summe_ist > I_Summe_Soll [I_Sum_is > I_Sum_Nominal]);
- Control frequency is greater than maximum allowable control frequency (f_ist > f_soll [f_is > f_nominal]);

System response:
- All current outputs are switched off (ZAE open)
- Neutral / Loss of a gear
- No retarder

Cancellation condition:
- No fault in the circuit of the pressure regulator
- Ignition off/on

System check:
1. Switch ignition off
2. Unplug electronic system incl. transmission cable
3. Connect transmission test cable
4. Measure resistance of proportional valve to other proportional valves (pin 12 to pin 9/13/19/8/22/10/24) Setpoint value: 20 - 30 ohm
5. TCU cable -> test transmission

In the event of deviations from the nominal value, check the wiring and the component.

043

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Pressure regulator D (DR_D) has a short circuit on another output (AIM).

Internal designation:
DR_D_ Kurzschluss AIM

Error description:
The circuit of pressure regulator D (DR_D) has a short on the circuit and/or output (AIM) of another pressure regulator.

Error detection by:
- Sum current detection
  (I_Summe_ist > I_Summe_Soll [I_Sum_is > I_Sum_Nominal]);
- Control frequency is greater than maximum allowable control frequency (f_ist > f_soll [f_is > f_nominal]);

System response:
- All current outputs are switched off (ZAE open)
- Neutral / Loss of a gear
- No retarder

Cancellation condition:
- No fault in the circuit of the pressure regulator
- Ignition off/on

System check:
1. Switch ignition off
2. Unplug electronic system incl. transmission cable
3. Connect transmission test cable
4. Measure resistance of proportional valve to other proportional valves (pin 22 to pin 9/12/19/8/13/10/24) Setpoint value: 20 - 30 ohm
5. TCU cable -> test transmission

In the event of deviations from the nominal value, check the wiring and the component.

044

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Pressure regulator E (DR_E) has a short circuit on another output (AIM).

Internal designation:
DR_E_ Kurzschluss AIM

Error description:
The circuit of pressure regulator E (DR_E) has a short on the circuit and/or output (AIM) of another pressure regulator.

Error detection by:
- Sum current detection
  (I_Summe_ist > I_Summe_Soll [I_Sum_is > I_Sum_Nominal]);
- Control frequency is greater than maximum allowable control frequency (f_ist > f_soll [f_is > f_nominal]);

System response:
- All current outputs are switched off (ZAE open)
- Neutral / Loss of a gear
- No retarder

Cancellation condition:
- No fault in the circuit of the pressure regulator
- Ignition off/on

System check:
1. Switch ignition off
2. Unplug electronic system incl. transmission cable
3. Connect transmission test cable
4. Measure resistance of proportional valve to other proportional valves (pin 24 to pin 9/12/19/8/22/10/13) Setpoint value: 20 - 30 ohm
5. TCU cable -> test transmission

In the event of deviations from the nominal value, check the wiring and the component.

045

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Pressure regulator F (DR_F) has a short circuit on another output (AIM).

Internal designation:
DR_F_ Kurzschluss AIM

Error description:
The circuit of pressure regulator F (DR_F) has a short on the circuit and/or output (AIM) of another pressure regulator.

Error detection by:
- Sum current detection
  (I_Summe_ist > I_Summe_Soll [I_Sum_is > I_Sum_Nominal]);
- Control frequency is greater than maximum allowable control frequency (f_ist > f_soll [f_is > f_nominal]);

System response:
- All current outputs are switched off (ZAE open)
- Neutral / Loss of a gear
- No retarder

Cancellation condition:
- No fault in the circuit of the pressure regulator
- Ignition off/on

System check:
1. Switch ignition off
2. Unplug electronic system incl. transmission cable
3. Connect transmission test cable
4. Measure resistance of proportional valve to other proportional valves (pin 19 to pin 9/12/13/8/22/10/24) Setpoint value: 20 - 30 ohm
5. TCU cable -> test transmission

In the event of deviations from the nominal value, check the wiring and the component.

046

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Pressure regulator WK [torque converter lock-up clutch] (DR_WK) has a short circuit on another output (AIM).

Internal designation:
DR_WK_ Kurzschluss AIM

Error description:
The circuit of pressure regulator WK (DR_WK) has a short on the circuit and/or output (AIM) of another pressure regulator.

Error detection by:
- Sum current detection
  (I_Summe_ist > I_Summe_Soll [I_Sum_is > I_Sum_Nominal]);
- Control frequency is greater than maximum allowable control frequency (f_ist > f_soll [f_is > f_nominal]);

System response:
- All current outputs are switched off (ZAE open)
- Neutral / Loss of a gear
- No retarder

Cancellation condition:
- No fault in the circuit of the pressure regulator
- Ignition off/on

System check:
1. Switch ignition off
2. Unplug electronic system incl. transmission cable
3. Connect transmission test cable
4. Measure resistance of proportional valve to other proportional valves (pin 9 to pin 13/12/19/8/22/10/24) Setpoint value: 20 - 30 ohm
5. TCU cable -> test transmission

In the event of deviations from the nominal value, check the wiring and the component.

047

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Main pressure regulator (DR_HD) has a short circuit on another output (AIM).

Internal designation:
DR_HD_ Kurzschluss AIM

Error description:
The circuit of main pressure regulator (DR_HD) has a short on the circuit and/or output (AIM) of another pressure regulator.

Error detection by:
- Sum current detection
  (I_Summe_ist > I_Summe_Soll [I_Sum_is > I_Sum_Nominal]);
- Control frequency is greater than maximum allowable control frequency (f_ist > f_soll [f_is > f_nominal]);

System response:
- All current outputs are switched off (ZAE open)
- Neutral / Loss of a gear
- No retarder

Cancellation condition:
- No fault in the circuit of the pressure regulator
- Ignition off/on

System check:
1. Switch ignition off
2. Unplug electronic system incl. transmission cable
3. Connect transmission test cable
4. Measure resistance of proportional valve to other proportional valves (pin 10 to pin 9/12/19/8/22/13/24) Setpoint value: 20 - 30 ohm
5. TCU cable -> test transmission

In the event of deviations from the nominal value, check the wiring and the component.

048

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Pressure regulator of retarder (DR_Ret) has a short circuit on another output (AIM).

Internal designation:
DR_Ret_ Kurzschluss AIM

Error description:
The circuit of pressure regulator of retarder (DR_Ret) has a short on the circuit and/or output (AIM) of another pressure regulator.

Error detection by:
- Sum current detection
  (I_Summe_ist > I_Summe_Soll [I_Sum_is > I_Sum_Nominal]);
- Control frequency is greater than maximum allowable control frequency (f_ist > f_soll [f_is > f_nominal]);

System response:
- All current outputs are switched off (ZAE open)
- Neutral / Loss of a gear
- No retarder

Cancellation condition:
- No fault in the circuit of the pressure regulator
- Ignition off/on

System check:
1. Switch ignition off
2. Unplug electronic system incl. transmission cable
3. Connect transmission test cable
4. Measure resistance of proportional valve to other proportional valves (pin 8 to pin 9/12/19/13/22/10/24) Setpoint value: 20 - 30 ohm
5. TCU cable -> test transmission

In the event of deviations from the nominal value, check the wiring and the component.

049

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Pressure regulator of PTO (DR_NA) has a short circuit on another output (AIM).

Internal designation:
DR_NA_ Kurzschluss AIM

Error description:
The circuit of pressure regulator of PTO (DR_NA) has a short on the circuit and/or output (AIM) of another pressure regulator.

Error detection by:
- Sum current detection
  (I_Summe_ist > I_Summe_Soll [I_Sum_is > I_Sum_Nominal]);
- Control frequency is greater than maximum allowable control frequency (f_ist > f_soll [f_is > f_nominal]);

System response:
- All current outputs are switched off (ZAE open)
- Neutral / Loss of a gear
- No retarder

Cancellation condition:
- No fault in the circuit of the pressure regulator
- Ignition off/on

System check:
None yet, as applications with a PTO are not feasible at this point.

050

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Pressure regulator G (DR_G) has a short circuit on another output (AIM).

Internal designation:
DR_G_ Kurzschluss AIM

Error description:
The circuit of pressure regulator G (DR_G) has a short on the circuit and/or output (AIM) of another pressure regulator.

Error detection by:
- Sum current detection
  (I_Summe_ist > I_Summe_Soll [I_Sum_is > I_Sum_Nominal]);
- Control frequency is greater than maximum allowable control frequency (f_ist > f_soll [f_is > f_nominal]);

System response:
- All current outputs are switched off (ZAE open)
- Neutral / Loss of a gear
- No retarder

Cancellation condition:
- No fault in the circuit of the pressure regulator
- Ignition off/on

System check:
None yet, as applications with a G-valve are not feasible at this point.

051

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Positive supply pins of all proportional valves (VPS) have sum current fault (temporary fault)

Internal designation:
Positive supply pins of all proportional solenoids (VPS) has sum current fault (temporary fault)

Error description:
The TCU identifies the fault at the positive supply pin of the proportional valve, but cannot uniquely designate the fault during subsequent active diagnostics. (Temporary fault)

Error detection by:
a) Sum current too high (for ground short);
TREX measures current via shunt only from KL 30
(limit 11.3 to 15 A dep. on U_Ref.)
Passive diagnosis: "HSD Short to ground",
If I_Summe_Fehler < 12..20 A then SW-sum current recognition possible.

b) Sum current too low (Output highly resistive)
Recognized at 32 V starting at 16 ohm.
Current fault to be identified.

System response:
- All current outputs are switched off (ZAE open)
- Neutral / Loss of a gear
- No retarder

Cancellation condition:
- No error
- Ignition off/on

System check:
1. Switch ignition off
2. Unplug electronic system incl. transmission cable
3. Connect transmission test cable
4. Measure resistance of proportional valves power supply to ground (KL31)/housing (pin 5 and pin 3 to ground (KL31)/housing) Setpoint value: >10 mohm
5. Measure resistance of both positive supply pins (pin 5 to pin 3) Setpoint value: 0 ohm
6. TCU cable -> test transmission

In the event of deviations from the nominal value, check the wiring and the proportional valves.

052

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Positive supply pins of all proportional valves (VPS) have a short circuit to ground.

Internal designation:
Positive supply pins of all proportional solenoids (VPS); Short to GND

Error description:
TCU detects a short circuit of positive supply pins of proportional valves to ground. E.g. chafe points on the internal cable harness

Error detection by:
- Sum current detection (I_Summe_Ist > I_Summe_Soll+Offset and control frequency -> 0Hz)
- U_VPS < U_VPS_min
- Output stage of TCU (TREX)

System response:
- All current outputs are switched off (ZAE open)
- Neutral / Loss of a gear
- No retarder

Cancellation condition:
- No fault VPS
- Ignition off/on

System check:
1. Switch ignition off
2. Unplug electronic system incl. transmission cable
3. Connect transmission test cable
4. Measure resistance of proportional valves (VPS) to ground (KL31) / housing (pin 5 and pin 3 to ground (KL31) / housing) Setpoint value: >10 mohm
5. TCU cable -> test transmission

In the event of deviations from the nominal value, check the wiring and the component.

053

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Electric fault turbine speed

Internal designation:
EF1 turbine rpm sensor electric fault

Error description:
Turbine rpm sensor indicates fault or TCU receives no signal or implausible signal

Possible fault causes:
- Voltage at speed input (EF1) of TCU too low (EF_Voltage low)
- Voltage at speed input (EF1) of TCU too high (EF_Voltage high)
- Speed input of TCU (EF1) has a short to positive pin (EF_Short to Plus)
- Speed input of TCU (EF1) has a short to ground / housing (EF_Short to ground)
- Interruption on speed input of TCU (EF1) (EF_Open load)

Error detection by:
- Return read voltage outside valid value

System response:
- Turbine speed (n_Tu) will be substituted from n_Mot or n_Ab*I_Gang, depending on its state
- Increased fuel consumption
- Reduced gearshifting quality
- Limited driving operation
- No NB (Neutral Ready)
- AIS switched off
- Limited engine torque
- Shifting pressure adaption switched off
- Shifting pressure of WK close controlled only
- Increased main pressure
- WK short-term opening and WK closing during gear-shifting locked
- Shifting point calculation based on default values
- Tractive force advance calculation switched off
- Subsequent shift preparation during gearshifting locked
- TOPO switched off

Cancellation condition:
- Ignition off/on

System check:

1. Switch ignition off
2. Unplug transmission electronics
3. Connect connector block between TCU and transmission
4. Switch ignition on
5. Measure voltage between pin 2 (EF1) and pin 6 (AU1) Setpoint value: 5 V
6. Switch ignition off
7. Unplug electronic system
8. Measure resistance between pin 6 (AU1) and ground / housing
   Setpoint value: >10 mohm
9. Measure resistance between pin 2 (EF1) and ground / housing Setpoint value: >10 mohm

In the event of deviations from the nominal value, check the wiring, the component, and the TCU.

054

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Hardware input TCU (EF1) turbine speed sensor fault

Internal designation:
EF1 turbine rpm sensor fault hardware input

Error description:
The output stage of the TCU (TREX) recognizes and signals a hardware failure of the turbine rpm sensor

Error detection by:
- Output stage of the TCU (TREX) signals a hardware failure

System response:
- Turbine speed (n_Tu) will be substituted from n_Mot or n_Ab*I_Gang, depending on its state
- Hold gear, no gear change
- Increased fuel consumption
- Reduced gearshifting quality
- Limited driving operation
- No NB (Neutral Ready)
- AIS switched off
- Limited engine torque
- Shifting pressure adaption switched off
- Shifting pressure of WK close controlled only
- Increased main pressure
- WK short-term opening and WK closing during gear-shifting locked
- Shifting point calculation based on default values
- Tractive force advance calculation switched off
- Subsequent shift preparation during gearshifting locked
- TOPO switched off

Cancellation condition:
- No turbine rpm fault
- Ignition off/on

System check:
1. Switch ignition off
2. Unplug transmission electronics
3. Connect connector block between TCU and transmission
4. Switch ignition on

5. Measure voltage between pin 2 (EF1) and pin 6 (AU1) Setpoint value: 5 V
6. Switch ignition off
7. Unplug electronic system
8. Measure resistance between pin 6 (AU1) and ground / housing
   Setpoint value: >10 mohm
9. Measure resistance between pin 2 (EF1) and ground / housing Setpoint value: >10 mohm

In the event of deviations from the nominal value, check the wiring, the component, and the TCU.

055

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Unreal frequency drop at EF1 turbine speed (Fall off)

Internal designation:
EF1 n_Tu signal indicates unreal frequency drop

Error description:
Unrealistic frequency drop of turbine speed at EF1 to 0 Hz in x seconds (no fault for Geberausfall_unecht due to heavy braking)

Error detection by:
- rpm drop to 0 Hz in x seconds

System response:
- Turbine speed (n_Tu) will be substituted from n_Mot or n_Ab*I_Gang, depending on its state
- Hold gear, no gear change
- Increased fuel consumption
- Reduced gearshifting quality
- Limited driving operation:
- No NB (Neutral Ready)
- AIS switched off
- Limited engine torque
- Shifting pressure adaption switched off
- Shifting pressure of WK close controlled only
- Increased main pressure
- WK short-term opening and WK closing during gear-shifting locked
- Shifting point calculation based on default values
- Tractive force advance calculation switched off
- Subsequent shift preparation during gearshifting locked
- TOPO switched off

Cancellation condition:
- No turbine rpm fault
- Ignition off/on

System check:
1. Switch ignition off
2. Unplug transmission electronics
3. Connect connector block between TCU and transmission
4. Switch ignition on

5. Measure voltage between pin 2 (EF1) and pin 6 (AU1) Setpoint value: 5 V
6. Switch ignition off
7. Unplug electronic system
8. Measure resistance between pin 6 (AU1) and ground / housing
   Setpoint value: >10 mohm
9. Measure resistance between pin 2 (EF1) and ground / housing Setpoint value: >10 mohm

In the event of deviations from the nominal value, check the wiring, the component, and the TCU.

056

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Electronic fault output speed

Internal designation:
EF2 output rpm sensor electronic fault

Error description:
Turbine rpm sensor indicates fault or TCU receives no signal or implausible signal

Possible fault causes:
- Voltage at speed input (EF2) of TCU too low (EF_Voltage low)
- Voltage at speed input (EF2) of TCU too high (EF_Voltage high)
- Speed input of TCU (EF2) has a short to positive pin (EF_Short to Plus)
- Speed input of TCU (EF2) has a short to ground / housing (EF_Short to ground)
- Interruption on speed input of TCU (EF2) (EF_Open load)

Error detection by:
- Return read voltage outside valid value

System response:
- Output speed (n_Ab) will be substituted from n_Tu / I_Gang
- Increased fuel consumption
- Reduced gearshifting quality
- Limited driving operation
- No NB (Neutral Ready)
- AIS switched off
- Limited engine torque
- Engine brake switched off
- Retarder torque limited
- For gear requests, only gearshifts into "high gears"; after that, downshifts into suitable gear
- Reverse gear only permitted when the brake pressure is high and a forward gear has been engaged (n_Tu=0)
- Shifting pressure adaption switched off
- Increased main pressure
- WK short-term opening and WK closing during gear-shifting locked
- Shifting point calculation based on default values
- Tractive force advance calculation switched off
- Subsequent shift preparation during gearshifting locked
- TOPO switched off

Cancellation condition:

- No output rpm fault
- Ignition off / on

System check:

1. Switch ignition off
2. Unplug transmission electronics
3. Connect connector block between TCU and transmission
4. Switch ignition on
5. Measure voltage between pin 10 (EF2) and pin 15 (AU2) Setpoint value: 5 V
6. Switch ignition off
7. Unplug electronic system
8. Measure resistance between pin 15 (AU2) and ground / housing Setpoint value: >10 mohm
9. Measure resistance between pin 10 (EF2) and ground / housing Setpoint value: >10 mohm

In the event of deviations from the nominal value, check the wiring, the component, and the TCU.

057

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Hardware input TCU (EF2) output speed sensor fault

Internal designation:
EF2 output rpm sensor fault hardware input

Error description:
The output stage of the TCU (TREX) recognizes and signals a hardware failure of the output rpm sensor

Error detection by:
Output stage of the TCU (TREX) signals a hardware failure

System response:
- Output speed (n_Ab) will be substituted from n_Tu / I_Gang
- Hold gear, no gear change
- Increased fuel consumption
- Reduced gearshifting quality
- Limited driving operation:
- No NB (Neutral Ready)
- AIS switched off
- Limited engine torque
- Engine brake switched off
- Retarder torque limited
- For gear requests, only gearshifts into "high gears"; after that, downshifts into suitable gear
- Reverse gear only permitted when the brake pressure is high and a forward gear has been engaged (n_Tu=0)
- Shifting pressure adaption switched off
- Increased main pressure
- WK short-term opening and WK closing during gear-shifting locked
- Shifting point calculation based on default values
- Tractive force advance calculation switched off
- Subsequent shift preparation during gearshifting locked
- TOPO switched off

Cancellation condition:
- No output rpm fault
- Ignition off/on
-

System check:

1. Switch ignition off
2. Unplug transmission electronics
3. Connect connector block between TCU and transmission
4. Switch ignition on
5. Measure voltage between pin 10 (EF2) and pin 15 (AU2) Setpoint value: 5 V
6. Switch ignition off
7. Unplug electronic system
8. Measure resistance between pin 15 (AU2) and ground / housing Setpoint value: >10 mohm
9. Measure resistance between pin 10 (EF2) and ground / housing Setpoint value: >10 mohm

In the event of deviations from the nominal value, check the wiring, the component, and the TCU.

058

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Unreal frequency drop at EF2 output speed (Fall off)

Internal designation:
EF2 n_Ab signal indicates unreal frequency drop

Error description:
Unrealistic frequency drop of output speed at EF2 to 0 Hz in x seconds (no fault for Geberausfall_unecht due to heavy braking)

Error detection by:
Rpm drop to 0Hz in x seconds only possible when driving

System response:
- Output speed (n_Ab) will be substituted from n_Tu / I_Gang
- Reverse gear only permitted when the brake pressure is high and a forward gear has been engaged (n_Tu=0)
- Increased fuel consumption
- Reduced gearshifting quality
- Limited driving operation:
- No NB (Neutral Ready)
- AIS switched off
- Limited engine torque
- Engine brake switched off
- Retarder torque limited
- For gear requests, only gearshifts into "high gears"; after that, downshifts into suitable gear
- Reverse gear only permitted when the brake pressure is high and a forward gear has been engaged (n_Tu=0)
- Shifting pressure adaption switched off
- Increased main pressure
- WK short-term opening and WK closing during gear-shifting locked
- Shifting point calculation based on default values
- Tractive force advance calculation switched off
- Subsequent shift preparation during gearshifting locked
- TOPO switched off

Cancellation condition:
- No output rpm fault
- Ignition off/on

System check:

1. Switch ignition off
2. Unplug transmission electronics
3. Connect connector block between TCU and transmission
4. Switch ignition on
5. Measure voltage between pin 10 (EF2) and pin 15 (AU2) Setpoint value: 5 V
6. Switch ignition off
7. Unplug electronic system
8. Measure resistance between pin 15 (AU2) and ground / housing Setpoint value: >10 mohm
9. Measure resistance between pin 10 (EF2) and ground / housing Setpoint value: >10 mohm

In the event of deviations from the nominal value, check the wiring, the component, and the TCU.

059

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Checksum of selected data field wrong (flash)

Internal designation:
Checksum of selected data field wrong (Flash)

Error description:
The checksum of the selected data field is not correct.

Error detection by:
Software / if ignition on. One possible cause for this is premature termination of the control unit run following ignition OFF as a result of a premature voltage drop on terminal 30.

System response:
- All current outputs are switched off (ZAE open)
- Neutral / Loss of a gear
- No retarder

Cancellation condition:
- Correct checksum
- Ignition off/on

System check:
No hardware check possible.
Check software, reload, if necessary.

060

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Driving program configuration is not available or not released.

Internal designation:
The block number entered by the customer for the driving program configuration is not available or not released

Error description:
The block number entered for the driving program configuration is not available or not released.

Error detection by:
Software

System response:
- All current outputs are switched off (ZAE open)
- Neutral / Loss of a gear
- No retarder

Cancellation condition:
- Activate enabled driving program configuration in EEProm
- Ignition off/on

System check:
Checking of the driving program configuration in EEProm

061

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Terminal 15 signal is missing even though the engine is running

Internal designation:
U_KI_15 signal is missing even though the engine is still running (not plausible)

Error description:
The voltage at terminal 15 is missing (ignition on), even though the engine is still running. If in the case of open circuit / not plausible KI 15 the engine is additionally being switched off, TCU goes into hunting mode and is deactivated.
After this, TCU remains switched off as long as KI 15 is missing.
As a result, the engine cannot be started because driving-switch neutral position is not available.

Error detection by:
Apply voltage at KL 15 < 4V for 5 seconds and the engine runs.

System response:
none

Cancellation condition:
none

System check:
Checking of the vehicle wiring (line, ignition lock, relay, plug-in connections...).
Terminal 15 to TCU Pin 25, low source (ground/source) at pins 17 and 18.

062

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Central cut-off unit (ZAE) does not cut off.

Internal designation:
Central cut-off unit (ZAE) no longer cuts off.

Error description:
The central cut-off unit (ZAE) no longer cuts off.

Error detection by:
ZAE test; during start, ZAE is tested by a brief lockup disable.

System response:
- All current outputs are switched off (internally)
- Neutral / Loss of a gear
- No retarder

Cancellation condition:
- No error present at central cut-off unit (ZAE)
- Ignition off/on

System check:
Check the TCU.

063

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Non-permissible shift element combination

Internal designation:
Non-permissible shift element combination

Error description:
This recognizes shift elements carrying too high currents that are not part of the gear.
Depending on the shift phase, a third SE is permissible up to a defined current.

Error detection by:
The shift elements monitor (SE_SMON) recognizes that more than two shift elements put out a high current for a non-permissible length of time

System response:
- All current outputs are switched off (ZAE open)
- Neutral / Loss of a gear
- No retarder

Cancellation condition:
Ignition off/on

System check:
Check the TCU and the software

064

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
TCU power supply (KL30) undervoltage

Internal designation:
KI_30 TCU power supply failure low

Error description:
Power supply of TCU (KL_30) has undervoltage. U_Batt > 16V Error does not apply to state "Start engine". Below 16 V, currents (I_AIM) cannot be guaranteed.
The fault applies to creeping voltage drops.

Error detection by:
TCU - input wiring / software

System response:
- All current outputs are switched off (ZAE open)
- Neutral / Loss of a gear
- No retarder

Cancellation condition:
- No undervoltage at KL30
- Speed range selector Neutral

System check:
1. Switch ignition off
2. Connect connector block between TCU and vehicle
3. Switch ignition on
4. Measure voltage between pin 8 (VP1) and pin 17 (VM1) Setpoint value: > 16 V

In the event of deviations from the nominal value, check the wiring and the power supply (on the vehicle).

065

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
TCU power supply (KL30) overvoltage

Internal designation:
KI_30 TCU power supply failure high

Error description:
Power supply of TCU (KL_30) has overvoltage. U_Batt > 38V
Error does not apply to status "Start engine".

Difference from error 68:
The voltage increase is faster for error 68.

Error detection by:
TCU - input wiring / software

System response:
- All current outputs are switched off (ZAE open)
- Neutral / Loss of a gear
- No retarder

Cancellation condition:
- No overvoltage at KL_30
- Ignition off/on

System check:
1. Switch ignition off
2. Connect connector block between TCU and vehicle
3. Switch ignition on
4. Measure voltage between pin 8 (VP1) and pin 17 (VM1) Setpoint value: < 38 V

In the event of deviations from the nominal value, check the power supply (on the vehicle).

066

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Key and driving direction signal from the speed range selector message are not plausible

Internal designation:
Key and driving direction signal from the speed range selector message are not plausible regarding driving direction

Error description:
Speed range selector message contains a key signal that does not match the driving direction signal (also message) or message failure or signal failure

Error detection by:
Software

System response:
- All current outputs are switched off (ZAE open)
- Neutral / Loss of a gear
- No retarder

Cancellation condition:
- Key signal matches driving direction signal; message and/or signal present,
- speed range selector Neutral

System check:
Check speed range selector
Check ZF-CAN hardware

1. Switch ignition off
2. Connect connector block between TCU and vehicle
3. Measure resistance of CAN bus (pin 2 to pin 11) Setpoint value: 60 ohm

In the event of deviations from the nominal value, check the wiring and components.

067

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Short-term overvoltage at the TCU KL_30 (temporary fault)

Internal designation:
KI_30 TCU short-term overvoltage (temporary fault with temporary load shedding)

Error description:
Short-term overvoltage at TCU KL_30 (U_Batt > 38 V).
Fault does not apply to status "Start engine".

Error detection by:
TCU - input wiring / software

System response:
Temporary load shedding; i. e. central switch-off unit ZAE temporarily open.

Cancellation condition:
Fault drop

System check:
1. Switch ignition off
2. Connect connector block between TCU and vehicle
3. Switch ignition on
4. Measure voltage between pin 8 (VP1) and pin 17 (VM1) Setpoint value: < 38 V

In the event of deviations from the nominal value, check the wiring and the power supply (on the vehicle).

068

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
KL_30 overvoltage at the TCU with subsequent load shedding

Internal designation:
KI_30 TCU overvoltage (fault with load shedding)

Error description:
Power supply of TCU (KL_30) has overvoltage. U_Batt > 38V
Fault does not apply to status "Start engine".

Difference from error 65:
The voltage increase is slower for error 65.

Error detection by:
If U_Batt (approx 0.2s) > 38 V;
fault is recognized by hardware (TCU – input wiring) and reported to software.
However, not immediately after ignition on and not immediately after ignition off (negative feed from on-board electronics possible; inductivity)

System response:
- All current outputs are switched off (ZAE open)
- Neutral / Loss of a gear
- No retarder

Cancellation condition:
- No voltage fault
- Ignition off/on

System check:
1. Switch ignition off
2. Unplug transmission electronics
3. Connect connector block between TCU and transmission
4. Switch ignition on
5. Measure voltage between pin 8 (VP1) and pin 17 (VM1)
   Setpoint value: < 38V (watch for voltage peaks)

In the event of deviations from the nominal value, check the power supply (on the vehicle).

069

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
TCU – temperature sensor failure; high temperature

Internal designation:
TCU temperature sensor failure low
U < Lower limit (corresponds to high temperature)

Error description:
TCU voltage – temperature sensor has fallen below lower failure limit, corresponds to >150°C.

Error detection by:
ADC value warm < 126, corresponds to >150°C

System response:
none

Cancellation condition:
ADC value > 126.
corresponds to < 150°C

System check:
Check the TCU

070

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
TCU – temperature sensor failure; high temperature

Internal designation:
TCU temperature sensor failure high
U > Upper limit (corresponds to low temperature)

Error description:
TCU voltage – temperature sensor has exceeded the upper failure limit, corresponds to < -30°C, and sump temperature > 50°C

Error detection by:
ADC value cold > 1009,
corresponds to <-30°C

System response:
none

Cancellation condition:
ADC value < 1009,
corresponds to > -30°C

System check:
Check the TCU

071

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Temperature sensor retarder / converter (ER2) failure high temperature

Internal designation:
ER2 retarder/ converter temperature sensor failure low
U < Lower limit (corresponds to high temperature)

Error description:
Temperature sensor of retarder / converter (ER2) has exceeded the lower failure limit, corresponds to > 195°C

Error detection by:
ADC value warm < 224,
corresponds to > 195°C

System response:
- Retarder torque limited

Cancellation condition:
- ADC value > 224,
- New retarder request

System check:
1. Switch ignition off
2. Unplug electronic system
3. Connect transmission test cable
4. Measure resistance of temperature sensor (pin 18) to sensor ground (pin 17).
   Setpoint value: 20°C -> approx. 120 kohm
   80°C -> approx. 12 kohm
   140°C -> approx. 2 kohm
   See temperature sensor data sheet for additional values.
5. TCU cable -> test transmission

In the event of deviations from the nominal value, check the wiring and the component.

072

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Temperature sensor retarder / converter (ER2) failure low temperature

Internal designation:
ER2 retarder/ converter temperature sensor failure high
U > Upper limit (corresponds to low temperature)

Error description:
Temperature sensor of retarder / converter (ER2) has exceeded the upper failure limit, corresponds to < 23°C and the sump temperature > 50°C

Error detection by:
ADC value cold > 1000,
corresponds to < 23°C and T_Sump > 50°C

System response:
- Retarder torque limited

Cancellation condition:
- ADC value < 1000
- New retarder request

System check:
1. Switch ignition off
2. Unplug electronic system
3. Connect transmission test cable
4. Measure resistance of temperature sensor (pin 18) to sensor ground (pin 17).
   Setpoint value: 20°C -> approx. 120 kohm
   80°C -> approx. 12 kohm
   140°C -> approx. 2 kohm
   See temperature sensor data sheet for additional values.
5. TCU cable -> test transmission

In the event of deviations from the nominal value, check the wiring and the component.

073

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Temperature sensor sump (ER1) failure high temperature

Internal designation:
ER1 sump temperature sensor failure low
U < Lower limit (corresponds to high temperature)

Error description:
Temperature sensor of sump (ER1) has fallen below the lower failure limit,
corresponds to > 175°C

Error detection by:
ADC value warm < 95,
corresponds to > 175°C

System response:
- No NB (Neutral Ready)
- AIS switched off
- Limited engine torque
- Retarder torque limited
- Shifting pressure adaption switched off

Cancellation condition:
- ADC value > 95,
- Ignition off/on

System check:
1. Switch ignition off
2. Unplug electronic system
3. Connect transmission test cable
4. Measure resistance of temperature sensor (pin 4) to sensor ground (pin 15).
   Setpoint value: 20°C -> approx. 62.3 kohm
   80°C -> approx. 6.3 kohm
   140°C -> approx. 1.2 kohm

Additional values see temperature sensor data sheet.
TCU cable -> test transmission

Note:
The voltage at PIN cannot be used, as the voltage is split internally.

In the event of deviations from the nominal value, check the wiring and the component.

074

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Temperature sensor sump (ER1) failure low temperature

Internal designation:
ER1 sump temperature sensor failure high
U > Upper limit (corresponds to low temperature)

Error description:
Temperature sensor of sump (ER1) has exceeded the upper failure limit, corresponds to < -40°C

Error detection by:
ADC value cold > 968,
corresponds to <-40°

System response:
- No NB (Neutral Ready)
- AIS switched off
- Limited engine torque
- Retarder torque limited
- Shifting pressure adaption switched off

Cancellation condition:
- ADC – value < 968,
- Ignition off/on

System check:
1. Switch ignition off
2. Unplug electronic system
3. Connect transmission test cable
4. Measure resistance of temperature sensor (pin 4) to sensor ground (pin 15).
   Setpoint value: 20°C -> approx. 62.3 kohm
   80°C -> approx. 6.3 kohm
   140°C -> approx. 1.2 kohm
   See temperature sensor data sheet for additional values.
5. TCU cable -> test transmission

Note:
The voltage at PIN cannot be used, as the voltage is split internally.

In the event of deviations from the nominal value, check the wiring and the component.

075

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
ER3 cooling water temperature sensor failure low

Internal designation:
ER3 cooling water temperature sensor failure low

Error description:
Currently there is no sensor installed.

Error detection by:
Not active

System response:
Not active

Cancellation condition:

System check:
Not possible

076

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
ER3 cooling water temperature sensor failure high

Internal designation:
ER3 cooling water temperature sensor failure high

Error description:
Currently there is no sensor installed.

Error detection by:
Not active

System response:
Not active

Cancellation condition:

System check:
Not possible

077

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Temperature TCU is too low

Internal designation:
Temperature TCU is too low
(Fault is unrealistic; diagnosis switched off via data field)

Error description:
Temperature TCU is too low

Error detection by:
Not active

System response:
Not active

Cancellation condition:

System check:
Not possible

078

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
TCU – temperature is too high

Internal designation:
Temperature off TCU is too high

Error description:
The temperature measured by the TCU temperature sensor has been higher than permitted for a specified time.

Error detection by:
TCU - temperature sensor detects a temperature > 138°C for a longer period of time.
(T_ECU_Temperatur > TEW_PCB_zul.)

System response:
none

Cancellation condition:
- TCU– temperature < 138°C
- Ignition off/on

System check:
Check TCU temperature with diagnosis tool

079

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Development tool active

Internal designation:
Transmission development tool has been activated (not relevant for volume production)

Error description:
A development tool is active

Error detection by:
Software

System response:
Retarder not effective.

Cancellation condition:
Remove development tool

System check:
Software is to be checked whether it is up to date

080

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Power supply turbine speed sensor (AU_1) short circuit to ground (GND)

Internal designation:
U_AU1 n_Tu sensor power supply has a short circuit to ground (GND)

Error description:
The power supply of the turbine speed sensor (AU_1 / +5V) has a short to ground (KL31) / housing

Error detection by:
TCU: U_AU1 < 4 V

System response:
- Turbine speed (n_Tu) will be substituted from n_Mot or n_Ab*I_Gang, depending on its state
- Hold gear, no gear change
- Increased fuel consumption
- Reduced gearshifting quality
- Limited driving operation:
- No NB (Neutral Ready)
- AIS switched off
- Limited engine torque
- Shifting pressure adaption switched off
- Shifting pressure of WK close controlled only
- Increased main pressure
- WK short-term opening and WK closing during gear-shifting locked
- Shifting point calculation based on default values
- Tractive force advance calculation switched off
- Subsequent shift preparation during gearshifting locked
- TOPO switched off

Cancellation condition:
- No turbine rpm fault
- Ignition off/on

System check:
1. Switch ignition off
2. Unplug electronic system
3. Connect transmission test cable
4. Measure resistance of power supply cable to ground / housing.

(Pin 23 to KL31 / housing)
Setpoint value: > 10 mohm

5. TCU cable -> test transmission

In the event of deviations from the nominal value, check the wiring and the component.

081

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Power supply turbine speed sensor (AU_1) short circuit to plus/high source [+] supply (VPS)

Internal designation:
U_AU1 n_Tu sensor power supply short circuit to plus/high source [+] supply (VPS)

Error description:
The power supply of the turbine speed sensor (AU_1 / +5V) has a short circuit to plus/high source [+] supply (VPS)

Error detection by:
TCU (U_AU1 > 5.5 V)

System response:
- Turbine speed (n_Tu) will be substituted from n_Mot or n_Ab*I_Gang, depending on its state
- Hold gear, no gear change
- Increased fuel consumption
- Reduced gearshifting quality
- Limited driving operation:
- No NB (Neutral Ready)
- AIS switched off
- Limited engine torque
- Shifting pressure adaption switched off
- Shifting pressure of WK close controlled only
- Increased main pressure
- WK short-term opening and WK closing during gear-shifting locked
- Shifting point calculation based on default values
- Tractive force advance calculation switched off
- Subsequent shift preparation during gearshifting locked
- TOPO switched off

Cancellation condition:
- No turbine rpm fault
- Ignition off/on

System check:
1. Switch ignition off
2. Unplug electronic system
3. Connect transmission test cable
4. Measure resistance of supply line to VPS of proportional valves (pin 3 to pin 23) Setpoint

value: > 10 mohm

5. TCU cable -> test transmission

In the event of deviations from the nominal value, check the wiring and the component.

082

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Power supply turbine speed sensor (AU_1) interruption

Internal designation:
U_AU1 n_Tu sensor voltage supply interruption inside the TCU (Interruption outside the TCU can only be registered on signal side and thus displayed as n_Tu- error 53).

Error description:
There is an interruption in the power supply of the turbine rpm sensor (AU_1). Interruption is mostly in the TCU as interruption on the outside can only be registered on signal side and leads to error 53.

Error detection by:
TCU internal: U_AU1 < 4V;
TCU external: Can only be recognized on signal side (EF1) -> error 53

System response:
- Turbine speed (n_Tu) will be substituted from n_Mot or n_Ab*I_Gang, depending on its state
- Hold gear, no gear change
- Increased fuel consumption
- Reduced gearshifting quality
- Limited driving operation
- No NB (Neutral Ready)
- AIS switched off
- Limited engine torque
- Shifting pressure adaption switched off
- Shifting pressure of WK close controlled only
- Increased main pressure
- WK short-term opening and WK closing during gear-shifting locked
- Shifting point calculation based on default values
- Tractive force advance calculation switched off
- Subsequent shift preparation during gearshifting locked
- TOPO switched off

Cancellation condition:
- No turbine rpm fault
- Ignition off/on

System check:
1. Switch ignition off

2. Unplug transmission electronics
3. Connect connector block between TCU and transmission
4. Switch ignition on
5. Measure voltage between pin 2 (EF1) and pin 6 (AU1) Setpoint value: 5 V
6. Switch ignition off
7. Unplug electronic system
8. Measure resistance between pin 6 (AU1) and ground / housing
   Setpoint value: >10 mohm
9. Measure resistance between pin 2 (EF1) and ground / housing Setpoint value: >10 mohm

In the event of deviations from the nominal value, check the wiring and the component.

083

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Power supply turbine speed sensor (AU_1) interruption

Internal designation:
U_AU2 n_Ab sensor power supply has a short circuit to ground (GND)

Error description:
The power supply of the output speed sensor (AU_2 / +5V) has a short to ground (KL31) / housing

Error detection by:
TCU: U_AU2 < 4 V

System response:
- Output speed (n_Ab) will be substituted from n_Tu / i_Gang
- Hold gear, no gear change
- Increased fuel consumption
- Reduced gearshifting quality
- Limited driving operation
- No NB (Neutral Ready)
- AIS switched off
- Limited engine torque
- Engine brake switched off
- Retarder torque limited
- For gear requests, only gearshifts into "high gears"; after that, downshifts into suitable gear
- Reverse gear only permitted when the brake pressure is high and a forward gear has been engaged (n_Tu=0)
- Shifting pressure adaption switched off
- Increased main pressure
- WK short-term opening and WK closing during gear-shifting locked
- Shifting point calculation based on default values
- Tractive force advance calculation switched off
- Subsequent shift preparation during gearshifting locked
- TOPO switched off

Cancellation condition:
- No output rpm fault
- Ignition off / on

System check:

1. Switch ignition off
2. Unplug electronic system
3. Connect transmission test cable
4. Measure resistance of power supply cable to ground / housing.
   (pin 21 to KL31 / housing) Setpoint value: > 10 mohm
5. TCU cable -> test transmission

In the event of deviations from the nominal value, check the wiring and the component.

084

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Power supply output speed sensor (AU_2) short circuit to plus/high source [+] supply (VPS)

Internal designation:
U_AU2 n_Ab sensor power supply short circuit to plus/high source [+] supply (VPS)

Error description:
The power supply of the turbine speed sensor (AU_2 / +5V) has a short circuit to plus/high source [+] supply (VPS)

Error detection by:
TCU (U_AU2 > 5.5 V)

System response:
- Output speed (n_Ab) will be substituted from n_Tu / i_Gang
- Hold gear, no gear change
- Increased fuel consumption
- Reduced gearshifting quality
- Limited driving operation
- No NB (Neutral Ready)
- AIS switched off
- Limited engine torque
- Engine brake switched off
- Retarder torque limited
- For gear requests, only gearshifts into "high gears"; after that, downshifts into suitable gear
- Reverse gear only permitted when the brake pressure is high and a forward gear has been engaged (n_Tu=0)
- Shifting pressure adaption switched off
- Increased main pressure
- WK short-term opening and WK closing during gear-shifting locked
- Shifting point calculation based on default values
- Tractive force advance calculation switched off
- Subsequent shift preparation during gearshifting locked
- TOPO switched off

Cancellation condition:
- No output rpm fault
- Ignition off / on

System check:

1. Switch ignition off
2. Unplug electronic system
3. Connect transmission test cable
4. Measure resistance of supply line to VPS of proportional valves (pin 3 to pin 21) Setpoint value: > 10 mohm
5. TCU cable -> test transmission

In the event of deviations from the nominal value, check the wiring and the component.

085

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Power supply output speed sensor (AU_2) interruption

Internal designation:
U_AU2 n_Ab sensor voltage supply interruption inside the TCU (Interruption outside the TCU can only be registered on signal side and thus displayed as n_Ab- error 56).

Error description:
There is an interruption in the power supply of the output rpm sensor (AU_2). Interruption is mostly in the TCU as interruption on the outside can only be registered on signal side and leads to error 56.

Error detection by:
TCU internal: U_AU2 < 4V;
TCU external: Can only be recognized on signal side (EF2) -> error 56

System response:
- Output speed (n_Ab) will be substituted from n_Tu / i_Gang
- Hold gear, no gear change
- Increased fuel consumption
- Reduced gearshifting quality
- Limited driving operation
- No NB (Neutral Ready)
- AIS switched off
- Limited engine torque
- Engine brake switched off
- Retarder torque limited
- For gear requests, only gearshifts into "high gears"; after that, downshifts into suitable gear
- Reverse gear only permitted when the brake pressure is high and a forward gear has been engaged (n_Tu=0)
- Shifting pressure adaption switched off
- Increased main pressure
- WK short-term opening and WK closing during gear-shifting locked
- Shifting point calculation based on default values
- Tractive force advance calculation switched off
- Subsequent shift preparation during gearshifting locked
- TOPO switched off

Cancellation condition:

- No output rpm fault
- Ignition off / on

System check:

1. Switch ignition off
2. Unplug transmission electronics
3. Connect connector block between TCU and transmission
4. Switch ignition on
5. Measure voltage between pin 10 (EF2) and pin 15 (AU2) Setpoint value: 5 V
6. Switch ignition off
7. Unplug electronic system
8. Measure resistance between pin 15 (AU2) and ground / housing Setpoint value: >10 mohm
9. Measure resistance between pin 10 (EF2) and ground / housing Setpoint value: >10 mohm

In the event of deviations from the nominal value, check the wiring and the component.

086

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
SAE J1708 BUS_OFF

Internal designation:
SAEJ1708 electronic fault (BUS_OFF error)

Error description:
If an active participant destroys the message or the message cannot be sent 30 times (does not apply when there is a short circuit or interruption)

Error detection by:
TCU / Software

System response:
Limited engine torque

Cancellation condition:
- No SAE J1708 fault
- Speed range selector Neutral + Stop

System check:
Check CAN signals / Check CAN bus system

087

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
SAE J1708 fault during sending / error warning

Internal designation:
SAEJ1708 electric fault during sending (error warning)

Error description:
During sending, an electronic fault was detected on SAE J1708 CAN bus.
Only if message is destroyed or cannot be sent (does not apply in case of short circuit or interruption)

Error detection by:
TCU / Software

System response:
Limited engine torque

Cancellation condition:
- No SAE J1708 fault
- Speed range selector Neutral + Stop

System check:
Check CAN signals / Check CAN bus system

088

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Checksum Area 1587 wrong (EEPROM)

Internal designation:
Checksum Area 1587 wrong (EEPROM)

Error description:
EEProm checksum has been determined wrongly

Error detection by:
Software / if ignition on. One possible cause for this is premature termination of the control unit run following ignition OFF as a result of a premature voltage drop on terminal 30.

System response:
None

Cancellation condition:
Correct data, the checksum is then being recalculated.

System check:
Check customer data, correct

089

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Retarder active without request or engine torque greater than limit value

Internal designation:
Retarder is active while engine torque is greater than limit value and/or without request

Error description:
The retarder is in pull operation and on / active

Error detection by:
Software (Ret_SMON)

System response:
- Retarder request switched off
- AIM_Retarder switched off

Cancellation condition:
New retarder request

System check:
- Check retarder requests
- Check load signal
- Check engine torque

090

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
ER4 oil level sensor U failure below

Internal designation:
ER4 oil level sensor U failure below

Error description:
Failure of the oil level sensor

Error detection by:
TCU - input wiring / software

System response:
???

Cancellation condition:
???

System check:
???

091

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
ER4 oil level sensor U failure above

Internal designation:
ER4 oil level sensor U failure above

Error description:
Failure of the oil level sensor

Error detection by:
TCU - input wiring / software

System response:
???

Cancellation condition:
???

System check:
???

092

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
CAN_A or CAN_B initialization error

Internal designation:
CAN_A / B has an error during initialization

Error description:
CAN_A or CAN_B has an error during initialization (false initial data).
The environment block can read out the CAN that caused the fault.
This is an application error

Error detection by:
Software

System response:
- All current outputs are switched off (ZAE open)
- Neutral / Loss of a gear
- No retarder

Cancellation condition:
- Correct initialization data
- Ignition off/on

System check:
Check CAN initialization data

093

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
CAN_A (vehicle CAN) BUS_OFF / electric fault

Internal designation:
CAN_A has an electronic fault (BUS_OFF- Fehler)

Error description:
Vehicle CAN has BUS_OFF due to an electronic fault (interruption, short circuit, short to ground...)

Error detection by:
TCU; CAN – Controller cannot re-read the written information. Node to bus is not available.

System response:
- Hold gear, no gear change
- Increased fuel consumption
- Reduced gearshifting quality
- Limited driving operation
- No NB (Neutral Ready)
- AIS switched off
- Limited engine torque
- Engine brake switched off
- Retarder torque limited
- Shifting pressure adaption switched off
- Increased main pressure
- WK short-term opening and WK closing during gear-shifting locked
- Shifting point calculation based on default values
- Tractive force advance calculation switched off
- Subsequent shift preparation during gearshifting locked
- TOPO switched off
- Engine control switched off
- N_Mot is replaced by n_Tu
- No enquiry of the load requirement

Cancellation condition:
- No BUS_OFF fault
- Ignition off/on

System check:

- Check software status of devices in the vehicle for topicality and compatibility
- Check CAN bus hardware

094

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
CAN B (ZF_CAN) BUS_OFF / electric fault

Internal designation:
CAN B has electronic fault (BUS_OFF fault) (only for ZF speed range selector)

Error description:
ZF-CAN (CAN_2) has BUS_OFF due to an electric fault (interruption, short circuit, short to ground...)

Error detection by:
TCU; CAN – Controller cannot re-read the written information. Node to bus is not available.

System response:
- All current outputs are switched off (ZAE open)
- Neutral / Loss of a gear
- No retarder
- Limit engine torque to specified value
- If the additional functionality Limp Home is available, then operation can continue in secure mode via PWM.

Cancellation condition:
- No BUS_OFF fault
- Ignition off/on

System check:
- Check software status of devices in the vehicle for topicality and compatibility
- Check CAN bus hardware Setpoint value resistance: 60 ohm

095

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
CAN_A error passive (vehicle CAN)

Internal designation:
CAN A Error Passive (if information is written to CAN but acknowledge is missing)

Error description:
Occurs if the controller can re-read the written information, but does not receive acknowledge.
Occurs with interrupted CAN or EMC.
Error occurs e.g. when CAN is interrupted or there are EMC faults.

Error detection by:
Software / if no acknowledge is read back after writing to CAN

System response:
- Hold gear, no gear change
- Increased fuel consumption
- Reduced gearshifting quality
- Limited driving operation
- No NB (Neutral Ready)
- AIS switched off
- Limited engine torque
- Engine brake switched off
- Retarder torque limited
- Shifting pressure adaption switched off
- Increased main pressure
- WK short-term opening and WK closing during gear-shifting locked
- Shifting point calculation based on default values
- Tractive force advance calculation switched off
- Subsequent shift preparation during gearshifting locked
- TOPO switched off
- Engine control switched off
- N_Mot is replaced by n_Tu
- No enquiry of the load requirement

Cancellation condition:
- No CAN fault
- Ignition off/on

System check:

- Check software status of devices in the vehicle for topicality and compatibility
- Check CAN bus hardware Setpoint value resistance: 60 ohm

096

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
CAN_A (veh. CAN) error warning / error while sending

Internal designation:
CAN A has an electrical fault when sending
(error warning); (for driveline and possibly ZF speed range selector)

Error description:
Error warning. CAN_A has an error when sending messages. Send memory is full.

Error detection by:
Software / If there is no acknowledge, sending is no longer possible and an overflow occurs in the send queue

System response:
- Hold gear, no gear change
- Increased fuel consumption
- Reduced gearshifting quality
- Limited driving operation
- No NB (Neutral Ready)
- AIS switched off
- Limited engine torque
- Engine brake switched off
- Retarder torque limited
- Shifting pressure adaption switched off
- Increased main pressure
- WK short-term opening and WK closing during gear-shifting locked
- Shifting point calculation based on default values
- Tractive force advance calculation switched off
- Subsequent shift preparation during gearshifting locked
- TOPO switched off
- Engine control switched off
- N_Mot is replaced by n_Tu
- No enquiry of the load requirement

Cancellation condition:
- No CAN fault
- Ignition off/on

System check:

- Check software status of devices in the vehicle for topicality and compatibility
- Check CAN bus hardware Setpoint value resistance: 60 ohm

097

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
CAN_B (ZF CAN) error warning / Error while sending

Internal designation:
CAN B has an electric fault when sending (Error warning); (only for ZF speed range selector)

Error description:
Error warning. CAN _B has an error when sending messages. Send memory is full.

Error detection by:
Software / If there is no acknowledge, sending is no longer possible and an overflow occurs in the send queue

System response:
- All current outputs are switched off (ZAE open)
- Neutral / Loss of a gear
- No retarder
- If the additional functionality Limp Home is available, then operation can continue in secure mode via PWM.

Cancellation condition:
- No CAN fault
- Speed range selector Neutral

System check:
- Check software status of devices in the vehicle for topicality and compatibility
- Check CAN bus hardware Setpoint value resistance: 60 ohm

098

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
CAN_B error passive (ZF CAN)

Internal designation:
CAN A Error Passive (if information is written to CAN but acknowledge is missing)

Error description:
Occurs if the controller can re-read the written information, but does not receive acknowledge.
Occurs with interrupted CAN or EMC.
Error occurs e.g. when CAN is interrupted or there are EMC faults.

Error detection by:
Software / if no acknowledge is read back after writing to CAN

System response:
- All current outputs are switched off (ZAE open)
- Neutral / Loss of a gear
- No retarder
- Limited engine torque
- Engine brake switched off
- Retarder torque limited

Cancellation condition:
- No CAN fault
- Speed range selector Neutral

System check:
- Check software status of devices in the vehicle for topicality and compatibility
- Check CAN bus hardware Setpoint value resistance: 60 ohm

099

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Too much positive engagement in NB (Neutral Ready)

Internal designation:
Too much positive engagement in NB (Neutral Ready)

Error description:
If non-permissible reduction of turbine speed is detected in NB, then already one shift element has too much positive engagement

Error detection by:
Neutral when stopped safety monitor (NB_SMON) / Software

System response:
- All current outputs are switched off (ZAE open)
- Neutral / Loss of a gear
- No retarder

Cancellation condition:
- No positive engagement in NB (Neutral Ready)
- Ignition off/on

System check:
Check system for electric faults
Software is to be checked whether it is compatible and up to date.

100

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Slip on locked WK [torque converter lock-up clutch]

Internal designation:
Slip on locked WK [torque converter lock-up clutch]

Error description:
The converter clutch (WK) cannot transmit the applicable torque; the holding torque is too low or the load torque too high.

Error detection by:
MON detects slip if the measured slip exceeds the permissible slip limit value in several back-to-back measurements

System response:
- Limited engine torque
- Engine brake switched off
- Increased main pressure

Cancellation condition:
- No WK slip error
- Ignition off/on

System check:
- Check oil level / oil filter
- Check temperature retarder / converter
- Check CAN load signal
- Check system for rpm errors

101

Error description

Project: EcoLife

Basic program status: AP61_1 / Step 1.1

Error:
Neutral - external via CAN not plausible

Internal designation:
NE_SMON (Neutral safety monitor for rail application)

Error description:
Neutral - external requirement from CAN is not plausible.

Error detection by:
TCU / Software

System response:
- Turns off central cut-off unit (ZAE)
- switch of all power ground outputs (AIM)
- switch to neutral internally
- Reset: Ignition off (reset via neutral not possible with power output errors because ZAE is open and therefore no active diagnosis is possible)

Cancellation condition:
- Neutral requirement via CAN is plausible

System check:

Check vehicle CAN for errors regarding neutral requirement.

102

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Failure of CAN message FMR1 ID 592 (IES) - vehicle engine controller

Internal designation:
Message FMR1 ID 592
Vehicle Engine Controller 1

Error description:
Failure of CAN message FMR1 ID 592 – Vehicle Engine Controller 1 (only with IES)
Transmission rate 10 ms
Error numbers are assigned to the different signals.

Error detection by:
Software / Timeout

System response:
- No NB (Neutral Ready)
- AIS switched off
- Limited engine torque
- Engine brake switched off
- Shifting pressure adaption switched off
- Increased main pressure
- Shifting point calculation based on default values
- Tractive force advance calculation switched off
- Topography switched off

Cancellation condition:
- Message available again
- Ignition off / on
- Neutral + Stop

System check:
- Check CAN hardware
- Check carried out the control unit indicated in the error for correct function, topicality, and compatibility.

103

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Failure of CAN message FMR2 ID 593 - vehicle engine controller 2 (IES)

Internal designation:
Message FMR2 ID 593
Vehicle Engine Controller 2

Error description:
Failure of message FMR2 ID 593 -
Vehicle Engine Controller 2 (only with IES)
Error numbers are assigned to the different signals.

Error detection by:
Software / Timeout

System response:
- No NB (Neutral Ready)
- AIS switched off
- Disable WK (LuC)
- Limited engine torque
- Engine brake switched off
- Retarder switched off
- Keep gear
- Engine control switched off
- Increased main pressure

Cancellation condition:
- Message available again
- Ignition off / on
- Neutral + Stop

System check:
- Check CAN hardware
- Check the control unit indicated in the error for correct function, topicality, and compatibility

104

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Failure of CAN message FMR3 ID 1360 - vehicle engine controller 3

Internal designation:
Message FMR3 ID 1360
Vehicle Engine Controller 3

Error description:
Failure of CAN message FMR3 ID 1360 - Vehicle Engine Controller 3 (only with IES)
Error numbers are assigned to the different signals.

Error detection by:
Software / Timeout

System response:
None, see signals received

Cancellation condition:
none

System check:
- Check CAN hardware
- Check the control unit indicated in the error for correct function, topicality, and compatibility

105

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Failure of CAN message ABS / EPB ID 512 - electric brake controller 1

Internal designation:
Message ABS/ EPB ID 512:
Electric Brake Controller 1

Error description:
Failure of message ABS / EPB ID 512 -
Electric Brake Controller 1 (only for IES)
Error numbers are assigned to the different signals.

Error detection by:
Software / Timeout

System response:
AIS switched off

Cancellation condition:
- Message available again
- Neutral + Stop

System check:
- Check CAN hardware
- Check the control unit indicated in the error for correct function, topicality, and compatibility

106

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Failure of CAN message ABS / EPB ID 1024 - electric brake controller 2

Internal designation:
Message ABS/ EPB ID 1024:
Electric Brake Controller 2

Error description:
Failure of message ABS/EPB ID 1024 -
Electric Brake Controller 2 (only for IES)
Transmission rate 50 ms
Error numbers are assigned to the different signals.

Error detection by:
Software / Timeout

System response:
AIS switched off

Cancellation condition:
- Message available again
- Neutral + Stop

System check:
- Check CAN hardware
- Check the control unit indicated in the error for correct function, topicality, and compatibility

107

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Failure CAN message FPS ID 1448 - freely programmable shift module

Internal designation:
Message FPS ID1448:
Freely programmable shift module

Error description:
Failure of message FPS ID 1448 -
Freely programmable shift module (IES)
Error numbers are assigned to the different signals.

Error detection by:
Software / Timeout

System response:
- AIS switched off
- Limited engine torque
- Retarder switched off
- Shifting pressure adaption switched off

Cancellation condition:
- Message available again
- Neutral + Stop

System check:
- Check CAN hardware
- Check the control unit indicated in the error for correct function, topicality, and compatibility

108

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Failure of CAN message EBC1 - electronic brake controller 1 (from ABS)

Internal designation:
Electronic Brake Controller 1 (to transmission) from ABS
(PGN: 61441 ID: 0x18F0010B)

Error description:
Failure of message EBC1 from ABS.
Transmission rate 100 ms.
Error numbers are assigned to the different signals.

Error detection by:
Software / Timeout

System response:
TOPO deactivated

Cancellation condition:
Neutral + Stop

System check:
- Check CAN hardware
- Check the control unit indicated in the error for correct function, topicality, and compatibility

109

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Failure of CAN message EBC3 - electronic brake controller 3 (from ABS)

Internal designation:
Electronic Brake Controller 3 (to transmission) from ABS
(PGN: 65197 ID: 0x18FEAD0B)

Error description:
Failure of message EBC3 from ABS.
Transmission rate: 100 ms
Error numbers are assigned to the different signals.

Error detection by:
Software / Timeout

System response:
None, see individual signals

Cancellation condition:
none

System check:
- Check CAN hardware
- Check the control unit indicated in the error for correct function, topicality, and compatibility

110

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Failure of CAN message EEC1 - electronic engine controller 2

Internal designation:
Electronic Engine Controller 1 (to transm.)
(PGN: 61444 ID: 0x0CF00400)
Transfer rate: engine speed dependent (> 1000 1/min max. 30 ms)

Error description:
Failure of CAN message EEC1 from engine.
Error numbers are assigned to the different signals.

Error detection by:
Software / Timeout

System response:
- No NB (Neutral Ready)
- AIS switched off
- Disable WK (LuC)
- Limited engine torque
- Engine brake switched off
- Retarder torque limited
- Keep gear
- Shifting pressure adaption switched off
- Increased main pressure

Cancellation condition:
- Message available again
- Ignition off / on
- Neutral + Stop

System check:
- Check CAN hardware
- Check the control unit indicated in the error for correct function, topicality, and compatibility

111

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Failure of CAN message EEC2 - electronic engine controller 2

Internal designation:
Electronic Engine Controller 2 (to transm.)
(PGN: 61443 ID: 0x0CF00300)
Transmission rate: 50 ms

Error description:
Failure of CAN message EEC2 from engine.
Transmission rate 50 ms.
Error numbers are assigned to the different signals.

Error detection by:
Software / Timeout

System response:
- No NB (Neutral Ready)
- AIS switched off
- Limited engine torque
- Engine brake switched off
- Retarder torque limited
- Shifting pressure adaption switched off
- Increased main pressure

Cancellation condition:
- Message available again
- Ignition off / on
- Neutral + Stop

System check:
- Check CAN hardware
- Check the control unit indicated in the error for correct function, topicality, and compatibility

112

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Failure of CAN message EEC3 - electronic engine controller 3

Internal designation:
Electronic Engine Controller 3 (to transm.)
(PGN: 65247 ID: 0x18FEDF00)
Transmission rate: 250 ms

Error description:
Failure of CAN message EEC3
Electronic Engine Controller 3 from engine.
Transmission rate: 250 ms
Error numbers are assigned to the different signals.

Error detection by:
Software / Timeout

System response:
Shifting pressure adaption switched off

Cancellation condition:
- Message available again
- Neutral + Stop

System check:
- Check CAN hardware
- Check the control unit indicated in the error for correct function, topicality, and compatibility

113

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Failure of CAN message ENC - engine configuration

Internal designation:
Engine configuration (to transm.)
(PGN: 65251 ID: 0x18FEE300

Error description:
Failure of message ENC –
Engine configuration from engine.
Error numbers are assigned to the different signals.

Error detection by:
Software / Timeout

System response:
None, see individual signal

Cancellation condition:
none

System check:
- Check CAN hardware
- Check the control unit indicated in the error for correct function, topicality, and compatibility

114

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Failure of CAN message TC1 from Shift Console

Internal designation:
Transm. control from speed range selector (to transm.)
(PGN: 256 ID: 0x0C010305)
Transmission rate: When active: 50 ms to the transmissions and axles

Error description:
Failure of message TC1 from speed range selector.
Error numbers are assigned to the different signals.

Error detection by:
Software / Timeout

System response:
Central switch-off unit open

Cancellation condition:
- Message available again
- Speed range selector Neutral

System check:
- Check CAN hardware
- Check the control unit indicated in the error for correct function, topicality, and compatibility

115

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Failure of CAN message TC1 from ABS/ASR

Internal designation:
Transm. control from ABS/ASR (to transm.)
(PGN: 256 ID: 0x0C01030B)
Transmission rate: When active: 50 ms to the transmissions and axles

Error description:
Failure of CAN message TC1 from ABS/ASR control unit.
Error numbers are assigned to the different signals.

Error detection by:
Software / Timeout

System response:
None, see individual signal

Cancellation condition:
none

System check:
- Check CAN hardware
- Check the control unit indicated in the error for correct function, topicality, and compatibility

116

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Failure of CAN message TC1 from unknown

Internal designation:
Transm. contr. from unknown send. xx (to transm.)
(PGN: 256 ID: 0x0C0103XX)
Transmission rate: When active: 50 ms to the transmissions and axles

Error description:
Failure of CAN message TC1 from unknown sender.
Error numbers are assigned to the different signals.

Error detection by:
Software / Timeout

System response:
None, see individual signal

Cancellation condition:
none

System check:
- Check CAN hardware
- Check the control unit indicated in the error for correct function, topicality, and compatibility

117

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Failure of CAN message ERC1 – electr. eng. ret. controller 1

Internal designation:
Engine brake controller (to transm.) Timeout error
(5.3.3) PGN: 61440 ID: 0x18F0000F Dross.KI.
PGN: 61440 ID: 0x18F00029 Ko.Dross.
Transmission rate: 100 ms

Error description:
Failure of CAN message ERC1 from engine brake controller.
Transmission rate 100 ms.
Error numbers are assigned to the different signals.

Error detection by:
Software / Timeout

System response:
Engine brake switched off

Cancellation condition:
- Message available again
- Neutral + Stop

System check:
- Check CAN hardware
- Check the control unit indicated in the error for correct function, topicality, and compatibility.

118

Error description

Project: EcoLife

Basic program status: AP83 / Step 2

Error:
Failure of CAN message cruise control (CC)/vehicle speed (VS)

Internal designation:
Vehicle computer sends timeout error to transmission
J1939.CC_VS_FROM_CC.Timeout
(PGN: 65265 ID: 0xFEF111 cruise control
(PGN: 65265 ID 0xFEF127 ??)
Transmission rate: 100 ms

Error description:
Failure of CAN message CruiseControl/VehicleSpeed
Transmission rate 100 ms
Error numbers are assigned to the different signals.

Error detection by:
Software / Timeout

System response:
None, see individual signal

Cancellation condition:
none

System check:
- Check CAN hardware
- Check the control unit indicated in the error for correct function, topicality, and compatibility

119

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Constant throttle signal not available (IES)

Internal designation:
Constant throttle signal not available

Error description:
The constant throttle signal is not available.
Signal is contained in message FMR1 ID 592 - Vehicle Engine Controller 1.

Error detection by:
Software

System response:
Engine brake switch-off

Cancellation condition:
Signal available again

System check:
- Check CAN hardware
- Check the control unit indicated in the error for correct function, topicality, and compatibility

120

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Engine speed failure (IES)

Internal designation:
Engine speed signal n_Mot not available

Error description:
Engine speed failure.
The engine speed transmitted by CAN is missing.
The engine speed is contained in messages FMR1 ID 592 - Vehicle Engine Controller 1 (IES-CAN).

Error detection by:
Software

System response:
Will be extracted, depending on state

- No NB (Neutral Ready)
- AIS switched off
- WK (LuC) open
- Limited engine torque
- Increased main pressure
- ZKVK switched off
- Shifting pressure adaption switched off

Cancellation condition:

- Engine speed available again
- Neutral + Stop

System check:

- Check CAN hardware
- Check the control unit indicated in the error for correct function, topicality, and compatibility

121

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Failure engine nominal torque (IES)

Internal designation:
Engine torque nominal value signal (from accelerator pedal) not available

Error description:
The engine nominal torque transmitted by CAN is missing.
The engine nominal torque is contained in message FMR2 ID 593 - Vehicle Engine Controller 2 (IES-CAN).

Error detection by:
Software

System response:
- No NB (Neutral Ready)
- AIS switched off
- Limited engine torque
- Engine brake switch-off
- Retarder torque limited
- Shifting pressure adaption switched off

Cancellation condition:
- Engine torque available again
- Neutral + Stop

System check:
- Check CAN hardware
- Check the control unit indicated in the error for correct function, topicality, and compatibility

122

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Actual value signal of input torque / brake torque not available (IES)

Internal designation:
Actual value signal of input torque / brake torque not available

Error description:
Input torque / brake torque actual value signal failure. The signal is transmitted by CAN.
Contained in message FMR2 ID 593 - Vehicle Engine Controller 2 (IES-CAN).
If the ignition is on, nominal torque will be sent. To determine pressure / engine control / adaption.
If value is positive: engine torque;
If value is negative: Sum of retarder brake torque, engine brake, coasting torque

Error detection by:
Software

System response:
- No NB (Neutral Ready)
- AIS switched off
- Limited engine torque
- Engine brake switched off
- Retarder torque limited
- Shifting pressure adaption switched off
- Increased main pressure

Cancellation condition:
- Signal available again
- Neutral + Stop

System check:
- Check CAN hardware
- Check the control unit indicated in the error for correct function, topicality, and compatibility

123

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Retarder target torque not available via CAN

Internal designation:
Retarder torque (nominal value signal at installation location) not available

Error description:
The target torque of the retarder is not available.
Signal is contained in messag FMR1 ID 593 - Vehicle Engine Controller 2 (IES-CAN).

Error detection by:
Software

System response:
none

Cancellation condition:
none

System check:
- Check CAN hardware
- Check the control unit indicated in the error for correct function, topicality, and compatibility

124

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Current maximum engine torque not available (IES)

Internal designation:
Current maximum engine torque signal not available

Error description:
The signal for the current maximum engine torque is not available.
Signal is contained in message FMR3 ID 1360 - Vehicle Engine Controller 3 (IES-CAN). Signal is needed for load determination / engine guide.

Error detection by:
Software

System response:
Switch off reproduction (adaptation) of engine torque characteristics

Cancellation condition:
Signal available again

System check:
- Check CAN hardware
- Check the control unit indicated in the error for correct function, topicality, and compatibility

125

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Brake nominal value is not available via CAN (IES)

Internal designation:
Brake nominal value signal is not available

Error description:
Brake nominal value is not available via CAN.
Signal included in message ABS/EPB ID 1024:
Electric Brake Controller 2 (IES-CAN) included. Signal is used for gear release and AIS.

Error detection by:
Software

System response:
AIS switched off

Cancellation condition:
- Signal available again
- Neutral + Stop

System check:
- Check CAN hardware
- Check the control unit indicated in the error for correct function, topicality, and compatibility

126

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Signal ABS intervention not available (IES)

Internal designation:
Signal ABS intervention not available

Error description:
The signal ABS intervention is not available via CAN.
Signal included in message ABS/EPB ID 512:
Electric Brake Controller 1.

Error detection by:
Software

System response:
none

Cancellation condition:
Signal available again

System check:
- Check CAN hardware
- Check the control unit indicated in the error for correct function, topicality, and compatibility

127

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Engine torque output in percent is not available via CAN (SAE)

Internal designation:
Engine torque in percent is not available (without friction torque) (J1939. EEC1_FROM_ENGINE.actu_Eng_prcTrq.Wert)

Error description:
The signal of engine output torque in percent is not available via CAN. Included in message EEC1 from engine.

Error detection by:
Software

System response:
- No NB (Neutral Ready)
- AIS switched off
- Limited engine torque
- Engine brake switched off
- Retarder torque limited
- Engine control switched off
- Shifting pressure adaption switched off
- Increased main pressure

Cancellation condition:
- Ignition on / off
- Neutral + Stop

System check:
- Check CAN hardware
- Check the control unit indicated in the error for correct function, topicality, and compatibility

128

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Engine speed not available via CAN (SAE)

Internal designation:
Engine speed signal n_Mot not available (J1939.EEC1_FROM_ENGINE.n_Mot.Wert)

Error description:
The signal engine speed is not available via CAN (SAE).
Signal included in message EEC1 from engine.

Error detection by:
Software

System response:
Signal will be extracted, depending on state

- No NB (Neutral Ready)
- AIS switched off
- WK (LuC) open
- Limited engine torque
- Engine brake switched off
- Shifting pressure adaption is switched off
- Increased main pressure
- Shifting point calculation based on default values
- ZKVK switched off

Cancellation condition:

- Signal available again
- Ignition on / off
- Neutral + Stop

System check:

- Check CAN hardware
- Check the control unit indicated in the error for correct function, topicality, and compatibility

129

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Engine torque requested in percent is not available via CAN (SAE)

Internal designation:
Driver request engine torque in percent not available
(J1939.EEC1_FROM_ENGINE.Drv_Dem_Eng_prcTrq.Wert)

Error description:
The signal for requested engine torque is not available via CAN (SAE). It is included in message EEC1 from engine.

Error detection by:
Software

System response:
- No NB (Neutral Ready)
- AIS switched off
- Limited engine torque
- Engine brake switched off
- Retarder torque limited
- Engine guide switched off during gearshift
- Shifting pressure adaption switched off
- Increased main pressure

Cancellation condition:
- Signal available again
- Ignition off / on
- Neutral + Stop

System check:
- Check CAN hardware
- Check the control unit indicated in the error for correct function, topicality, and compatibility

130

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Engine torque requested in percent is not available via CAN (SAE)

Internal designation:
Driver request engine torque in percent not available
(J1939.EEC1_FROM_ENGINE.Drv_Dem_Eng_prcTrq.Wert)

Error description:
The signal for requested engine torque is not available via CAN (SAE). It is included in message EEC1 from engine.

Error detection by:
Software

System response:
- No NB (Neutral Ready)
- AIS switched off
- Limited engine torque
- Engine brake switched off
- Retarder torque limited
- Engine guide switched off during gearshift
- Shifting pressure adaption switched off
- Increased main pressure

Cancellation condition:
- Signal available again
- Ignition off / on
- Neutral + Stop

System check:
- Check CAN hardware
- Check the control unit indicated in the error for correct function, topicality, and compatibility

131

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Engine torque in percent at current speed is not available (SAE)

Internal designation:
Engine torque in percent at current speed is not available (J1939.EEC2_FROM_ENGINE.prcLoad_at_current_Speed.Wert)

Error description:
Engine torque in percent at current speed is not available via CAN (SAE). Signal included in message EEC2 from engine.

Error detection by:
Software

System response:
Engine guide switched off during gearshift

Cancellation condition:
Signal available again

System check:
- Check CAN hardware
- Check the control unit indicated in the error for correct function, topicality, and compatibility

132

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Friction torque in percent is not available via CAN (SAE)

Internal designation:
Friction torque signal in percent not available (J1939.EEC3_FROM_ENGINE.
nom_friction_prcTrq.Wert)

Error description:
The engine friction torque in percent is not available via CAN. It is included in message EEC3 from engine.

Error detection by:
Software

System response:
The default value is used.

Cancellation condition:
Signal available again

System check:
- Check CAN hardware
- Check the control unit indicated in the error for correct function, topicality, and compatibility

133

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
The engine reference torque is not available via CAN or outside of the specification window (SAE)

Internal designation:
Engine reference torque signal not available or value outside of the specification window (J1939. ENGINE_CONFIG. Ref_Eng_Trq. Wert)

Error description:
The engine reference torque is not available via CAN or outside of the specification window. Signal included in message ENC from engine.

Error detection by:
Software

System response:
The last valid value is used.

Cancellation condition:
Signal available again

System check:
- Check CAN hardware
- Check the control unit indicated in the error for correct function, topicality, and compatibility

134

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Directional signal (V/N/R) from speed range selector not available via CAN (SAE)

Internal designation:
CAN speed range selector directional signal (V/N/R) not available.

Error description:
Driving direction signal (V/N/R) from speed range selector not available via CAN (SAE). The driving direction signal is included in message TC1 from the control switch group (Requested Gear).

Error detection by:
Software

System response:
- All current outputs are switched off (ZAE open)
- Neutral / Loss of a gear
- No retarder

Cancellation condition:
- Signal available again
- Neutral + Stop

System check:
- Check CAN hardware
- Check the control switch group for correct function, topicality, and compatibility.

135

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
CAN speed range selector key signal not available via CAN (SAE)

Internal designation:
CAN speed range selector key signal not available
(J1939. TC1_FROM_SC. req_Range. Wert)

Error description:
The speed range selector key signal is not available via CAN. Signal included in message TC1 from speed range selector (Transm. Requested Range).

Error detection by:
Software

System response:
- All current outputs are switched off (ZAE open)
- Neutral / Loss of a gear
- No retarder

Cancellation condition:
- Signal available again
- Speed range selector Neutral

System check:
- Check CAN hardware
- Check the control switch group for correct function, topicality, and compatibility.

136

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Engine brake control mode signal not available (SAE)

Internal designation:
Engine brake control mode signal not available
(J1939. ERC1_FROM_ENGRET. EngRet_TrqMode. Wert)

Error description:
The signal for engine brake control mode is not available. Signal is included in message ERC1 from engine brake electronics.

Error detection by:
Software

System response:
Engine brake switched off

Cancellation condition:
Signal available again

System check:
- Check CAN hardware
- Check the control unit indicated in the error for correct function, topicality, and compatibility

137

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Engine torque in percent not available (SAE)

Internal designation:
Requested engine brake torque signal in percent not available (J1939. ERC1_FROM_ENGRET. actu_EngRet_prcTrq.Wert)

Error description:
The signal of engine brake torque in percent is not available. It is included in message ERC1 (Actual Retarder - Percent Torque) from the engine brake electronics.

Error detection by:
Software

System response:
Engine brake switched off

Cancellation condition:
Signal available again

System check:
- Check CAN hardware
- Check the control unit indicated in the error for correct function, topicality, and compatibility

138

Error description

Project: EcoLife

Basic program status: AP83 / Step 2

Error:
Parking brake signal not available (SAE)

Internal designation:
Switch for parking brake signal not available,
J1939.CC_VS_FROM_CC.Parking_Brake_Switch_Sig

Error description:
The parking brake signal is not available. It is included in message CC/VS (Parking Brake Switch) from the vehicle computer.

Error detection by:
Software

System response:
none

Cancellation condition:
Signal available again

System check:
- Check CAN hardware
- Check signal transmitter
- Check the control unit indicated in the error for correct function, topicality, and compatibility

139

Error description

Project: EcoLife

Basic program status: AP83 / Step 2

Error:
Brake switch signal not available via CAN (SAE)

Internal designation:
Switch for brake signal not available (J1939.CC_VS_FROM_CC.Brake_Switch_Sig)

Error description:
The signal of the brake switch is not available via CAN. It is included in message CC/VS (Brake Switch) from the vehicle computer.

Error detection by:
Software

System response:
none

Cancellation condition:
Signal available again

System check:
- Check CAN hardware
- Check signal transmitter
- Check the control unit indicated in the error for correct function, topicality, and compatibility

140

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Signal ASR engine control active is not available (SAE)

Internal designation:
Signal ASR engine control active is not available (J1939. EBC1_FROM_ABS. ASR_Eng_Ctrl_active.Wert)

Error description:
Signal ASR engine control active is not available. It is included in message EBC1 (ASR Engine Control Active) from the ABS control unit.

Error detection by:
Software

System response:
none

Cancellation condition:
Signal available again

System check:
- Check CAN hardware
- Check the control unit indicated in the error for correct function, topicality, and compatibility

141

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Signal ABS active is not available (SAE)

Internal designation:
Signal ABS active is not available (J1939. EBC1_FROM_ABS. ABS_active.Wert)

Error description:
The signal ABS active is not available via CAN. It is included in message EBC1 (Anti-lock Braking (ABS) Active) from the ABS control unit.

Error detection by:
Software

System response:
none

Cancellation condition:
Signal available again

System check:
- Check CAN hardware
- Check the control unit indicated in the error for correct function, topicality, and compatibility

142

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Brake pedal position in percent not available (SAE)

Internal designation:
Signal for brake pedal position in percent not available (J1939. EBC1_FROM_ABS. Brake_Pedal_Position.Wert)

Error description:
The brake pedal position in percent signal is not available via CAN. It is included in message EBC1 (Brake Pedal Position) from the ABS control unit.

Error detection by:
Software

System response:
TOPO deactivated

Cancellation condition:
Signal available again

System check:
- Check CAN hardware
- Check the control unit indicated in the error for correct function, topicality, and compatibility

143

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
CAN_A sending error

Internal designation:
CAN A TX sending error

Error description:
Occurs when messages cannot be sent.

Error detection by:
When acknowledge is missing.
Sending is then no longer possible and an overflow occurs in the send queue.

System response:
- No NB (Neutral Ready)
- AIS switched off
- Limited engine torque
- Engine brake switched off
- Retarder torque limited
- Engine guide switched off during gearshift
- WK opening and closing blocked during gear changes

Cancellation condition:
- No CAN_A sending error
- Ignition off/on

System check:
- Check CAN hardware
- Check the control unit indicated in the error for correct function, topicality, and compatibility

144

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
CAN_B sending error

Internal designation:
CAN B TX sending error

Error description:
Occurs when messages cannot be sent.

Error detection by:
When acknowledge is missing.
Sending is then no longer possible and an overflow occurs in the send queue.

System response:
- Limited engine torque
- Engine brake switched off
- Retarder torque limited

Cancellation condition:
- No CAN_B sending error
- Speed range selector Neutral + Stop

System check:
- Check CAN hardware
- Check the control unit indicated in the error for correct function, topicality, and compatibility

145

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Failure of CAN message TSC1 – torque/speed control 1 from cruise control to retarder (SAE)

Internal designation:
Transm. electr. retarder limiter (to retarder) timeout error
(PGN: 0 ID: 0x0C001011 cruise control)

Error description:
Timeout of message TSC1 (Torque/Speed Control 1 to Retarder) from cruise control to retarder is not available via CAN.
Transmission rate 50 ms if active.
Error numbers are assigned to the different signals.

Error detection by:
Software

System response:
none

Cancellation condition:
- Signal available again
- New retarder request

System check:
- Check CAN hardware
- Check the control unit indicated in the error for correct function, topicality, and compatibility

146

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Failure of CAN message TSC1 – torque/speed control 1 from ABS/ASR to retarder (SAE)

Internal designation:
Transm. electr. retarder limiter (to retarder) timeout error
(PGN: 0 ID: 0x0C00100B ABS/ASR)

Error description:
Timeout of message TSC1 (torque/speed control 1 to retarder) from ABS/ASR to retarder is not available via CAN.
Transmission rate 50 ms if active.
Error numbers are assigned to the different signals.

Error detection by:
Software

System response:
none

Cancellation condition:
none

System check:
- Check CAN hardware
- Check the control unit indicated in the error for correct function, topicality, and compatibility

147

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Timeout configuration engine brake (to transmission) (SAE)

Internal designation:
Engine brake configuration (to transm.) timeout error
(PGN: 65249 ID: 0 x18FEE10F Dross.Kl.
PGN: 65249 ID: 0x18FEE129 Ko.Dross.)
Transmission rate: on request

Error description:
Timeout of message RC (Eng. retarder configuration) from engine brake to transmission is not available via CAN.
Transmission rate upon request.
Error numbers are assigned to the different signals.

Error detection by:
Software

System response:
none

Cancellation condition:
Signal available again

System check:
- Check CAN hardware
- Check the control unit indicated in the error for correct function, topicality, and compatibility

148

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
J1939.VDC1_FROM_ABS.Timeout (Vehicle Dynamic Stability Control) (SAE)

Internal designation:
J1939.VDC1_FROM_ABS.Timeout (Vehicle Dynamic Stability Control)

Error description:
Message VDC1 is not available via CAN.

Error detection by:
Software

System response:
none

Cancellation condition:
Signal available again

System check:
- Check CAN hardware
- Check the control unit indicated in the error for correct function, topicality, and compatibility

149

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Timeout of time/date message (SAE)

Internal designation:
Time/date Timeout error
(PGN: 65254 ID: 18FEE617 Instrument Cluster)
Transmission rate: on request

Error description:
Message TD (Time Date) is not available via CAN.
The instrument cluster only sends the message upon request.
The error becomes apparent in the environment block if the information is missing.

Error detection by:
Software

System response:
Wrong time stamp in environment block

Cancellation condition:
Signal available again

System check:
- Check CAN hardware
- Check the control unit indicated in the error for correct function, topicality, and compatibility

150

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Timeout odometer reading (SAE)

Internal designation:
Odometer Timeout error HRVD
(PGN: 65217 ID: 18FEC1??)
Transmission rate: 1000 ms

Error description:
The message VDHR (High Resolution Vehicle Distance) is not available via CAN. Transmission rate 1000ms.

Error detection by:
Software

System response:
Faulty odometer reading in environment block and statistic memory

Cancellation condition:
Signal available again

System check:
- Check CAN hardware
- Check the control unit indicated in the error for correct function, topicality, and compatibility

151

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Reference torque of engine brake in Nm missing (SAE)

Internal designation:
Engine brake torque reference signal in Nm not available (J1939.ENGRETCFG.Ref_EngRet_Trq.Wert)

Error description:
The signal is not available via CAN. It is included in message RC (Reference Retarder Torque) from the control unit of the engine brake.

Error detection by:
Software

System response:
None

Cancellation condition:
Signal available again

System check:
- Check CAN hardware
- Check the control unit indicated in the error for correct function, topicality, and compatibility

152

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Retarder limit / torque requested by cruise control is missing (SAE)

Internal designation:
Requested signal for retarder torque/limit in percent not available (J1939. TSC1_FROM_CC.req_Trq_TrqLim_CC.Wert)

Error description:
The torque / limit requested from retarder by the cruise control (Retarder Requested Torque/Torque Limit) is not available via CAN. It is included in message TSC1 to the retarder.

Error detection by:
Software

System response:
None

Cancellation condition:
none

System check:
- Check CAN hardware
- Check the control unit indicated in the error for correct function, topicality, and compatibility.

153

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Retarder limit / torque in percent requested by ABS is missing (SAE)

Internal designation:
Requested signal for retarder limit / torque in percent is not available (J1939. TSC1_FROM_ABS.req_Trq_TrqLim_ABS.Wert)

Error description:
The torque / limit in percent requested from retarder by the ABS (Retarder Requested Torque/Torque Limit) is not available via CAN. It is included in message TSC1 to the retarder.

Error detection by:
Software

System response:
None

Cancellation condition:
none

System check:
- Check CAN hardware
- Check the control unit indicated in the error for correct function, topicality, and compatibility.

154

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Slip reduction during gearshifts too low

Internal designation:
Slip reduction during gearshifts too low

Error description:
Detects the slip reduction to be expected during gearshifts. If the additional pressure is faulty, the monitor is never triggered, since the controller immediately increases the shifting pressure, which also increases the main pressure.

Error detection by:
Software / The safety monitor of slip development (n_Verl_SMON) reports an error: expected slip reduction does not happen

System response:
- No NB (Neutral Ready)
- AIS switched off
- Hold gear, no gear change
- Putting in gear is locked

Cancellation condition:
- Correct slip reduction during gear change
- Ignition off / on

System check:
- Check oil level
- Check oil filter
- Check system for rpm errors

155

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Checksum EEPROM incorrect

Internal designation:
Checksum in customer data range incorrect (EEPROM)

Error description:
EEprom checksum is false.

Error detection by:
Software, if ignition on. One possible cause for this is premature termination of the control unit run following ignition OFF as a result of a premature voltage drop on terminal 30.

System response:
none

Cancellation condition:
none

System check:
- EEProm settings
- Voltage supply of the control unit
- Software up to date, compatibility

156

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Composite error for TCU hardware (internal)

Internal designation:
TCU-internal composite error for hardware

Error description:
Composite error for TCU-internal hardware errors

Error detection by:
TCU / Software

System response:
- Central cut-off unit (ZAE) open
- Neutral
- No retarder

Cancellation condition:
- No TCU hardware fault
- Ignition off/on

System check:
Check the TCU

157

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Composite error for TCU software (internal)

Internal designation:
TCU-internal composite error for software

Error description:
Composite error for TCU-internal software errors

Error detection by:
TCU / Software

System response:
- Central cut-off unit (ZAE) open
- Neutral
- No retarder

Cancellation condition:
- No TCU hardware fault
- Ignition off/on

System check:
Check software status
Check the TCU
Check EEPROM parameters for plausiblity, EEPROM can contain incorrect or implausible values

158

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
TCU-internal error information 1, warning only

Internal designation:
TCU internal error information 1

Error description:
Control unit internal error information. This is only a warning e.g. program overrun

Error detection by:
TCU / Software

System response:
none

Cancellation condition:
none

System check:
Check software status
Check the TCU
Check EEPROM parameters for plausiblity, EEPROM can contain incorrect or implausible values

159

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
TCU-internal error information 2, warning only

Internal designation:
TCU internal error information 2

Error description:
Control unit internal error information. This is only a warning e.g. program overrun

Error detection by:
TCU / Software

System response:
none

Cancellation condition:
none

System check:
Check software status
Check the TCU
Check EEPROM parameters for plausiblity, EEPROM can contain incorrect or implausible values

160

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
TCU-internal error information 3, warning only

Internal designation:
TCU internal error information 3

Error description:
Control unit internal error information. This is only a warning e.g. program overrun

Error detection by:
TCU / Software

System response:
none

Cancellation condition:
none

System check:
Check software status
Check the TCU
Check EEPROM parameters for plausiblity, EEPROM can contain incorrect or implausible values

161

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
TCU internal error information 4, warning only

Internal designation:
TCU internal error information 4

Error description:
Control unit internal error information. This is only a warning e.g. program overrun

Error detection by:
TCU / Software

System response:
none

Cancellation condition:
none

System check:
Check software status
Check the TCU
Check EEPROM parameters for plausiblity, EEPROM can contain incorrect or implausible values

162

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
TCU internal error information 5, warning only

Internal designation:
TCU internal error information 5

Error description:
Control unit internal error information. This is only a warning e.g. program overrun

Error detection by:
TCU / Software

System response:
none

Cancellation condition:
none

System check:
Check software status
Check the TCU
Check EEPROM parameters for plausiblity, EEPROM can contain incorrect or implausible values

163

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Failure of turbine speed (n_Tu) and output speed (n_Ab)

Internal designation:
n_Tu and n_Ab failed

Error description:
Failure of turbine rpm (n_Tu) and failure of output rpm (n_Ab)

Error detection by:
- Readback channel
- Output stage of TCU (TREX)
- Rpm drop to 0Hz in x seconds only possible when driving
- Output stage of the TCU (TREX) signals a hardware failure

System response:
Will be extracted differently, depending on state (see error matrix).
- No NB (Neutral Ready)
- AIS switched off
- Disable WK lockup (quickly, without delay ramps)
- Limited engine torque
- Switch off engine brake
- Retarder request switched off and AIM_Retarder switched off
- Keep gear
- Lock gearshifts from Neutral to Reverse
- If a gear is requested, speed range selector shifts into "high gear"
- Shifting pressure of WK (LuC) close controlled only
- Switch off shift pressure adaptation (gear change); continue to use last values
- Neutral-Immediately if shifting into Neutral (without delay and holding ramps); applies to stationary and driving vehicle
- Increase main pressure to specified value
- WK short-term opening and WK closing during gear-shifting locked
- Shifting point calculation based on default values;
- Switch off tractive force advance calculation;
- Lock subsequent shift preparation during gearshifts;
- Switch off TOPO

Cancellation condition:
- No rpm error
- Neutral + Stop
- Ignition off/on

System check:

1. Switch ignition off
2. Unplug transmission electronics
3. Connect connector block between TCU and transmission
4. Switch ignition on
5. Measure voltage between pin 10 (EF2) and pin 15 (AU2) Setpoint value: 5V
6. Measure voltage between pin 2 (EF1) and pin 6 (AU1) Setpoint value: 5V
7. Switch ignition off
8. Unplug electronic system
9. Measure resistance between pin 15 (AU2) and ground / housing Setpoint value: >10 mohm
10. Measure resistance between pin 10 (EF2) and ground / housing Setpoint value: >10 mohm
11. Measure resistance between pin 6 (AU1) and ground / housing Setpoint value: >10 mohm
12. Measure resistance between pin 2 (EF1) and ground / housing Setpoint value: >10 mohm

In the event of deviations from the nominal value, check the wiring, the component, and the TCU.

164

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Failure of turbine speed (n_Tu) and engine speed (n_Mot)

Internal designation:
n_Tu and n_Mot failed

Error description:
Failure of turbine rpm (n_Tu) and failure of engine rpm (n_Mot)

Error detection by:
- Readback channel
- Output stage of TCU (TREX)
- Rpm drop to 0Hz in x seconds only possible when driving
- Output stage of the TCU (TREX) signals a hardware failure
- Failure CAN message

System response:
Will be extracted differently, depending on state (see error matrix).
- No NB (Neutral Ready)
- AIS switched off
- Disable WK lockup (quickly, without delay ramps)
- Limited engine torque
- Switch off engine brake
- Retarder request switched off and AIM_Retarder switched off
- Keep gear
- Switch off shift pressure adaptation (gear change); continue to use last values
- Neutral-Immediately if shifting into Neutral (without delay and holding ramps); applies to stationary and driving vehicle
- Increase main pressure to specified value
- WK short-term opening and WK closing during gear-shifting locked
- Shifting point calculation based on default values
- Switch off tractive force advance calculation
- Lock subsequent shift preparation during gearshifts
- Switch off TOPO

Cancellation condition:
- No rpm error
- Neutral + Stop
- Ignition off/on

System check:

1. Switch ignition off
2. Unplug transmission electronics
3. Connect connector block between TCU and transmission
4. Switch ignition on
5. Measure voltage between pin 2 (EF1) and pin 6 (AU1) Setpoint value: 5V
6. Switch ignition off
7. Unplug electronic system
8. Measure resistance between pin 6 (AU1) and ground / housing Setpoint value: >10 mohm
9. Measure resistance between pin 2 (EF1) and ground / housing Setpoint value: >10 mohm
10. Check the source of signals of the engine speed

In the event of deviations from the nominal value, check the wiring, the component, and the TCU.

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Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Failure of engine speed (n_Mot) and output speed (n_Ab)

Internal designation:
n_Mot and n_Ab failed

Error description:
Failure of engine rpm (n_Mot) and failure of output rpm (n_Ab)

Error detection by:
- Readback channel
- Output stage of TCU (TREX)
- Rpm drop to 0Hz in x seconds only possible when driving
- Output stage of the TCU (TREX) signals a hardware failure
- Failure CAN message

System response:
Will be extracted differently, depending on state. (See error matrix)
- No NB (Neutral Ready)
- AIS switched off
- Disable WK lockup (quickly, without delay ramps)
- Limited engine torque
- Switch off engine brake
- Retarder request switched off and AIM_Retarder switched off
- Keep gear
- Reverse gear only permitted when the brake pressure is high and a forward gear has been engaged (n_Tu=0)
- If gear request from speed range selector, shift into "high gear"
- Switch off shift pressure adaptation (gear change); continue to use last values
- Neutral-Immediately if shifting into Neutral (without delay and holding ramps); applies to stationary and driving vehicle
- Increase main pressure to specified value
- WK short-term opening and WK closing during gear-shifting locked
- Shifting point calculation based on default values
- Switch off tractive force advance calculation
- Lock subsequent shift preparation during gearshifts
- Switch off TOPO

Cancellation condition:

- No rpm error
- Neutral + Stop
- Ignition off/on

System check:

1. Switch ignition off
2. Unplug transmission electronics
3. Connect connector block between TCU and transmission
4. Switch ignition on
5. Measure voltage between pin 10 (EF2) and pin 15 (AU2) Setpoint value: 5V
6. Switch ignition off
7. Unplug electronic system
8. Measure resistance between pin 15 (AU2) and ground / housing Setpoint value: >10 mohm
9. Measure resistance between pin 10 (EF2) and ground / housing Setpoint value: >10 mohm
10. Check the source of signals of the engine speed

In the event of deviations from the nominal value, check the wiring, the component, and the TCU.

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Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Pressure adaptation offset if upshifts higher than limit value

Internal designation:
p_Adapt offset during upshift is greater than specified limit value

Error description:
Offset of shifting pressure adaption for upshifts is greater than a given limit value. This is a **reference warning** to prevent a mechanical defect.

Error detection by:
If adaption is active through software (pressure adaption offset > limit value during upshift)

System response:
none

Cancellation condition:
Pressure adaption offset < limit value

System check:
- Check oil level / oil filter
- Check main pressure
- Check shifts with data logger

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Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Pressure adaptation offset if downshifts greater than limit value

Internal designation:
p_Adapt offset during downshifts is greater than specified limit value

Error description:
Offset of shifting pressure adaption for downshifts is greater than a given limit value. This is a **reference warning** to prevent a mechanical defect.

Error detection by:
If adaption is active through software (pressure adaption offset > limit value during downshift)

System response:
none

Cancellation condition:
Pressure adaption offset < limit value

System check:
- Check oil level / oil filter
- Check main pressure
- Check shifts with data logger

168

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Pressure adaptation system limit for upshifts exceeded

Internal designation:
p_Adapt offset for during upshifts can no longer be performed because system limit was exceeded

Error description:
Offset for pressure adaption for upshifts has **exceeded the system limit**.

Error detection by:
Only possible with active adaption via software

System response:
The adaption uses the last valid value

Cancellation condition:
Pressure adaption - offset < system limit

System check:
- Check oil level / oil filter
- Check main pressure
- Check shifts with data logger

169

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Pressure adaptation system limit for downshifts exceeded

Internal designation:
p_Adapt offset for during downshifts can no longer be performed because system limit was exceeded

Error description:
Offset for pressure adaption for downshifts has **exceeded the system limit.**

Error detection by:
Only possible with active adaption via software

System response:
The adaption uses the last valid value

Cancellation condition:
Pressure adaption - offset < system limit

System check:
- Check oil level / oil filter
- Check main pressure
- Check shifts with data logger

170

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Speed range selector internal system error

Internal designation:
Speed range selector internal system error

Error description:
Speed range selector internal composite error: e.g. Watchdog etc.

Error detection by:
Transmit speed range selector via CAN to TCU

System response:
- Turns off central cut-off unit (ZAE)
- Neutral / Loss of a gear
- No retarder

Cancellation condition:
- No speed range selector error
- Speed range selector Neutral

System check:
Check speed range selector function,
check speed range selector wiring

171

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Speed range selector inputs / outputs (I/O)

Internal designation:
CAN messages of digital inputs and additional information from the speed range selector: Timeout errors

Error description:
CAN messages of digital inputs and additional information from the speed range selector have Timeout errors.
Speed range selector internal I_O composite error: Send / receive CAN

Error detection by:
Speed range selector / TCU software

System response:
See individual signal / error matrix

Cancellation condition:
- No speed range selector error
- See individual signal

System check:
Check speed range selector function
Check ZF-CAN hardware

1. Switch ignition off
2. Connect connector block between TCU and vehicle
3. Measure resistance of CAN bus (pin 2 to pin 11) Setpoint value: 60 ohm

In the event of deviations from the nominal value, check the wiring and the function of the speed range selector

172

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Range selector inputs are digital

Internal designation:
Digital input channels of the speed range selector defective (ADC converter defective)

Error description:
Digital input channels of the speed range selector defective (ADC converter defective)

Error detection by:
Speed range selector / TCU software
Speed range selector internal ED collective error: Digital signal is read by an analog input. Use test voltage to check if error detection of ADC converter is working

System response:
See individual signal

Cancellation condition:
- No speed range selector error
- See individual signal

System check:
Check speed range selector function / input signals

173

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
System error E-Box

Internal designation:
E-Box system error

Error description:
A system error has occurred on the E-Box (converter of digital and analog signals from/to CAN)

Error detection by:
E-Box reports error to TCU

System response:
See individual signal

Cancellation condition:
- No E-Box error
- See individual signal

System check:
Check E-Box
Check input and output signals

174

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Digital output of gear signal of driving switch or E-Box faulty

Internal designation:
Speed range selector/E-box detects error on the digital output of gear signal
interruption; short to GND; short to Plus

Error description:
Speed range selector or the E-box detects error at the digital output of the gear signal.
Possible causes:
interruption; short to GND; short to Plus

Error detection by:
The speed range selector / E-Box detects the error based on failure limits received from the TCU and transmits the calculated error status back to the TCU.
Limit values (applicable):
Interruption 50 % U_Nenn
Short on Plus > 80 % U_Nenn
Short to GND < 20 % U_Nenn

System response:
None

Cancellation condition:
- No speed range selector / E-Box error
- No short circuit / interruption

System check:
Check relay of gear signal
Check wiring

175

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Digital output of gear signal of speed range or E-Box faulty

Internal designation:
Speed range selector / E-box detects error on the digital output of starter lock signal interruption; short to GND; short to Plus

Error description:
Speed range selector or the E-box detects error at the digital output of the starter lock signal.
Possible causes:
interruption; short to GND; short to Plus

Error detection by:
The speed range selector / E-Box detects the error based on failure limits received from the TCU and transmits the calculated error status back to the TCU.
Limit values (applicable):
Interruption 50 % U_Nenn
Short on Plus > 80 % U_Nenn
Short to GND < 20 % U_Nenn

System response:
Engine start may not be possible

Cancellation condition:
- No speed range selector / E-Box error
- No short circuit / interruption

System check:
Check relay of starter lock
Check wiring

176

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Digital output of gear signal of speed range or E-Box faulty

Internal designation:
Speed range selector / E-box detects error on the digital output of reverse gear signal interruption; short to GND short to Plus

Error description:
Speed range selector or the E-box detects error at the digital output of the reverse gear signal.
Possible causes:
interruption; short to GND; short to Plus

Error detection by:
The speed range selector / E-Box detects the error based on failure limits received from the TCU and transmits the calculated error status back to the TCU.
Limit values (applicable):
Interruption 50 % U_Nenn
Short on Plus > 80 % U_Nenn
Short to GND < 20 % U_Nenn

System response:
none

Cancellation condition:
- No speed range selector / E-Box error
- No short circuit / interruption

System check:
Check reverse gear relay
Check wiring

177

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Current of pressure regulator A (DR_A) > 7 mA without request

Internal designation:
DR_A actual current > 0 if request = 0

Error description:
Current from pressure regulator A (DR_A) should be 0 mA but is higher.

Error detection by:
actual current > 7 mA if target current = 0 mA
(If the current regulator (TREX) activates the output independently)

System response:
- All current outputs are switched off (ZAE open)
- Neutral / Loss of a gear
- No retarder

Cancellation condition:
- No pressure regulator error
- Ignition off/on

System check:
Check the TCU

178

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Current of pressure regulator B (DR_B) > 7 mA without request

Internal designation:
DR_V actual current > 0 if request = 0

Error description:
Current from pressure regulator B (DR_B) should be 0 mA but is higher.

Error detection by:
actual current > 7 mA if target current = 0 mA
(If the current regulator (TREX) activates the output independently)

System response:
- All current outputs are switched off (ZAE open)
- Neutral / Loss of a gear
- No retarder

Cancellation condition:
- No pressure regulator error
- Ignition off/on

System check:
Check the TCU

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Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Current of pressure regulator D (DR_D) > 7 mA without request

Internal designation:
DR_D actual current > 0 if request = 0

Error description:
Current from pressure regulator D (DR_D) should be 0 mA but is higher.

Error detection by:
actual current > 7 mA if target current = 0 mA
(If the current regulator (TREX) activates the output independently)

System response:
- All current outputs are switched off (ZAE open)
- Neutral / Loss of a gear
- No retarder

Cancellation condition:
- No pressure regulator error
- Ignition off/on

System check:
Check the TCU

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Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Current of pressure regulator E (DR_E) > 7 mA without request

Internal designation:
DR_E actual current > 0 if request = 0

Error description:
Current from pressure regulator E (DR_E) should be 0 mA but is higher.

Error detection by:
actual current > 7 mA if target current = 0 mA
(If the current regulator (TREX) activates the output independently)

System response:
- All current outputs are switched off (ZAE open)
- Neutral / Loss of a gear
- No retarder

Cancellation condition:
- No pressure regulator error
- Ignition off/on

System check:
Check the TCU

181

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Current of pressure regulator F (DR_F) > 7 mA without request

Internal designation:
DR_F actual current > 0 if request = 0

Error description:
Current from pressure regulator F (DR_F) should be 0 mA but is higher.

Error detection by:
actual current > 7 mA if target current = 0 mA
(If the current regulator (TREX) activates the output independently)

System response:
- All current outputs are switched off (ZAE open)
- Neutral / Loss of a gear
- No retarder

Cancellation condition:
- No pressure regulator error
- Ignition off/on

System check:
Check the TCU

182

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Current of pressure regulator WK [torque converter lock-up clutch] (DR_WK) > 7 mA without request

Internal designation:
DR_WK actual current > 0 if request = 0

Error description:
Current from pressure regulator WK (DR_WK) should be 0 mA but is higher.

Error detection by:
actual current > 7 mA if target current = 0 mA
(If the current regulator (TREX) activates the output independently)

System response:
- All current outputs are switched off (ZAE open)
- Neutral / Loss of a gear
- No retarder

Cancellation condition:
- No pressure regulator error
- Ignition off/on

System check:
Check the TCU

183

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Current of main pressure regulator (DR_HD) > 7 mA without request

Internal designation:
DR_HD actual current > 0 if request = 0

Error description:
Current from main pressure regulator (DR_HD) should be 0 mA but is higher.

Error detection by:
actual current > 0 mA if target current = 0 mA (If the current regulator (TREX) activates the output independently)

System response:
- All current outputs are switched off (ZAE open)
- Neutral / Loss of a gear
- No retarder

Cancellation condition:
- No pressure regulator error
- Ignition off/on

System check:
Check the TCU

184

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Current of pressure regulator for retarder (DR_Ret) > 7 mA without request

Internal designation:
DR_Ret actual current > 0 if request = 0

Error description:
Current from pressure regulator for retarder (DR_Ret) should be 0 mA but is higher.

Error detection by:
actual current > 7 mA if target current = 0 mA
(If the current regulator (TREX) activates the output independently)

System response:
- All current outputs are switched off (ZAE open)
- Neutral / Loss of a gear
- No retarder

Cancellation condition:
- No pressure regulator error
- Ignition off/on

System check:
Check the TCU

185

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Current of pressure regulator for PTO (DR_NA) > 7 mA without request

Internal designation:
DR_NA actual current > 0 if request = 0

Error description:
Current from pressure regulator for PTO (DR_NA) should be 0 mA but is higher.

Error detection by:
actual current > 7 mA if target current = 0 mA
(If the current regulator (TREX) activates the output independently)

System response:
- All current outputs are switched off (ZAE open)
- Neutral / Loss of a gear
- No retarder

Cancellation condition:
- No pressure regulator error
- Ignition off/on

System check:
Currently there is no PTO installed.

186

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Current of pressure regulator G (DR_G) > 7 mA without request

Internal designation:
DR_G actual current > 0 if request = 0

Error description:
Current from pressure regulator G (DR_G) should be 0 mA but is higher.

Error detection by:
actual current > 7 mA if target current = 0 mA
(If the current regulator (TREX) activates the output independently)

System response:
- All current outputs are switched off (ZAE open)
- Neutral / Loss of a gear
- No retarder

Cancellation condition:
- No pressure regulator error
- Ignition off/on

System check:
None yet, since a version with G-valve is not feasible at this point.

187

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Gear not plausible relative to driving direction signal from speed range selector

Internal designation:
Actual gear not plausible relative to checked driving direction signal (V/N/R) from speed range selector (Check actual gear calculation for software errors from VR_SMON)

Error description:
The forward-reverse safety monitor
(VR_SMON) reports an error. Check whether driving direction signal matches "actual gear".
This is to detect software errors. A plausibility check of the driving direction signal has already been performed.

Error detection by:
Forward-reverse safety monitor (VR_SMON) in software

System response:
- All current outputs are switched off (ZAE open)
- Neutral / Loss of a gear
- No retarder

Cancellation condition:
- Plausible driving direction signal relative to gear
- Speed range selector Neutral

System check:
Check software status

188

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Slip in fixed gear

Internal designation:
Slip in fixed gear

Error description:
The shift elements cannot transmit the applicable torque. Holding torque too low or load torque too high.

Error detection by:
Software / MON detects slip if the measured slip exceeds the permissible slip limit value in several back-to-back measurements.

System response:
- Limited engine torque
- Engine brake switch-off
- Retarder torque limited
- Increased main pressure

Cancellation condition:
- No slip detected
- downtime
- Neutral
- Ignition off/on

System check:
- Check oil level / oil filter
- Check engine moment and load signal
- Check system for rpm errors
- Check transmission for wear

189

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Pressure regulator F (DR_F) - readback voltage too low

Internal designation:
DR_F_Rücklesekanal AIM; U_AIM off less than U_Nenn

Error description:
Readback voltage at the readback channel of pressure regulator F and switched off AIM is less than the expected voltage (expected voltage = on-board power supply voltage – voltage drop at proportional solenoid)

Error detection by:
Readback voltage at readback channel with current output (AIM) OFF.

System response:
- All current outputs are switched off (ZAE open)
- Neutral / Loss of a gear
- No retarder

Cancellation condition:
- Readback voltage at readback channel = on-board power supply voltage – voltage of proportional valve
- Ignition off/on

System check:
1. Switch ignition off
2. Unplug electronic system
3. Connect transmission test cable
4. Measure resistance of proportional valve (pin 5 to pin 19) Setpoint value: 10 - 15 ohm
5. Measure resistance of proportional valve to ground (pin 19 to ground (KL31) / housing) Setpoint value: > 10 mohm
6. TCU cable -> test transmission

In the event of deviations from the nominal value, check the wiring and the component.

190

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Pressure regulator (DR_WK) - readback voltage too low

Internal designation:
DR_WK_Rücklesekanal AIM; U_AIM off less than U_Nenn

Error description:
Readback voltage at the readback channel of pressure regulator WK and switched off AIM is less than the expected voltage (expected voltage = on-board power supply voltage – voltage drop at proportional solenoid).

Error detection by:
Readback voltage at readback channel with current output (AIM) OFF.

System response:
- All current outputs are switched off (ZAE open)
- Neutral / Loss of a gear
- No retarder

Cancellation condition:
- Readback voltage at readback channel = on-board power supply voltage – voltage of proportional valve
- Ignition off/on

System check:
1. Switch ignition off
2. Unplug electronic system
3. Connect transmission test cable
4. Measure resistance of proportional valve (pin 5 to pin 9) Setpoint value: 10 - 15 ohm
5. Measure resistance of proportional valve to ground (pin 9 to ground (KL31) / housing) Setpoint value: > 10 mohm
6. TCU cable -> test transmission

In the event of deviations from the nominal value, check the wiring and the component.

191

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Main pressure regulator (DR_HD) - readback voltage too low

Internal designation:
DR_HD_Rücklesekanal AIM; U_AIM off less than U_Nenn

Error description:
Readback voltage at the readback channel of pressure regulator HD and switched off AIM is less than the expected voltage (expected voltage = on-board power supply voltage – voltage drop at proportional solenoid)

Error detection by:
Readback voltage at readback channel with current output (AIM) OFF.

System response:
- All current outputs are switched off (ZAE open)
- Neutral / Loss of a gear
- No retarder

Cancellation condition:
- Readback voltage at readback channel = on-board power supply voltage – voltage of proportional valve
- Ignition off/on

System check:
1. Switch ignition off
2. Unplug electronic system
3. Connect transmission test cable
4. Measure resistance of proportional valve (pin 5 to pin 10) Setpoint value: 10 - 15 ohm
5. Measure resistance of proportional valve to ground (pin 10 to ground (KL31) / housing) Setpoint value: > 10 mohm
6. TCU cable -> test transmission

In the event of deviations from the nominal value, check the wiring and the component.

192

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Pressure regulator retarder (DR_Ret) - readback voltage too low

Internal designation:
DR_Ret_Rücklesekanal AIM; U_AIM off less than U_Nenn

Error description:
Readback voltage at the readback channel of pressure regulator Ret and switched off AIM is less than the expected voltage (expected voltage = on-board electronics voltage – voltage drop at proportional solenoid).

Error detection by:
Readback voltage at readback channel with current output (AIM) OFF.

System response:
- All current outputs are switched off (ZAE open)
- Neutral / Loss of a gear
- No retarder

Cancellation condition:
- Readback voltage at readback channel = on-board power supply voltage – voltage of proportional valve
- Ignition off/on

System check:
1. Switch ignition off
2. Unplug electronic system
3. Connect transmission test cable
4. Measure resistance of proportional valve (pin 5 to pin 8) Setpoint value: 10 - 15 ohm
5. Measure resistance of proportional valve to ground (pin 8 to ground (KL31) / housing) Setpoint value: > 10 mohm
6. TCU cable -> test transmission

In the event of deviations from the nominal value, check the wiring and the component.

193

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Pressure regulator A (DR_A) - readback voltage too low

Internal designation:
DR_A_Rücklesekanal AIM; U_AIM off less than U_Nenn

Error description:
Readback voltage at the readback channel of pressure regulator A and switched off AIM is less than the expected voltage (expected voltage = on-board power supply voltage – voltage drop at proportional solenoid)

Error detection by:
Readback voltage at readback channel with current output (AIM) OFF.

System response:
- All current outputs are switched off (ZAE open)
- Neutral / Loss of a gear
- No retarder

Cancellation condition:
- Readback voltage at readback channel = on-board power supply voltage – voltage of proportional valve
- Ignition off/on

System check:
1. Switch ignition off
2. Unplug electronic system
3. Connect transmission test cable
4. Measure resistance of proportional valve (pin 5 to pin 13) Setpoint value: 10 - 15 ohm
5. Measure resistance of proportional valve to ground (pin 13 to ground (KL31) / housing) Setpoint value: > 10 mohm
6. TCU cable -> test transmission

In the event of deviations from the nominal value, check the wiring and the component.

194

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Pressure regulator B (DR_B) - readback voltage too low

Internal designation:
DR_B_Rücklesekanal AIM; U_AIM off less than U_Nenn

Error description:
Readback voltage at the readback channel of pressure regulator B and switched off AIM is less than the expected voltage (expected voltage = on-board electronics voltage – voltage drop at proportional solenoid).

Error detection by:
Readback voltage at readback channel with current output (AIM) OFF.

System response:
- All current outputs are switched off (ZAE open)
- Neutral / Loss of a gear
- No retarder

Cancellation condition:
- Readback voltage at readback channel = on-board power supply voltage – voltage of proportional valve
- Ignition off/on

System check:
1. Switch ignition off
2. Unplug electronic system
3. Connect transmission test cable
4. Measure resistance of proportional valve (pin 5 to pin 12) Setpoint value: 10 - 15 ohm
5. Measure resistance of proportional valve to ground (pin 12 to ground (KL31) / housing) Setpoint value: > 10 mohm
6. TCU cable -> test transmission

In the event of deviations from the nominal value, check the wiring and the component.

195

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Pressure regulator D (DR_D) - readback voltage too low

Internal designation:
DR_D_Rücklesekanal AIM; U_AIM off less than U_Nenn

Error description:
Readback voltage at the readback channel of pressure regulator D and switched off AIM is less than the expected voltage (expected voltage = on-board power supply voltage – voltage drop at proportional solenoid).

Error detection by:
Readback voltage at readback channel with current output (AIM) OFF.

System response:
- All current outputs are switched off (ZAE open)
- Neutral / Loss of a gear
- No retarder

Cancellation condition:
- Readback voltage at readback channel = on-board power supply voltage – voltage of proportional valve
- Ignition off/on

System check:
1. Switch ignition off
2. Unplug electronic system
3. Connect transmission test cable
4. Measure resistance of proportional valve (pin 5 to pin 22) Setpoint value: 10 - 15 ohm
5. Measure resistance of proportional valve to ground (pin 22 to ground (KL31) / housing) Setpoint value: > 10 mohm
6. TCU cable -> test transmission

In the event of deviations from the nominal value, check the wiring and the component.

196

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Pressure regulator E (DR_E) - readback voltage too low

Internal designation:
DR_E_Rücklesekanal AIM; U_AIM off less than U_Nenn

Error description:
Readback voltage at the readback channel of pressure regulator E and switched off AIM is less than the expected voltage (expected voltage = on-board power supply voltage – voltage drop at proportional solenoid).

Error detection by:
Readback voltage at readback channel with current output (AIM) OFF.

System response:
- All current outputs are switched off (ZAE open)
- Neutral / Loss of a gear
- No retarder

Cancellation condition:
- Readback voltage at readback channel = on-board power supply voltage – voltage of proportional valve
- Ignition off/on

System check:
1. Switch ignition off
2. Unplug electronic system
3. Connect transmission test cable
4. Measure resistance of proportional valve (pin 5 to pin 24) Setpoint value: 10 - 15 ohm
5. Measure resistance of proportional valve to ground (pin 24 to ground (KL31) / housing) Setpoint value: > 10 mohm
6. TCU cable -> test transmission

In the event of deviations from the nominal value, check the wiring and the component.

197

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Pressure regulator of PTO (DR_NA) - readback voltage too low

Internal designation:
DR_NA_Rücklesekanal AIM; U_AIM off less than U_Nenn

Error description:
Readback voltage at the readback channel of pressure regulator NA and switched off AIM is less than the expected voltage (expected voltage = on-board power supply voltage – voltage drop at proportional solenoid).

Error detection by:
Readback voltage at readback channel with current output (AIM) OFF.

System response:
- All current outputs are switched off (ZAE open)
- Neutral / Loss of a gear
- No retarder

Cancellation condition:
- Readback voltage at readback channel = on-board power supply voltage – voltage of proportional valve
- Ignition off/on

System check:
Currently no application with PTO

198

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Pressure regulator G (DR_G) - readback voltage too low

Internal designation:
DR_G_Rücklesekanal AIM; U_AIM off less than U_Nenn

Error description:
Readback voltage at the readback channel of pressure regulator G and switched off AIM is less than the expected voltage (expected voltage = on-board electronics voltage – voltage drop at proportional solenoid).

Error detection by:
Readback voltage at readback channel with current output (AIM) OFF.

System response:
- All current outputs are switched off (ZAE open)
- Neutral / Loss of a gear
- No retarder

Cancellation condition:
- Readback voltage at readback channel = on-board power supply voltage – voltage of proportional valve
- Ignition off/on

System check:
None yet, since a version with G-valve is not feasible at this point.

199

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
The data field ID entered does not exist or has not been enabled

Internal designation:
The parts list number or configuration entered by the customer was not found or is not enabled

Error description:
The data field ID entered (in EEProm) does not match any of the available data field IDs.

Error detection by:
Software

System response:
Activation of the default data field
(data field 1 / maneuvering software)

Cancellation condition:
Set correct data field in EEProm
+ Ignition off / on

System check:
Set correct data field with diagnostic tool

200

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Application error warning

Internal designation:
Application error warning
(not relevant for volume production)

Error description:
If the settings of the application are faulty and this has been verified.
Several application errors may be listed

Error detection by:
Software, e. g.. If maximum gear > maximum gear in gear set (V and R)

System response:
E. g.: applied maximum gear is limited to maximum gear in gear set

Cancellation condition:
Apply correct maximum gear

System check:
Check application

201

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Currently not assigned

Internal designation:

Error description:

Error detection by:

System response:

Cancellation condition:

System check:

202

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Implausible voltage difference between KL30 and VPS

Internal designation:
Implausible voltage difference between U_KL30 and U_VPS (ZAE_MON)

Error description:
Monitors the difference between U_KL30 and U_VPS.
If - with the ZAE switched on - this voltage difference is greater than the threshold value (≈ 1.5V), it must be assumed that the output stage of the TCU (TREX) goes into test mode (unintentional switching on of low side drivers).
To prevent unintentional switching on of current outputs, the central switch-off unit (ZAE) must be switched off by an error response.

Error detection by:
Voltage difference between U_KL30 and U_VPS too great (voltage drop at ZAE too great)

System response:
- All current outputs are switched off (ZAE open)
- Neutral / Loss of a gear
- No retarder

Cancellation condition:
- No fault in central switch-off unit (ZAE)
- Ignition off/on

System check:
Check the TCU

203

Error description

Project: EcoLife

Basic program status: AP83 / Step 2

Error:
Engine limit / retarder limit mode is missing (SAE)

Internal designation:
Engine and retarder torque mode signal not available
(Indicates which mode of Mot. or Ret. currently limits or regulates the torque / J1939.EEC1_FROM_ENGINE.Eng_Trq_Mode_Sig)

Error description:
Engine and retarder torque mode not available via CAN. This mode indicates which limit is currently active. The mode is included in message EEC1 (Engine / Retarder - Torque mode) from the engine control unit to the transmission.

Error detection by:
Software

System response:
- none

Cancellation condition:
- Signal available again

System check:
- Check CAN hardware
- Check the control unit indicated in the fault for correct function, topicality, and compatibility

204

Error description

Project: EcoLife

Basic program status: AP83 / Step 2

Error:
Kickdown signal is not available via CAN (SAE)

Internal designation:
Kickdown signal not available (J1939.EEC2_FROM_ENGINE.Acc_Ped_Kickdown_Sig)

Error description:
The kickdown signal is not available via CAN.
The kickdown signal is included in message EEC2 from the engine control unit to the transmission (Accelerator Pedal Kickdown Switch).

Error detection by:
Software

System response:
No kickdown switch points

Cancellation condition:
Signal available again

System check:
- Check CAN hardware
- Check the control unit indicated in the fault for correct function, topicality, and compatibility

205

Error description

Project: EcoLife

Basic program status: AP83 / Step 2

Error:
Torque loss signal via CAN is missing (SAE)

Internal designation:
Parasitic loss torque signal not available
(through PTO consumer e.g. air conditioning.
J1939.EEC3_FROM_ENGINE.Parasitic_Losses_Prc_Trq_Sig)

Error description:
The parasitic torque loss is not available via CAN.
It is included in message EEC3 (Estimated Engine Parasitic Losses - Percent Torque) from the engine control unit to the transmission. This value indicates how much engine torque is lost due to other consumers. The transmission software must include this torque loss in its calculations.

Error detection by:
Software

System response:
Shifting pressure adaption switched off

Cancellation condition:
- Signal available again
- Neutral + Stop

System check:
- Check CAN hardware
- Check the control unit indicated in the fault for correct function, topicality, and compatibility

206

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Brake switch signal not available via CAN (SAE)

Internal designation:
Gearshift inhibit request signal not available
(J1939.TC1_FROM_ABS.Gear_Shift_inh_req_ABS.Wert)

Error description:
The signal for inhibiting gearshifts is not available via CAN.
The gearshift inhibit request is included in message TC1 from the ABS/ASR control unit to the transmission (Gear Shift Inhibit Request (ABS/ASR)).

Error detection by:
Software

System response:
none

Cancellation condition:
Signal available again

System check:
- Check CAN hardware
- Check the control unit indicated in the fault for correct function, topicality, and compatibility

207

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Torque converter lock-up clutch disable signal not available via CAN (SAE)

Internal designation:
Request converter lock-up clutch disable signal is not available
(J1939.TC1_FROM_ABS.Trq_ConvLk_dis_req_ABS.Wert)

Error description:
The signal for requesting converter lock-up clutch disable is not available via CAN.
The request to disable the LuC is included in message TC1 from the ABS/ASR control unit to the transmission (Torque Converter Lockup Disable Request (ABS/ASR)).

Error detection by:
Software

System response:
none

Cancellation condition:
Signal available again

System check:
- Check CAN hardware
- Check the control unit indicated in the fault for correct function, topicality, and compatibility

208

Error description

Project: EcoLife

Basic program status: AP83 / Step 2

Error:
Signal cruise control active via CAN is missing (SAE)

Internal designation:
Cruise control active

Error description:
The signal Cruise Control active is not available via CAN.
J1939.CC_VS_FROM_CC.CC_active_Sig
The signal Cruise Control active is included in message CC/VS from the vehicle computer to the transmission.

Error detection by:
Software

System response:
none

Cancellation condition:
Signal available again

System check:
- Check CAN hardware
- Check the control unit indicated in the fault for correct function, topicality, and compatibility

209

Error description

Project: EcoLife

Basic program status: AP83 / Step 2

Error:
Speed signal (measured at the wheel) via CAN is missing (SAE)

Internal designation:
Speed measured at the wheel
J1939.CC_VS_FROM_CC.Wheelbased_Veh_Speed_Sig
(Wheel- based vehicle speed)

Error description:
The speed signal measured at the wheel is not available via CAN.
This speed is included in message CC/VS from the vehicle computer to the transmission.

Error detection by:
Software

System response:
none

Cancellation condition:
Signal available again

System check:
- Check CAN hardware
- Check the control unit indicated in the fault for correct function, topicality, and compatibility

210

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Request gearshift inhibit signal is not available via CAN (unknown control unit) (SAE)

Internal designation:
Gearshift inhibit request signal not available
(J1939.TC1_FROM_ABS.Gear_Shift_inh_req_ABS.Wert)

Error description:
The signal for inhibiting gearshifts is not available via CAN.
The request to inhibit gearshifts is included in message TC1 from an unknown control unit to the transmission

Error detection by:
Software

System response:
none

Cancellation condition:
Signal available again

System check:
- Check CAN hardware
- Check the control unit indicated in the fault for correct function, topicality, and compatibility

211

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Torque converter lock-up clutch disable signal is not available via CAN (unknown control unit) (SAE)

Internal designation:
Request converter lock-up clutch disable signal is not available (J1939.TC1_FROM_ABS.Trq_ConvLk_dis_req_ABS.Wert)

Error description:
The signal for requesting converter clutch lockup disable is not available via CAN.
The request to disable the lockup is included in message TC1 from an unknown control unit to the transmission.

Error detection by:
Software

System response:
none

Cancellation condition:
Signal available again

System check:
- Check CAN hardware
- Check the control unit indicated in the fault for correct function, topicality, and compatibility

212

Error description

Project: EcoLife

Basic program status: AP83 / Step 2

Error:
Request Neutral - External not available via CAN

Internal designation:
Request Neutral - External not available

Error description:
The Neutral request from an unknown CAN – device is not available
J1939.TC1_FROM_XX.Disengage_Driveline_Req_Sig
(Disengage driveline request).

Error detection by:
Software

System response:
none

Cancellation condition:
Make Neutral - External signal available

System check:
- Check CAN hardware
- Check the control unit indicated in the fault for correct function, topicality, and compatibility

213

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
The signal ASR Brake Control active is not available via CAN (SAE)

Internal designation:
Signal ASR Brake Control active is not available
(J1939.EBC1_FROM_ABS.ASR_Brake_Ctrl_active.Wert)

Error description:
The signal ASR Electronic Brake Controller active is not available via CAN.
This signal (ASR Brake Control Active) is contained in message EBC1 from the Electronic Brake Controller to the transmission

Error detection by:
Software

System response:
none

Cancellation condition:
Signal available again

System check:
- Check CAN hardware
- Check the control unit indicated in the fault for correct function, topicality, and compatibility

214

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Signal ABS (fully operational) is not available via CAN (SAE)

Internal designation:
Signal ABS (fully operational) is not available
(J1939.EBC1_FROM_ABS.ABS_fully_operational.Wert
For switch-off of retarder for step board)

Error description:
Signal ABS (fully operational) is not available via CAN.
This signal (ASR Brake Control Active) is used for retarder switch-off for step board. It is contained in message EBC1 from the Electronic Brake Controller to the transmission.

Error detection by:
Software

System response:
none

Cancellation condition:
Signal available again

System check:
- Check CAN hardware
- Check the control unit indicated in the fault for correct function, topicality, and compatibility

215

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Signal ABS (fully operational) is not available via CAN (SAE)

Internal designation:
Signal ABS (fully operational) is not available
(J1939.EBC1_FROM_ABS.ABS_fully_operational.Wert
For switch-off of retarder for step board)

Error description:
Signal ABS (fully operational) is not available via CAN.
This signal (ASR Brake Control Active) is used for retarder switch-off for step board. It is contained in message EBC1 from the Electronic Brake Controller to the transmission.

Error detection by:
Software

System response:
none

Cancellation condition:
Signal available again

System check:
- Check CAN hardware
- Check the control unit indicated in the fault for correct function, topicality, and compatibility

216

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Brake pressure signal front axle, left wheel, not available via CAN (SAE)

Internal designation:
Brake pressure signal front axle, right wheel, not available
(J1939.EBC3_FROM_ABS.Brake_press_front_rt.Wert)

Error description:
The brake pressure signal measured at the front axle, left wheel is not available via CAN.
This signal (Brake Application Pressure High Range, Front Axle, Right Wheel) is contained in message EBC3 from the Electronic Brake Controller to the transmission

Error detection by:
Software

System response:
none

Cancellation condition:
Signal available again

System check:
- Check CAN hardware
- Check the control unit indicated in the fault for correct function, topicality, and compatibility

217

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Brake pressure signal rear axle 1, left wheel, not available via CAN (SAE)

Internal designation:
Brake pressure signal rear axle 1, left wheel, not available
(J1939.EBC3_FROM_ABS.Brake_press_rear1_lf.Wert)

Error description:
The brake pressure signal measured at the rear axle, left wheel is not available via CAN.
This signal (Brake Application Pressure High Range, Rear Axle 1, Left Wheel) is contained in message EBC3 from the Electronic Brake Controller to the transmission

Error detection by:
Software

System response:
none

Cancellation condition:
Signal available again

System check:
- Check CAN hardware
- Check the control unit indicated in the fault for correct function, topicality, and compatibility

218

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Brake pressure signal rear axle 1, left wheel, not available via CAN (SAE)

Internal designation:
Brake pressure signal rear axle 1, right wheel, not available
(J1939.EBC3_FROM_ABS.Brake_press_rear1_lf.Wert)

Error description:
The brake pressure signal measured at the rear axle, left wheel is not available via CAN.
This signal (Brake Application Pressure High Range, Rear Axle 1, Right Wheel) is contained in message EBC3 from the Electronic Brake Controller to the transmission

Error detection by:
Software

System response:
none

Cancellation condition:
Signal available again

System check:
- Check CAN hardware
- Check the control unit indicated in the fault for correct function, topicality, and compatibility

219

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Signal Vehicle Dynamic Control Fully Operational is not available via CAN (SAE)

Internal designation:
Signal Vehicle Dynamic Control Fully Operational is not available
(J1939.VDC1.VDC_fully_operational.Wert
Vehicle dynamic control)

Error description:
Signal Vehicle Dynamic Control Fully Operational is not available via CAN.
This signal (ASR Brake Control Active) is contained in message VDC1.

Error detection by:
Software

System response:
none

Cancellation condition:
Signal available again

System check:
- Check CAN hardware
- Check the control unit indicated in the fault for correct function, topicality, and compatibility

220

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Signal ROP Engine Control Active is not available via CAN (SAE)

Internal designation:
Signal ROP Engine Control Active is not available (J1939.VDC1.ROP_Eng_Ctrl_active.Wert Roll over prevention)

Error description:
Signal ROP Engine Control Active is not available via CAN.
This signal (ROP Engine Control Active) is contained in message VDC1.

Error detection by:
Software

System response:
none

Cancellation condition:
Signal available again

System check:
- Check CAN hardware
- Check the control unit indicated in the fault for correct function, topicality, and compatibility

221

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Signal ROP Brake Control Active is not available via CAN (SAE)

Internal designation:
Signal ROP Brake Control Active is not available (J1939.VDC1.ROP_Brake_Ctrl_active.Wert)

Error description:
Signal ROP Brake Control Active is not available via CAN.
This signal (ROP Brake Control Active) is contained in message VDC1

Error detection by:
Software

System response:
none

Cancellation condition:
Signal available again

System check:
- Check CAN hardware
- Check the control unit indicated in the fault for correct function, topicality, and compatibility

222

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Signal TS (tracking stability) by controlling the engine control activated by CAN is not available (SAE)

Internal designation:
Signal TS (tracking stability) Engine Control Active is not available
(J1939.VDC1.YC_Eng_Ctrl_active.Wert
Yaw Control)

Error description:
The signal TS (tracking stability) via controlling the engine control activated by CAN is not available.
This signal (YC Engine Control Active) is contained in message VDC1

Error detection by:
Software

System response:
none

Cancellation condition:
Signal available again

System check:
- Check CAN hardware
- Check the control unit indicated in the fault for correct function, topicality, and compatibility

223

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Signal TS (tracking stability) Brake Control Active is not available via CAN (SAE)

Internal designation:
Signal TS (tracking stability) Brake Control Active is not available (J1939.VDC1.YC_Brake_Ctrl_active.Wert)

Error description:
Signal TS (tracking stability) Brake Control Active is not available via CAN.
This signal (YC Brake Control Active) is contained in message VDC1.

Error detection by:
Software

System response:
none

Cancellation condition:
Signal available again

System check:
- Check CAN hardware
- Check the control unit indicated in the fault for correct function, topicality, and compatibility

224

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Low-idle switch signal is not available via CAN (IES)

Internal designation:
Low-idle switch
Message FMR1 ID 592 / Vehicle Engine Controller 1

Error description:
The signal of the low-idle switch is not available via CAN.
This signal is included in message FMR1 ID 592.

Error detection by:
Software

System response:
none

Cancellation condition:
Signal available again

System check:
- Check CAN hardware
- Check accelerator pedal
- Check the CAN network for correct function, topicality, and compatibility.

225

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Kickdown signal is not available via CAN (IES)

Internal designation:
Kickdown signal not available (IES.FMR592.Kickdown.Wert)

Error description:
The kickdown signal is not available via CAN.
This signal is included in message FMR1 ID 592.

Error detection by:
Software

System response:
none

Cancellation condition:
Signal available again

System check:
- Check CAN hardware
- Check accelerator pedal
- Check the CAN network for correct function, topicality, and compatibility.

226

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Parking brake signal is not available via CAN (IES)

Internal designation:
Parking brake signal is not available
(IES.FMR592.Feststellbremse.Wert)

Error description:
The parking brake signal is not available via CAN.
This signal is included in message FMR1 ID 592.
The missing signal may lead to functional restrictions; e.g. no AIS.

Error detection by:
Software

System response:
none

Cancellation condition:
Signal available again

System check:
- Check CAN hardware
- Check the CAN network for correct function, topicality, and compatibility.

227

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
C3 – Signal (speed signal) is not available via CAN (IES)

Internal designation:
C3 – signal missing

Error description:
The C3 speed signal is not available via CAN.
This signal is included in message FMR1 ID 592.
In the event of a failure, the last I_HA adaption value is maintained.

Error detection by:
Software

System response:
none

Cancellation condition:
Signal available again

System check:
- Check CAN hardware
- Check the CAN network for correct function, topicality, and compatibility.

228

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
The signal ASR intervention is not available via CAN (IES)

Internal designation:
Signal ASR intervention not available (IES.ABS512.ASR_Eingriff.Wert)

Error description:
The signal ASR intervention is not available via CAN.
This signal is included in message ABS/ EPB ID 512.

Error detection by:
Software

System response:
none

Cancellation condition:
Signal available again

System check:
- Check CAN hardware
- Check the CAN network for correct function, topicality, and compatibility.

229

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
The signal roll-back (hill holder) lock is not available via CAN (IES)

Internal designation:
Signal Roll-back Lock is not available (IES.ABS512.Rueckrollsperre.Wert)

Error description:
The roll-back lock signal is not available via CAN.
This signal is included in message ABS/ EPB ID 512.
The missing signal may lead to functional restrictions; e.g. no AIS.

Error detection by:
Software

System response:
none

Cancellation condition:
Signal available again

System check:
- Check CAN hardware
- Check the CAN network for correct function, topicality, and compatibility.

230

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
The bus stop brake signal is not available via CAN (IES)

Internal designation:
Frequent Stop Brake signal (electronic request) not available (IES.ABS1024.
Bremswert_Soll.Wert
for gear release and AIS)

Error description:
The bus stop brake signal is not available via CAN.
This signal is included in message FPS ID 1448.
The missing signal may lead to functional restrictions; e.g. no AIS.

Error detection by:
Software

System response:
none

Cancellation condition:
Signal available again

System check:
- Check CAN hardware
- Check the CAN network for correct function, topicality, and compatibility.

231

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Engine friction torque signal is not available via CAN (IES)

Internal designation:
Engine friction torque signal not available

Error description:
The engine friction torque is not available via CAN.
This signal is included in message FMR2 ID 593.

Error detection by:
Software

System response:
none

Cancellation condition:
Signal available again

System check:
- Check CAN hardware
- Check the CAN network for correct function, topicality, and compatibility.

232

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Failure of engine speed (n_Mot), turbine speed (n_Tu), and output speed (n_Ab)

Internal designation:
n_Ab, n_Tu, and n_Mot failed

Error description:
Failure of engine speed (n_Mot), turbine speed (n_Tu), and output speed (n_Ab).

Error detection by:
If n_Ab, n_Tu, and n_Mot display simultaneous errors

System response:
- All current outputs are switched off (ZAE open)
- Neutral / Loss of a gear
- No retarder
- Quick WK lock-up clutch disable (without drop / delay ramps)
- Limit engine torque
- Limit retarder torque
- Lock gearshifts;
- Lock gearshifts from Neutral to Reverse
- Switch off shift pressure adaptation (gear change); continue to use last values
- Neutral - Immediately if shifting into Neutral (without delay and holding ramps); applies to stationary and driving vehicle
- Increase main pressure
- WK short-term opening and WK closing during gear-shifting locked
- Shifting point calculation based on default values
- Switch off tractive force advance calculation
- Lock subsequent shift preparation during gearshifts
- Switch off TOPO

Cancellation condition:
- No triple rpm error
- Neutral + Stop
- Ignition off/on

System check:
1. Switch ignition off
2. Unplug transmission electronics
3. Connect connector block between TCU and transmission
4. Switch Ignition on
5. Measure voltage between pin 10 (EF2) and pin 15 (AU2) Setpoint value: 5V

6. Measure voltage between pin 2 (EF1) and pin 6 (AU1) Setpoint value: 5V
7. Switch ignition off
8. Unplug electronic system
9. Measure resistance between pin 15 (AU2) and ground / housing Setpoint value: >10 mohm
10. Measure resistance between pin 10 (EF2) and ground / housing Setpoint value: >10 mohm
11. Measure resistance between pin 6 (AU1) and ground / housing Setpoint value: >10 mohm
12. Measure resistance between pin 2 (EF1) and ground / housing Setpoint value: >10 mohm
13. Check the source of signals of the engine speed

In the event of deviations from the nominal value, check the wiring, the component, and the TCU.

233

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Signal EBS electronic brake switch missing / faulty (SAE)

Internal designation:
EBS electronic brake switch
(Electronic Brake Controller 1 (to transm.) from ABS
(PGN: 61441 ID: 0x18F0010B))

Error description:
The signal EBS electronic brake switch is not available via CAN.
This signal is contained in message EBC1 from the Electronic Brake Controller to the transmission.
The missing signal may lead to functional restrictions; e.g. no AIS

Error detection by:
Software

System response:
none

Cancellation condition:
no signal available again

System check:
- Check CAN hardware
- Check the control unit indicated in the fault for correct function, topicality, and compatibility

234

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Neutral external request not available via CAN (SAE)

Internal designation:
The Neutral external request is not available (Disengage Driveline Request).

Error description:
The Neutral request is not available via CAN.
This signal is contained in message TC 1.

Error detection by:
Software

System response:
None

Cancellation condition:
no signal available again

System check:
- Check CAN hardware
- Check the CAN network for correct function, topicality, and compatibility.

235

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Warning increase sump temperature

Internal designation:
Increased sump temperature

Error description:
The sump temperature is above 115°C

Error detection by:
T_Sumpf > limit value T_Sumpf too high (approx. 115 °C)

System response:
Limit retarder torque

Cancellation condition:
- Sump temperature < limit value
- New retarder request

System check:
- Check oil level / oil filter
- Check system for slip faults
- Check for retarder faults
- Check cooling system
- Check cooler changeover valve
- Check main pressure
- Check lock-up clutch

236

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Sump temperature overheating

Internal designation:
Sump temperature overheat

Error description:
The sump temperature is above 125°C

Error detection by:
T_Sumpf > limit value T_Sumpf increased (approx. 125 °C)

System response:
- Limited engine torque
- Retarder request switched off and AIM_Retarder switched off
- Engine brake switched off

Cancellation condition:
- Sump temperature < limit value
- Neutral + Stop
- New retarder request

System check:
- Check oil level / oil filter
- Check system for slip faults
- Check for retarder faults
- Check cooling system
- Check cooler changeover valve
- Check main pressure
- Check lock-up clutch

237

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Warning increased retarder temperature

Internal designation:
Retarder temperature too high

Error description:
The retarder temperature is above 160°C

Error detection by:
T_Ret > limit value T_Ret. too high (approx 160 °C)

System response:
Retarder torque limited

Cancellation condition:
- Retarder temperature < limit value
- New retarder request

System check:
- Check oil level / oil filter
- Check system for slip faults
- Check for retarder faults
- Check cooling system
- Check cooler changeover valve
- Check main pressure
- Check lock-up clutch

238

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Retarder temperature overheating

Internal designation:
Temperature retarder overheat

Error description:
The retarder temperature is above 160°C

Error detection by:
T_Ret > limit value T_Ret. too high (approx. 160 °C)

System response:
Retarder request switched off and AIM_Retarder switched off

Cancellation condition:
- Retarder temperature < limit value
- New retarder request

System check:
- Check oil level / oil filter
- Check system for slip faults
- Check for retarder faults
- Check cooling system
- Check cooler changeover valve
- Check main pressure
- Check lock-up clutch

239

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Test stand data field active

Internal designation:
Test stand data field active

Error description:
The test stand data field was activated

Error detection by:
Software

System response:
- All current outputs are switched off (ZAE open)
- Neutral / Loss of a gear
- No retarder

Cancellation condition:
- Set correct data field in EEProm
- Ignition off/on

System check:
Correct data field with diagnostic tool in EEProm

240

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Message FMR1104 timeout (IES)

Internal designation:
FMR1104_TIMEOUT

Error description:
Timeout of message FMR1104

Error detection by:
Software

System response:
none

Cancellation condition:
Message available again

System check:
- Check CAN hardware
- Check the CAN network for correct function, topicality, and compatibility

241

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Message PLD1364 timeout (IES)

Internal designation:
PLD1364_TIMEOUT

Error description:
Timeout of message PLD 1364

Error detection by:
Software

System response:
none

Cancellation condition:
Message available again

System check:
- Check CAN hardware
- Check the CAN network for correct function, topicality, and compatibility

242

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Parking brake signal is not available via CAN (IES)

Internal designation:
The retarder lever position signal is not available

Error description:
The retarder lever position signal is not available via CAN. This information is included in message FMR114.

Error detection by:
Software

System response:
none

Cancellation condition:
Signal available again

System check:
- Check CAN hardware
- Check the CAN network for correct function, topicality, and compatibility

243

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
The signal brake pressure circuit 1 is not available via CAN (IES)

Internal designation:
Brake pressure signal circuit 1 not available

Error description:
Brake pressure in brake circuit 1 is not available via CAN. The missing signal may lead to functional restrictions; e.g. no AIS

Error detection by:
Software

System response:
none

Cancellation condition:
Signal available again

System check:
- Check CAN hardware
- Check the CAN network for correct function, topicality, and compatibility

244

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
The signal brake pressure circuit 2 is not available via CAN (IES)

Internal designation:
Brake pressure signal circuit 2 not available

Error description:
Brake pressure in brake circuit 2 is not available via CAN. The missing signal may lead to functional restrictions; e.g. no AIS

Error detection by:
Software

System response:
none

Cancellation condition:
Signal available again

System check:
- Check CAN hardware
- Check the CAN network for correct function, topicality, and compatibility

245

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
The engine cooling water temperature is not available via CAN (IES)

Internal designation:
IES_T_MOT_KUEHLWASSER_SIG

Error description:
The cooling water temperature sent by CAN is not available. It is included in message PLD1364

Error detection by:
Software

System response:
none

Cancellation condition:
Signal available again

System check:
- Check CAN hardware
- Check the CAN network for correct function, topicality, and compatibility

246

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
The message FPS 1451 is not available via CAN (IES)

Internal designation:
Message FPS ID1451:
(Freely programmable shift module)

Error description:
Timeout of message FPS ID 1451

Error detection by:
Software

System response:
none

Cancellation condition:
Message available again

System check:
- Check CAN hardware
- Check the CAN network for correct function, topicality, and compatibility

247

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
The approval signal second gear forward is not available via CAN (IES)

Internal designation:
Approval signal second gear forward not available

Error description:
The approval signal second gear forward is not available via CAN. This signal is included in message FPS ID 1451.

Error detection by:
Software

System response:
There may be no gear approval

Cancellation condition:
Signal available again

System check:
- Check CAN hardware
- Check the CAN network for correct function, topicality, and compatibility

248

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
The approval signal second gear reverse is not available via CAN (IES)

Internal designation:
The approval signal second gear reverse is not available

Error description:
The approval signal second gear reverse is not available via CAN. This signal is included in message FPS ID 1451.

Error detection by:
Software

System response:
There may be no gear approval

Cancellation condition:
Signal available again

System check:
- Check CAN hardware
- Check the CAN network for correct function, topicality, and compatibility

249

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
The driving program selection signal is not available via CAN (IES)

Internal designation:
The driving program selection signal is not available

Error description:
The driving program selection signal is not available via CAN. This signal is included in message FPS ID 1451.

Error detection by:
Software

System response:
There is no driving program switching

Cancellation condition:
Signal available again

System check:
- Check CAN hardware
- Check the CAN network for correct function, topicality, and compatibility

250

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
The acceleration/restriction status signal is not available via CAN (SAE)

Internal designation:
Acceleration restriction status

Error description:
The acceleration/restriction status signal is not available via CAN.

Error detection by:
Software

System response:
none

Cancellation condition:
Signal available again

System check:
- Check CAN hardware
- Check the CAN network for correct function, topicality, and compatibility

251

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
J1939.AUXIO1.Timeout supplement Input / Output (IES)

Internal designation:
Supplement Input / Output status timeout error
PGN65241

Error description:
Timeout of the message

Error detection by:
Software

System response:
none

Cancellation condition:
Message available again

System check:
- Check CAN hardware
- Check the CAN network for correct function, topicality, and compatibility

252

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Retarder hand lever signal digital is not plausible

Internal designation:
Retarder hand lever signal digital is implausible

Error description:
Faulty signal

Error detection by:
Software

System response:
none

Cancellation condition:
Signal is plausible

System check:
- Check CAN hardware
- Check the CAN network for correct function, topicality, and compatibility

253

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Retarder footplate signal digital is not plausible

Internal designation:
Retarder footplate signal digital is implausible

Error description:
Faulty signal

Error detection by:
Software

System response:
none

Cancellation condition:
Signal is plausible

System check:
- Check CAN hardware
- Check the CAN network for correct function, topicality, and compatibility

254

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
ECU temperature gradient too big

Internal designation:
ECU temperature gradient too big

Error description:
The temperature rose too quickly in the fixed time period.

Error detection by:
Software

System response:
none

Cancellation condition:
Normal temperature rise

System check:
- Heat dissipation inadequate
- Check cooling system
- Check transmission oil level

255

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Sump temperature gradient too big

Internal designation:
Sump temperature gradient too big

Error description:
The temperature rose too quickly in the fixed time period.

Error detection by:
Software

System response:
none

Cancellation condition:
Normal temperature rise

System check:
- Heat dissipation inadequate
- Check cooling system
- Check transmission oil level

256

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Retarder temperature gradient too big

Internal designation:
Retarder temperature gradient too big

Error description:
The temperature rose too quickly in the fixed time period.

Error detection by:
Software

System response:
none

Cancellation condition:
Normal temperature rise

System check:
- Heat dissipation inadequate
- Check cooling system
- Check retarder reduction
- Check transmission oil level

257

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
ER3 coolant temperature gradient too big

Internal designation:
ER3 coolant temperature gradient too big

Error description:
The temperature rose too quickly in the fixed time period.

Error detection by:
Software

System response:
none

Cancellation condition:
Normal temperature rise

System check:
- Heat dissipation inadequate
- Check cooling system

258

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Speed range selector CAN signal and speed range selector limp home signal not available

Internal designation:
Speed range selector CAN signal and speed range selector limp home signal not available

Error description:
No valid speed range selector signal from either Limp Home or CAN

Error detection by:
Software

System response:
ZAE deactivation (deactivate all AIM internally; deactivate neutral internally)

Cancellation condition:
No CAN signal error or signal present,
speed range selector in neutral

System check:
- Check speed range selector
- Check CAN hardware
- Check the CAN network for correct function, topicality, and compatibility

259

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Speed range selector limp home signal not available, however, speed range selector CAN signal OK

Internal designation:
Speed range selector limp home signal not available, however, speed range selector CAN signal OK

Error description:
CAN drive signal interface is OK
PDM drive signal interface defective.

Error detection by:
Software

System response:
none

Cancellation condition:
Signal is plausible

System check:
- Check PDM drive signal interface

260

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Table mode activated (the table mode is only admissible for laboratory use because the diagnosis mode is switched off)

Internal designation:
Table mode activated (the table mode is only admissible for laboratory use because the diagnosis mode is switched off)

Error description:
Reference to table mode

Error detection by:
Software

System response:
none

Cancellation condition:
Connect control unit to vehicle and transmission

System check:

261

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Direct retarder request via switch (retarder torque target value) is not available

Internal designation:
Direct retarder request switch (retarder torque setpoint value) is not available

Error description:
CAN signal error or no signal

Error detection by:
Software

System response:
none

Cancellation condition:
No CAN signal error or signal present

System check:
- Check CAN hardware
- Check the CAN network for correct function, topicality, and compatibility

262

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Missing signal from the electronic brake system EBC5

Internal designation:
EBC5 Electronic Brake Controller 5: Timeout

Error description:
no signal EBC5_FROM_ABS

Error detection by:
Software

System response:
none

Cancellation condition:
No CAN signal error or signal present

System check:
- Check electronic brake controller
- Check the CAN network for correct function, topicality, and compatibility

263

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Bus stop brake signal error

Internal designation:
Stopover Brake EBC5_FROM_ABS_HALT_BRAKE_MODE_SIG

Error description:
no Bus Stop Brake signal or CAN signal error

Error detection by:
Software

System response:
none

Cancellation condition:
No CAN signal error or signal present

System check:
- Have Bus Stop Brake checked
- Check the CAN network for correct function, topicality, and compatibility

264

Error description

Project: EcoLife

Basic program status: AP83 / Step 2

Error:
EvoBus MCM C01 J1939 signal error

Internal designation:
J1939EVO.MCM_C01.Timeout

Error description:
No signal within the determined period or CAN signal error
J1939EVO.MCM_C01

Error detection by:
Software

System response:
none

Cancellation condition:
No CAN signal error or signal present

System check:
- Check the CAN network for correct function, topicality, and compatibility

265

Error description

Project: EcoLife

Basic program status: AP83 / Step 2

Error:
EvoBus MCM C02 J1939 signal error

Internal designation:
J1939EVO.MCM_C02.Timeout

Error description:
No signal within the determined period or CAN signal error J1939EVO.PT_MCM_C02

Error detection by:
Software

System response:
- Shut down NB function (NB = shift element F is shifted to neutral)
- Shut down AIS function (Automatic Idle Shift)
- Limit engine torque to specified value
- Limit retarder torque to specified value
- Switch off engine brake
- Switch off PTO request
- Switch off shift pressure adaptation (gear change); continue to use last values
- Safe opening or closing of lock-up clutch
- Neutral-Immediately if shifting into Neutral (without delay and holding ramps); applies to stationary and driving vehicle
- Main pressure max. value from terminal and total max. value across all assemblies incl. engine.
- Shift point calculation based on default values; switch off tractive force pre-calculation; block sequential shift preparation for gear change; switch off TOPO
- Switch off engine control during gear change
- Block and/or abort temporary opening of lock-up clutch and closing of lock-up clutch during gear changes
- n_Mot replaced by n_Tu (regarding RS_SMON function, n_Mot and n_Tu are queried. Thus, n_Tu is used as a substitute for lock-up clutch open and lock-up clutch closed)
- M_Mot_Ist (actual) replaced by M_Mot_Soll (target) (vehicle interface)
- SPHA: no "Sync. Starten GgEin" phase (because for the phase end detection, the speeds n_Mot and/or n_Tu are missing)
- Switch off reproduction (adaptation) of engine torque characteristics

Cancellation condition:

- Ignition off
- Error not active
- N and standstill
- New retarder request
- Engine brake is available for the next possible activation after a load request above 0%
- PTO, new request

System check:

- Check the CAN network for correct function, topicality, and compatibility

266

Error description

Project: EcoLife

Basic program status: AP83 / Step 2

Error:
EvoBus MCM C07 J1939 signal error

Internal designation:
J1939EVO.MCM_C07.Timeout

Error description:
No signal within the determined period or CAN signal error J1939EVO.PT_MCM_C07

Error detection by:
Software

System response:
none

Cancellation condition:
No CAN signal error or signal present

System check:

- Check the CAN network for correct function, topicality, and compatibility

267

Error description

Project: EcoLife

Basic program status: AP83 / Step 2

Error:
EvoBus MCM C23 J1939 signal error

Internal designation:
J1939EVO.MCM_C23.Timeout

Error description:
No signal within the determined period or CAN signal error J1939EVO.PT_MCM_C23.Timeout

Error detection by:
Software

System response:
none

Cancellation condition:
No CAN signal error or signal present

System check:

- Check the CAN network for correct function, topicality, and compatibility

268

Error description

Project: EcoLife

Basic program status: AP83 / Step 2

Error:
EvoBus CPC C01 J1939 signal error

Internal designation:
J1939EVO.CPC_C01.Timeout

Error description:
No signal within the determined period or CAN signal error J1939EVO.CPC_C01.Timeout

Error detection by:
Software

System response:
none

Cancellation condition:
No CAN signal error or signal present

System check:

- Check the CAN network for correct function, topicality, and compatibility

269

Error description

Project: EcoLife

Basic program status: AP83 / Step 2

Error:
EvoBus CPC C11 J1939 signal error

Internal designation:
J1939EVO.CPC_C11.Timeout

Error description:
No signal within the determined period or CAN signal error J1939EVO.CPC_C11.Timeout

Error detection by:
Software

System response:
- Switch off shift pressure adaptation (gear change); continue to use last values
- Main pressure max. value from terminal and total max. value across all assemblies incl. engine.
- Switch off engine control during gear change
- Block and/or abort temporary opening of lock-up clutch and closing of lock-up clutch during gear changes
- M_Mot_Soll (target) and/or L_Anf replaced by M_Mot_Ist (actual) (vehicle interface)
- No load request query regarding gear engagement condition (with missing load signal; Info: n_Tu and M_Mot_Soll (target) will continue to be queried)
- no M_Mot_Soll- and/or load request query regarding gear engagement condition
- Load from M_Mot_Soll (target) replacement
- Switch off reproduction (adaptation) of engine torque characteristics

Cancellation condition:
- N and standstill
- No CAN signal error or signal present

System check:
- Check the CAN network for correct function, topicality, and compatibility

270

Error description

Project: EcoLife

Basic program status: AP83 / Step 2

Error:
EvoBus CPC C03 J1939 signal error

Internal designation:
J1939EVO.CPC_C03.Timeout

Error description:
No signal within the determined period or CAN signal error J1939EVO.CPC_C03.Timeout

Error detection by:
Software

System response:
none

Cancellation condition:
No CAN signal error or signal present

System check:
- Check the CAN network for correct function, topicality, and compatibility

271

Error description

Project: EcoLife

Basic program status: AP83 / Step 2

Error:
EvoBus CPC C06 J1939 signal error

Internal designation:
J1939EVO.CPC_C06.Timeout

Error description:
No signal within the determined period or CAN signal error J1939EVO.CPC_C06.Timeout
Timeout (10 ms)

Error detection by:
Software

System response:
none

Cancellation condition:
No CAN signal error or signal present

System check:
- Check the CAN network for correct function, topicality, and compatibility

272

Error description

Project: EcoLife

Basic program status: AP83 / Step 2

Error:
EvoBus CPC C07 J1939 signal error

Internal designation:
J1939EVO.CPC_C07.Timeout

Error description:
No signal within the determined period or CAN signal error J1939EVO.CPC_C07.Timeout

Error detection by:
Software

System response:
none

Cancellation condition:
No CAN signal error or signal present

System check:

- Check the CAN network for correct function, topicality, and compatibility

273

Error description

Project: EcoLife

Basic program status: AP83 / Step 2

Error:
EvoBus CPC C10 J1939 signal error

Internal designation:
J1939EVO.CPC_C10.Timeout

Error description:
No signal within the determined period or CAN signal error J1939EVO.CPC_C10.Timeout

Error detection by:
Software

System response:
- Shut down NB function (NB = shift element F is shifted to neutral)
- Shut down AIS function (Automatic Idle Shift)
- Limit engine torque to specified value
- Switch off retarder request and AIM_Retarder
- Limit retarder torque to specified value
- Switch off engine brake
- Switch off PTO request
- Switch off shift pressure adaptation (gear change); continue to use last values
- Main pressure max. value from terminal and total max. value across all assemblies incl. engine.
- Switch off engine control during gear change
- Block and/or abort temporary opening of lock-up clutch and closing of lock-up clutch during gear changes
- M_Mot_Ist (actual) replaced by M_Mot_Soll (target) (vehicle interface)
- No load request query regarding gear engagement condition (with missing load signal; Info: n_Tu and M_Mot_Soll (target) will continue to be queried)
- no M_Mot_Soll- and/or load request query regarding gear engagement condition
- Load from M_Mot_Soll (target) replacement
- Switch off reproduction (adaptation) of engine torque characteristics

Cancellation condition:
- Ignition off
- Error not active
- N and standstill
- New retarder request
- Engine brake is available for the next possible activation after a load request above 0%
- PTO, new request

System check:

- Check the CAN network for correct function, topicality, and compatibility

274

Error description

Project: EcoLife

Basic program status: AP83 / Step 2

Error:
EvoBus CPC C12 J1939 signal error

Internal designation:
J1939EVO.CPC_C12.Timeout

Error description:
No signal within the determined period or CAN signal error J1939EVO.CPC_C12.Timeout

Error detection by:
Software

System response:
none

Cancellation condition:
No CAN signal error or signal present

System check:

- Check the CAN network for correct function, topicality, and compatibility

275

Error description

Project: EcoLife

Basic program status: AP83 / Step 2

Error:
EvoBus BS E2 J1939 signal error

Internal designation:
J1939EVO.BS_E2.Timeout

Error description:
No signal within the determined period or CAN signal error J1939EVO.BS_E2.Timeout

Error detection by:
Software

System response:
none

Cancellation condition:
No CAN signal error or signal present

System check:
- Check the CAN network for correct function, topicality, and compatibility

276

Error description

Project: EcoLife

Basic program status: AP83 / Step 2

Error:
EvoBus BS E3 J1939 signal error

Internal designation:
J1939EVO.BS_E3.Timeout

Error description:
No signal within the determined period or CAN signal error J1939EVO.BS_E3.Timeout

Error detection by:
Software

System response:
- TOPO deactivated

Cancellation condition:
- Error not active

System check:
- Check the CAN network for correct function, topicality, and compatibility

277

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
EvoBus EBS BUS B02 J1939 signal error

Internal designation:
J1939EVO.EBS_BUS_B02.Timeout

Error description:
No signal within the determined period or CAN signal error J1939EVO.EBS_BUS_B02.Timeout

Error detection by:
Software

System response:
- TOPO deactivated

Cancellation condition:
- Error not active

System check:
- Check the CAN network for correct function, topicality, and compatibility

278

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
EvoBus MUX3 B33 J1939 signal error

Internal designation:
J1939EVO.MUX3_B33.Timeout

Error description:
No signal within the determined period or CAN signal error J1939EVO.MUX3_B33.Timeout

Error detection by:
Software

System response:
none

Cancellation condition:
No CAN signal error or signal present

System check:
- Check the CAN network for correct function, topicality, and compatibility

279

Error description

Project: EcoLife

Basic program status: AP83 / Step 2

Error:
Signal error, EvoBus engine brake constant throttle signal 1
MCM C01 EngBrk1 Stat MR PT J1939

Internal designation:
J1939EVO.PT_MCM_C01.EngBrk1_Stat_MR_PT_Sig

Error description:
Transmitted value (IES.FMR592.) constant throttle is not plausible or no signal
J1939EVO.PT_MCM_C01.EngBrk1_Stat_MR_PT_Sig value not plausible or no signal
Torque still comes correctly via ACTUAL drive brake torque

Error detection by:
Software

System response:
none

Cancellation condition:
No CAN signal error or signal present

System check:
- Check the CAN network for correct function, topicality, and compatibility

280

Error description

Project: EcoLife

Basic program status: AP83 / Step 2

Error:
Signal error, EvoBus engine brake constant throttle signal 2
MCM C01 EngBrk2 Stat MR PT J1939

Internal designation:
J1939EVO.PT_MCM_C01.EngBrk2_Stat_MR_PT_Sig

Error description:
Transmitted value (IES.FMR592.) constant throttle is not plausible or no signal
J1939EVO.PT_MCM_C01.EngBrk2_Stat_MR_PT_Sig value is not plausible or no signal
Torque still comes correctly via ACTUAL drive brake torque

Error detection by:
Software

System response:
none

Cancellation condition:
No CAN signal error or signal present

System check:
- Check the CAN network for correct function, topicality, and compatibility

281

Error description

Project: EcoLife

Basic program status: AP83 / Step 2

Error:
EvoBus signal error, engine speed signal
PT MCM C02 ENGSPD CVAL PT SIG

Internal designation:
J1939EVO.PT_MCM_C02.EngSpd_Cval_PT_Sig

Error description:
Transmitted value for engine speed signal (IES.FMR592.n_Mot.Wert) is not plausible or no signal
J1939EVO.PT_MCM_C02.EngSpd_Cval_PT_Sig value is not plausible or no signal

Error detection by:
Software

System response:
- Shut down NB function (NB=shift element F is shifted to neutral)
- Shut down AIS function (Automatic Idle Shift)
- Limit engine torque to specified value
- Switch off engine brake
- Switch off PTO request
- Switch off shift pressure adaptation (gear change); continue to use last values
- Safe opening or closing of lock-up clutch
- Neutral-Immediately if shifting into Neutral (without delay and holding ramps); applies to stationary and driving vehicle
- Main pressure max. value from terminal and total max. value across all assemblies incl. engine.
- Shift point calculation based on default values; switch off tractive force pre-calculation; block sequential shift preparation for gear change; switch off TOPO
- Block and/or abort temporary opening of lock-up clutch and closing of lock-up clutch during gear changes
- n_Mot replaced by n_Tu (regarding RS_SMON function, n_Mot and n_Tu are queried. Thus, n_Tu is used as a substitute for lock-up clutch open and lock-up clutch closed)
- SPHA: no "Sync. Starten GgEin" phase (because for the phase end detection, the speeds n_Mot and/or n_Tu are missing)
- Switch off reproduction (adaptation) of engine torque characteristics

Cancellation condition:
- Error not active

- With ignition off
- N and standstill
- Engine brake is available for the next possible activation after a load request above 0%
- PTO with new request

System check:

- Check the CAN network for correct function, topicality, and compatibility

282

Error description

Project: EcoLife

Basic program status: AP83 / Step 2

Error:
EvoBus actual engine torque, signal error
PT MCM C02 EngTrq Cval PT Sig

Internal designation:
J1939EVO.PT_MCM_C02.EngTrq_Cval_PT_Sig

Error description:
Transmitted value for engine torque (IES.FMR593.M_Mot_Ist.Wert) is not plausible or no signal
J1939EVO.PT_MCM_C02.EngTrq_Cval_PT_Sig value is not plausible or no signal
If the ignition is on, nominal torque will be sent. To determine pressure / engine control / adaptation.
After that, if pos.: engine torque; if neg.: sum of brake torques from retarder, engine brake, overrun torque

Error detection by:
Software

System response:
- Shut down NB function (NB=shift element F is shifted to neutral)
- Shut down AIS function (Automatic Idle Shift)
- Limit engine torque to specified value
- Limit retarder torque to specified value
- Switch off engine brake
- Switch off PTO request
- Switch off shift pressure adaptation (gear change); continue to use last values
- Main pressure max. value from terminal and total max. value across all assemblies incl. engine
- Switch off engine control during gear change
- Block and/or abort temporary opening of lock-up clutch and closing of lock-up clutch during gear changes
- M_Mot_Ist (actual) replaced by M_Mot_Soll (target) (vehicle interface)
- Switch off reproduction (adaptation) of engine torque characteristics

Cancellation condition:
- Error not active
- With ignition off
- N and standstill
- Retarder with new request
- Engine brake is available for the next possible activation after a load request above 0%
- PTO with new request

System check:

- Check the CAN network for correct function, topicality, and compatibility.

283

Error description

Project: EcoLife

Basic program status: AP83 / Step 2

Error:
EvoBus engine friction torque, signal error
PT MCM C23 EngFrictTrq Cval PT Sig J1939

Internal designation:
J1939EVO.PT_MCM_ C23.EngFrictTrq_Cval_PT_Sig

Error description:
Transmitted value for engine friction torque is not plausible or no signal
J1939EVO.PT_MCM_C23.EngFrictTrq_Cval_PT_Sig value is not plausible or no signal

Error detection by:
Software

System response:
- Switch off reproduction (adaptation) of engine torque characteristics

Cancellation condition:
- Error not active

System check:
- Check the CAN network for correct function, topicality, and compatibility.

284

Error description

Project: EcoLife

Basic program status: AP83 / Step 2

Error:
EvoBus signal error, maximum current torque signal
PT MCM C02 MaxActIEngTrq Cval PT Sig J1939

Internal designation:
J1939EVO.PT_MCM_C02.MaxActIEngTrq_Cval_PT_Sig

Error description:
Transmitted value for maximum current torque signal is not plausible or no signal
IES.FMR1360.M_Mot_Max_Momentan (current): value for load determination/engine control
J1939EVO.PT_MCM_C02.MaxActIEngTrq_Cval_PT_Sig value is not plausible or no signal

Error detection by:
Software

System response:
- Switch off reproduction (adaptation) of engine torque characteristics

Cancellation condition:
- Error not active

System check:
- Check the CAN network for correct function, topicality, and compatibility.

285

Error description

Project: EcoLife

Basic program status: AP83 / Step 2

Error:
EvoBus signal error, coolant temperature
PT MCM C07 CoolTemp Cval PT Sig J1939

Internal designation:
J1939EVO.PT_MCM_ C07.CoolTemp_Cval_PT_Sig

Error description:
Transmitted value for engine coolant temperature is not plausible or no signal.
Is used to reduce retarder
No measure because: safeguarding by T_Ret and T_Su available.
J1939EVO.PT_MCM_C07.CoolTemp_Cval_PT_Sig value is not plausible or no signal

Error detection by:
Software

System response:
none

Cancellation condition:
No CAN signal error or signal present

System check:
- Check the CAN network for correct function, topicality, and compatibility.

286

Error description

Project: EcoLife

Basic program status: AP83 / Step 2

Error:
EvoBus signal error, ASR intervention signal
PT CPC3 C01 ATC BrkCtrl Stat PT Sig J1939

Internal designation:
J1939EVO.PT_CPC3_ C01.ATC_BrkCtrl_Stat_PT_Sig

Error description:
Transmitted value for ASR intervention is not plausible or not present
IES.ABS512.ASR_Eingriffwert (intervention value)
J1939EVO.PT_CPC3_C01.ATC_BrkCtrl_Stat_PT_Sig value is not plausible or no signal present

Error detection by:
Software

System response:
none

Cancellation condition:
No CAN signal error or signal present

System check:
- Check the CAN network for correct function, topicality, and compatibility.

287

Error description

Project: EcoLife

Basic program status: AP83 / Step 2

Error:
EvoBus signal error, ABS intervention signal
BS E2 ABS Actv2 Stat PT Sig J1939

Internal designation:
J1939EVO.BS_E2.ABS_Actv2_Stat_PT_Sig

Error description:
Transmitted value for ABS intervention signal is not plausible or not present
IES.ABS512.ABS_Eingriffwert (intervention value)
J1939EVO.BS_E2.ABS_Actv2_Stat_PT_Sig value is not plausible or no signal present

Error detection by:
Software

System response:
none

Cancellation condition:
No CAN signal error or signal present

System check:
- Check the CAN network for correct function, topicality, and compatibility.

288

Error description

Project: EcoLife

Basic program status: AP83 / Step 2

Error:
EvoBus signal error, kickdown signal
PT CPC3 C03 KickDn Stat PT Sig J1939

Internal designation:
J1939EVO_PT_CPC3_ C03_KICKDN_STAT_PT_SIG

Error description:
Transmitted value for kickdown signal is not plausible or not present
IES.FMR592.Kickdownwert (kickdown value)
J1939EVO.PT_CPC3_C03.KICKDN_STAT_PT_SIG value is not plausible or no signal present.

Error detection by:
Software

System response:
Kickdown is not available

Cancellation condition:
No CAN signal error or signal present

System check:
- Check the CAN network for correct function, topicality, and compatibility.

289

Error description

Project: EcoLife

Basic program status: AP83 / Step 2

Error:
EvoBus signal error, speed signal
J1939EVOBus CPC C10 VehSpd Cval PT Sig

Internal designation:
J1939EVO.CPC_C10.VehSpd_Cval_PT_Sig

Error description:
Transmitted value for current speed signal is not plausible or not present.
If the speed signal fails, the last i_HA (i, rear axle) adaptation value is maintained to calculate the factor for the rear axle ratio with dynamic tire radius.
J1939EVO.CPC_C10.VehSpd_Cval_PT_Sig (C3 592) value is not plausible or no signal present.

Error detection by:
Software

System response:
- The rear axle adaptation i- HAA is deactivated. If the required speeds are not available, the rear axle adaptation is deactivated automatically.

Cancellation condition:
- Error not active

System check:
- Check the CAN network for correct function, topicality, and compatibility.

290

Error description

Project: EcoLife

Basic program status: AP83 / Step 2

Error:
EvoBus signal error, parking brake signal
PT CPC C06 PrkBrk Stat PT Sig J1939

Internal designation:
J1939EVO.CPC_C06.PrkBrk_Stat_PT_Sig

Error description:
Transmitted value for parking brake signal is not plausible or not present.
IES.FMR592.Feststellbremsewert (parking brake value)
J1939EVO.CPC_C06.PrkBrk_Stat_PT_Sig value is not plausible or no signal present.

Error detection by:
Software

System response:
none

Cancellation condition:
No CAN signal error or signal present

System check:
- Check the CAN network for correct function, topicality, and compatibility.

291

Error description

Project: EcoLife

Basic program status: AP83 / Step 2

Error:
EvoBus signal error, cruise control signal (SPN 595)
PT CPC C09 CC Actvn Stat PT Sig J1939

Internal designation:
J1939EVO.CPC_C09.CC_Actvn_Stat_PT_Sig

Error description:
Transmitted value for cruise control signal is not plausible or not present.
J1939EVO.CPC_C09.CC_Actvn_Stat_PT_Sig value is not plausible or no signal present.

Error detection by:
Software

System response:
none

Cancellation condition:
No CAN signal error or signal present

System check:
- Check the CAN network for correct function, topicality, and compatibility.

292

Error description

Project: EcoLife

Basic program status: AP83 / Step 2

Error:
EvoBus signal error, retarder lever setting signal
J1939EVOBus CPC C07 RetSwPosn2 Stat PT Sig

Internal designation:
J1939EVO.CPC_C07.RetSwPosn2_Stat_PT_Sig

Error description:
Transmitted value for retarder lever setting signal is not plausible or not present.
J1939EVO.CPC_C07.RetSwPosn2_Stat_PT_Sig value is not plausible or no signal present.

Error detection by:
Software

System response:
Retarder cannot be operated via CAN hand lever.

Cancellation condition:
No CAN signal error or signal present

System check:
- Check the CAN network for correct function, topicality, and compatibility.

293

Error description

Project: EcoLife

Basic program status: AP83 / Step 2

Error:
EvoBus signal error, engine target torque signal
J1939EVOBus CPC C11 TargetEngTrqETP rq PT

Internal designation:
J1939EVO.CPC_C11.TargetEngTrqETP_rq_PT

Error description:
Transmitted value for engine target torque signal for load determination and engine control is not plausible or not present.
IES.FMR593.M_Mot_Sollwert (target value)
J1939EVO.CPC_C11.TargetEngTrqETP_rq_PT value is not plausible or no signal present.

Error detection by:
Software

System response:
- Shut down NB function (NB=shift element F is shifted to neutral)
- Shut down AIS function (Automatic Idle Shift)
- Limit engine torque to specified value
- Switch off retarder request and AIM_Retarder
- Limit retarder torque to specified value
- Switch off engine brake
- Switch off PTO request
- Switch off shift pressure adaptation (gear change); continue to use last values
- Main pressure max. value from terminal and total max. value across all assemblies incl. engine
- Switch off engine control during gear change
- Block and/or abort temporary opening of lock-up clutch and closing of lock-up clutch during gear changes
- M_Mot_Soll (target) and/or L_Anf replaced by M_Mot_Ist (actual) (vehicle interface)
- No load request query regarding gear engagement condition (with missing load signal; Info: n_Tu and M_Mot_Soll (target) will continue to be queried)
- no M_Mot_Soll- and/or load request query regarding gear engagement condition
- Load from M_Mot_Soll (target) replacement
- Switch off reproduction (adaptation) of engine torque characteristics

Cancellation condition:
- Error not active
- Ignition off

- N and standstill
- New retarder request
- Engine brake is available for the next possible activation after a load request above 0%
- PTO, new request

System check:

- Check the CAN network for correct function, topicality, and compatibility.

294

Error description

Project: EcoLife

Basic program status: AP83 / Step 2

Error:
EvoBus signal error, retarder target torque signal
J1939EVOBus CPC C12 RetTrq Rq PT Sig

Internal designation:
J1939EVO.CPC_C12.RetTrq_Rq_PT_Sig

Error description:
Transmitted value for retarder target torque signal is not plausible or not present.
IES.FMR593.M_Ret_Sollwert (target value)
J1939EVO.CPC_C12.RetTrq_Rq_PT_Sig value is not plausible or no signal present.

Error detection by:
Software

System response:
none

Cancellation condition:
No CAN signal error or signal present

System check:
- Check the CAN network for correct function, topicality, and compatibility.

295

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
EvoBus signal error, hill holder signal
BS E3 DispHaltBrk Cmd BS Sig J1939

Internal designation:
J1939EVO.BS_E3.DispHaltBrk_Cmd_BS_Sig

Error description:
Transmitted value for the hill holder signal is not plausible or not present.
IES.ABS512.Rueckrollsperrenwert (hill holder value)
J1939EVO.BS_E3.DispHaltBrk_Cmd_BS_Sig value is not plausible or no signal present.

Error detection by:
Software

System response:
none

Cancellation condition:
No CAN signal error or signal present

System check:
- Check the CAN network for correct function, topicality, and compatibility.

296

Error description

Project: EcoLife

Basic program status: AP83 / Step 2

Error:
EvoBus signal error, brake value setpoint value
J1939EVOBus BS E3.Brk Cval Sig

Internal designation:
J1939EVO.BS_E3.Brk_Cval_Sig

Error description:
Transmitted value for brake value setpoint value is not plausible or not present.
IES.ABS1024.brake value setpoint value
J1939EVO.BS_E3.Brk_Cval_Sig value is not plausible or no signal present.

Error detection by:
Software

System response:
- Topographical functionalities are deactivated

Cancellation condition:
- Error not active

System check:
- Check the CAN network for correct function, topicality, and compatibility.

297

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Signal error, EvoBus, brake circuit 1 pressure signal
AIR1 ICUC BrkAirPress1 Stat Sig

Internal designation:
J1939EVO.AIR1_ICUC.BrkAirPress1_Stat_Sig

Error description:
Transmitted value for brake circuit 1 pressure signal (pressure in brake circuit 1) is not plausible or not present.
J1939EVO.AIR1_ICUC.BrkAirPress1_Stat_Sig value is not plausible or no signal present.

Error detection by:
Software

System response:
- Topographical functionalities are deactivated

Cancellation condition:
- Error not active

System check:
- Check the CAN network for correct function, topicality, and compatibility.

298

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Signal error, EvoBus, brake circuit 2 pressure signal
AIR1 ICUC BrkAirPress2 Stat Sig

Internal designation:
J1939EVO.AIR1_ICUC.BrkAirPress2_Stat_Sig

Error description:
Transmitted value for brake circuit 2 pressure signal (pressure in brake circuit 2) is not plausible or not present.
J1939EVO.AIR1_ICUC.BrkAirPress2_Stat_Sig value is not plausible or no signal present.

Error detection by:
Software

System response:
- Topographical functionalities are deactivated

Cancellation condition:
- Error not active

System check:
- Check the CAN network for correct function, topicality, and compatibility.

299

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
EvoBus signal error, forward gear release signal
MUX3 B33 EnblGrD Rq Sig J1939

Internal designation:
J1939EVO.MUX3_B33.EnblGrD_Rq_Sig

Error description:
Transmitted value for forward gear release signal is not plausible or not present.
EvoBus reads in forward gear release signal (1451) and sends it to TCU, brake condition is still present.
J1939EVO.MUX3_B33.EnblGrD_Rq_Sig value is not plausible or no signal present.

Error detection by:
Software

System response:
- No gear release

Cancellation condition:
- Error not active

System check:
- Check the CAN network for correct function, topicality, and compatibility.

300

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
EvoBus signal error, signal for bus stop brake request
MUX3 B33 HaltBrk Rq Mux Sig J1939

Internal designation:
J1939EVO.MUX3_B33.HaltBrk_Rq_Mux_Sig

Error description:
Transmitted value for bus stop brake request signal (1448) is not plausible or not present.
J1939EVO.MUX3_B33.HaltBrk_Rq_Mux_Sig value is not plausible or no signal present.

Error detection by:
Software

System response:
none

Cancellation condition:
No CAN signal error or signal present

System check:
- Check the CAN network for correct function, topicality, and compatibility.

301

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
EvoBus signal error, retarder direct signal via CAN
MUX3 B33 RetDirectSw Rq PT Sig J1939

Internal designation:
J1939EVO.MUX3_B33.RetDirectSw_Rq_PT_Sig

Error description:
Transmitted value for retarder direct signal via CAN is not plausible or not present.
Retarder directly via CAN (FPS ID 1448) 100 ms.
In the case of a defect, the default value is set in such a way that the signal no longer issues a retarder request. Driving can be continued with the other signals.
J1939EVO.MUX3_B33.RetDirectSw_Rq_PT_Sig value is not plausible or no signal present.

Error detection by:
Software

System response:
- No retarder request
- No additional error measure: In the case of a defect, the default value is set in such a way that the signal no longer issues a request. Driving can be continued with the other signals.

Cancellation condition:
- Error not active

System check:
- Check the CAN network for correct function, topicality, and compatibility.

302

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
EvoBus signal error, reverse gear release
MUX3 B33 RlsRevGr Rq PT Sig J1939

Internal designation:
J1939EVO.MUX3_B33.RlsRevGr_Rq_PT_Sig

Error description:
Transmitted value for reverse gear release signal is not plausible or not present.
EvoBus reads in reverse gear release signal (1451) and sends it to TCU, brake condition is still present.
J1939EVO.MUX3_B33.RlsRevGr_Rq_PT_Sig is not plausible or no signal present.

Error detection by:
Software

System response:
- No reverse gear release

Cancellation condition:
- Error not active

System check:
- Check the CAN network for correct function, topicality, and compatibility.

303

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
EvoBus signal error, signal for drive program selection
MUX3 B33 SelAutoTxProg Stat PT Sig J1939

Internal designation:
J1939EVO.MUX3_B33.SelAutoTxProg_Stat_PT_Sig

Error description:
Transmitted value for drive program selection signal (program selection 1451) is not plausible or not present.
EvoBus reads in the signal and transmits it to the TCU.
In the case of failure, the default value is set (as set in IDAS).
J1939EVO.MUX3_B33.SelAutoTxProg_Stat_PT_Sig is not plausible or no signal present.

Error detection by:
Software

System response:
- It is not possible to select a drive program.

Cancellation condition:
- Error not active

System check:
- Check the CAN network for correct function, topicality, and compatibility.

304

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
EvoBus signal error, EBC1 brake electronics 1 (of xx) : Timeout (PGN 61441)
EBC1 FROM XX Timeout J1939

Internal designation:
J1939.EBC1_FROM_XX.Timeout

Error description:
No signal within the determined period of EBC1 brake electronics 1.
Transmitted value for EBC1 brake electronics 1 is not plausible or not present.
IES.ABS1024.brake setpoint value timeout error
J1939.EBC1_FROM_XX.Timeout due to missing signal.
Brake electronics sends to. Transmission rate: 100 ms

Error detection by:
Software

System response:
- Topography-dependent shift program changeover deactivated

Cancellation condition:
- Error not active, no timeout error

System check:
- Check the CAN network for correct function, topicality, and compatibility.

305

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
EvoBus signal error, signal for brake pedal position
EBC1 FROM XX Brake Pedal Position Sig J1939

Internal designation:
J1939.EBC1_FROM_XX.Brake_Pedal_Position_Sig

Error description:
Transmitted value for brake pedal position signal (J1939_SPN: 521) is not plausible or not present.
J1939.EBC1_FROM_XX.Brake_Pedal_Position_Sig is not plausible or no signal present.

Error detection by:
Software

System response:
- Topographical functionalities are deactivated

Cancellation condition:
- Error not active

System check:
- Check the CAN network for correct function, topicality, and compatibility.

306

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Signal for neutral externally from secondary message is not plausible to neutral externally from digital input

Internal designation:
N_EXT_CAN_UNPLAUSIBLE_TO_ED

Error description:
Signal for neutral externally from secondary message is not plausible with neutral externally from digital input (DI) or not present - red error. (Transmission rate >100 ms)
N_EXT_CAN_UNPLAUSIBLE_TO_ED not plausible or no signal.

Error detection by:
Software

System response:
- ZAE deactivation (deactivate all AIM internally; deactivate neutral internally)

Cancellation condition:
- Error not active
- N speed range selector

System check:
- Check the CAN network for correct function, topicality, and compatibility.

307

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Max. limit value for main pressure adaptation was exceeded.

Internal designation:
Main pressure - upward adaptation offset > threshold value
MAIN_PRESS_ADAP_OFFSET_MAX_LIM

Error description:
The max. admissible parameterized value for main pressure adaptation was exceeded.

Error detection by:
Software

System response:
- Limit engine torque to specified value
- Limit retarder torque to specified value
- Switch off engine brake

Cancellation condition:
- Error not active
- N and standstill
- New retarder request
- One-time torque request above 0%

System check:
- Check transmission oil level
- If possible, check oil grade and oil condition.
- Failure possibly caused by worn components
- Check for damage caused by overheating, transmission was operated too long at excessive temperatures.
- Low delivery rate of main pressure pump
- Poor filling characteristics resulting from too high internal leakage due to leaking oil supply
- High level of wear on hydraulic control unit

308

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
EvoBus signal error, brake pressure circuit 1 signal
IES FPS 1451 brake pressure circuit1 Sig

Internal designation:
IES.FPS_1451.Bremsdruck_Kr1_Sig

Error description:
Transmitted value for signal from brake pressure circuit 1 (IES 1451) is not plausible or not present.
IES.FPS_1451.Bremsdruck_Kr1_Sig value is not plausible or no signal present.

Error detection by:
Software

System response:
none

Cancellation condition:
No CAN signal error or signal present

System check:
- Check the CAN network for correct function, topicality, and compatibility.

309

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
EvoBus signal error, brake pressure circuit 2 signal
IES FPS 1451 brake pressure circuit2 Sig

Internal designation:
IES.FPS_1451.Bremsdruck_Kr2_Sig

Error description:
Transmitted value for signal from brake pressure circuit 2 (IES 1451) is not plausible or not present.
IES.FPS_1451.Bremsdruck_Kr2_Sig value is not plausible or no signal present.

Error detection by:
Software

System response:
none

Cancellation condition:
No CAN signal error or signal present

System check:
- Check the CAN network for correct function, topicality, and compatibility.

310

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
EvoBus signal error, engine coolant temperature signal
J1939 ET1 FROM ENGINE Eng Coolant Temp Sig

Internal designation:
J1939.ET1_FROM_ENGINE.Eng_Coolant_Temp_Sig

Error description:
Transmitted value for engine coolant temperature (J1939_SPN: 110) is not plausible or not present.
J1939.ET1_FROM_ENGINE.Eng_Coolant_Temp_Sig value is not plausible or no signal present.

Error detection by:
Software

System response:
none

Cancellation condition:
No CAN signal error or signal present

System check:
- Check the CAN network for correct function, topicality, and compatibility.

311

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
EvoBus signal error, no signal of ET1 engine temperature
J1939 ET1 FROM ENGINE Timeout

Internal designation:
J1939.ET1_FROM_ENGINE.Timeout

Error description:
No ET1 engine temperature signal (PGN 65262) within determined period
CAN signal error J1939.ET1_FROM_ENGINE Timeout

Error detection by:
Software

System response:
none

Cancellation condition:
No CAN signal error or signal present

System check:
- Check the CAN network for correct function, topicality, and compatibility.

312

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Signal error, signal for speed range selector or E-box sends error
SC EBOX V 1 SIG

Internal designation:
SC_EBOX_V_1_SIG

Error description:
Transmitted value for the signal from the speed range selector or E-box sends error
SC_EBOX_V_1_SIG value is not plausible or no signal present.

Error detection by:
Software

System response:
none

Cancellation condition:
No CAN signal error or signal present

System check:
- Check the CAN network for correct function, topicality, and compatibility.

313

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Signal error, signal for speed range selector or E-box sends error
SC EBOX V 2 SIG

Internal designation:
SC_EBOX_V_2_SIG

Error description:
Transmitted value for the signal from the speed range selector or E-box sends error
SC_EBOX_V_2_SIG value is not plausible or no signal present.

Error detection by:
Software

System response:
none

Cancellation condition:
No CAN signal error or signal present

System check:
- Check the CAN network for correct function, topicality, and compatibility.

314

Error description

Project: EcoLife

Basic program status: AP63 / Step 1.1

Error:
Signal error, signal for speed range selector or E-box sends error
SC EBOX GEAR 2 SIG

Internal designation:
SC_EBOX_ GEAR _2_SIG

Error description:
Transmitted value for the signal from the speed range selector or E-box sends error
SC_EBOX_ GEAR _2_SIG value is not plausible or no signal present.

Error detection by:
Software

System response:
none

Cancellation condition:
No CAN signal error or signal present

System check:
- Check the CAN network for correct function, topicality, and compatibility.

315

Error description

Project: EcoLife

Basic program status: AP83 / Step 2

Error:
EvoBus signal error, no signal from CC/VS cruise control
J1939 CCVS FROM XX Timeout

Internal designation:
J1939.CC_VS_FROM_XX.Timeout

Error description:
No signal from CC/VS cruise control (PGN 65265) within determined period
Vehicle computer should send signal to transmission
CAN signal error J1939.CC_VS_FROM_XX.Timeout, transmission rate: 100 ms

Error detection by:
Software

System response:
none

Cancellation condition:
No CAN signal error or signal present

System check:
- Check the CAN network for correct function, topicality, and compatibility.

316

Error description

Project: EcoLife

Basic program status: AP83 / Step 2

Error:
EvoBus signal error, signal for the speed measured at the wheel
CCVS FROM XX Wheelbased Veh Speed Sig J1939

Internal designation:
J1939.CC_VS_FROM_XX.Wheelbased_Veh_Speed_Sig

Error description:
Transmitted value for speed measured at wheel (J1939_SPN: 84) is not plausible or not present.
In the event of a failure, the last i_HA adaptation value is maintained for the rear-axle ratio.
J1939.CC_VS_FROM_XX.Wheelbased_Veh_Speed_Sig is not plausible or no signal present.

Error detection by:
Software

System response:
- The rear axle adaptation i- HAA is deactivated
- If the required speeds are not available, the rear axle adaptation is deactivated automatically

Cancellation condition:
- Error not active

System check:
- Check the CAN network for correct function, topicality, and compatibility.

317

Error description

Project: EcoLife

Basic program status: AP83 / Step 2

Error:
Engine torque at stall speed is too high
TORQUE AT STALLSPEED TO HIGH

Internal designation:
TORQUE_AT_STALLSPEED_TO_HIGH

Error description:
Excessive engine torque was detected when reaching stall speed.
Possible causes:

- Engine's response to torque limitation is too sluggish or no response at all.
- The actual engine torque deviates too much from the engine torque transmitted.
- CAN failure when reaching stall speed.

Error detection by:
Software.
Error is detected only at standstill.
The reference torque is derived from the parameterized converter performance curve.

System response:

- none

Cancellation condition:

- Error not active

System check:

- Check the CAN network for correct function, topicality, and compatibility.
- Check engine torque output together with the vehicle manufacturer.
- Have engine control unit checked for errors.

318

Error description

Project: EcoLife

Basic program status: AP83 / Step 2

Error:
EvoBus J1939EVO.EBC5_BS.Timeout signal error

Internal designation:
J1939EVO.EBC5_BS.Timeout

Error description:
No signal within the determined period or CAN signal error J1939EVO.EBC5_BS.Timeout

Error detection by:
Software

System response:
- none

Cancellation condition:
- Error not active

System check:
- Check the CAN network for correct function, topicality, and compatibility.

319

Error description

Project: EcoLife

Basic program status: AP83 / Step 2

Error:
EvoBus J1939EVO.MCM_C03.Timeout signal error

Internal designation:
J1939EVO.MCM_C03.Timeout

Error description:
No signal within the determined period or CAN signal error J1939EVO.MCM_C03.Timeout

Error detection by:
Software

System response:
- none

Cancellation condition:
- Error not active

System check:
- Check the CAN network for correct function, topicality, and compatibility.

320

Error description

Project: EcoLife

Basic program status: AP83 / Step 2

Error:
EvoBus J1939EVO.CPC_C09.Timeout signal error

Internal designation:
J1939EVO.CPC_C09.Timeout

Error description:
No signal within the determined period or CAN signal error J1939EVO.CPC_C09.Timeout

Error detection by:
Software

System response:
- none

Cancellation condition:
- Error not active

System check:
- Check the CAN network for correct function, topicality, and compatibility.

321

Error description

Project: EcoLife

Basic program status: AP83 / Step 2

Error:
EvoBus J1939EVO.MCM_C03.AbsMaxEngTrq_Cval_PT_Sig signal error

Internal designation:
J1939EVO.MCM_C03.AbsMaxEngTrq_Cval_PT_Sig

Error description:
No signal within the determined period or CAN signal error
J1939EVO.MCM_C03.AbsMaxEngTrq_Cval_PT_Sig

Error detection by:
Software

System response:
- none

Cancellation condition:
- Error not active

System check:
- Check the CAN network for correct function, topicality, and compatibility.

322

Error description

Project: EcoLife

Basic program status: AP83 / Step 2

Error:
HyLife signal error HybridCAN
HyCAN.H2T_1.Timeout

Internal designation:
HyCAN.H2T_1.Timeout

Error description:
No signal within the determined period or CAN signal error HyCAN.H2T_1.Timeout

Error detection by:
Software

System response:
- none

Cancellation condition:
- Error not active

System check:
- Check the CAN network for correct function, topicality, and compatibility.

323

Error description

Project: EcoLife

Basic program status: AP83 / Step 2

Error:
HyLife signal error HybridCAN
HyCAN.H2T_2.Timeout

Internal designation:
HyCAN.H2T_2.Timeout

Error description:
No signal within the determined period or CAN signal error HyCAN.H2T_2.Timeout

Error detection by:
Software

System response:
- none

Cancellation condition:
- Error not active

System check:
- Check the CAN network for correct function, topicality, and compatibility.

324

Error description

Project: EcoLife

Basic program status: AP83 / Step 2

Error:
HyLife signal error HybridCAN
HyCAN.H2T_3.Timeout

Internal designation:
HyCAN.H2T_3.Timeout

Error description:
No signal within the determined period or CAN signal error HyCAN.H2T_3.Timeout

Error detection by:
Software

System response:
- none

Cancellation condition:
- Error not active

System check:
- Check the CAN network for correct function, topicality, and compatibility.

325

Error description

Project: EcoLife

Basic program status: AP83 / Step 2

Error:
HyLife signal error HybridCAN
HyCAN.H2T_4.Timeout

Internal designation:
HyCAN.H2T_4.Timeout

Error description:
No signal within the determined period or CAN signal error HyCAN.H2T_4.Timeout

Error detection by:
Software

System response:
- none

Cancellation condition:
- Error not active

System check:
- Check the CAN network for correct function, topicality, and compatibility.

326

Error description

Project: EcoLife

Basic program status: AP83 / Step 2

Error:
HyLife signal error HybridCAN
HyCAN.H2T_5.Timeout

Internal designation:
HyCAN.H2T_5.Timeout

Error description:
No signal within the determined period or CAN signal error HyCAN.H2T_5.Timeout

Error detection by:
Software

System response:
- none

Cancellation condition:
- Error not active

System check:
- Check the CAN network for correct function, topicality, and compatibility.

327

Error description

Project: EcoLife

Basic program status: AP83 / Step 2

Error:
HyLife signal error HybridCAN
HyCAN.H2T_1.stsEMotMode_Sig

Internal designation:
HyCAN.H2T_1.stsEMotMode_Sig

Error description:
No signal within the determined period or CAN signal error HyCAN.H2T_1.stsEMotMode_Sig

Error detection by:
Software

System response:
- none

Cancellation condition:
- Error not active

System check:
- Check the CAN network for correct function, topicality, and compatibility.

328

Error description

Project: EcoLife

Basic program status: AP83 / Step 2

Error:
HyLife signal error HybridCAN
HyCAN.H2T_1.trms_ctrlOpen_req_Sig

Internal designation:
HyCAN.H2T_1.trms_ctrlOpen_req_Sig

Error description:
No signal within the determined period or CAN signal error
HyCAN.H2T_1.trms_ctrlOpen_req_Sig

Error detection by:
Software

System response:
- none

Cancellation condition:
- Error not active

System check:
- Check the CAN network for correct function, topicality, and compatibility.

329

Error description

Project: EcoLife

Basic program status: AP83 / Step 2

Error:
HyLife signal error HybridCAN
HyCAN.H2T_1.CL1_ctrlMode_req_Sig

Internal designation:
HyCAN.H2T_1.CL1_ctrlMode_req_Sig

Error description:
No signal within the determined period or CAN signal error
HyCAN.H2T_1.CL1_ctrlMode_req_Sig

Error detection by:
Software

System response:
- none

Cancellation condition:
- Error not active

System check:
- Check the CAN network for correct function, topicality, and compatibility.

330

Error description

Project: EcoLife

Basic program status: AP82 / Step 2

Error:
HyLife signal error HybridCAN
HyCAN.H2T_1.trqCL1_req_Sig

Internal designation:
HyCAN.H2T_1.trqCL1_req_Sig

Error description:
No signal within the determined period or CAN signal error HyCAN.H2T_1.trqCL1_req_Sig

Error detection by:
Software

System response:
- none

Cancellation condition:
- Error not active

System check:
- Check the CAN network for correct function, topicality, and compatibility.

331

Error description

Project: EcoLife

Basic program status: AP83 / Step 2

Error:
HyLife signal error HybridCAN
HyCAN.H2T_2.nEMot_Sig

Internal designation:
HyCAN.H2T_2.nEMot_Sig

Error description:
No signal within the determined period or CAN signal error HyCAN.H2T_2.nEMot_Sig

Error detection by:
Software

System response:
- none

Cancellation condition:
- Error not active

System check:
- Check the CAN network for correct function, topicality, and compatibility.

332

Error description

Project: EcoLife

Basic program status: AP83 / Step 2

Error:
HyLife signal error HybridCAN
HyCAN.H2T_2.trqEMot_Sig

Internal designation:
HyCAN.H2T_2.trqEMot_Sig

Error description:
No signal within the determined period or CAN signal error HyCAN.H2T_2.trqEMot_Sig

Error detection by:
Software

System response:
- none

Cancellation condition:
- Error not active

System check:
- Check the CAN network for correct function, topicality, and compatibility.

333

Error description

Project: EcoLife

Basic program status: AP83 / Step 2

Error:
HyLife signal error HybridCAN
HyCAN.H2T_3.stsHCUModeRcmd_Sig

Internal designation:
HyCAN.H2T_3.stsHCUModeRcmd_Sig

Error description:
No signal within the determined period or CAN signal error
HyCAN.H2T_3.stsHCUModeRcmd_Sig

Error detection by:
Software

System response:
- none

Cancellation condition:
- Error not active

System check:
- Check the CAN network for correct function, topicality, and compatibility

334

Error description

Project: EcoLife

Basic program status: AP83 / Step 2

Error:
HyLife signal error HybridCAN
HyCAN.H2T_3.trqEngDrvDem_Sig

Internal designation:
HyCAN.H2T_3.trqEngDrvDem_Sig

Error description:
No signal within the determined period or CAN signal error HyCAN.H2T_3.trqEngDrvDem_Sig

Error detection by:
Software

System response:
- none

Cancellation condition:
- Error not active

System check:
- Check the CAN network for correct function, topicality, and compatibility

335

Error description

Project: EcoLife

Basic program status: AP83 / Step 2

Error:
HyLife signal error HybridCAN
HyCAN.H2T_3.trqEMotDrvDem_Sig

Internal designation:
HyCAN.H2T_3.trqEMotDrvDem_Sig

Error description:
No signal within the determined period or CAN signal error HyCAN.H2T_3.trqEMotDrvDem_Sig

Error detection by:
Software

System response:
- none

Cancellation condition:
- Error not active

System check:
- Check the CAN network for correct function, topicality, and compatibility

336

Error description

Project: EcoLife

Basic program status: AP83 / Step 2

Error:
HyLife signal error HybridCAN
HyCAN.H2T_3.reltrqDrvDem_Sig

Internal designation:
HyCAN.H2T_3.reltrqDrvDem_Sig

Error description:
No signal within the determined period or CAN signal error HyCAN.H2T_3.reltrqDrvDem_Sig

Error detection by:
Software

System response:
- none

Cancellation condition:
- Error not active

System check:
- Check the CAN network for correct function, topicality, and compatibility

337

Error description

Project: EcoLife

Basic program status: AP83 / Step 2

Error:
HyLife signal error HybridCAN
HyCAN.H2T_4.ctrlShiftRcmd_Sig

Internal designation:
HyCAN.H2T_4.ctrlShiftRcmd_Sig

Error description:
No signal within the determined period or CAN signal error HyCAN.H2T_4.ctrlShiftRcmd_Sig

Error detection by:
Software

System response:
- none

Cancellation condition:
- Error not active

System check:
- Check the CAN network for correct function, topicality, and compatibility

338

Error description

Project: EcoLife

Basic program status: AP83 / Step 2

Error:
HyLife signal error HybridCAN
HyCAN.H2T_4.GearHCU_req_Sig

Internal designation:
HyCAN.H2T_4.GearHCU_req_Sig

Error description:
No signal within the determined period or CAN signal error HyCAN.H2T_4.GearHCU_req_Sig

Error detection by:
Software

System response:
- none

Cancellation condition:
- Error not active

System check:
- Check the CAN network for correct function, topicality, and compatibility

339

Error description

Project: EcoLife

Basic program status: AP83 / Step 2

Error:
HyLife signal error HybridCAN
HyCAN.H2T_5.trqEMotAct_max_Sig

Internal designation:
HyCAN.H2T_5.trqEMotAct_max_Sig

Error description:
No signal within the determined period or CAN signal error HyCAN.H2T_5.trqEMotAct_max_Sig

Error detection by:
Software

System response:
- none

Cancellation condition:
- Error not active

System check:
- Check the CAN network for correct function, topicality, and compatibility

340

Error description

Project: EcoLife

Basic program status: AP83 / Step 2

Error:
HyLife signal error HybridCAN
HyCAN.H2T_5.trqEMotPred_max_Sig

Internal designation:
HyCAN.H2T_5.trqEMotPred_max_Sig

Error description:
No signal within the determined period or CAN signal error
HyCAN.H2T_5.trqEMotPred_max_Sig

Error detection by:
Software

System response:
- none

Cancellation condition:
- Error not active

System check:
- Check the CAN network for correct function, topicality, and compatibility

341

Error description

Project: EcoLife

Basic program status: AP83 / Step 2

Error:
HyLife signal error HybridCAN
HyCAN.H2T_5.trqEMotAct_min_Sig

Internal designation:
HyCAN.H2T_5.trqEMotAct_min_Sig

Error description:
No signal within the determined period or CAN signal error HyCAN.H2T_5.trqEMotAct_min_Sig

Error detection by:
Software

System response:
- none

Cancellation condition:
- Error not active

System check:
- Check the CAN network for correct function, topicality, and compatibility

342

Error description

Project: EcoLife

Basic program status: AP83 / Step 2

Error:
HyLife signal error HybridCAN
HyCAN.H2T_5.trqEMotPred_min_Sig

Internal designation:
HyCAN.H2T_5.trqEMotPred_min_Sig

Error description:
No signal within the determined period or CAN signal error
HyCAN.H2T_5.trqEMotPred_min_Sig

Error detection by:
Software

System response:
- none

Cancellation condition:
- Error not active

System check:
- Check the CAN network for correct function, topicality, and compatibility

343

Error description

Project: EcoLife

Basic program status: AP83 / Step 2

Error:
UNUSED_343

Internal designation:
UNUSED_343

Error description:
UNUSED_343

Error detection by:

System response:

- none

Cancellation condition:

- none

System check:

- none

344

Error description

Project: EcoLife

Basic program status: AP83 / Step 2

Error:
EvoBus signal error, accelerator pedal load signal error
J1939EVO.CPC_C12.HiResAccelPdlPosn_Cval_Sig

Internal designation:
J1939EVO.CPC_C12.HiResAccelPdlPosn_Cval_Sig

Error description:
Transmitted value for the accelerator pedal position is not plausible or no signal.
J1939EVO.PT_MCM_C02.MaxActIEngTrq_Cval_PT_Sig value is not plausible or no signal

Error detection by:
Software

System response:
- Shut down AIS function (Automatic Idle Shift)
- Limit engine torque to specified value
- Switch off retarder request and AIM_Retarder
- Limit retarder torque to specified value
- Switch off engine brake
- Switch off NI (Neutral internal)
- Switch off shift pressure adaptation (gear change); continue to use last values
- Main pressure max. value from terminal and total max. value across all assemblies incl. engine
- Switch off engine control during gear change
- Block and/or abort temporary opening of lock-up clutch and closing of lock-up clutch during gear changes
- M_Mot_Soll (target) and/or L_Anf replaced by M_Mot_Ist (actual) (vehicle interface)
- No load request query regarding gear engagement condition (with missing load signal; Info: n_Tu and M_Mot_Soll (target) will continue to be queried)
- no M_Mot_Soll- and/or load request query regarding gear engagement condition
- Load from M_Mot_Soll (target) replacement
- Switch off reproduction (adaptation) of engine torque characteristics

Cancellation condition:
- Error not active
- Neutral and Stop
- New retarder request
- Single load > 0

System check:
- Check the CAN network for correct function, topicality, and compatibility

345

Error description

Project: EcoLife

Basic program status: AP83 / Step 2

Error:
EvoBus J1939EVO.CGW_C1 signal error

Internal designation:
J1939EVO.CGW_C1.Timeout

Error description:
No signal within the determined period or CAN signal error
J1939EVO.CGW_C1.Timeout

Error detection by:
Software

System response:
none

Cancellation condition:
No CAN signal error or signal present

System check:

- Check the CAN network for correct function, topicality, and compatibility

346

Error description

Project: EcoLife

Basic program status: AP83 / Step 2

Error:
EvoBus J1939EVO.CGW_VIN signal error

Internal designation:
J1939EVO.CGW_VIN.Timeout

Error description:
No signal within the determined period or CAN signal error
J1939EVO.CGW_VIN.Timeout

Error detection by:
Software

System response:
none

Cancellation condition:
No CAN signal error or signal present

System check:
- Check the CAN network for correct function, topicality, and compatibility

347

Error description

Project: EcoLife

Basic program status: AP83 / Step 2

Error:
The EEPROM array has not been written in

Internal designation:
EEP_DTFD_NOT_WRITTEN

Error description:
Notice message: The EEPROM array has not been written in EEP_DTFD_NOT_WRITTEN

Error detection by:
Software

System response:
none

Cancellation condition:
- Write monitored value in the EEPROM.

System check:
- none

348

Error description

Project: EcoLife

Basic program status: AP83 / Step 2

Error:
CAN signal error BoxCAN.InputValues

Internal designation:
EBoxCAN.InputValues.Timeout

Error description:
No signal within the determined period or CAN signal error
EBoxCAN.InputValues.Timeout

Error detection by:
Software

System response:
none

Cancellation condition:
No CAN signal error or signal present

System check:
- Check the CAN network for correct function, topicality, and compatibility

349

Error description

Project: EcoLife

Basic program status: AP83 / Step 2

Error:
CAN signal error BoxCAN.InputValues

Internal designation:
EBoxCAN.InputValues_Sig

Error description:
No signal within the determined period or CAN signal error EBoxCAN.InputValues_Sig

Error detection by:
Software

System response:
none

Cancellation condition:
No CAN signal error or signal present

System check:
- Check the CAN network for correct function, topicality, and compatibility

350

Error description

Project: EcoLife

Basic program status: AP83 / Step 2

Error:
CAN signal error FSCAN.InputValues

Internal designation:
FSCAN.InputValues.Timeout

Error description:
No signal within the determined period or CAN signal error FSCAN.InputValues.Timeout

Error detection by:
Software

System response:
none

Cancellation condition:
No CAN signal error or signal present

System check:
- Check the CAN network for correct function, topicality, and compatibility

351

Error description

Project: EcoLife

Basic program status: AP83 / Step 2

Error:
CAN signal error FSCAN.InputValues_Sig

Internal designation:
FSCAN.InputValues_Sig

Error description:
No signal within the determined period or CAN signal error FSCAN.InputValues_Sig

Error detection by:
Software

System response:
none

Cancellation condition:
No CAN signal error or signal present

System check:
- Check the CAN network for correct function, topicality, and compatibility

352

Error description

Project: EcoLife

Basic program status: AP83 / Step 2

Error:
CAN signal error SC_EBOX_BRAKE_LIGHT

Internal designation:
SC_EBOX_BRAKE_LIGHT_SIG

Error description:
No signal within the determined period or CAN signal error SC_EBOX_BRAKE_LIGHT_SIG

Error detection by:
Software

System response:
none

Cancellation condition:
No CAN signal error or signal present

System check:
- Check the CAN network for correct function, topicality, and compatibility

353

Error description

Project: EcoLife

Basic program status: AP83 / Step 2

Error:
CAN signal error SC_EBOX_TEMP_WARN_1

Internal designation:
SC_EBOX_TEMP_WARN_1_SIG

Error description:
No signal within the determined period or CAN signal error SC_EBOX_TEMP_WARN_1_SIG

Error detection by:
Software

System response:
none

Cancellation condition:
No CAN signal error or signal present

System check:
- Check the CAN network for correct function, topicality, and compatibility

354

Error description

Project: EcoLife

Basic program status: AP83 / Step 2

Error:
CAN signal error SC_EBOX_TEMP_WARN_2

Internal designation:
SC_EBOX_TEMP_WARN_2_SIG

Error description:
No signal within the determined period or CAN signal error SC_EBOX_TEMP_WARN_2_SIG

Error detection by:
Software

System response:
none

Cancellation condition:
No CAN signal error or signal present

System check:
- Check the CAN network for correct function, topicality, and compatibility

355

Error description

Project: EcoLife

Basic program status: AP83 / Step 2

Error:
CAN signal error SC_EBOX_AIS_ACTIVE

Internal designation:
SC_EBOX_AIS_ACTIVE_SIG

Error description:
No signal within the determined period or CAN signal error SC_EBOX_AIS_ACTIVE_SIG

Error detection by:
Software

System response:
none

Cancellation condition:
No CAN signal error or signal present

System check:
- Check the CAN network for correct function, topicality, and compatibility

356

Error description

Project: EcoLife

Basic program status: AP83 / Step 2

Error:
CAN signal error SC_EBOX_WARNING_LIGHT_ERROR

Internal designation:
SC_EBOX_WARNING_LIGHT_ERROR_SIG

Error description:
No signal within the determined period or CAN signal error SC_EBOX_WARNING_LIGHT_ERROR_SIG

Error detection by:
Software

System response:
none

Cancellation condition:
No CAN signal error or signal present

System check:
- Check the CAN network for correct function, topicality, and compatibility

357

Error description

Project: EcoLife

Basic program status: AP83 / Step 2

Error:
CAN signal error, activation bus stop brake
J1939.EBC5_FROM_ABS.parking_brake_fully_activ_Sig

Internal designation:
J1939.EBC5_FROM_ABS.parking_brake_fully_activ_Sig

Error description:
Transmitted value to activate the bus stop brake is not plausible or no signal
J1939.EBC5_FROM_ABS.parking_brake_fully_activ_Sig is not plausible or no signal present

Error detection by:
Software

System response:
- none

Cancellation condition:
- Error not active

System check:
- Check the CAN network for correct function, topicality, and compatibility

358

Error description

Project: EcoLife

Basic program status: AP83 / Step 2

Error:
EvoBus, J1939EVO.MCM_C04 signal error

Internal designation:
J1939EVO.MCM_C04.Timeout

Error description:
No signal within the determined period or CAN signal error J1939EVO.MCM_C04.Timeout

Error detection by:
Software

System response:
none

Cancellation condition:
No CAN signal error or signal present

System check:
- Check the CAN network for correct function, topicality, and compatibility

359

Error description

Project: EcoLife

Basic program status: AP83 / Step 2

Error:
EvoBus, J1939EVO.MCM_C04.ThermoSupport_Rq_Sig signal error

Internal designation:
J1939EVO.MCM_C04.ThermoSupport_Rq_Sig

Error description:
Transmitted value is not plausible or no signal.
J1939EVO.MCM_C04.ThermoSupport_Rq_Sig

Error detection by:
Software

System response:
none

Cancellation condition:
No CAN signal error or signal present

System check:
- Check the CAN network for correct function, topicality, and compatibility

360

Error description

Project: EcoLife

Basic program status: AP83 / Step 2

Error:
CAN signal error, SC_EBOX_HST_ANF

Internal designation:
SC_EBOX_HST_ANF_SIG

Error description:
No signal within the determined period or CAN signal error
SC_EBOX_HST_ANF_SIG

Error detection by:
Software

System response:
none

Cancellation condition:
No CAN signal error or signal present

System check:
- Check the CAN network for correct function, topicality, and compatibility

361

Error description

Project: EcoLife

Basic program status: AP83 / Step 2

Error:
CAN signal error, analog retarder request pedal
RETARDER_ANALOG_PEDAL_ERROR

Internal designation:
RETARDER_ANALOG_PEDAL_ERROR

Error description:
Transmitted value for analog retarder request (pedal) is not plausible or no signal.
RETARDER_ANALOG_PEDAL_ERROR

Error detection by:
Software

System response:
- none

Cancellation condition:
- Error not active

System check:
- Check the CAN network for correct function, topicality, and compatibility

362

Error description

Project: EcoLife

Basic program status: AP83 / Step 2

Error:
CAN signal error, J1939.DLN5

Internal designation:
J1939.DLN5.Timeout

Error description:
No signal within the determined period or CAN signal error
J1939.DLN5.Timeout
Proprietary message Scania

Error detection by:
Software

System response:
none

Cancellation condition:
No CAN signal error or signal present

System check:
- Check the CAN network for correct function, topicality, and compatibility

363

Error description

Project: EcoLife

Basic program status: AP83 / Step 2

Error:
CAN signal error, retarder cut-off
J1939.DLN5.RetarderBrakeAssist

Internal designation:
J1939.DLN5.RetarderBrakeAssist_Sig

Error description:
No signal within the determined period or CAN signal error for retarder cut-off
J1939.DLN5.RetarderBrakeAssist_Sig

Error detection by:
Software

System response:
none

Cancellation condition:
No CAN signal error or signal present

System check:
- Check the CAN network for correct function, topicality, and compatibility

364

Error description

Project: EcoLife

Basic program status: AP83 / Step 2

Error:
TCU system error, parameter assignment error in FP config. (unreleased block set)
DP_CONFIG_TAB_CHECK_ERROR

Internal designation:
DP_CONFIG_TAB_CHECK_ERROR

Error description:
TCU system error, im EEPROM an inadmissible (locked) block (FP, SP, customer, AIS or acceleration restriction block) activated.
DP_CONFIG_TAB_CHECK_ERROR

Error detection by:
Software

System response:
none

Cancellation condition:
- Cancel blocks (parameter group 4)
- Set valid vehicle configuration

System check:
- Correct valid vehicle configuration in EEPROM

365

Error description

Project: EcoLife

Basic program status: AP83 / Step 2

Error:
CAN signal error, hill holder transmitting invalid value
J1939.EBC5_FROM_ABS.Hill_Holder_Mode

Internal designation:
J1939.EBC5_FROM_ABS.Hill_Holder_Mode_Sig

Error description:
Invalid signal from the hill holder
J1939.EBC5_FROM_ABS.Hill_Holder_Mode_Sig

Error detection by:
Software

System response:
none

Cancellation condition:
No CAN signal error or signal present

System check:
- Check the CAN network for correct function, topicality, and compatibility

366

Error description

Project: EcoLife

Basic program status: AP83 / Step 2

Error:
CAN signal error, cleaning the diesel-soot trap
J1939.TC1_FROM_XX.TrmsAutomDrvlSep_inhibit

Internal designation:
J1939.TC1_FROM_XX.TrmsAutomDrvlSep_inhibit_Sig

Error description:
Automatic cleaning of the diesel-soot trap,
traction in the transmission may not be disrupted,
(AIS not permitted) to keep exhaust temperature high
J1939.TC1_FROM_XX.TrmsAutomDrvlSep_inhibit_Sig

Error detection by:
Software

System response:
- AIS not permitted

Cancellation condition:
No CAN signal error or signal present

System check:
- Automatic cleaning of the diesel-soot trap
- Consultation with OEM service

367

Error description

Project: EcoLife

Basic program status: AP83 / Step 2

Error:
HyLife system error, electrical auxiliary oil pump does not deliver the required volume flow
EZOEP_FAULT_Q_LOW

Internal designation:
EZOEP_FAULT_Q_LOW

Error description:
The delivery rate of the electric auxiliary oil pump is inadequate.
EZOEP_FAULT_Q_LOW

Error detection by:
Software

System response:
none

Cancellation condition:
- electric auxiliary oil pump can realize rpm request again

System check:
- Cabling and plug connectors for auxiliary oil pump
- Power supply for auxiliary oil pump
- Inverter for auxiliary oil pump
- Mechanical damage, storage, wear, leakage

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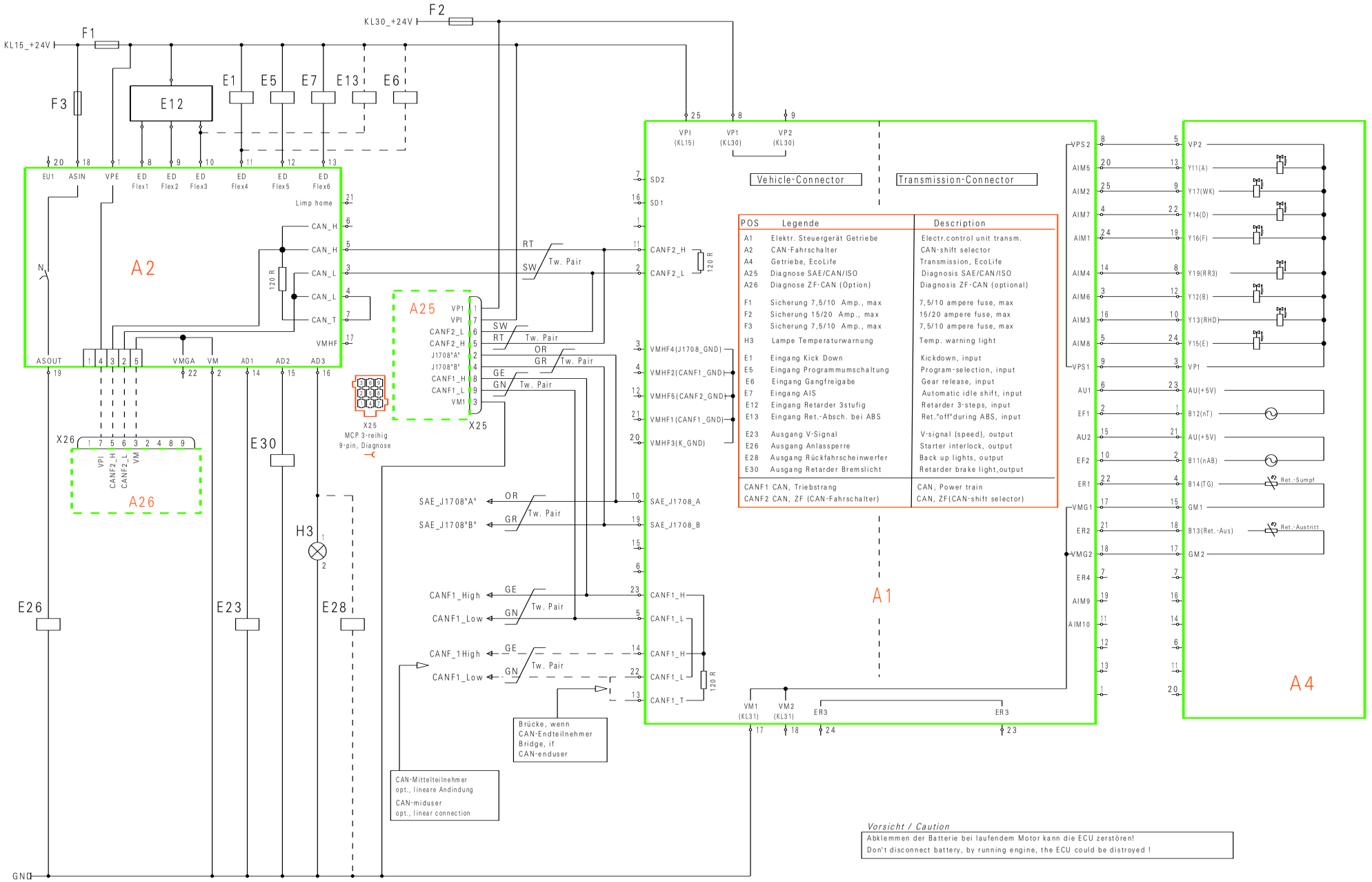
WORKSHOP MANUAL

E-Modul Circuit

Diagram

14.5.1 Stromlaufplan allgemein, CAN-End/CAN-Mit/SAE J1708/ISO 9141

Aus Zeichnung-Nr.: 6029 739 017a/1



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WORKSHOP MANUAL

Recommended

Lubricant List

**Powershift transmissions, type EcoLife,
for buses**

List of lubricants TE-ML 20

1. Vehicle classification

EcoLife transmissions are operated under loads and at oil temperatures which vary significantly. Oil releases and oil-change intervals are therefore vehicle-dependent. Consult the owner's manual for your vehicle to check whether TE-ML 20.100, 20.105 or 20.110 applies.

2. Approved lubricant classes for EcoLife

Product groups	Vehicle classification acc. to owner's manual	Lubricant classes for service fill (1)
EcoLife 6AP1000B, 6AP1200B, 6AP1400B, 6AP1700B, 6AP2000B and accessory bevel-gear variants	**TE-ML 20.100**	**20C / 20E / 20F**
	TE-ML 20.105	**20E / 20F**
	TE-ML 20.110	**20F**

(1) Refer to the following pages for approved commercial products and oil change intervals.

Additives of any kind added **later** to the oil change the oil in a manner that is unpredictable, and they are therefore not permitted. No liability of any kind will be accepted by ZF for any damage resulting from the use of such additives.

The list of lubricants TE-ML 20, **Edition 01.10.2013** replaces all previous editions. The current list can be requested from any ZF after-sales service center or accessed on the Internet under www.zf.com/lubricants.	**ZF Friedrichshafen AG** D-88038 Friedrichshafen phone: + 49 7541 77 7461 fax: + 49 7541 77 7319

3. Oil and filter change intervals for buses:

Table 1: Vehicle classification TE-ML 20.100 (Oil sump temperatures up to 100°C)

Lubricant class (1)	Oil and pressure filter change interval [km/year] (2)
20C	120.000 km 1 x every 2 years
20E	240.000 km 1 x every 3 years
20F	240.000 km 1 x every 3 years

Table 2: Vehicle classification TE-ML 20.105 (Oil sump temperatures up to 105°C)

Lubricant class (1)	Oil and pressure filter change interval [km/year] (2)
20E	180.000 km 1 x every 3 years
20F	180.000 km 1 x every 3 years

Table 3: Vehicle classification TE-ML 20.110 (Oil sump temperatures up to 110°C)

Lubricant class (1)	Oil and pressure filter change interval [km/year] (2)
20F	120.000 km 1 x every 3 years

(1) Refer to the following pages for approved commercial products and oil change intervals.

(2) Oil and filter change required, depending on what occurs first. Use only ZF original filter elements, ZF order no. 4181 298 002.

Lubricant class 20C

Manufacturer (20C)	Trade name (20C)
ARAL AG, BOCHUM/DE	ARAL GETRIEBEÖL ATF LD
BP PLC., LONDON/GB	BP AUTRAN LTF
BP PLC., LONDON/GB	BP AUTRAN SYN 295
CASTROL LTD, LONDON/GB	CASTROL TRANSMAX Z
CASTROL LTD, LONDON/GB	CASTROL TRANSYND
EXXONMOBIL CORPORATION, FAIRFAX, VA/US	MOBIL DELVAC SYNTHETIC ATF
OOO "LLK-INTERNATIONAL", MOSCOW/RU	LUKOIL ATF SYNTH MN Z3
PAKELO MOTOR OIL, SAN BONIFACIO (VR)/IT	AUXON III PLUS
SASOL OIL, RANDBURG/ZA	SYN TRANSMISSION OIL VI
STATOIL LUBRICANTS, STOCKHOLM/SE	TRANSWAY ATF ULTRA

Lubricant class 20E

Manufacturer (20E)	Trade name (20E)
PETRONAS LUBRICANTS INTERNATIONAL SDN BH, KUALA LUMPUR/MY	TUTELA TRANSMISSION ATF 120
SHELL INTERNATIONAL PETROLEUM COMP. LTD, LONDON/GB	SHELL SPIRAX S6 ATF ZM
ZF FRIEDRICHSHAFEN AG, FRIEDRICHSHAFEN/DE	ZF-ECOFLUID A PLUS

Lubricant class 20F

Manufacturer (20F)
ZF FRIEDRICHSHAFEN AG, FRIEDRICHSHAFEN/DE

Trade name (20F)
ZF-ECOFLUID LIFE

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WORKSHOP MANUAL

Important general information

- The present Manual aims to help the user properly to execute the necessary maintenance and repair work on the HEMA Hydraulic Steering Gear product.

- Read the Manual before starting any inspection and repair work.

- On completion of the maintenance and repair work, the specialist personnel must make certain that the product is once more operating flawlessly.

- ***Please note that the HEMA Hydraulic Steering Gear product must be repaired only in workshops that***

  - ***employ personnel trained by***
  - ***have the prescribed equipment, including a test rig, crack detector and special tools***
  - ***use HEMA genuine spare parts.***

- This Manual is only for foremen and fitters who have undergone practical and theoretical training in our Customer Service School. Together with service information bulletins, it is intended to supplement their knowledge.
- All work carried out on HEMA products must be executed with extreme care and diligence. This applies in particular to products and transmission components from vehicles damaged in accidents.
- Before dismantling the HEMA Steering Gear unit, the operating liquid contained in it (e.g. lubricant) must be drained without leaving any residue, if possible, and must be disposed within the internal disposing system of your company.
- All metals that cannot be reused must be recycled according to the individual materials. All other parts (e.g. sealing parts) must be disposed properly on the basis of the applicable regulations.

- The manufacturer does not, of course, accept any liability for damage and its consequences arising from incorrectly or inexpertly executed repairs.

- This Manual draws attention to notes on safety as follows:

Note: Where incorrect and careless work can cause damage to the product.

⚠ **Attention:** Where incorrect and careless work can lead to personal injury and endanger life.

- This Manual is not part of the updating service.

- The contents of the additional service information bulletins must also be observed.

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I. Safety note

Attention: Important safety note for the driver and the workshop personnel, respectively

If the steering system is in a perfect working order, the steering efforts the driver has to exert on tie steering wheel are low (e.g., 30 N corresponding to approx. 3 kg).

In the event of a failure of the hydraulic assistance (for example owing to lack of oil) the effort needed to carry out a steering motion will increase considerably (for example to 450 N corresponding to approx. 45 kg).

As this happens very seldom and unexpectedly, the driver may be led to believe, erroneously, that the steering system cannot be moved at all any longer.

However, even in the event of a failure of the hydraulic assistance, there is always a mechanical connection between the steering wheel and the road wheel ensuring that manual steering at increased steering efforts can take place.

To avoid damages inside the steering gear and damages to the steering column, the steering effort at the steering wheel rim must not exceed 700 N (approx. 70 kg) when steering motions are carried out without hydraulic assistance and at vehicle standstill

II. Design and operation 1

Design

The housing of the HEMA steering gear houses the steering valve, the steering cylinder and a complete manual steering gear.

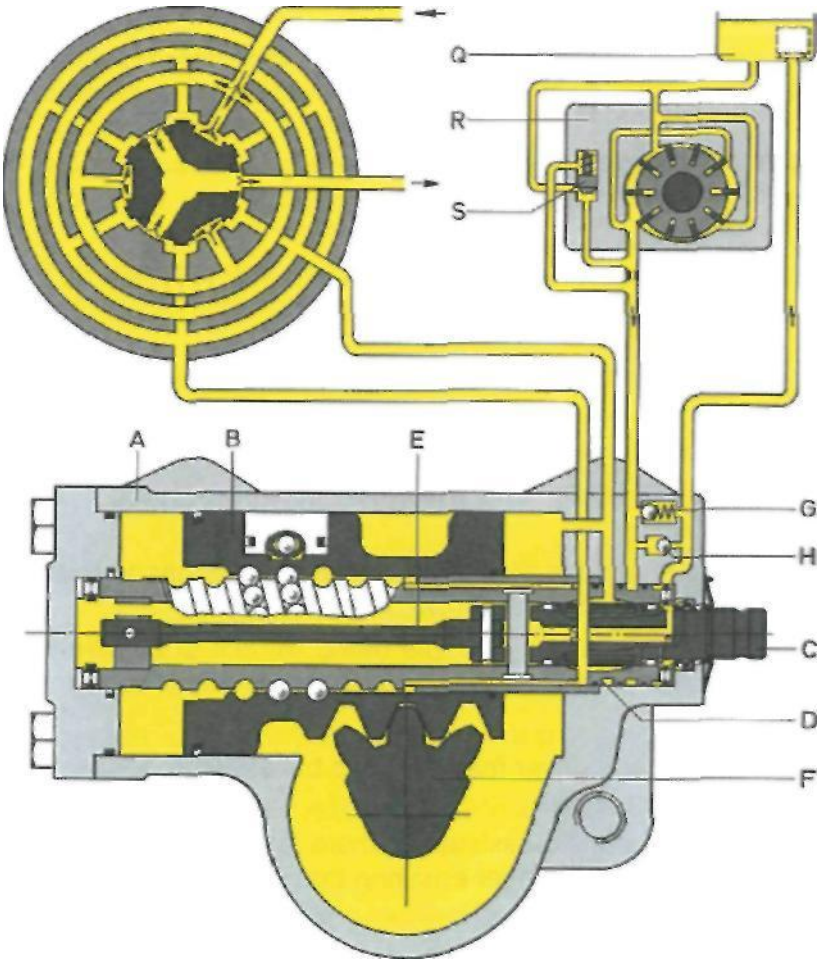
The oil flow and the pressure required by the steering gear is supplied by an engine-driven pump. To achieve this, the oil is taken in from the oil tank and fed back to the tank via the pump and the steering gear.

The housing (A) - see ***Fig. 1*** - and the piston (B) have the function of a cylinder. The piston transforms the rotation of the steering input shaft (C) and of the worm (D) into an axial motion which it transmits to the sector shaft (F).

The piston (B) and the worm (C) are positively connected with each other by means of a ball chain. As the worm rotates, the balls at one end of the chain are taken up by a recirculation tube and fed back to the other end so that an endless ball chain is formed.

The teeth of the piston (B) and of the sector shaft (F) cause the sector shaft to rotate when the piston is displaced.

Fig. 1
Valve rotor in mid-position



A Housing
B Piston
C Valve rotor/steering input shaft
D Valve sleeve/worm
E Torsion bar
F Sector shaft
G Pressure relief valve
H Replenishment valve
Q Oil tank
R Vane pump
S Flow limiting valve

Return line pressure

The steering valve consists of the valve rotor (C) which is carried in a needle bearing in the worm and is provided with six control grooves on the circumference, and of the valve sleeve (D) on the worm.

A torsion bar (E) pinned to the valve rotor (C) and the worm (D) keeps the steering valve in mid-position as long as no effort is exerted on the steering wheel.

A pressure relief valve (G) limiting the maximum pressure within the steering system may be integrated in the steering gear housing.

In addition, a replenishment valve (H) sucking oil from the return oil line when a steering motion without hydraulic assistance takes place can be fitted to the housing or to the steering valve.

In comparison with constant ratio steering gears, variable ratio steering gears are more direct around centre than outside the mid-position area, which has a favourable effect on the steering performance during straight ahead driving as minor steering corrections only, if any, are required.

At the same time, in the static parking range requiring a wider steering wheel turning angle a higher hydraulic torque is available at the sector shaft owing to the more indirect steering ratio.

In the event of a failure of the hydraulic assistance the steering efforts at the steering wheel rim are lower in this range than they would be for a constant ratio steering gear.

The 3 functional drawings to ***Figs. 1 to 3*** give a simplified representation of the steering valve and the oil flow. In addition, these figures give a cross-sectional view of the steering valve in order to schematically represent the connections from the steering valve to the cylinder chambers and the mode of operation of the valve.

2 Operation

When a torque is transmitted from the steering input shaft to the worm or vice-versa, the torsion bar is subjected to a deformation in the elastic area of its length, causing a torsion to occur between the valve rotor and the valve sleeve and, thus, to move the control grooves of the valve rotor away from the mid-position as compared with the position of the valve sleeve control grooves.

When the steering wheel is released, the action of the torsion bar will make the steering valve return to the neutral (mid) position.

Through the bore in the housing, the oil flows into the annular groove of the valve sleeve and is fed to the arcuate control grooves of the inner valve rotor through three symmetrically-arranged radial bores.

The position of the control grooves in the valve rotor and the valve sleeve is such that, in the mid-position of the steering valve, the oil can flow through the inlet slots (J and K) to the axial grooves (N and O) of the valve sleeve, which are also arcuate. From there, the oil can freely flow through radial bores to the cylinder chambers.

As long as the steering valve is in the mid-position, the oil can flow to both cylinder chambers, and via the three return grooves (P) in the valve rotor it can also flow off to the oil tank.

2.1 Forward steering motion to the right (piston with right-handed thread)

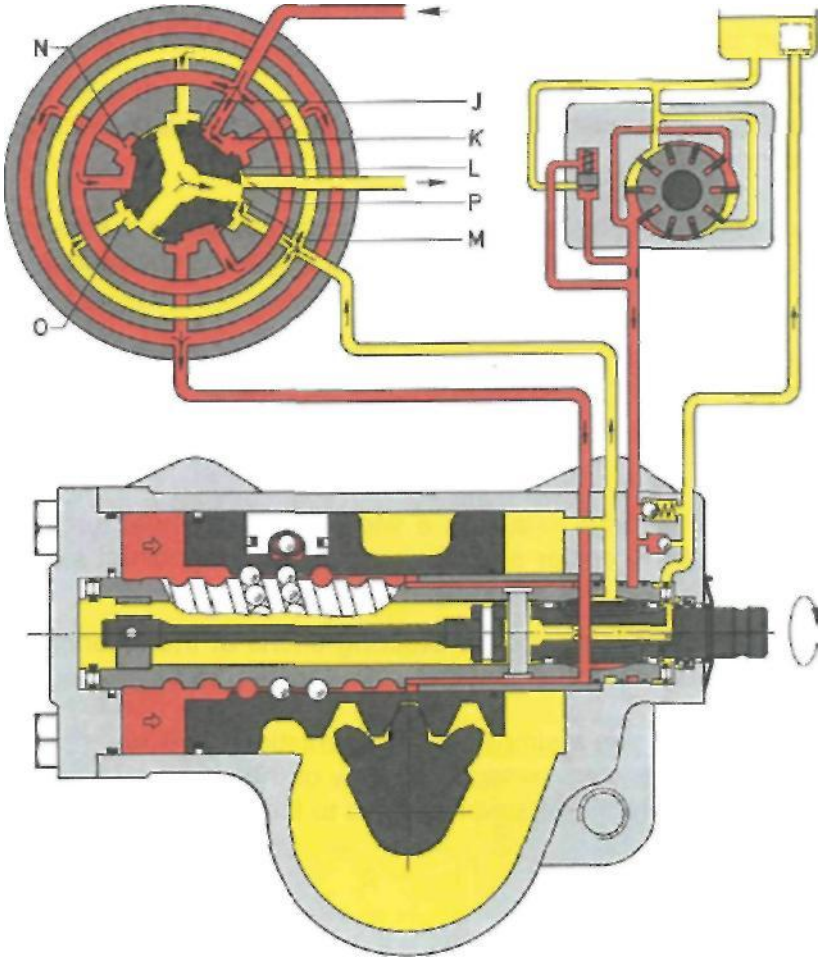


Fig. 2
Valve rotor in operating position Steering wheel turned clockwise

J Inlet slot
K Inlet slot
L Return slot
M Return slot
N Axial groove
O Axial groove
P Return groove

Operating pressure

Return line pressure

When the steering wheel is turned to the right, the piston will shift to the right ***(Fig. 2)***. A pressure will now build up in the left-hand cylinder chamber which is a function of the steering effort required.

To achieve this, the control grooves of the valve rotor are displaced clockwise and the inlet slots (K) are opened wider to admit the oil, while the inlet slots (J) are closed to the same extent and thus obstruct the feeding of oil to the axial grooves (O) of the valve sleeve.

The oil will now flow through the inlet slots (K) to the axial grooves (N) of the valve sleeve and, from there, will pass through the ball screw thread and flow to the left-hand cylinder chamber. The closed inlet slots (J) prevent the oil from flowing off to the tank and, thus, cause a pressure to build up.

The oil from the right-hand cylinder chamber is displaced. Via the opened return slots (M), it flows to the return grooves (P) of the valve rotor. From there, it can at any time flow through the central oil bore in the valve rotor and the worm and off to the oil tank.

2.2 Forward steering motion to the left (piston with right-handed thread)

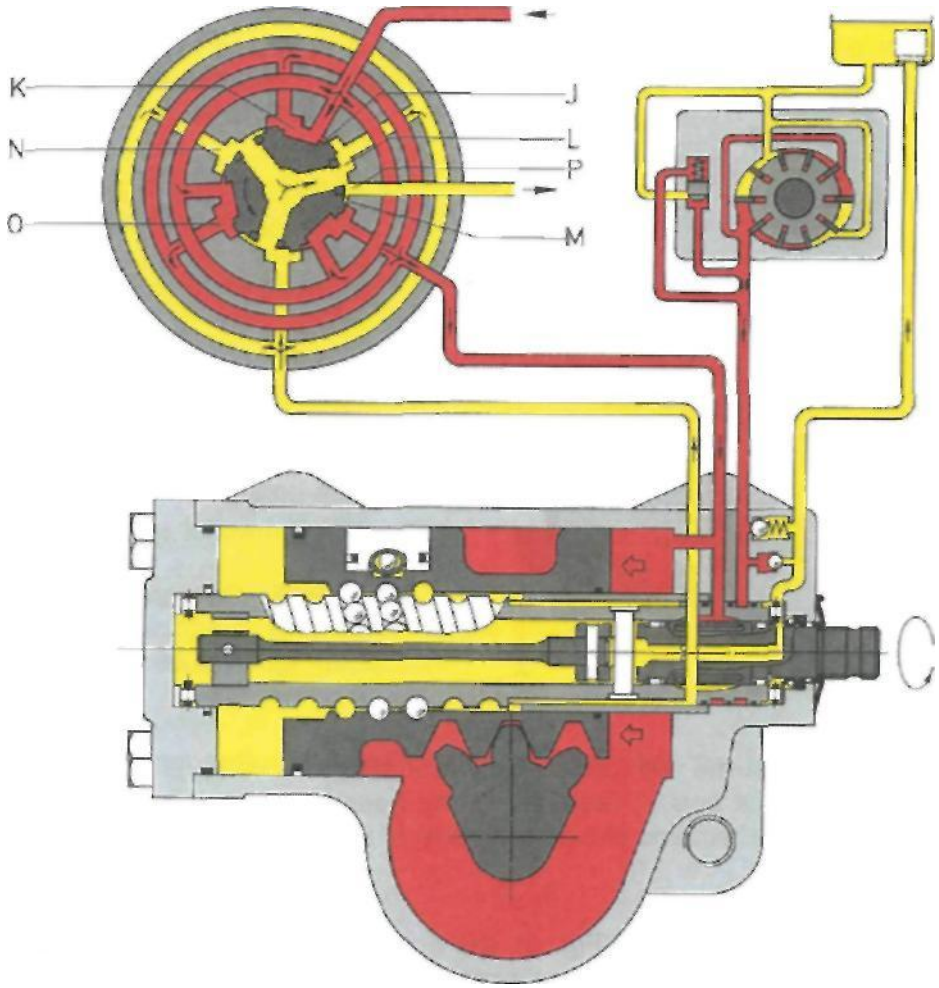


Fig. 3

Valve rotor in operating position

Steering wheel turned counter-clockwise

J Inlet slot
K Inlet slot
L Return slot
M Return slot
N Axial groove
O Axial groove
P Return groove

Operating pressure

Return line pressure

When the steering wheel is turned to the left, the piston will shift to the left ***(Fig. 3)***. Therefore, pressure build-up now takes place in the right-hand cylinder chamber.

The control grooves of the valve rotor are displaced counter-clockwise and allow the oil to flow through the opened inlet slots (J) to the axial grooves (O) from where there is **a** connection to the right-hand cylinder chamber.

The oil from the left-hand cylinder chamber flows to the return grooves (P) of the valve rotor, via the ball screw thread and the opened return slots (L), and can then freely flow off to the oil tank through the central bore in the valve rotor and the worm.

3 Operation of the hydraulic steering limitation

The hydraulic steering limitation prevents a steering to the lock stops at full hydraulic pressure. It, thus, protects the pump and the steering linkage and prevents high oil temperatures.

A double-acting steering limiting valve with spring-loaded valve pins (T and U) is arranged in the longitudinal direction in the piston (B). The valve pins project over the right-hand and the left-hand front faces of the piston ***(Fig. 4)***.

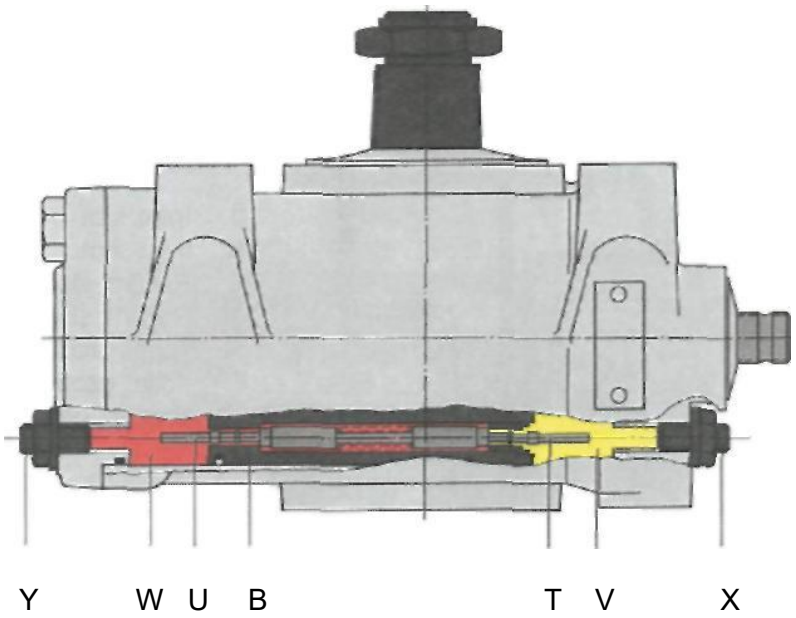


Fig. 4 Steering limiting valve closed

T Right-hand valve pin of steering limiting valve
U Left-hand valve pin of steering limiting valve

V Right-hand cylinder chamber W Left-hand cylinder chamber

X Right-hand adjusting screw Y Left-hand adjusting screw

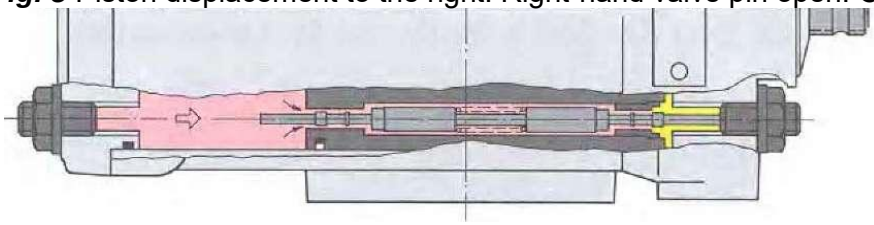
Operating pressure

Return line pressure

If the piston is shifted to the right or to the left towards the lock stop, the valve pins (T and U) are actuated by the adjusting screws (X and Y) fastened in the housing and the cylinder cover, respectively. The steering limiting valve remains closed until one of the valve pins hits against an adjusting screw.

If for instance the piston is displaced to the right ***(Fig. 5)***, the right-hand valve pin will hit against the adjusting screw (X) before the piston end position is reached. Valve pin (U) is displaced by the oil pressure so that the oil can flow away from cylinder chamber (W) to cylinder chamber (V) and from there to the return line. When the piston is displaced to the left, the same sequence of operations as described above will take place by analogy.

Fig. 5 Piston displacement to the right. Right-hand valve pin open. Oil pressure greatly reduced.



As soon as the steering limiting valve is open, the steering gear can be turned forward further at an increased steering effort and with greatly reduced hydraulic assistance until the lock stop is reached.

III. Servicing work

1) Hints

In a number of countries a safety inspection (Sicherheitsprüfung = SP) is prescribed by law for vehicles with more than 8 passenger seats or a gross vehicle weight rating in excess of 7.5 t.

Attention:

On vehicles not subject to the safety inspection (SP), the work detailed in Chapter III. Servicing work, paras 3.5,..3.10, has to be carried out in addition.

Following a **test drive** and a subsequent visual inspection of the complete steering system (steering column, bevel box, steering gear, drag links, pump, and hydraulic lines) we recommend to carry out the following work.

Within the scope of **maintenance** the proper functioning of the steering system is checked by a test drive and a visual inspection.

During an **inspection**, safety-critical characteristics are tested.

2) Maintenance

Maintenance intervals:
We recommend to carry out the following work within the scope of the general maintenance work. [1]

2.1 Test driving

During the test drive, in particular look out for the following chacteristics:

- return to neutral
- sticking
- increased friction
  play

2.2 Checking and inspecting for external leakproofness/damages

Check the steering gear (with bellows), the protecting caps, the pumps (engine-driven and ground-driven), the valves and the steering cylinders, the lines and the screwed connections for leakproofness and damages. The piston rod of the steering cylinder may be covered by a thin oil film but there must not be any oil drops.

Note:
When cleaning with a high pressure cleaning machine, make sure not to direct the water jet directly towards the sealing elements of the steering system. Ingressing water and impurities can cause malfunctions.

2.3 Checking the oil level

Oil grade required: please refer to List of Lubricants TE-ML 09

Prior to pulling out the oil dipstick, thoroughly clean the oil tank and its immediate vicinity to protect the hydraulic oil from being soiled by impurities.

Attention:
Too low an oil level may cause malfunctions which can entail a failure of the hydraulic assistance of the steering system,

[1] see vehicle manufacturer's instructions

3) Inspection

Attention:

The inspection intervals depend on how the vehicle is used.

Therefore, the table below distinguishes between different kinds of use which may, though, be overlapping.

For the sake of increased traffic safety, we recommend to inspect the steering system in accordance with the inspection intervals listed below.

Minor variations in inspection intervals are permissible if it is desirable to adjust these intervals to the vehicle-specific inspection intervals.

Note:

The work listed below also includes work that has to be carried out within the scope of the safety inspection (SP).

Such work is marked "(part of SP)". Therefore, inspection steps bearing this mark can be omitted when vehicles subject to safety inspection (SP) are checked within the scope of the normal inspection.

In addition, the safety inspection (SP) rules applying in the country of registration of the vehicle being inspected have to be complied with.

3.1 Inspection intervals

□ **up to date of manufacture 12/93**

Kind of use	**1st inspection** Inspection on the vehicle	**IInd** inspection Inspection on the vehicle	**IIIrd inspection**
Long-distance vehicles	100 000 km 60 000 miles	200 000 km 120 000 miles	300 000 krn 180 000 miles
Vehicles in long and short distance use	100 000 km 60 000 miles	175 000 km 105 000 miles	250 000 km 150 000 miles
Construction site vehicles and vehicles in off-road use	80 000 km 50 000 miles 2 500 op.hrs	150 000 km 90 000 miles 4 500 op.hrs	200 000 km 120 000 miles 6 000 op.hrs

Additionally, at the time of the IIIrd inspection, the mechanical transmission elements of the HEMA Hydraulic steering gear have to be inspected.

To this effect, dismantle the steering gear and visually inspect and crack test all transmission elements (see Repair Instructions).

□ **starting from date of manufacture/repair 1/94**

Kind of use	**1st inspection** Inspection on the vehicle	**Further inspections** Inspection on the vehicle
Long-distance vehicles Coaches with high mileages	600 000 km	after a further 300 000 km, ea.
Buses Construction site vehicles Vehicles in short-distance use Vehicles subject to extreme loads	300 000 km 7 500 op.hrs	every 300 000 km 7 500 op.hrs

3.2 Test driving

During test driving, in particular look out for the following characteristics:

- return to neutral
- sticking
- increased friction

play

3.3 Visual inspection

- Check the screws of the complete steering system (steering column, bevel box, steering gear, drag links and steering cylinder) for correct fastening.

  Check whether the locking plate and the split pin are still perfectly secured.
- By turning the steering wheel to both sides or by applying a load to it, check whether the fit of the drop arm on the sector shaft is still tight.

  Check the axle stops, the drag links and the tie rods for damages and cracks.
- With the engine running, check the complete steering system for external leakproofness.

3.4 Replacing the oil filter

⚠ **Attention:**

Before taking off the oil tank cover, thoroughly clean the oil tank and its immediate vicinity to prevent the ingress of impurities into the hydraulic fluid.

Pull the filter insert out of the oil tank.

Avoid any dripping of oil from the insert into the tank.

If heavily soiled, clean the oil tank.

Fit a new filter insert.

Attention:

Below is a list of alt work that has to be carried out on the steering gear within the scope of the safety inspection (SP).

This list represents the currently valid status and is not subject to the Updating

3.5 Steering gear play (part of SP)

- Start the engine
- Rotate the steering gear to the straight ahead driving position.
- Slowly turn the steering wheel and, simultaneously, watch the front wheel to see how far the steering wheel has to be turned to make the front wheel move.

  perm, total displacement (stg. wheel 0 500 mm): max. 50 mm

  max. 55 mm for version with bevel box

3.6 Hydraulic steering limitation (part of SP)

The hydraulic steering limitation causes the pressure to drop in the area of the steering stop, thus protecting the steering pump and the steering linkage and preventing increased temperatures.

- For a check of the setting please refer to Chapter III., para. 5.

3.7 Light operation of the steering gear (part of SP)

If the steering system has a hydraulic defect, this is indicated by increased steering efforts.

- Start the engine.
- At vehicle standstill, quickly rotate the steering gear twice from lock to lock and look out for stiff operation of the steering.

3.8 Points of stiff operation (part of SP)

Defective transmission elements (steering column, universal joints, ...) may cause a temporarily stiff operation of the steering gear.

- Relieve the front axle (conform to vehicle manufacturer's instructions)

  With the engine cut off, rotate the steering gear from lock to lock and look out for points of stiff operation.

3.9 Automatic return to neutral (part of SP)

The axle geometry ensures automatic return to neutral during driving.

- Test drive the vehicle on a cordoned-off ground.

  During the test drive, rotate the steering gear to full lock.

  Release the steering wheel and find out whether the steering gear automatically returns to mid-position.

3.10 Steering wheel (part of SP)

- Check whether the steering wheel is properly fastened.

  Check the steering wheel for damages.

4 Oil change and bleeding

4.1 Oil change

4.1.1 Draining the oil

Note:
An oil change is only required if steering gear units were repaired or replaced.

Do not use any drained oil to refill the system. Avoid any blending of oils.

4.1.2 Draining the steering system

Jack the steered axle up. [1]

Unscrew the pressure and return lines from the steering gear.

Then have the engine run for a short time (maximum 10 seconds) to allow the oil to be sucked from the pump and the oil tank. Collect any escaping oil in a pan.

Screw in again all components unscrewed earlier.

4.1.3 Draining the steering gear

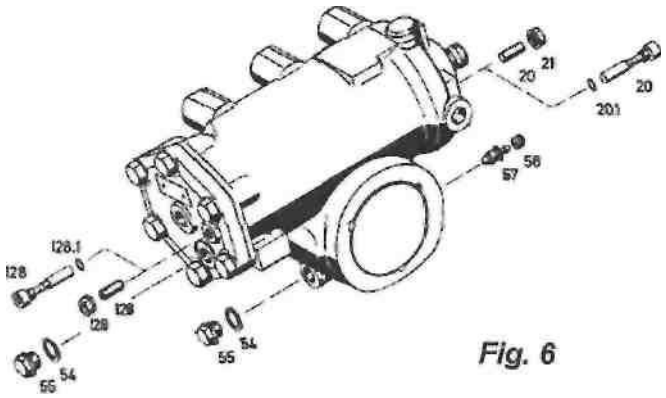


Fig. 6

If existing on the version inspected, unscrew

- the screw plugs (55) from the cylinder cover or the housing
- the set screw or the collar nut (20 or 128)
- the screw (20 or 128)
- the bleeder (57)

(Fig. 6).

[1] see vehicle manufacturer's instructions

To achieve a quick draining, open the one among the components referred to above which is lowest in the installed position.

Rotate the steering gear manually from lock to lock until no more oil is draining.

Unscrewed components must be screwed in again at the following tightening torques:

Screw plug (55):	40 Nm (M16x1.5)
	50 Nm (M18x1.5)
Collar nut (21 and 129):	20+10 Nm
Screw (20 and 128):	12+3 Nm
Bleeder (57):	30 Nm

Note:
Even after unscrewing all components mentioned above, a residual oil quantity may be left over in the steering gear.
A complete draining of the steering gear may be necessary depending on the amount of impurities in the oil. To this effect the steering gear has to be removed from the vehicle and opened at a HEMA Service Centre.

4.2 Oil filling

Attention:
When the steering system is filled with oil, there is a risk of impurities getting into the steering oil circuit. To avoid malfunctions caused by foreign bodies in the system, maximum cleanliness is of paramount importance both at initial fill and when topping up with oil,

For admitted oil grades, refer to the List of Lubricants TE-ML 09.

Fill the tank with oil to the rim.

Start the engine and have it run at idling speed to fill the steering system with oil.

During this operation, the oil level in the tank will quickly drop.

Therefore, to avoid any suction of air, the oil tank has to be topped up constantly.

In addition, for vehicles equipped with a ground-driven emergency steering pump:

Jack up the drive axle, 1

Select a gear and have the engine run at idling speed.

To avoid any suction of air, constantly top up with oil.

1 see vehicle manufacturer's instructions

4.3 Bleeding

- For steering gear versions with automatic bleeding:

Steering gear versions with automatic bleeding do not have any bleed scews. These steering gears automatically bleed any air remaining within the steering system.

Note:
Automatic bleed valves operate in the idle pressure range only; therefore, any unnecessary pressure build-up should be avoided.

When the steering system is filled to an extent preventing the oil level from dropping below the upper mark of the oil dipstick:

Have the engine run at low speed for 2...3 minutes.

Rotate the steering wheel several times from lock to lock and, while doing so, watch the oil level.

Top up with oil if required.

- In addition, for vehicles equipped with a ground-driven emergency steering pump: Jack up the drive axle. [1]

With a gear selected and the engine running, bleed the emergency steering pump. 2...3 minutes later rotate the steering wheel several times from lock to lock.

Note:
In the end positions, do not pull heavier at the steering wheel than is necessary to rotate the steering gear.
Top up with oil if required.

- Versions with additional steering cylinder:

The line connections of the steering cylinder must point upward to allow for an escaping of the air in the cylinder.

If required turn the steering cylinder to a suitable position and mount it again in its original position after air bleeding.

1 see vehicle manufacturer's instructions

- Versions with bleeder (57):

With the engine running, open the bleeder (57) until nothing but oil is coming out ***(Fig. 7)***.
Afterwards, close the bleeder again until it is oil-tight.
On versions without automatic bleeding (installed position horizontal, steering output shaft in the bottom position) the topmost screw/set screw (20 and 128, respectively) can be used for bleeding.

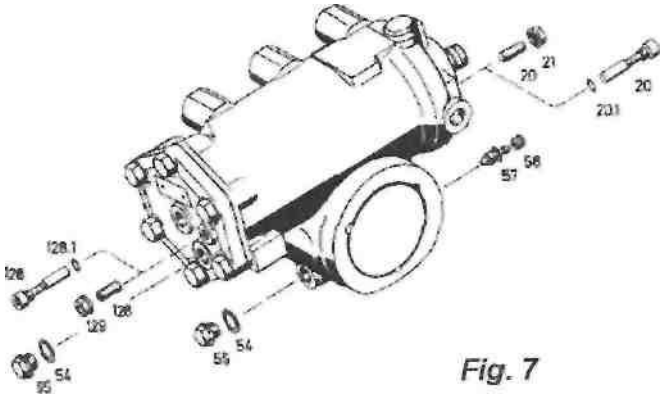


Fig. 7

- Versions with screw (20 and 128):

Open the topmost screw (20 and 128, respectively) until nothing but oil is coming out.
Re-tighten the screw (20 or 128) using a torque of 12+3 Nm.

- Versions with set screw (20 and 128): Slacken the collar nut (21 or 129) of the topmost set screw (20 or 128) until nothing but oil is coming out.

Re-tighten the collar nut (21 and 129) using a torque of 20+10 Nm. The hydraulic steering limitation must be checked after bleeding.

- For versions with flange (335), in addition:

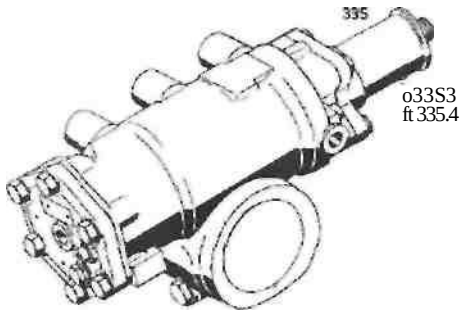


Fig. 8

Open the screw plug (335.4) until nothing but oil is coming out *(Fig. 8).*
Then close the screw plug again. Tightening torque: 8+1 Nm (M8x1)

- If bleeding was done correctly, the oil level in the tank must not rise by more than 1 to 2 cm when the engine is stopped. Turn the engine off and lower the jacked-up steered axle or drive axle to the ground.

5 Setting the hydraulic steering limitation

A setting of the steering limitation is necessary if or when

- a new or repaired steering gear is fitted or
- new screws (20 and 128) were fitted to the automatically adjusting steering limitation or
- alterations to or adjustments of the front axle were carried **out.**

5.1 Hydraulic steering limitation with manual setting *(Fig. 9)*

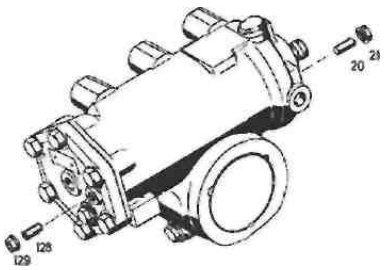
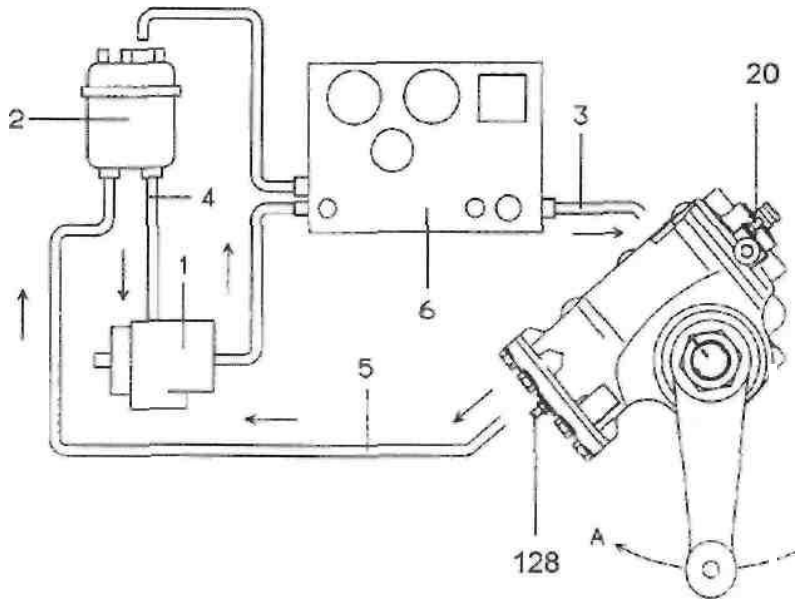


Fig. 9

Fit a pressure gauge (pressure range up to 250 bar) or tool [1] (HEMA Hydraulic steering gear tester) to the pressure line between the pump and the steering gear ***(see Fig. 10)***.



1 Pump
2 Oil Tank
3 Suction line
4 Suction line
5 Return line
6 HEMA tester

Fig. 10

If the setting takes place at set screw (128) the drop arm will be caused to move in direction "B" ***(Fig. 10).***
If the setting takes place at set screw (20) the drop arm will be caused to move in direction "A".

Test temperature: 50° C ±10°

- Rigid axle:

Relieve the axle by jacking it up or place it on swivel plates. UJ

- Single-wheel suspension:

Place the steered wheels on swivel plates.

- With the engine running at **idling speed**, rotate the steering gear to the lock stop.

Upon reaching the lock stop, overcome the return force of the steering valve by rotating the steering wheel further for a short time (5 sec. maximum) until a positive steering stop is reached.

Read the pressure at the pressure gauge or at tool [1] (HEMA Hydraulic steering gear tester).

Specified values:	Steering systems	up to 16 dm^3/min:	40...50 bar
		up to 20 dm^3/min:	50...60 bar
		above 20 dm^3/min:	70...80 bar

To correct, slacken the corresponding collar nut (21 or 129) and screw the set screw (20 or 128) ***Fig. 14*** in or out.

If a higher pressure is measured, the corresponding set screw must be **screwed in** further.

If a lower pressure is measured, the corresponding set screw must be **screwed out** further.

While doing so, release the steering wheel so that idle pressure only can build up during this work.

Then tighten the collar nut (21 or 129) using a torque of 20+10 Nm.

Attention:

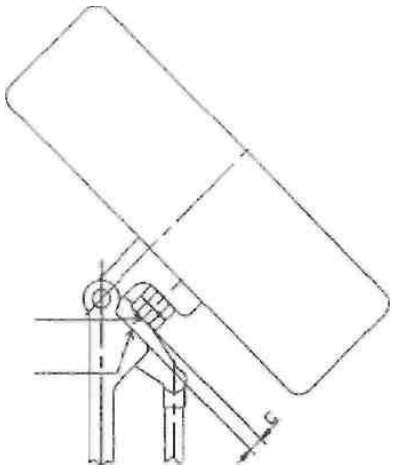
During the setting operation as well as in the built in condition, the set screws (20 and 128) must be screwed in at least 3 threads deep for otherwise, because of insufficient thread overlap, they would run the risk of being ejected when maximum pressure is built up in the steering gear.

1 see vehicle manufacturer's instructions

Proceed as described above for the setting of the second lock stop.

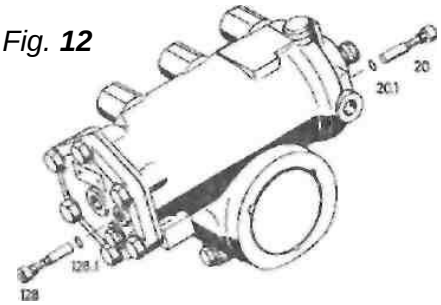
Note:
At variance with the setting described above, the vehicle manufacturer may specify a different way of adjustment, e.g. by inserting a spacer to ensure that, when the steering limitation responds, a distance dimension "C" can be kept ***(Fig. 11)***.

Fig. 11



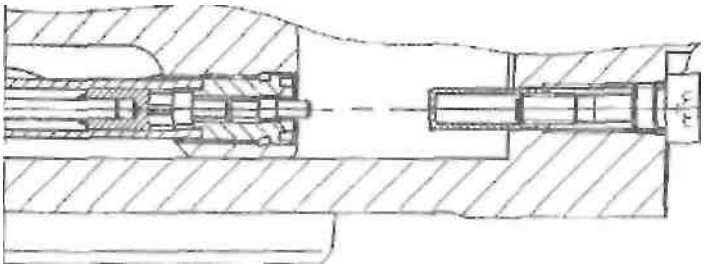
5.2 Automatically adjusting hydraulic steering limitation *(Fig. 12)*

Fig. ***12***



Attention:
Steering gears with automatically adjusting steering limitations must not be rotated manually to the end positions when the steering linkage is removed or when the steering gear is removed from the vehicle, for the sliding bushes of the screws (20 and 128, respectively) would, thereby, be shifted to the cut-off position that is at maximum possible, and an automatic adjustment on the vehicle would only be possible with **new** screws (20 and 128) ***(Fig, 12)***, The screws (20 and 128) and the set screws (20 and 128) are **not** interchangeable.

Fig. 13 Initial position
Sliding bushes not yet adjusted



5.2.1 Operating mode of the automatically adjusting steering limitation

In the end positions, the valve piston tappets run up against the sliding bushes (20 and 128, respectively) and open the steering limiter valves (U and T, respectively).

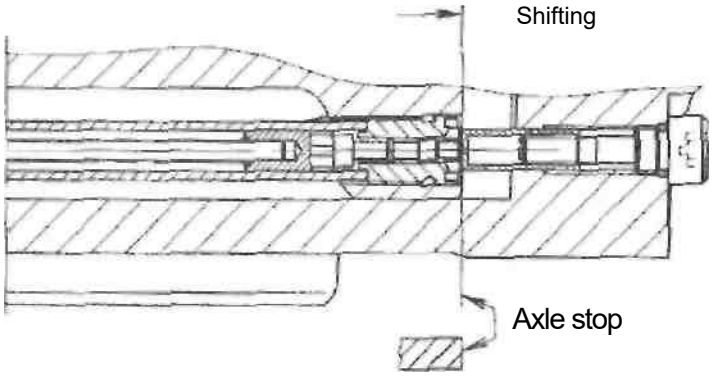
The opening of the steering limiter valve is determined by the position of the sliding bushes on the screws (20 and 128).

5.2.2 Setting

Note:
This setting ***(Fig. 14)*** can only be carried out after the steering gear was fitted to the vehicle. To enable the setting, the steering linkage and the axle stops must be installed and set.

Fig. 14 Setting operation

Positioning of the
sliding bushes



- For vehicles with a rigid axle:

Relieve the steered axle by jacking it up (there must, however, still be a load on the steered axle) or place it on swivel plates. 1

1 see vehicle manufacturer's instructions

- For vehicles with single-wheel suspension:

  Place the wheels on swivel plates.

- Rotate the steering wheel, with and without hydraulic assistance, to the maximum lock stop.

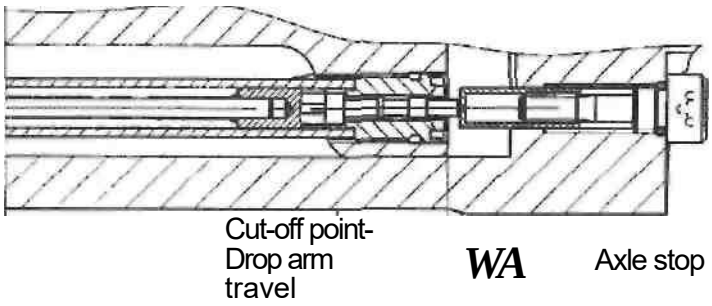
  This will cause the piston to push the sliding bush on the screw (20 and 128) up to the required cut-off position ***(Fig. 15)***.

Note:
During this setting operation the steering limiter valve is constantly open which means that, with as well as without hydraulic assistance, the steering wheel can only be rotated further at an increased effort.

Repeat the setting operation for the other direction of rotation.

Fig. 15

Left-hand steering limiter valve
open, oil pressure highly reduced



5.2.3 Correcting the drop arm travel

Increasing the drop arm travel:

Carry out the setting as described above.

Reducing the drop arm travel:

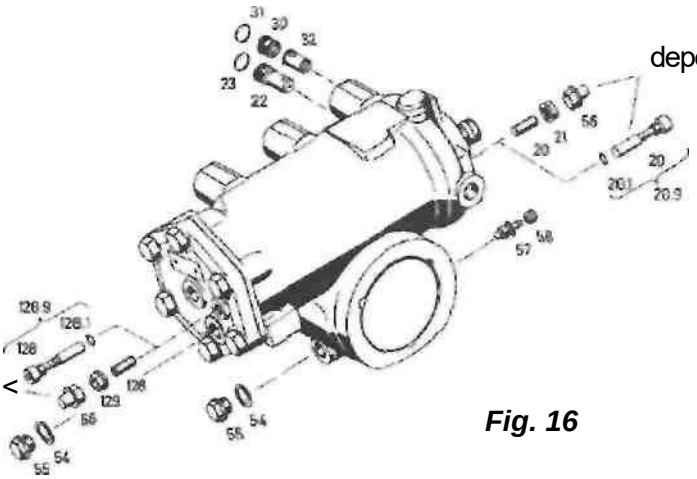
Fit new screws (20 and 128, respectively).

Attention:
The sliding bushes on the screws (20 and 128) may not be pulled back.

Tightening torque for the screws (20 and 128, respectively): 12+3 Nm

IV. Repair of external leakages

depending on the case



depending on the case <

Fig. 16

1) Valve insert (22) - Pressure relief valve

Unscrew the valve insert (22) from the housing ***(Fig. 16)*** and remove O ring rests. If the pressure does not conform to the specified value or if there is any leakage, replace the complete valve insert (22).
Fit a new greased O ring (23) to the valve insert (22) and screw it in again.
Tightening torque: 30+10 Nm

2) Valve insert (32) - Replenishment valve

Unscrew the screw (30) and the valve insert (32). Put the valve insert (32) into the housing bore. Remove o ring rests. Fit a new greased O ring (31) to the screw (30) and screw it in again. Tightening torque: 30+10 Nm

3) Screws (20 and 128)

Screw in new screws (20 and 128)
Tightening torque: 12+3 Nm
Setting the steering limitation - please refer to Chapter III., para. 5.

4) Screws (201 and 129)

Screw in new screws (21 and 129)
Tightening torque: 20+10 Nm
Setting the steering limitation - please refer to Chapter III., para. 5.

5) Screw plug (55)

Unscrew the screw plug (55), fit a new sealing ring (54) and screw it in again.
Tightening torque: 40 Nm (M 16x1.5)
50 Nm (M18x1.5)

6) **Bleeder (57)**

Screw in a new bleeder (57).
Tightening torque: 30 Nm

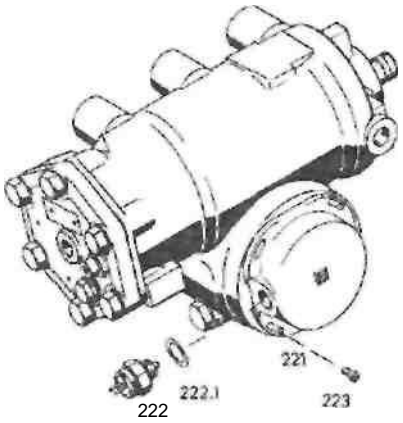
⚠ **Attention:**

Apart from the work detailed above, no further repair work may be carried out. Any repair work exceeding the extent described above has to be done by a HEMA Service Centre

V. Replacing and setting the switch (222) and the potentiometer (232)

Fig. 17

1 Replacing the switch (222)



Unscrew the switch (222) and replace it by a new one (tightening torque: 50 Nm).

Starting from mid-position, rotate the steering gear to the left and to the right. The contact of the switch (222) must open after drop arm travels of 5° (±10%), each (110° ± 10% drop arm travel corresponding to 0.3 steering wheel turns) ***(Fig. 17).*** Make sure that the steer angles to the left and to the right are uniform. If required, correct the symmetry of the switching range by rotating the cover (221).

Tightening torque:
Cap screws (223): 5.5 Nm

Testing tool: Multimeter

Note:
The switching range is set by varying the screw-in depth of the switch (222). Washers (222.1) of different thicknesses are available to enable this setting.

Do not use more than 3 washers (222.1) for the setting operation. (A washer thickness of approx. 0.25 mm corresponds to a drop arm travel of 1° - 22° at the steering wheel). The cover (221) must be filled with 50 cm^3 of oil (see list of lubricants TE-ML 09).

2) Replacing the potentiometer

Rotate the steering gear to mid-position.

2.1 Removing the potentiometer (232)

Clean the area surrounding the potentiometer (232) ***(Fig. 18).***

Mark the position of the potentiometer (232).

Unscrew the cap screws (235).

Remove the potentiometer (232) along with the screening plate (234), the spacing sleeves (233) and the O ring (232).

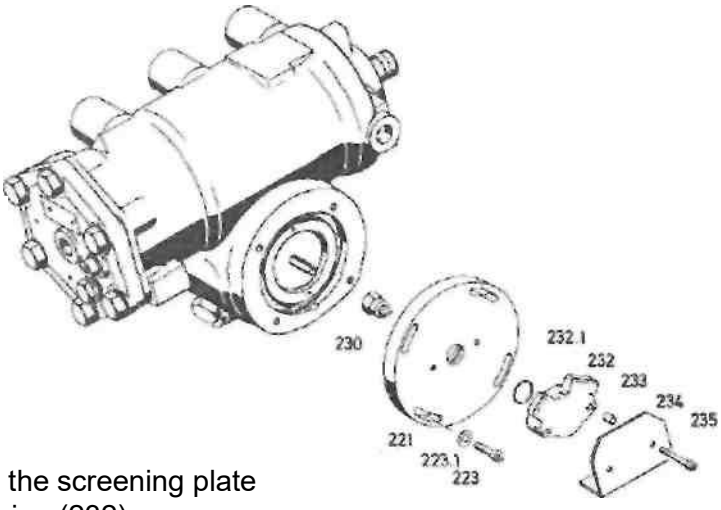


Fig. 18

2.2 Fitting the potentiometer

(232) again Check whether the steering gear is in mid-position.

Fit an O ring **(232.1)** to the **potentiometer** (232).

Place the deep groove of the potentiometer (232) drive on the carrier (230).

Note:
The slider of the potentiometer (232) being spring-loaded, it will return **to** its **initial** position when disassembled.

Therefore, check whether the potentiometer (232) can be turned through 50° minimum to either side when the steering gear is in mid-position.

Fasten the potentiometer (232) along with the spacing sleeves (233), the screening plate (234) and the cap screws (235).

Tightening torque: 2.8 Nm

Check:

The installed position of the potentiometer (232) must be identical with the position as marked during disassembly.

2.3 Setting the potentiometer (232)

Attention:

A maximum value of 6 V must not be exceeded for otherwise the potentiometer (232) would be destroyed.
The tumbler switch of the Hydraulic steering gear with sensor tester (tool [7]) must not be switched to speedo position
as otherwise the potentiometer would be destroyed.

Rotate the steering gear to mid-position (dividing the total number of steering Wheel turns in two).

- Setting a voltage of 5V

Connect tools [6] and [7] (or use a suitable transformer)and the Multimeter measuring instrument as shown in ***(Fig. 19).***

Switch the tumbler switch of the hydraulic steering gear with sensor tester (tool [7]) to transducer position.

Continue adjusting the transducer regulator until the Multimeter measuring instrument reads 5V.

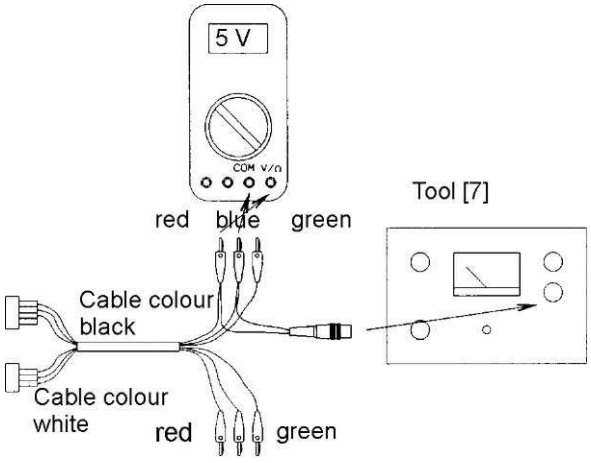
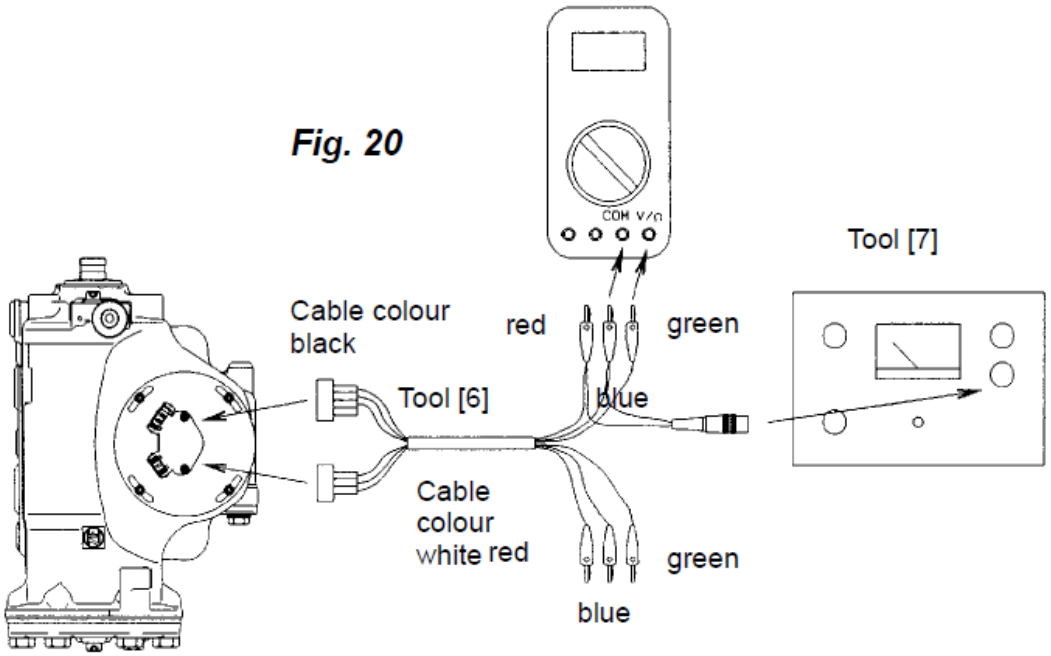


Fig. 19

- **Setting the potentiometer (232) to steering gear mid-position**

Connect tools [6] and [7] and the Multimeter measuring instrument as shown in ***(Fig. 20)***



Rotate the potentiometer (232) together with the cover (221) until the Multimeter measuring instrument reads half the voltage applied, namely 2.5 V + 0.03 V.

In this position, tighten the cap screws (223) (tightening torque: 4+1.5 Nm).

VI. Removal and re-installation of the steering gear

1 Removing the steering gear

1.1 Thoroughly clean the steering gear and its immediate surroundings, in particular the pipe connections.

Drain the oil as described in Chapter III..

Unscrew the pressure and return lines.

Obturate all oil pipes (danger of soiling).

1.2 Check whether the marks on the sector shaft and the drop arm coincide.

Note:
If the marks are offset from each other, prior to fitting the drop arm inquire with the vehicle manufacturer whether differing assembly instructions exist.

Screw out the locking screw (50). Pull

the drop arm off, using tool [5].

Attention

Heating up the drop arm or driving in a wedge between the housing and the drop arm or removing the drop arm by means of hammer blows is not permitted as such action may cause changes to the material and/or inner damages to the steering gear.

1.3 Additionally, for vehicles with adjustable steering column:

- Adjust the driver's workplace to the topmost position to relieve the ball-track relay shaft as much as possible.
- By means of a suitable tool, for instance a ratchet belt, relieve the ball-track relay shaft in such a way that no thrust force can act towards the steering gear.

  When a ratchet belt is used, pass the belt through the yoke spaces if possible (see arrows in ***Fig. 21***). Tension the belt to an extent avoiding any damage to the sealing elements or the steering gear protection cap caused by a dislocation of the universal joints at the moment the clamping screws are unscrewed.

1.4 Unscrew the universal joint or the elastic coupling between the steering gear and the steering column or the separately mounted bevel box.

Unscrew the mounting screws and remove the steering gear.

Note:
If a fitting bolt was used, write its position down.



Fig. 21

2 Re-installing the steering gear

Attention:

To guarantee a safe operation of the steering system, maximum cleanliness is an absolute must when re-installing all units that are part of the system.

Note:

To avoid malfunctions caused by foreign bodies or impurities in the oil circuit of the steering gear, the plugs in the ports of the steering gear, the oil pump, the steering cylinder, the valves etc. ... should only be removed at the moment the lines are connected. Remove protecting sleeves in the installed position, only, if this is possible. Connecting lines and screwed connections must be thoroughly cleaned and deburred.

2.1 Rotate the steering wheel to the straight ahead driving position.

Clean the locating surfaces of the mounting bracket and the steering gear.

2.2 Additionally, for vehicles with adjustable driver's workplace:

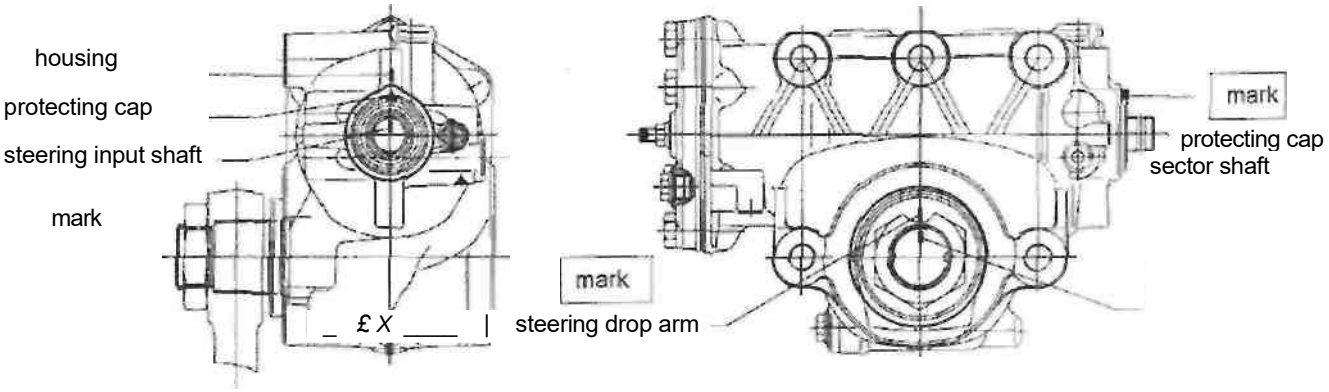


Fig. 21

Using a suitable tool, for example a ratchet belt, constrict the ball-track relay shaft until there is sufficient space for the steering gear to be built in without constricting the ball-track relay shaft any further. ***(Fig. 22)***.

2.3 Rotate the steering gear to mid-position by dividing the total number of steering wheel turns in two. Then continue to rotate until the marks (see **Fig. 23**) on the input shaft, the protection cap and housing coinside.

Fig. 23



2.4 Place the steering gear into the mounting bracket and fasten it with screws.

Note:
Make sure that the position of the fitting bolt is correct.
For the tightening torque, please refer to the technical cover sheet of the spare parts list.
If no data is given in the list, the values below shall apply.

Depending on the vehicle type, space restrictions may require a previous fitment of the drop arm.

Tightening torque:

Thread	Screw grade	Tightening torque
M18x1.5	10.9	410+10% Nm
M20x1.5	10.9	520+10% Nm

Attention:
Conform to vehicle manufacturer's instructions.

2.5 Fit the universal joint or the elastic coupling between the steering column and the steering gear.

Note:
The clamping slot in the universal joint must point towards the mark on the cover cap or on the input shaft.

2.6 Additionally, for vehicles with adjustable driver's workplace:

Put the universal joint on without damaging the steering gear seal. Tighten the clamping screw (M 10x1,25) applying a torque of 48+5 Nm. Relieve the tool, e.g. the ratchet belt (see ***Fig. 22***), cautiously and remove it.

2.7 Move the steered wheels of the vehicle to the straight ahead driving position.

This position is reached when the steered wheels are in line with or parallel to, respectively, the second pair of road wheels (place a graduated ruler against the front and rear wheels).

2.8 Put the drop arm on the serration, making sure that the marks on the drop arm and on the sector shaft coincide *(see **Fig. 23**).*

Screw the locking nut (50) on and tighten it, applying the torques specified below.

- For versions with tapered serration:

Note:

For the tightening torque, please refer to the technical data sheet of the spare parts list. If no data is given in the list, the following values shall apply.

Thread	Serration	Tightening torque	Exception
M30x1.5	1 3/8"x36	250 Nm +10%	
M30x1.5	1 1/2"x36	300 Nm +10%	
M30x1.5	1 5/8"x36	330 Nm +10%	
M35x1.5		400 Nm +10%	
M42X1.5		500 Nm +10%	
M45X1.5		550 Nm +10%	MAN: 850 Nm+10%

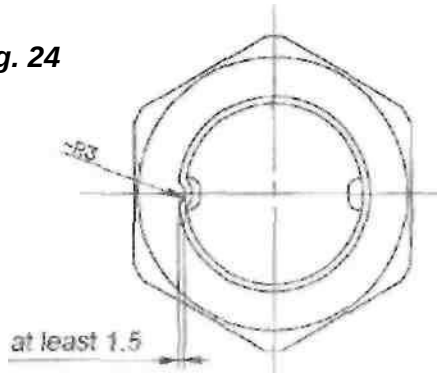
If the vehicle manufacturer specifies different values, manufacturer's values shall apply.

- For versions with cylindrical serration and/or clamping screws:

Apply the tightening torque specified by the vehicle manufacturer.

2.9 Peen the locking nut (50) as shown in ***Fig. 24*** [1]

Fig. 24



Put the drag link or the tie rod into place and tighten it. [JJ

Rotate the steering gear to the left until reaching the stop. Take off the drag link or the tie rod.

2.10 Additionally, for versions with automatically adjusting steering limitation:

Unscrew the screws (20 and 128).

2.11 Check at the steering wheel whether any further movement to the left is possible.

If the steering gear cannot be rotated any further to the left, the lock stop and the axle stop. respectively, must be re-set.

Attention

It must be guaranteed that the steering angle limitation takes place at the lock stops and the axle stops, respectively, and is not done by the steering gear.

Mount the drag link or the tie rod. [1]

Repeat the check for the right-hand side and, if required, re-set the lock stop and the axle stop, respectively.

2.12 Additionally, for versions with automatically adjusting steering limitation:

Screw in the screws (20 and 128). Tightening torque: 12+3 Nm

2.13 Mount the drag link or the tie rod. [1]

[1] see vehicle manufacturer's instructions

2.14 Connect the pressure and return lines between the pump, the steering gear and the steering cylinder.

Fill the steering system with oil and bleed it.

See Chapter III.

2.15 Set the hydraulic steering limitation.

See Chapter III.

2.16 Check the oil level

Before pulling out the oil dipstick, thoroughly clean the oil tank and its immediate vicinity to prevent dirt from getting into the hydraulic fluid.

 Attention

If the oil level is too low, it can entail malfunctions which, in turn, may cause a failure of the hydraulic steering assistance.

VII. Special tools

Note:

The tools described below are universal tools. For special applications, special tools recommended by the vehicle manufacturer may therefore be necessary.

Special Hand Tools for the Power Steering types HD090, HD095 and HD098	**Ordering ref. no:** **015.9098.001**
Guide Sleeve for Shaft Seal Mounting (1 Psc)…….....	8090.798.002
Guide Sleeve for Shaft Seal Mounting (1 Psc)……..	8090.798.003
Sleeve for Pressing the Housing Covers (1 Psc)……	8090.798.006
Mandrel for Shaft Seal Mounting (1 Psc)……..…	8090.798.051
Mandrel for Shaft Seal Mounting (1 Psc)……..……	8090.798.101
Dial Gauge Holder 8090 (1 Psc)……	8090.798.151
Adjusting Device for Pressure Point Setting (1 Psc)……..	8090.798.551
Insert for Adjusting Device (2 Psc)…….	8090.798.601H
Puller for Cover Bearing (1 Psc)…….	8095.798.101
Dial Gauge Holder 8095-8098 (1 Psc)……	8098.798.002
Sleeve for Pressing the Housing Covers (1 Psc)……	8098.798.551
Insert for Adjusting Device (2 Psc)……..	8098.798.654
Punch for Screwed Valve Insert (1 Psc)…….	8095.798.002
Sleeve for Pressing the Housing Covers (1 Psc)…….	8098.798.551
Adjusting Device for Pressure Point Setting (2 Psc)…….	8095.798.601H
Puller for Cover Bearing (1 Psc)…….	8098.798.601H
Puller for Cover Bearing (1 Psc)……..	

Assembly Vice Portable Test…….....	015.8000.000
Equipment Special Torque……	015.8000.000
Measuring Device Adapter for……	7470.798.703
Torque Device……..	7419.798.551

Hand Tools for Steering Pumps	**Ordering ref. no:**
Rotor Assembly Pliers with a Special Rim…….....	7673.798.011
1 Side Plate Pliers with a Special Rim…….	7673.798.010
Insert Sleeve for Shaft Seal Mounting…….	7672.798.052
Insert Sleeve for Shaft Seal Mounting……	7672.798.051
Insert Sleeve for Shaft Seal Mounting…….	7673.798.002
Insert Sleeve for Shaft Seal Mounting……..	7673.798.001

VIII. Troubleshooting

1 Troubleshooting on the steering system, incl. checking the hydraulic functions

1.1 Checking the play of the input shaft bearing in the steering column

By moving (shaking) the steering wheel sideward to and fro, checks whether there is any play. If so, replace or repair the steering column/the bearing.

1.2 Checking the universal joint, the telescopic shaft and the bevel box for angular play or stiff operation

If play (can be identified by the noticeable rattling noise occurring when the steering wheel is turned to and fro) or stiff operation are ascertained, replace the defective components.

1.3 Checking for leakage

- Start the engine.
- Check whether all screwed connections, lines and sealing elements of the complete steering system (bevel box, steering gear, pump and steering cylinder) are leakproof.
- Check all hoses and lines, protecting caps and bellows for possible traces of chafing and embrittlement cracks.
- Switch the engine off.

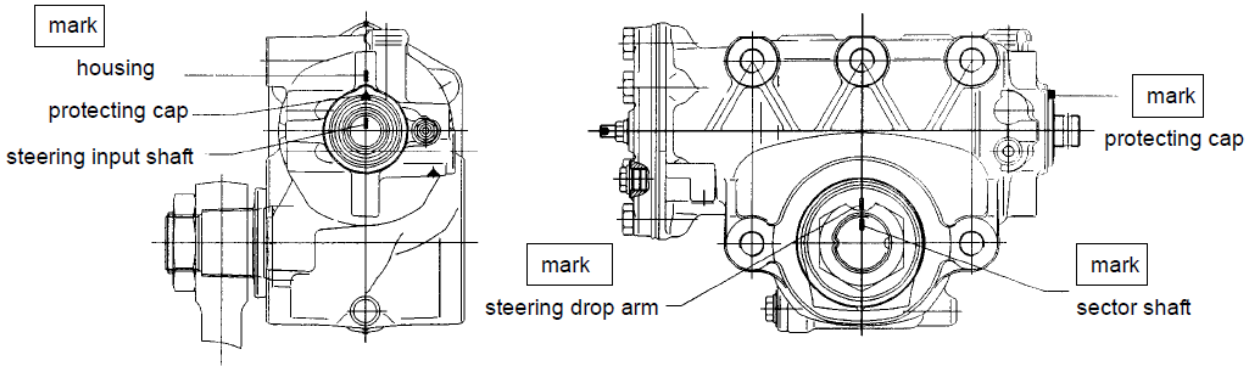
Attention:
When you replace hose lines or parts with externally visible damages such as for instance cracks only use spare parts that are pressure-tested and released by the vehicle manufacturer.

1.4 Checking the straight ahead driving position of the steering gear and the vehicle

Attention:
Steering gears equipped with an automatically adjusting hydraulic steering limitation must not be rotated to the end positions if the steering linkage had been removed previously.

- Vehicles with single-wheel suspension.
  Place the wheels of the steered axle on swivel plates.
- Vehicles with a rigid axle:
  Jack the steered axle up 0
- Move the steering gear to mid-position by rotating it half the total number of steering wheel turns. Then rotate it further until the marks *(see **Fig. 25**)* coincide.

Fig.25



Now turn the steered wheels to the straight ahead driving position.

Corrections can be made by screwing the ball joint on the drag link further in or out.

Attention:
If the steering wheel position is not correct or if a length correction of the steering linkage turns out to be necessary, it may well be that this necessity originates in a preceding accident-like event. We, therefore, recommend to check whether the serration of the sector shaft (30) is twisted (to do so, pull the drop arm off), whether the input shaft is installed in a twisted position and whether some or all further transmission elements are bent or have cracks. In addition, check the play as detailed in Chapter III., para. 3. Deformed components may not be re-bent to shape but must be replaced.

Additionally, for versions with automatically adjusting hydraulic steering limitation:

If required, fit new screws (20 and 128, respectively) and reset the steering limitation - see Chapter III., para. 5.

1 see vehicle manufacturer's instructions

1.5 Checking the belt tension of the pump drive

Check the tension of the drive belt. 1

Even at maximum pump pressure, the drive belt must transmit the power without any slip.

1.6 Checking the hydraulic functioning of pump and steering gear

1.6.1 Installing tool [1] (HEMA Hydraulic steering gear tester)

For the implementation of the pressure and leakage oil tests described below, it is necessary to distinguish 2 kinds (variants 1 and 2) of steering systems.

Variant 1

Steering systems with the **pressure relief valve arranged in the pump or in the pressure line between the pump and tool [1] (HEMA Hydraulic steering gear tester)** ***(Fig. 26).*** This means that pressure relief takes place ahead of built-in tool [1], On steering systems of this type the nameplate of the pump or of the pressure relief valve will indicate the maximum pressure, e.g. 130 bar.

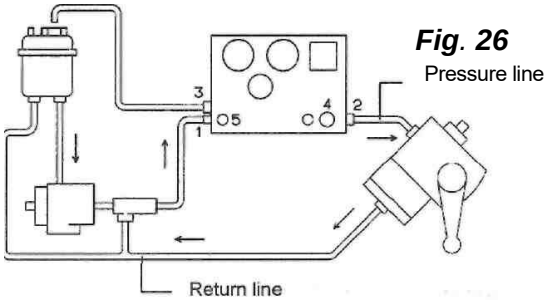
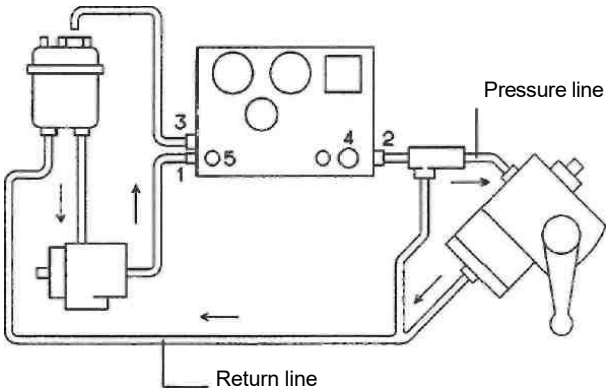


Fig. 26

Variant 2

Steering systems with the **pressure relief valve arranged in the steering gear or in the pressure line between tool [1] (HEMA Hydraulic steering gear tester) and the steering gear** ***(Fig. 27).***

On steering systems of this type the nameplate of the steering gear or of the pressure relief valve will indicate the maximum pressure, e.g. 130 bar.



1 see vehicle manufacturer's instructions

Fit tool [1] (HEMA Hydraulic steering gear test) to variants 1 or *2* in such a way that the readings can be seen from the driver's seat.

Check the oil level and bleed the steering system - see Chapter III. Test

conditions: oil temperature 50°C

1.6.2 Checking the maximum pressure of the HEMA pump

Read the maximum permissible pressure from the nameplate of the steering gear/the pump or of the separately arranged pressure relief valve. Start the engine.

Set the pressure relief of tool [1] (HEMA Hydraulic steering gear test) to a value excluding any damages to the steering system during the tests described below.

1.6.2.1 For steering systems with pressure relief **ahead of** tool [1]: **Variant** 1
Have the engine run at idling speed.

Close the shut-off valve of tool [1] (HEMA Hydraulic steering gear test) and read the maximum pressure.

Attention:
Admit maximum pressure for a short time only (10 seconds maximum) to avoid an excessive heating-up of the inner parts of the pump and, in consequence, a premature wear of these parts.

Specified value: maximum pressure (see nameplate) +10 %

Open the shut-off valve again.

If the specified value is not reached, replace or repair the pump.

1.6.2.2 For steering systems with pressure relief **aft of** tool [1]: Variant 2

Attention:
If tool [1] is installed to variant 2 make absolutely sure that during the entire period of pressure testing the engine is running at idling speed, only. An increase in engine speed would entail an immediate and sharp rise in system pressure which could cause a damage to the pressure line/the

Have the engine run at idling speed.

While watching the pressure gauge of tool [1], slowly close the shut-off valve until the maximum pressure indicated is reached.

Do not close the shut-off valve any further. Admit maximum pressure for a short time only (maximum 10 seconds) to avoid an excessive heating of the inner parts of the pump. Have the shut-off valve return to its initial position.

If maximum pressure is not reached during this measurement, the pump has to be replaced or repaired.

1.6.3 Checking the flow rate of the HEMA pump

Note:
Specified values for flow rate, test pressure and test speed: see table below. Designations and operation of tool [1] (HEMA Hydraulic steering gear tester 5..): see separate operating instructions for HEMA tester 5.. .

- **Checking the controlled flow rate**

Raise the engine speed until the pump flow rate remains constant despite a further increase in speed (approx. 1300 r.p.m.)

The pump is now in the flow setting range.

Specified value: see spare parts list

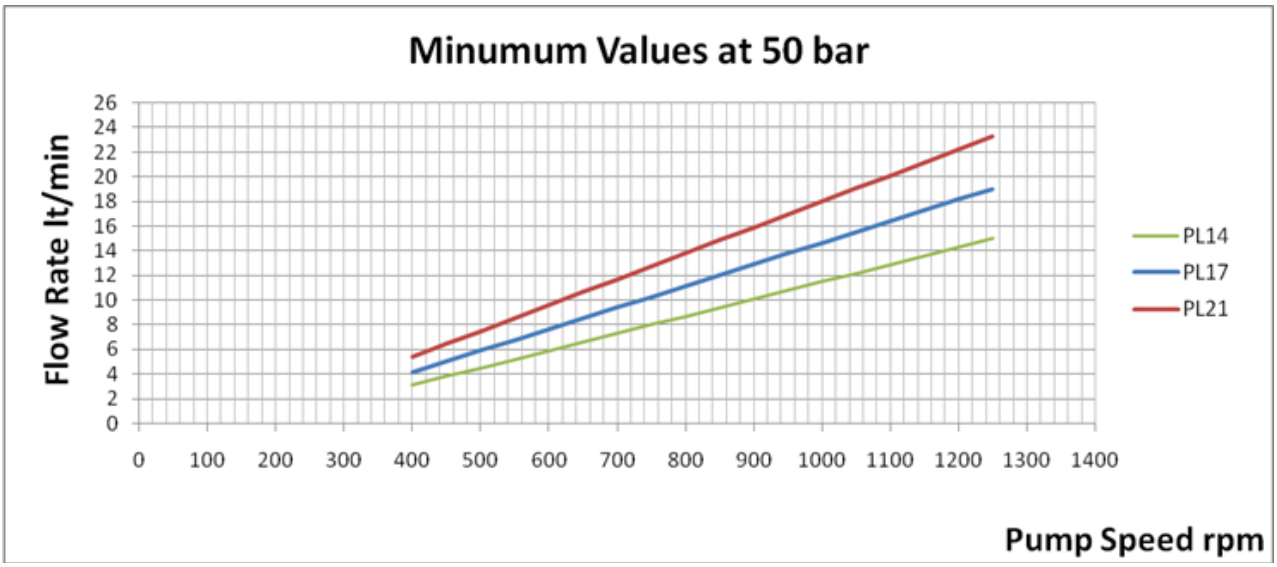
- **Checking the minimum flow rate**

With the engine running at idling speed, progressively close the shut-off valve until the test pressure specified for the pump type in question is built up.

Read the flow rate.

Make sure the engine speed/pump speed ratio is correct.

Pump Type	Test Speed [r.p.m.]	Test Pressure [bar]	Minimum Flow Rate [dm^3/min]
PL14	500	50	4.5
PL17	500	50	5.9
PL21	500	50	7.5



1.6.4 Checking the hydraulic steering limitation

1.6.4.1 Manually adjustable hydraulic steering limitation

- Vehicles with a rigid axle: Jack
  the steered axle up. 1
- Vehicles with single-wheel suspension:
  Place the wheels of the steered axle on swivel plates.
- Rotate the steering wheel clockwise. When the axle stop and the lock stop, respectively, are reached, continue to rotate the steering wheel until a positive stop is reached.
  In this position read the pressure at the pressure gauge:

Specified values: Steering systems	up to 16 dm^3/min:	40...50 bar
	up to 20 dm^3/min:	50...60 bar
	above 20 dm^3/min:	70...80 bar

Repeat this test for the other direction of rotation. Setting the steering limitation: see Chapter III., para. 5.

1.6.4.2 Automatically adjusting hydraulic steering limitation

Carry out the test as described in para. 1.6.4.1.

If there is no more space left at the lock stop components or if the oil pressure does not drop to the specified value, fit new screws (20) and (128), respectively, and reset the steering limitation as specified in Chapter III., para. 5.

Specified values: Steering systems	up to 16 dm^3/min:	40...50 bar
	up to 20 dm^3/min:	50...60 bar
	above 20 dm^3/min:	70...80 bar

If there is too much space available at the lock stop components and if the oil pressure does not drop to the specified value, reset the steering limitation as specified in Chapter III., para. 5.

Repeat this test for the other direction of rotation.

1 see vehicle manufacturer's instructions

1.6.5 Checking the maximum pressure and the leakage oil of the steering gear

Between the lock stops, insert tool [3] or approx. 15 mm thick thrust pads ***(Fig. 28)*** ensuring that the steering motion is stopped 1/2 to 3/4 steering wheel turn before reaching the axle stop/lock stop. The restriction of the steering motion must take place at tool [3] or at the said thrust pads and must not be done by the piston in the steering gear.

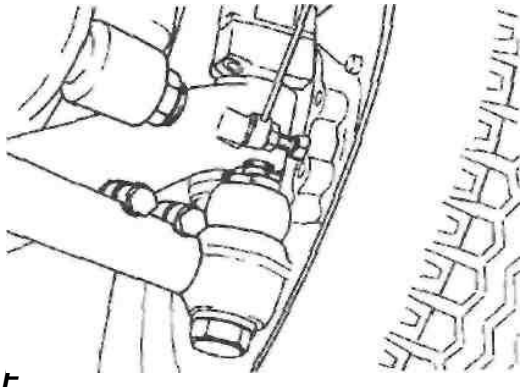


Fig. 28

Attention:

A tool under pressure may be ejected - avoid any direct visual contact with the tool. Danger of accidents by squeezing.

Use the special tool specified by the vehicle manufacturer for the axle version in question.

At engine idling speed, rotate the steering wheel to the stop and continue to turn for abt. 5 seconds with an effort of 100..200 N at the steering wheel. Read the maximum pressure and the leakage oil.

Repeat this test in the opposite direction of rotation.

Maximum permissible leakage oil values:	Type HD090:	2.0 dm^3/min
	Types HD095...HD098:	2.5 dm^3/min

Checking the leakage oil at a reduced flow rate.

Set too! [1] (HEMA Hydraulic steering gear test) 5.. to a flow rate which is 0.5 dm^3/min higher than the maximum
permissible leakage oil value.

Repeat the leakage oil test as described above. The leakage oil value measured in this repetition test must not exceed the value measured previously - see above.

Cause of insufficient maximum pressure/too much leakage oil:

- Pressure relief valve and/or replenishment valve defective.
- Pressure cut-off of steering limitation valve comes too early - refer to Chapter III., para. 5 for setting.
- Seals in the steering gear defective.

For steering systems with pressure relief aft of the tester: Variant *2*
The shut-off valve (4) must be closed completely and the throttle valve (5) must be closed progressively until a pressure is achieved that is 30 bar lower than maximum pressure. Re-open the shut-off valve (4).
Repeat this test as described above.

1-6.6 Checking the return to neutral of the valve

Note:

Make sure the steering column has sufficient clearance (floor carpets, coverings).

By rotating the steering wheel, close the steering valve, thus causing maximum pressure to build up. Then rotate the steering wheel back until idle pressure is available. Next, raise the pressure to idle pressure +10 bar.

Release the steering wheel and watch the pressure which must drop to idle pressure (at maximum 0.5 bar higher) within 1 second.

Example: Idle pressure: 4.0 bar Maximum permissible value: 4.5 bar

1.6.7 Checking the steering gear play

Prerequisite for the test described below:

The transmission parts between the steering wheel and the road wheel must be free from play.

- Versions with leaf spring:

Lock the LH front wheel (the RH front wheel if the vehicle is RH steered) in the straight ahead driving position by fitting tool [4] between the wheel rim (rear and front) and the front spring ***(Fig. 29)***.

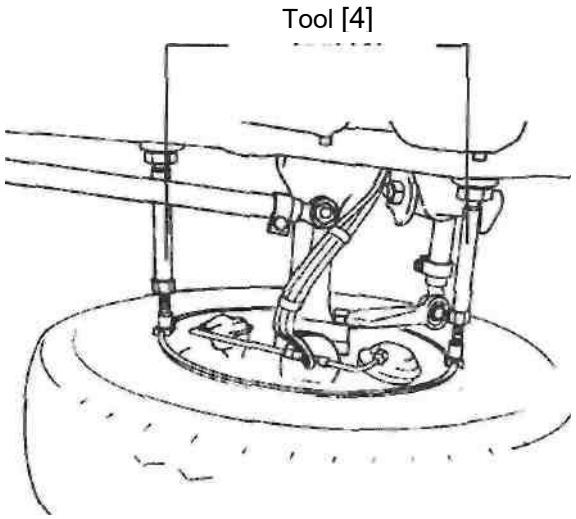


Fig. 29

Attention:

Do not exert any pressures in excess of those mentioned below on the tools and the wheel rim in order to avoid damages to the wheel rim.

- Versions with single-wheel suspension:

Lock the LH front wheel (the RH front wheel if the vehicle is RH steered) as per vehicle manufacturer's instructions.

- Put tool [2] on the steering wheel and attach the pointer to the dashboard or to the windscreen ***(Fig. 30)***.

Raise the engine speed to approx. 1000 r.p.m..

Read the idle pressure at tool [1] HEMA Hydraulic steering gear test/pressure gauge).

Rotate the steering wheel to the left until a pressure of 1 bar above idle pressure is indicated.

On tool [2] read the dial value.

Rotate the steering wheel to the right until a pressure of 1 bar above idle pressure is indicated.

On tool [2] read the dial value.

Calculate the total travel covered.

Specified value: max. 50 mm (steering wheel Ø 500 mm)

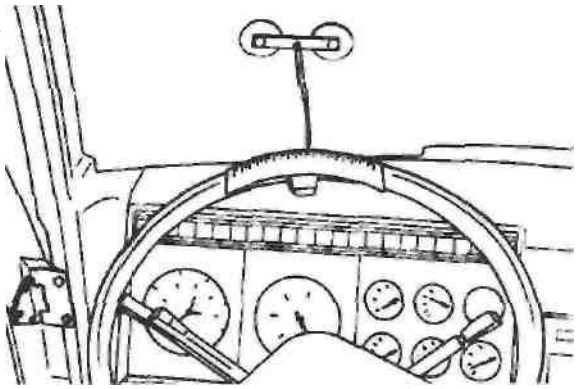


Fig. 30

For versions with bevel box:

Specified value: max. 55 mm (steering wheel Ø 500 mm)

If the maximum value is exceeded, check the play of the steering column and, if required, repair or replace the steering gear.

Remove tool [1] HEMA Hydraulic steering gear test) / the pressure gauge.

Check the oil level and bleed the steering system - see Chapter III.

2 Troubleshooting aid

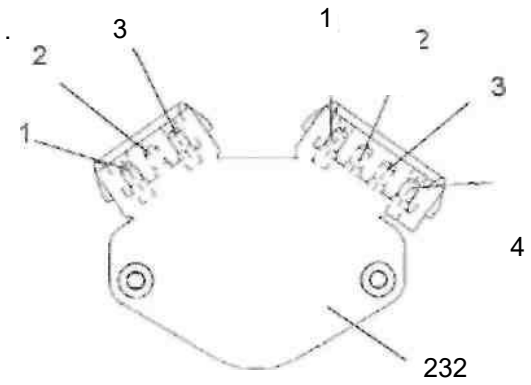
Fault	Cause	Remedial action
Noise	Air in the oil Oil level too low	Bleed steering system 3 Top up with oil
	Pump defective	Repair 2 Replace 2
Stiff operation to either side	Oil level too low	Repair leakage Top up with oil 3
	Steering system is sucking in air (Suction area)	Repair leakage Top up with oil 3 Bleed steering system 4
	Universal joints/steering column Stiff operation	Check Replace 1
	Oil filter soiled	Replace 3
	Steering gear defective	Repair 2 Replace 2
	Pump defective	Repair 2 Replace 2
Stiff operation in one direction	Incorrect setting of steering limitation	Set 3
	Steering gear defective	Repair 2 Replace
Stiff operation during fast steering motion	Steering system is sucking in air (Suction area)	Repair leakage Top up with oil Bleed steering system 3
	Pump defective or wrong version	Replace pump 2

1 see vehicle manufacturer's instructions
2 approach HEMA service center
3 see Chapter III

Fault	Cause	Remedial action
Self-centring hampered	Stiff operation of axle/ axle guide components	Repair 1
	Steering gear/steering column fitted in twisted position	Eliminate twisting 1
	Stiff operation of steering column	Eliminate stiff operation 1
	Steering gear defective	Repair 2 Replace 2
Exact straight ahead driving impossible	Oil level too low	Repair leakage Top up with oil 3 Bleed steering system 3
	Axle/axle guide components/ steering column not play-free	Check 1 Replace 1
	Steering gear not play-free	Check 3 Replace 2

Additionally, for versions with potentiometer (232):

Pin assignment at potentiometer and plug, respectively (vehicle electrical system)



Potentiometer (232) does not work	No operating voltage	At plug (vehicle electrical system) measure between pins 1-3 Specified value: operating voltage 1
	Contact problems	Remove dirt and/or corrosion

Fault	**Cause**	**Remedial action**
	Internal malfunction	Check potentiometer **(see** below)
	No tripping of potentiometer (232)	Replace steering gear 2
Wrong operation of potentiometer (232)	Wrong setting	Set potentiometer 4
	Wrong cabling	Check cabling 4
	Cap screws (223 and 235) loose	Check and tighten 4
	Potentiometer (232) mounted incorrectly	Check 4

1 see vehicle manufacturer's instructions

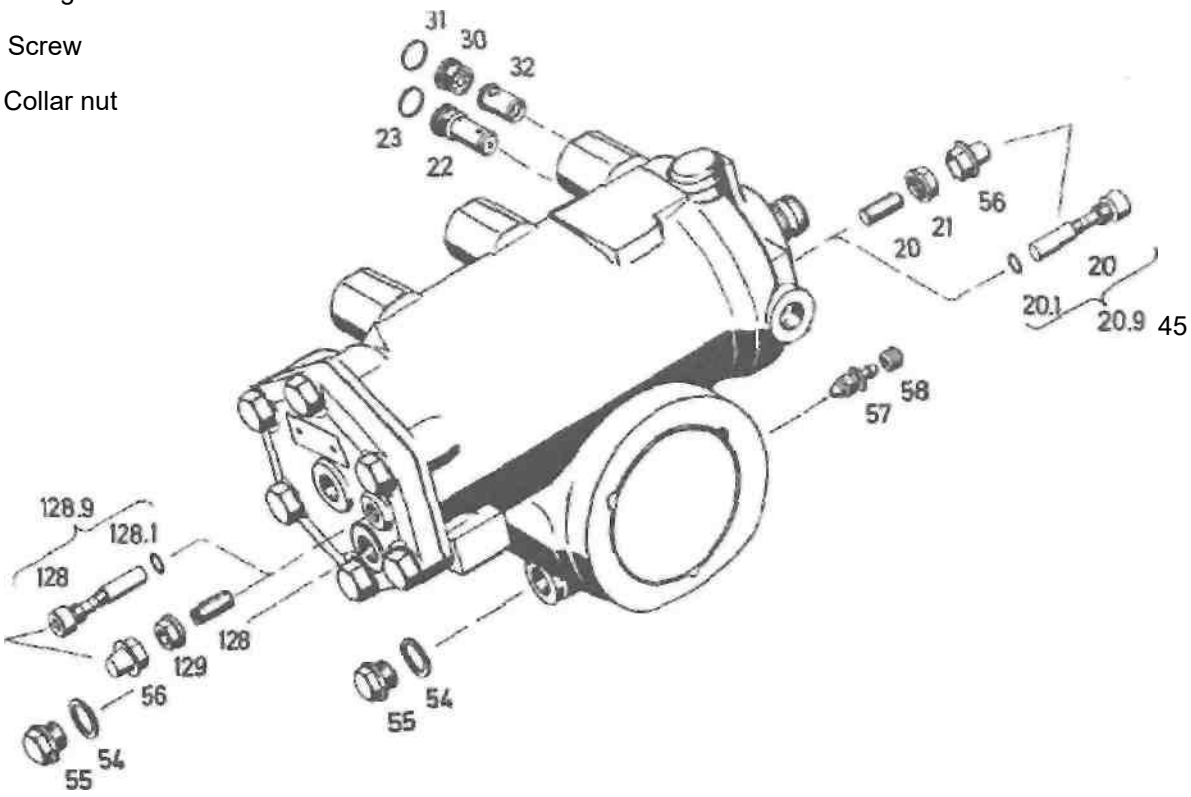
2 approach HEMA Service Centre

3 see Chapter III.

4 see Chapter V.

IX. Key to numbers in figures and exploded drawing

20	Set screw/screw
20.1	O ring
20.9	Screw
21	Collar nut
22	Valve insert
23	0 ring
30	Screw
31	O ring
32	Valve insert
54	Sealing ring
55	Screw plug
57	Bleeder
128	Set screw/screw
128.1	O ring
128.9	Screw
129	Collar nut



Customer: ..... Steering gear version: .....

Vehicle manufacturer: ..... Pump manufacturer: .....

Vehicle type (or model): ..... Pump version: .....

Mileage: ..... Emergency steering pump: .....

1 **Test drive carried out** ☐ yes ☐ no

Complaints: .....

2 **Tested or checked for external leakproofness / damages** ☐ yes ☐ no

Complaints: .....

3 **Oil level checked** ☐ yes ☐ no

Remarks: .....

.....

Checked by (name): ..... Date: .....

Customer: ..... Steering gear version: .....

Vehicle manufacturer: ..... Pump manufacturer: .....

Vehicle type (or model): ..... Pump version: .....

Mileage: ..... Emergency steering pump: .....

1	**Inspection intervals (see Chapter III.)**		
2	**Test drive carried out**	☐ yes	☐ no
	Complaints:		
3	**Visual inspection carried out**	☐ yes	☐ no
	Complaints:		
4	**Oil filter replaced**	☐ yes	☐ no
5	**Steering gear play checked**	☐ yes	☐ no
	Specified value:	Measured value: ..... mm	
	max. 50 mm		
	max. 55 mm (for versions with bevel box)		
6	**Safety inspection (SP) checks carried out**	☐ yes	☐ no

Remarks: .....

Checked by (name): ..... Date: .....

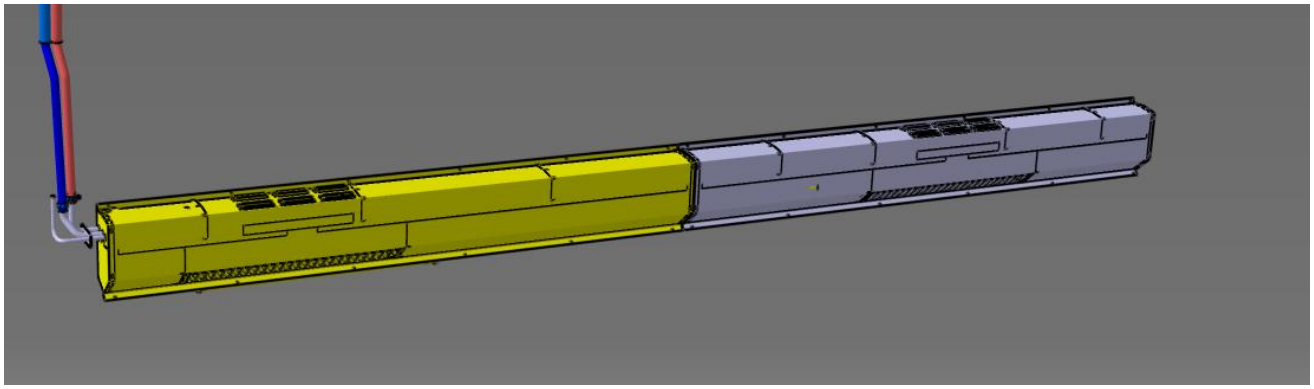
CITIPORT



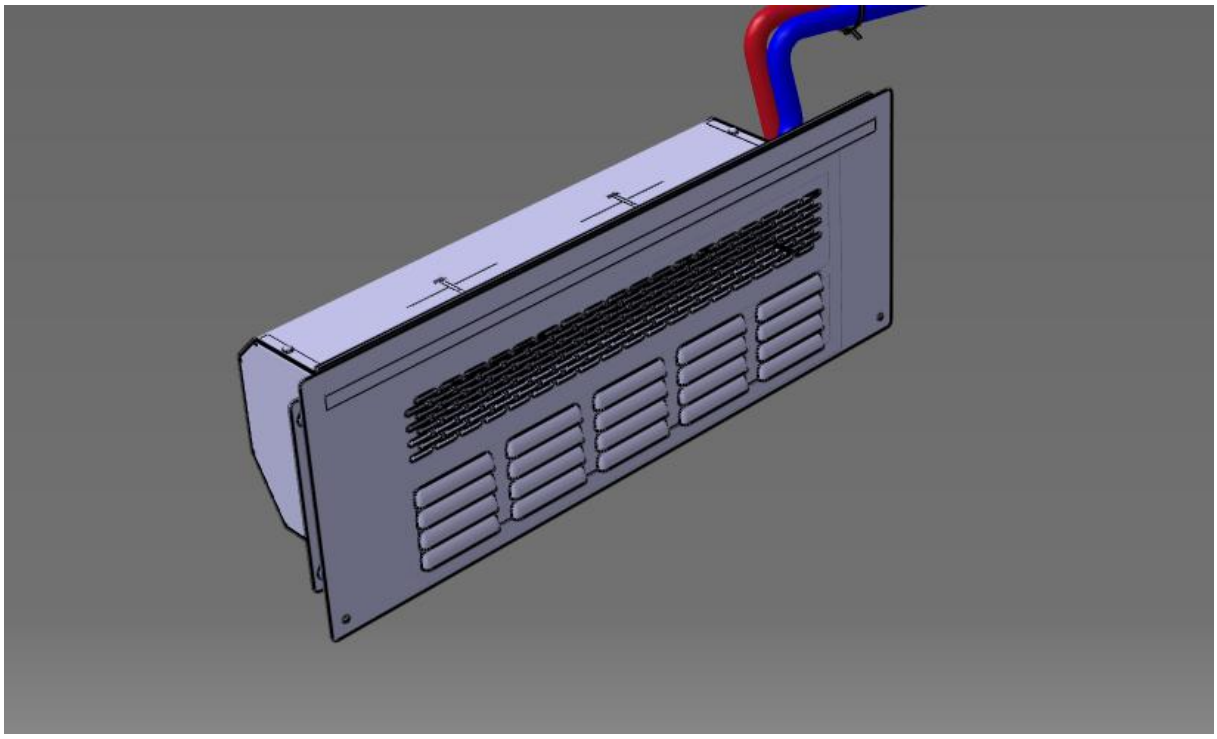
WORKSHOP MANUAL
HVAC SYSTEMS

CITIPORT ISITMA SOĞUTMA SİSTEMİ HVAC BAKIM KILAVUZU

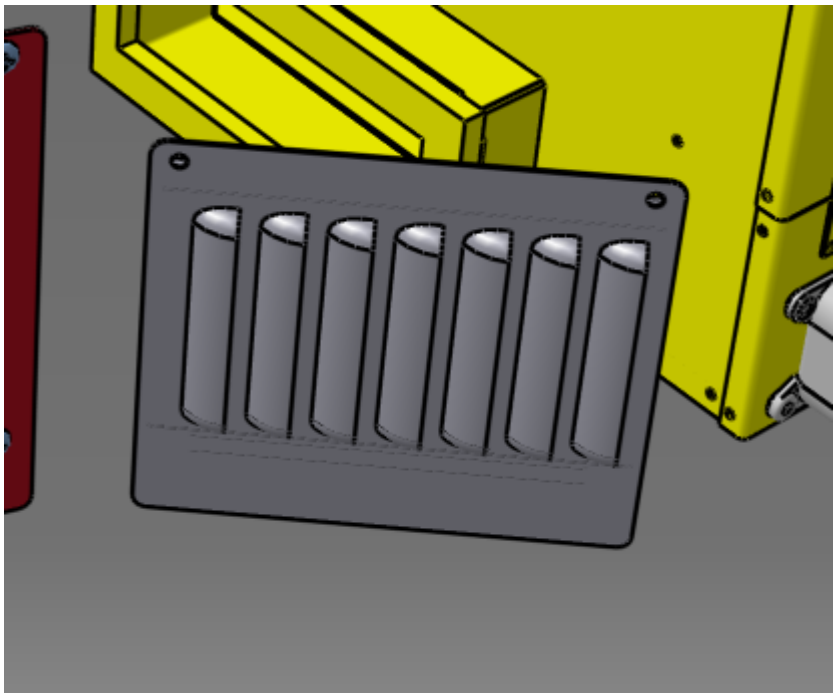
ISITMA



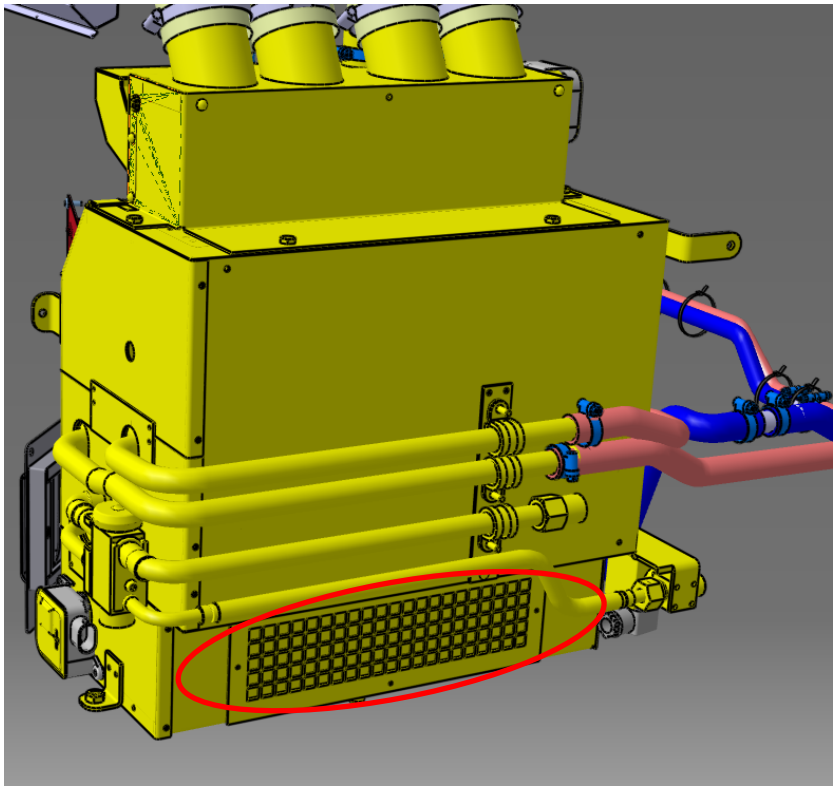
6 ayda bir kaloriferlerin filtreleri temizlenmelidir.Emişe gelen kısımlarda kapaklar sökülerek filtreler temizlenmelidir. Filtreler mümkünse yıkanmalı ve ardından yerine takılmalıdır. Yıkanma ihtimali yok ise hava tutulması suretiyle filtreler temizlenir.



Ön kaloriferin emişini sağlayan kapak filtreside 6 ayda bir temizlenmelidir.



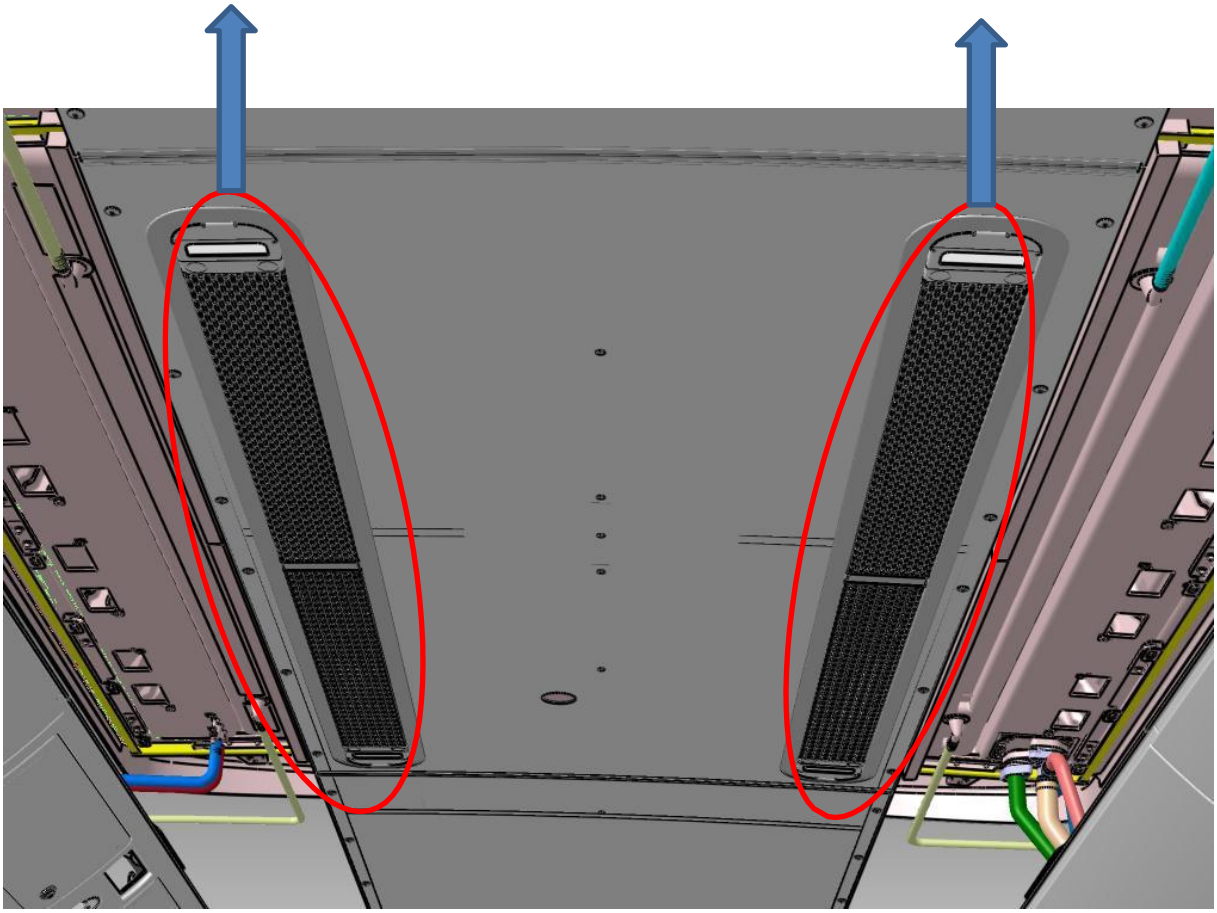
Ön kalorifer filtreside 6 ayda bir temizlenmelidir.



KLİMA

Klimayla ilgili bir arıza olduğunda Isuzu servisleri işlem yapmayacaktır.Tedarikçi firmanın teknik servisi işlem yapacaktır.

6 ayda bir klima hava emiş filtreleri temizlenmelidir.Emişe gelen kısımlarda kapaklar sökülerek filtreler temizlenmelidir. Filtreler mümkünse yıkanmalı ve ardından yerine takılmalıdır. Yıkanma ihtimali yok ise hava tutulması suretiyle filtreler temizlenir.1 yılda bir ise yeni filtre ile değiştirilmelidir.



ISUZU

ISUZU ACADEMY TECH CENTER

CITIPORT



WORKSHOP MANUAL

Circuit Diagrams

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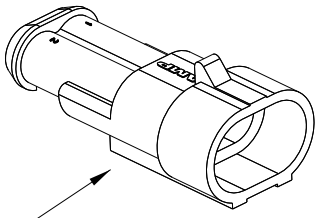
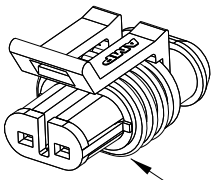
CITIPORT E6
COLOR CODE

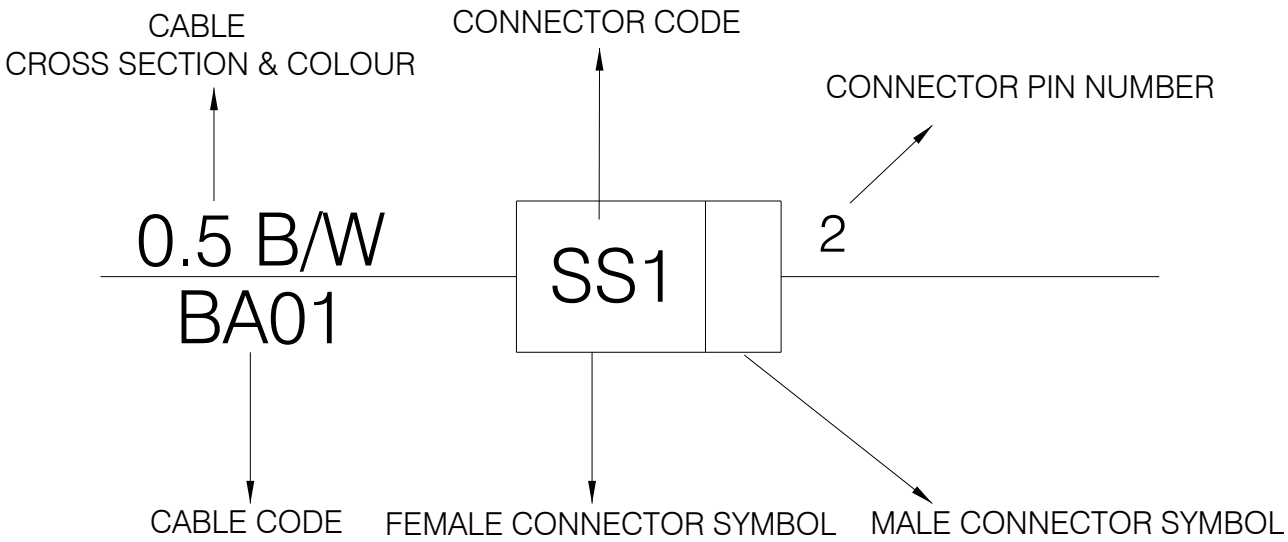
CABLE CODE	COLOR CODE MEANING
B	BLACK
W	WHITE
R	RED
G	GREEN
Y	YELLOW
L	BLUE
O	ORANGE
BR	BROWN
V	VIOLET
LG	LIGHT GREEN
GY	GREY
P	PINK
SB	SKY BLUE
PU	PURPLE
DG	DARK GREEN



FEMALE CONNECTOR



MALE CONNECTOR



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ANADOLU ISUZU OTOMOTIV SANAYI VE TICARET A.S.

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SAYFA NO / SHEET NO: X

CITIPORT E6
XXXX XXXXX

CIRCUIT DIAGRAM NAME

VEHICLE MODEL

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CITIPORT E6
CIRCUIT DIAGRAM SYMBOLS

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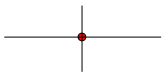
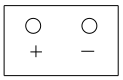
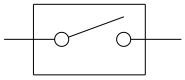
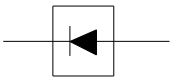
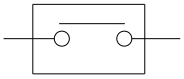
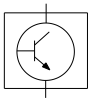
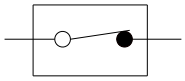
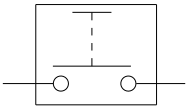
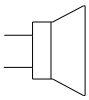
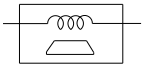
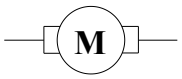
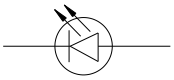
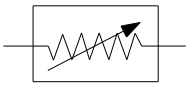
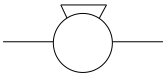
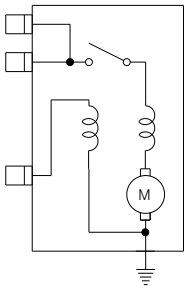
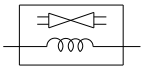
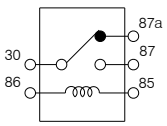
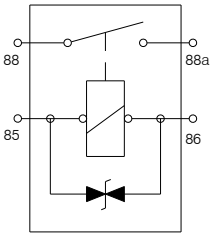
SYMBOL	EXPLANATION	SYMBOL	EXPLANATION
	FUSE		CABLE SPLICE POINT
	DELAYED FUSE		BATTERY
	SWITCH (Normal Open)		DIODE
	SWITCH		ELECTRONIC PART
	SWITCH (Normal Close)		RESISTANCE
	CIRCUIT BRAKER		SPEAKER
	LAMP		SOUND WARNING
	DOUBLE FILAMENT LAMP		CONNECTOR
	MOTOR		LED
	RHEOSTAT		CAPACITOR
	INDUCTOR,SELENOID, MAGNETİC VALVE		HORN
	STARTER MOTOR		SELENOID
	RELAY		MAIN RELAY

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SAYFA NO / SHEET NO: 4

CITIPORT E6
CONNECTOR LAY-OUT

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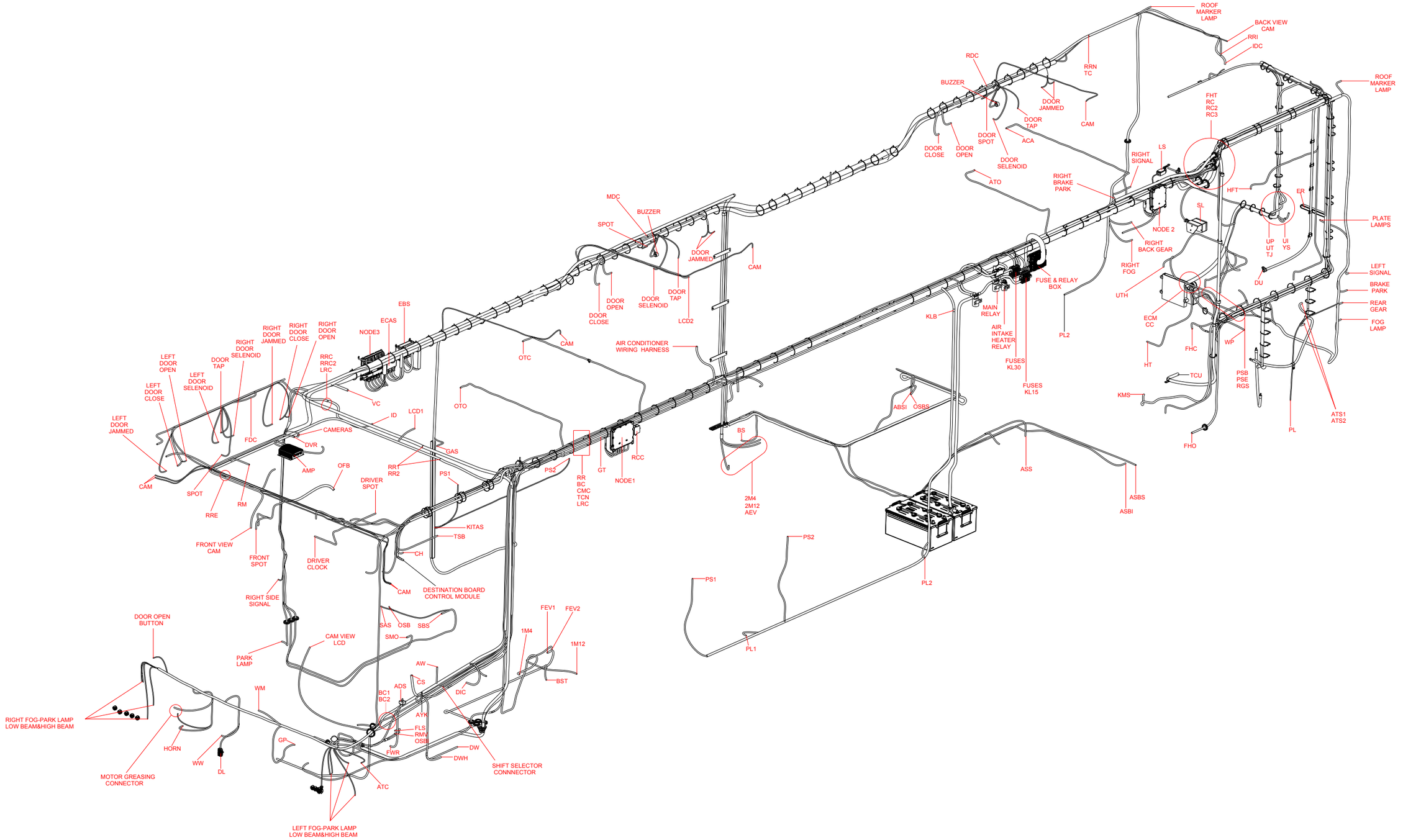

2M12	AXLE MODULATOR 2M 12 PINS
2M4	AXLE MODULATOR 2M 4 PINS
ABSI	REAR LEFT LINING WARNING
AC	AMPHI CONTROL
ACA	REAR WINDOW OF REAR ROOF
ACC	AIR CONDITIONER CONNECTOR
ADH	AIR DRYER HEATER
ADS	EMERGENCY SWITCH
AEV	REAR ECAS VALVE
AFC	AIR FILTER WARNING CONNECTION
AKU	AMPHI CONTROL UNIT
AMP	AMPHI
ASBI	REAR RIGHT LINING WARNING
ASBS	REAR RIGHT PRESSURE SENSOR
ASS	REAR RIGHT SENSOR
ATC	AMBIENT AIR TEMP. CONNECTOR
ATO	FRONT WINDOW OF REAR ROOF
ATS1	ALTERNATOR CONNECTOR-1
ATS2	ALTERNATOR CONNECTOR-2
AW	AUTOMATIC WINDOW CONTROL
AYK	MIRROR CONTROL
BC	BODY CONNECTOR
BC1	BODY CONNECTOR-1
BC2	BODY CONNECTOR-2
BE	TICKET MATIC(READER) SUPPLY
BEG	TICKET MATIC SUPPLY INPUT
BM	PRESSURE SENSOR
BS	BRAKE SENSOR
BST	BRAKE SIGNAL TRANSMITTER
BX1	EBS CONNECTOR X1
CC	14 PIN CROSSOVER CONNECTION
CCC	REAR CONTROL CONNECTION CONN.
CEA	CAN ECM AREA CONNECTOR
CEC	CAN ECM CONNECTOR
CH	AIR CONDITIONER-HEATER CONTROL
CLC	COOLANT LEVEL CONNECTOR
CMC	CAN MUX CONNECTOR
CMI	CAN MUX CONNECTOR INPUT
CMI1	CAN MUX CONNECTOR INPUT-1
CMO	CAN MUX CONNECTOR OUTPUT
CMO2	CAN MUX CONNECTOR OUTPUT-2
CP	CAN POWER CONNECTOR
CP1	CAN POWER CONNECTOR-1
CP2	CAN POWER CONNECTOR-2
CPD	CAN POWER DISTRIBUTION
CS	LIGHTER
CTS	CAN ROOF CONNECTOR
CX1	ECAS CONNECTOR X1
DCR	DRIVER RIGHT CURTAIN
DF	DOOR AIR FINISHED SENSOR
DIC	DIAGNOSTIC CONNECTOR
DJ1	FRON DOOR IS JAMMED-1
DJ2	FRONT DOOR IS JAMMED-2
DL	DAYTIME RUNNING LIGHTS MODULAT.
DOP	DOOR OPENER BUTTON
DR	DISABLED RAMP
DRR	DRIVER REGION
DS	DRIVER SPOT
DS2	DRIVER SPOT-2
DU	DOSING UNIT
DVR	DVR SUPPLY
DW	DRIVER WINDOW CONNECTOR
DWH	DRIVER WINDOW HEATER
EB	DISABLED BUTTON
EF	ECM FINISHER
EFI	HAND BRAKE WARNING SENSOR
EGS	EGP CONNECTOR
EPS	EGP FINISHER
ER	ENGINE ROOM LIGHT
ER1	ENGINE ROOM-1
ER2	ENGINE ROOM-2
ER3	ENGINE ROOM-3
ES	EXHAUST SYSYTEM CONTROL
EX2	ECAS ECU X2 CONNECTOR
EX3	ECAS ECU X3 CONNECTOR
FC1	FRONT CONNECTOR-1
FC2	FRONT CONNECTOR-2
FD1	FRONT DOOR CLOSE-1
FD2	FRONT DOOR CLOSE-2
FDC	FRONT DOOR CONNECTOR
FEV1	FRONT ECAS VALVE-1
FEV2	FRONT ECAS VALVE-2
FHC	FRONT HEATER CONNECTION
FHL	FRONT HEATER CONTROL
FHN	FRONT HEATER CONNECTION
FHO	FRONT HEATER CONNECTOR

FHR	FRONT HEATER ROOF
FHT	FRONT HEATER TAIL CONNECTOR
FLS	FRONT LEFT SENSOR
FR	FRONT ROUTE INFO DISPLAY
FR2	FRONT ROUTE INFO DISPLAY-2
FRC	FRONT ROOF CONNECTION
FRO	FRONT ROOF COMMISSURE
FS1	FRONT DOOR SELENOID-1
FS2	FRONT DOOR SELENOID-2
FW	FIRE WARNING
FWR	FIXED WINDOW HEATER
GAS	GAS PEDAL (RIGHT ROOF HARNESS)
GCC	GEAR CAN CONNECTION
GL	GEAR LUGGAGE CONNECTOR
GP	GAS PEDAL (BODY HARNESS)
GT	GRESSING TIMER
HFT	HYDRAULIC FAN DRIVE
HR1	HORN-1
HR2	HORN-2
HT	HEATER
HV	HZ VALVE
ID	INFO DISPLAY
IDC	INFO DISPLAY CONNECTOR
KA1	FRONT DOOR OPEN-1
KA2	FRONT DOOR OPEN-2
KAY	FRONT DOOR LIGHTING
KLB	HEATER CONNECTION
KMS	KM SENSOR CONNECTOR
KX1	CONTROL MODUL X1
KX2	CONTROL MODUL X2
KX3	CONTROL MODUL X3
LC	LEFT ROOM COMMISSURE
LC2	LEFT ROOM COMMISSURE-2
LCD	LCD SUPPLY
LCD1	LCD-1 SUPPLY
LCD2	LCD-2 SUPPLY
LCDA	LCD ON/OFF CONTROL
LDC	LEFT DRIVER CURTAIN
LIS	LIGHTING CONNECTOR
LM	LEFT MIRROR
LRC	LEFT ROOF CONNECTOR
LRC1	LEFT ROOF CONNECTION-1
LRC2	LEFT ROOF CONNECTION-2

LRO	LEFT ROOF COMMISSURE
LS	LUGGAGE SWITCH
LSS	LEFT SIDE SIGNAL
MK	MK VALVE
MRC	MIDDLE DOOR CONNECTION
N101	NODE 1 CN101
N102	NODE1 CN102
N103	NODE1 CN103
N104	NODE1 CN104
N105	NODE1 CN105
N106	NODE1 CN106
N2C1	NODE2 CN1
N2C2	NODE2 CN2
N2C3	NODE2 CN3
N301	NODE3 CN101
N302	NODE3 CN102
N303	NODE3 CN103
N304	NODE3 CN104
N305	NODE3 CN105
N306	NODE3 CN106
OC	OIL COMPLETION
OEC	OEM ECM 96-PIN CONNECTOR
OFB	FRONT BRAKE PRESSURE SENSOR
OKS	FRONT HEATER CONNECTOR
OSB	FRONT RIGHT LINING WARNING
OSBI	FRONT LEFT LINING WARNING
OSBS	REAR LEFT PRESSURE SENSOR
OT	OUTSIDE TEMPERATURE SENSOR
OTC	REAR OF FRONT ROOF GLASS
OTO	FRONT OF FRONT ROOF GLASS
PC	PARK CONNECTOR
PCN1	PODIUM CN1
PCN2	PODIUM CN2
PCN3	PODIUM CN3
PCN4	PODIUM CN4
PCN6	PODIUM CN6
PCN7	PODIUM CN7
PL1	PARK LAMP-1
PL2	PARK LAMP-2
PL3	PARK LAMP-3
PS1	PRIORITY STOP-1
PS2	PRIORITY STOP-2
PSB	PARK SENSOR BUZZER

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CITIPORT E6
CONNECTORS CODES-3

ISUZU ACADEMY TECH CENTER

PSE	PARK SENSOR SUPPLY
RA	RADIO A CONNECTOR
RB	RADIO B CONNECTOR
RBP	REAR BRAKE SENSOR PRESSURE
RC	ROOF CONNECTOR
RC2	ROOF CONNECTOR-2
RCC	REMOTE CONTROL CONNECTION
RDC	REAR DOOR CONNECTION
REC	RESISTANCE CONNECTOR
RGS	REVERSE GEAR ALERT SOUND
RIC	ROUTE INFO DISPLAY CONNECTION
RID	ROUTE INFO DISPLAY CONTROL
RM	RIGHT MIRROR
RMV	RIGHT ABS MODULATOR VALVE
RN	ROOF CONNECTOR
RR	RIGHT ROOF CONNECTOR
RR1	RIGHT ROOF CONNECTION-1
RR2	RIGHT ROOF CONNECTION-2
RRC	RIGHT ROOF CONNECTION
RRC2	RIGHT ROOF CONNECTION-2
RRE	RIGHT ROOF CONNECTION
RRI	REAR ROUTE INFO DISPLAY
RRN	RIGHT ROOF CONNECTION
RRO	RIGHT ROOF CONNECTION
S1	SENSOR-1
S2	SENSOR-2
SAS	FRONT RIGHT SENSOR
SBS	FRONT RIGHT PRESSURE SENSOR
SID	STOP INFO DISPLAY
SL	STARTER
SLV	STEERING LOCK VALVE
SMI	STARTER MOTOR IMS CONNECTION
SMO	RIGHT ABS MODULATOR VALVE
SPK	SPEAKER
SS	SELENOID
ST1	PCB AIR CONDITIONER CONN. ST1
ST2	CONNECTION CONNECTOR ST2
ST21	FRONT PANEL CONNECTION ST21
ST4	PCB HEATER CONNECTOR ST4
ST5	FRONT PANEL CONNECTION ST5
TAC	TAP CONNECTOR
TC	TAIL CONNECTION
TCN	TAKO CAN

TE	TACHOGRAPH SUPPLY CONNECTOR
TJ	TBAP JUMPER
TLC	TAIL CONNECTOR
TPC	TAKO POWER CAN
RC3	ROOF CONNECTOR-3
TSB	TACHOGRAPH CONNECTOR-B
TSE	TBAP SENSOR
TW	TREE WAY VALVE
UG	UP GABARI
UI	UREA LINE HEATER (INTAKE)
UP	UREA LINE HEATER (PRESSURE)
UR	UREA LINE HEATER (RETURN)
UTH	UREA TANK HEATER VALFE
UTT	UREA TANK TEMPERATURE LEVEL
UTV	UREA TANK VDC INPUT
VC	VENTILATION CONNECTION
VO	VALVE CONTROL
WM	WIPER MOTOR CONNECTION
WP	WATER PUMP
WPS	NODE3 CN106
WS	WATER PUMP SENSOR-1
WW	WIPER WATER PUMP CONNECTOR
X2	EBS ECU X2 CONNECTOR
X4	EBS ECU X4 CONNECTOR
X5	EBS ECU X5 CONNECTOR
YS	OIL LEVEL
YS1	FIRE SENSOR-1
YS2	FIRE SENSOR-2
YS3	FIRE SENSOR-3
YS4	FIRE SENSOR-4
RC3	ROOF CONNECTOR-3
LRC3	LEFT ROOF CONNECTION-1
TCU	TRANSMISSION CONTROL UNIT

ANADOLU ISUZU
ANADOLU ISUZU OTOMOTIV SANAYI VE TICARET A.S.

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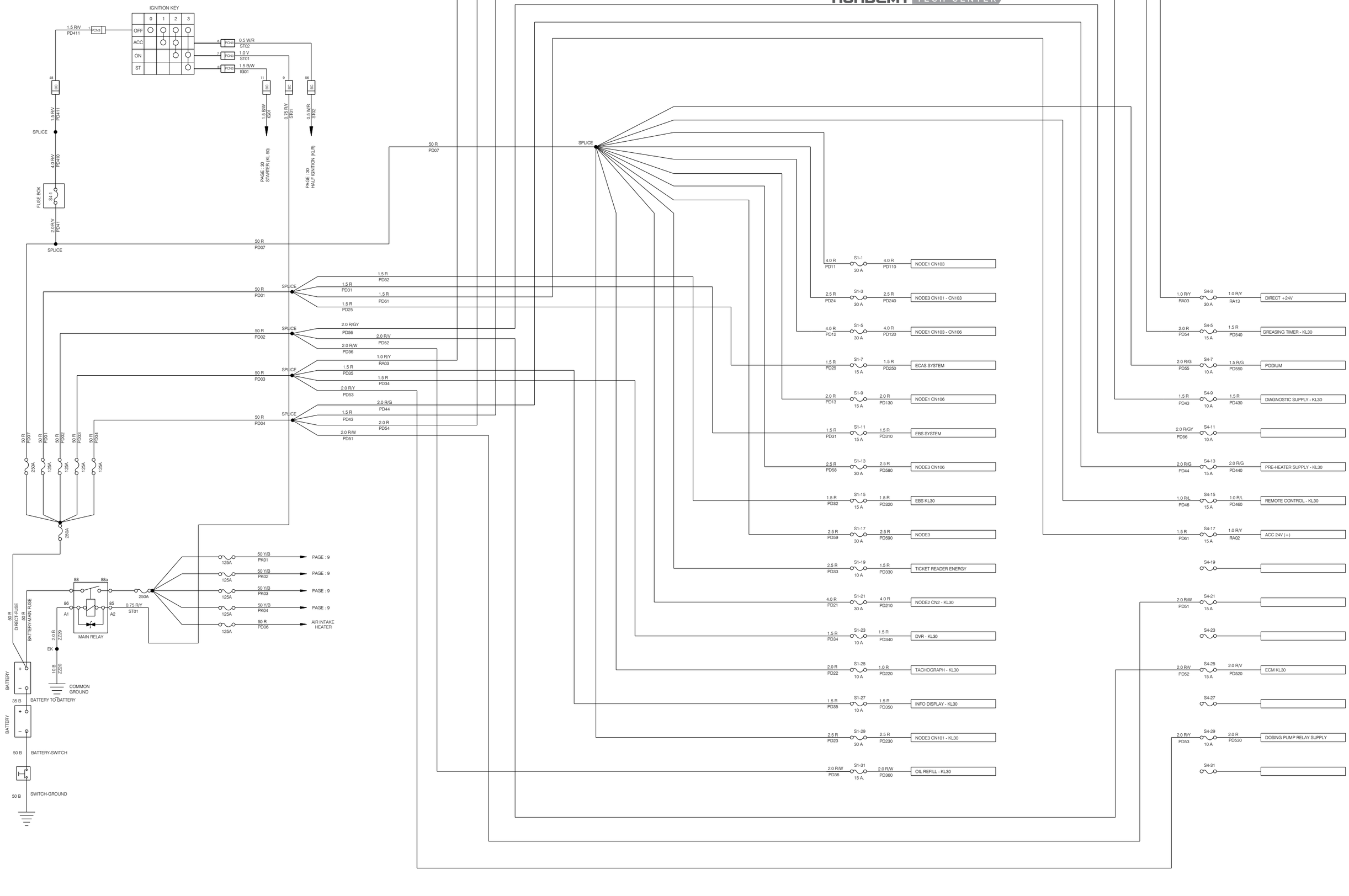
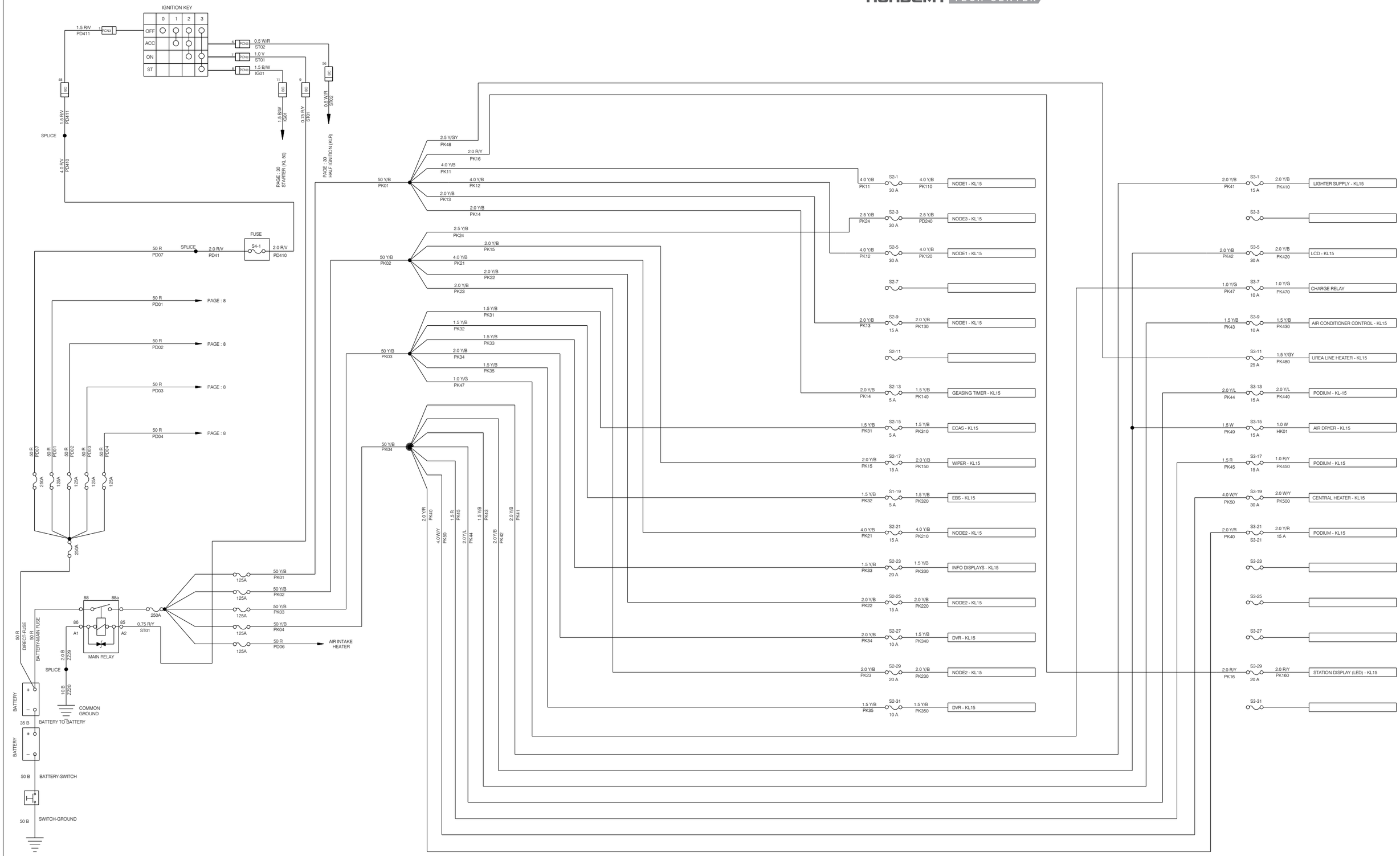
SAYFA NO / SHEET NO: 8

CITIPORT E6
FUSE SYSTEM - 1



BU BELGE ANADOLU ISUZU OTOMOTIV SANAYI VE TIC. AS. NIN YAZILI IZNI OLMADAN HICBIR SEKILDE KOPYALANAMAZ.THIS DOCUMENT CAN NOT BE REPRODUCED WITHOUT WRITTEN PERMISSION OF ANADOLU ISUZU OTOMOTIV SANAYI VE TIC. AS.

CITIPORT E6
FUSE SYSTEM - 2



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ANADOLU ISUZU
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SAYFA NO / SHEET NO: 10

CITIPORT E6
NODE1 SYSTEM

ISUZU ACADEMY TECH CENTER

IGNITION KEY
0 1 2 3
OFF
ACC
ON
ST

1.5 R/V PD411 — 1 CN3
0.5 W/R ST02 — 6 CN3
1.0 V ST01 — 7 CN3
1.5 B/W IG01 — 8 CN3

48 IEC — 1.5 R/V PD411 — SPLICE — 4.0 R/V PD410
11 IEC — 1.5 B/W IG01 — PAGE : 30 STARTER (KL 50)
9 IEC — 0.75 R/Y ST01
56 IEC — 0.5 W/R ST02 — PAGE : 30 HALF IGNITION (KL R)

FUSE BOX
S4-1 — 2.0 R/V PD41
S1-5 — 4.0 R PD12
S1-9 — 2.0 R PD13
S1-1 — 4.0 R PD11
S4-15 — 1.0 R/L PD46
4.0 R PD110
4.0 R PD120
2.0 R PD130
4.0 R/V PD410

50 R PD07 — SPLICE
50 R PD01
50 R PD02
50 R PD03
50 R PD04

50 R PD07 — 250A
50 R PD01 — 125A
50 R PD02 — 125A
50 R PD03 — 125A
50 R PD04 — 125A
250A

FUSE BOX
S2-5 — 4.0 Y/B PK12
S2-1 — 4.0 Y/B PK11
S2-9 — 2.0 Y/B PK13
4.0 Y/B PK120
4.0 Y/B PK110
2.0 Y/B PK130

50 Y/B PK01 — 125A — SPLICE
50 Y/B PK02 — 125A
50 Y/B PK03 — 125A
50 Y/B PK04 — 125A
50 R PD06 — 125A — AIR INTAKE HEATER

88 — 88a — 250A — 0.75 R/Y ST01
86 — A1 — MAIN RELAY — A2 — 85
50 R DIRECT FUSE
50 R BATTERY-MAIN FUSE
2.0 B ZZ29 — SPLICE — 10 B ZZ20 — COMMON GROUND
BATTERY — BATTERY TO BATTERY — 35 B
BATTERY — 50 B BATTERY-SWITCH
50 B SWITCH-GROUND

4.0 R PD120 — 6P IEC — 2.0 R PD122
4.0 Y/B PK120 — SPLICE — 2.0 Y/B PK122
4.0 Y/B PK110 — SPLICE
4.0 R PD110 — SPLICE

REMOTE CONTROL
1 — 1.0 R/L PD460
3 — 0.75 L/R NK01
2 — 1.0 B Z208

FRONT BRAKE PRESSURE SENSOR
1 — 1.0 R/L PK303
3 — 0.5 P/GY BA02
2 — 1.0 B Z301

STEERING WHEEL LOCK
1 — 0.5 GY/L SL01
2 — 1.0 B Z205

26 IEC — 1.0 R/L PK304 — 1.0 Y/B PK103 — SPLICE
PAGE : 12 NODE3 CN102 / 13

PAGE : 20 AUTOMATIC WINDOW HEATER REMOTE CONTROL SIGNAL — 2.0 R PD111 — 1.5 B/G WH01 — 0.75 L/R NK01
PAGE : 31 FRONT INFO DISPLAY — 2.0 R PD112 — 1.0 G/B DB01
FRONT OF FRONT SUNROOF (-) — 2.0 Y/B PK121 — 1.0 G/B CW02
PAGE : 23 MIDDLE HEATER LEVEL 1 — 1.5 G/Y JA01 — 1.0 GY/W KL01
PAGE : 23 MIDDLE HEATER LEVEL 2 — 2.0 R PD121 — 1.0 GY/B KL02
PAGE : 15 DAYTIME RUNNING LIGHT — 2.0 B ZZ03 — 0.5 W GF01
STOP INFO - FRONT — 2.0 B ZZ04 — 1.0 G/R DB02
PAGE : 32 GREEN WARNING LAMP — 1.0 Y GR101 — 2.0 B ZZ02
PAGE : 19 WIPER PARK LIGHT — 0.75 Y/W WP02
PAGE : 32 RED WARNING LAMP — 1.0 G GR001 — 0.75 L/BR KO01
PAGE : 22 PCB AIR CONDITIONER GND ST1 / 6
PAGE : 15 RIGHT FOG LAMP — 2.0 R PD122 — 1.5 G/O SF01
PAGE : 16 PARKING LIGHTS — 2.5 R/W PF06
PAGE : 15 LEFT FOG LAMP — 1.5 G/W SF02
DISABLED STOP BUTTON — 0.5 B/GY BA02 — 0.75 L/Y EB01
PAGE : 22 AIR CONDITIONING WORKED INFORMATION — 0.75 W/L AC01 — 0.75 GY/L SL01
PAGE : 19 MOTOR OF WINDSHIELD WIPERS WATER — 2.0 Y/B PK122 — 0.75 G/BR WP01 — 2.0 B ZZ06 — 2.0 Y/B PK130
REAR OF FRONT SUNROOF (+) — 2.0 B ZZ07 — 1.0 LG/R CW03
DRIVER SPOT 1 — 1.0 W/L LD01

27 IEC

CN101 — 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21
CN106 — 1 2 3 4 5 6
CN105 — 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21

NODE1

CN103 — 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
CN104 — 1 2 3 4 5 6 7 8 9 10 11 12
CN102 — 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18

22 IEC — 1.5 G HR01 — 1.5 GY HR01 — 1.5 G/W JA02 — 1.5 R/O KF01 — 0.5 LG/R T01 — 1.5 R/W KF02 — 1.0 B/R AY01
6 IEC — 1.0 GY HR01
PAGE : 16 LEFT FRONT SIGNAL LAMP
PAGE : 16 RIGHT FRONT SIGNAL LAMP
PAGE : 15 RIGHT DIPPED BEAM
ENGINE TEMPERATURE WARNING
PAGE : 15 LEFT DIPPED BEAM
PAGE : 21 MIRROR HEATER

1.5 R/W WP03 — PAGE : 19 WIPER HIGH SPEED
1.0 R PD570 — PAGE : 24 PRE HEATER CONTROL
1.0 G/R CW01 — FRONT OF FRONT ROOF GLASS (+)
0.5 GR NZ01 — PAGE : 14 REAR DOOR TAP (-)
1.5 O/R UF01 — PAGE : 15 RIGHT HIGH BEAM
1.0 O/W WP04 — PAGE : 19 WIPER LOW SPEED

0.75 R/Y ST11 — PAGE : 13 ECM
0.5 G CL01 — PAGE : 26 MUX CAN LOW
0.5 Y CH01 — PAGE : 26 MUX CAN HIGH
2.0 B ZZ05
0.5 G CU02 — PAGE : 26 MUX CAN LOW
0.5 Y CH02 — PAGE : 26 MUX CAN HIGH
0.75 B AR02 — ADRESS DISPLAY

51 IEC — 0.5 W/B WK01 — DOOR OPEN BUTTON
12 IEC — 1.5 W/R UF02 — PAGE : 15 LEFT HIGH BEAM
1.0 LG/B CW04 — REAR OF FRONT SUNROOF(-)
0.75 B AR01 — ADRESS DISPLAY
0.5 B ZZ06

SPLICE — 1.0 GY HR02 — HORN 1
SPLICE — 1.0 GY HR03 — HORN 2

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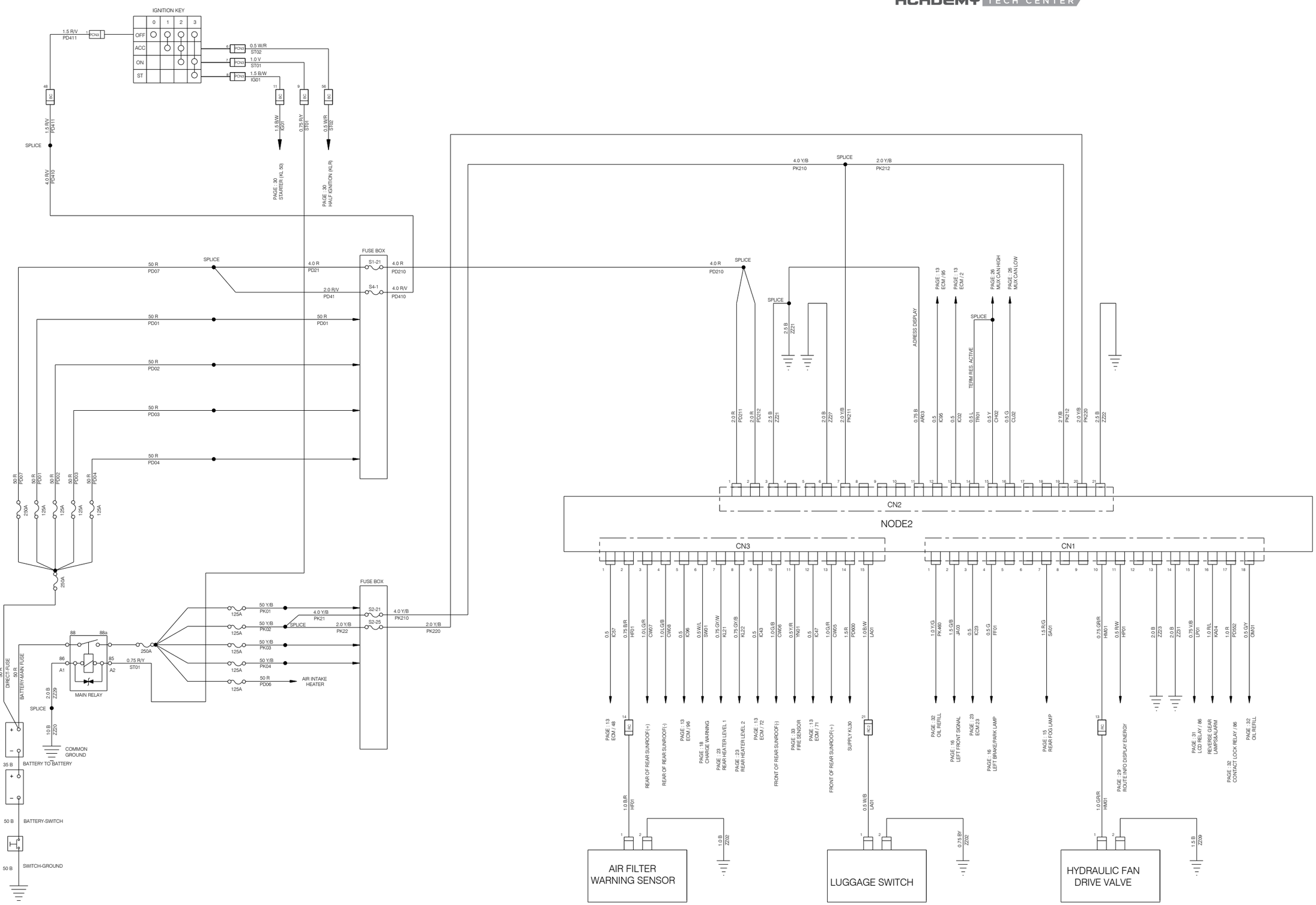
SAYFA NO / SHEET NO: 11

CITIPORT E6
NODE2 SYSTEM

ISUZU ACADEMY TECH CENTER



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SAYFA NO / SHEET NO: 12

CITIPORT E6
NODE-3

REAR BRAKE PRESSURE SENSOR

PARKING BRAKE ALARM SENSOR

IGNITION KEY

FUSE BOX

MAIN RELAY

BATTERY

BATTERY TO BATTERY

COMMON GROUND

BATTERY-SWITCH

SWITCH-GROUND

AIR INTAKE HEATER

FUEL LEVEL SENSOR

CN101 CN106 CN105 CN103 CN104 CN102

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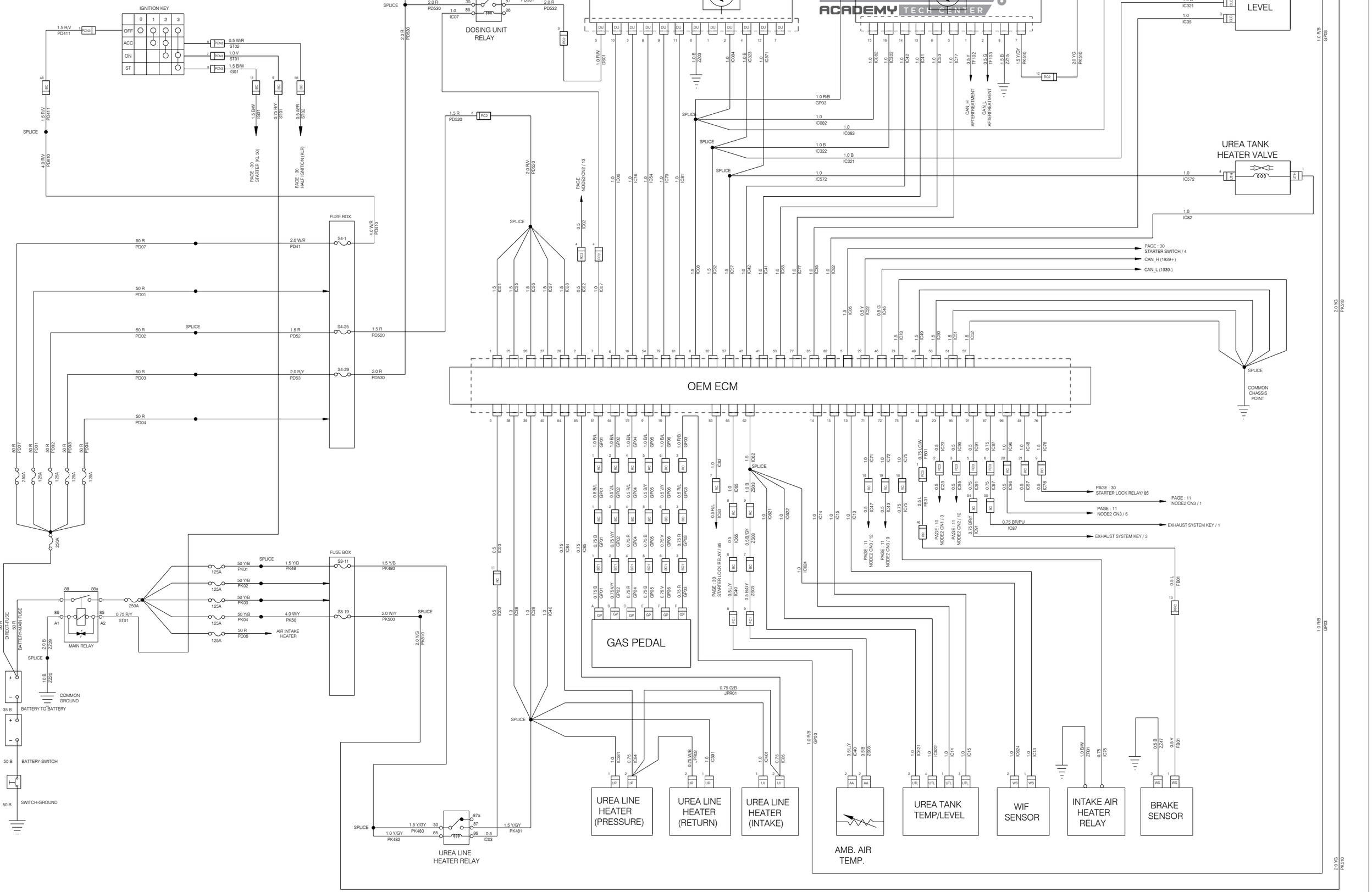
SAYFA NO / SHEET NO: 13

CITIPORT E6
ECM SYSTEM



BU BELGE ANADOLU ISUZU OTOMOTIV SANAYI VE TIC. AS. NIN YAZILI IZNI OLMADAN HICBIR SEKILDE KOPYALANAMAZ.THIS DOCUMENT CAN NOT BE REPRODUCED WITHOUT WRITTEN PERMISSION OF ANADOLU ISUZU OTOMOTIV SANAYI VE TIC. AS.

ANADOLU ISUZU
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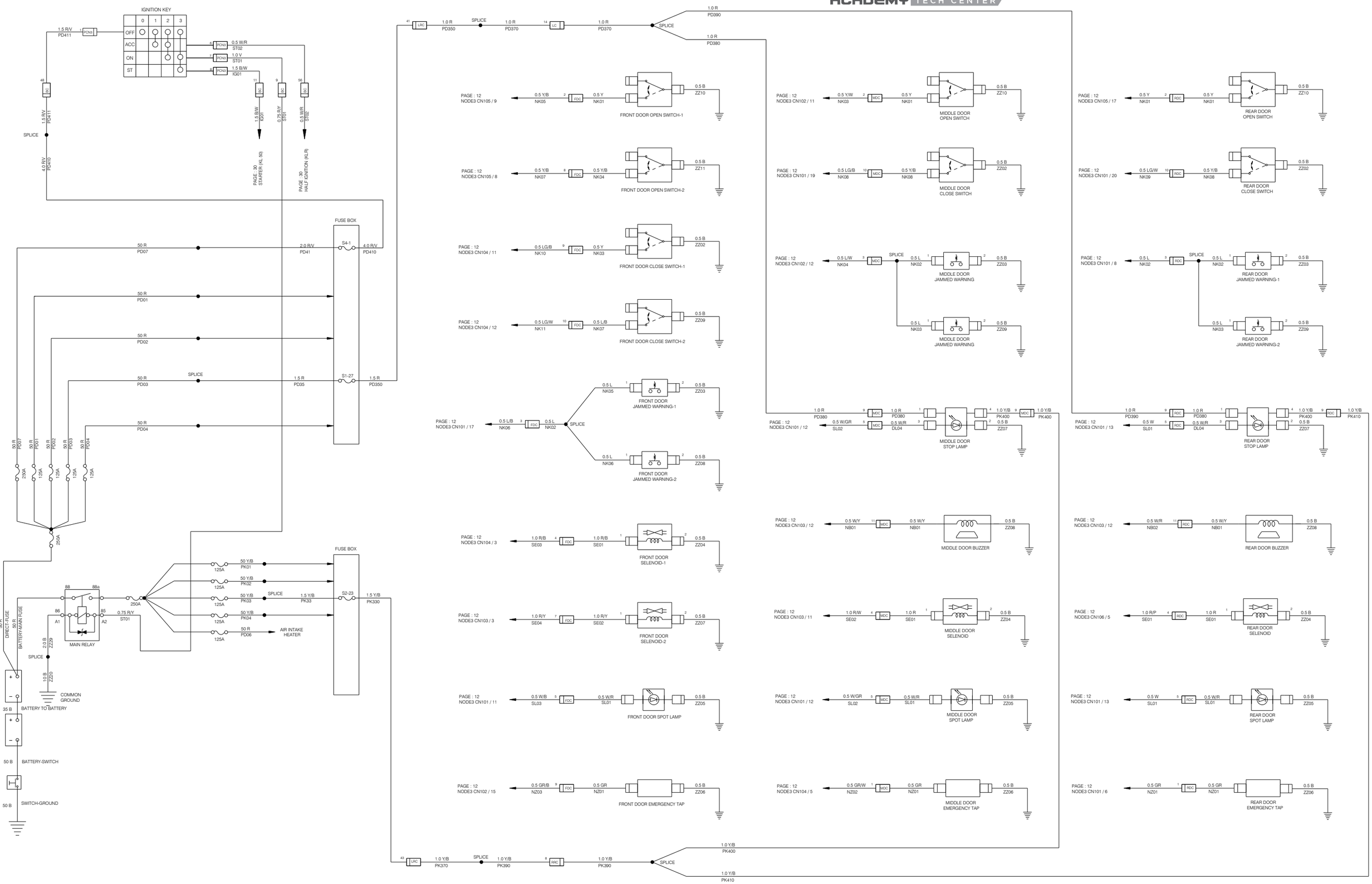
SAYFA NO / SHEET NO: 14

CITIPORT E6
DOOR CONTROL



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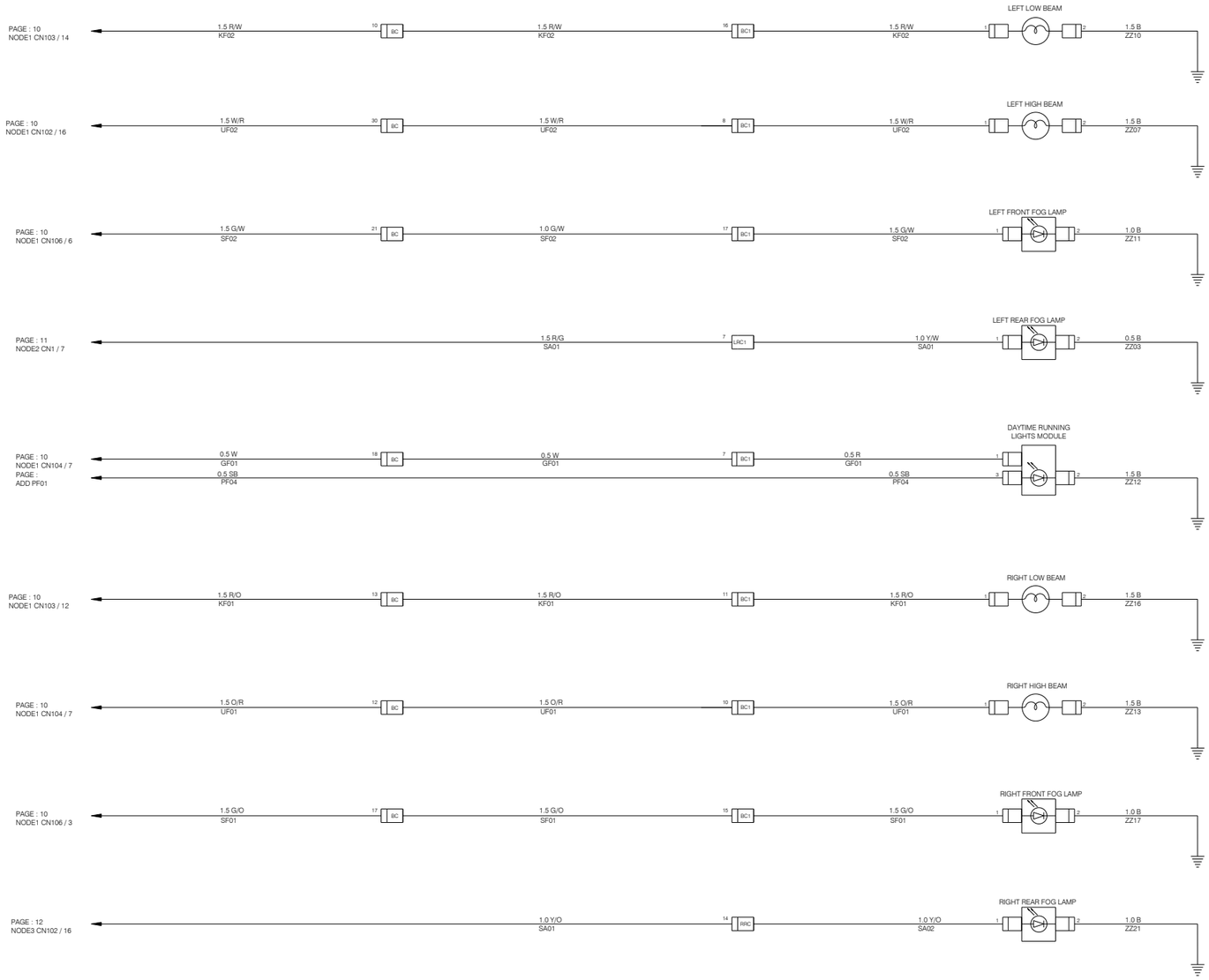
CITIPORT E6
HEADLIGHTS & FOG SYSTEM



BU BELGE ANADOLU ISUZU OTOMOTIV SANAYI VE TIC. AS. NIN YAZILI IZNI OLMADAN HICBIR SEKILDE KOPYALANAMAZ.THIS DOCUMENT CAN NOT BE REPRODUCED WITHOUT WRITTEN PERMISSION OF ANADOLU ISUZU OTOMOTIV SANAYI VE TIC. AS.

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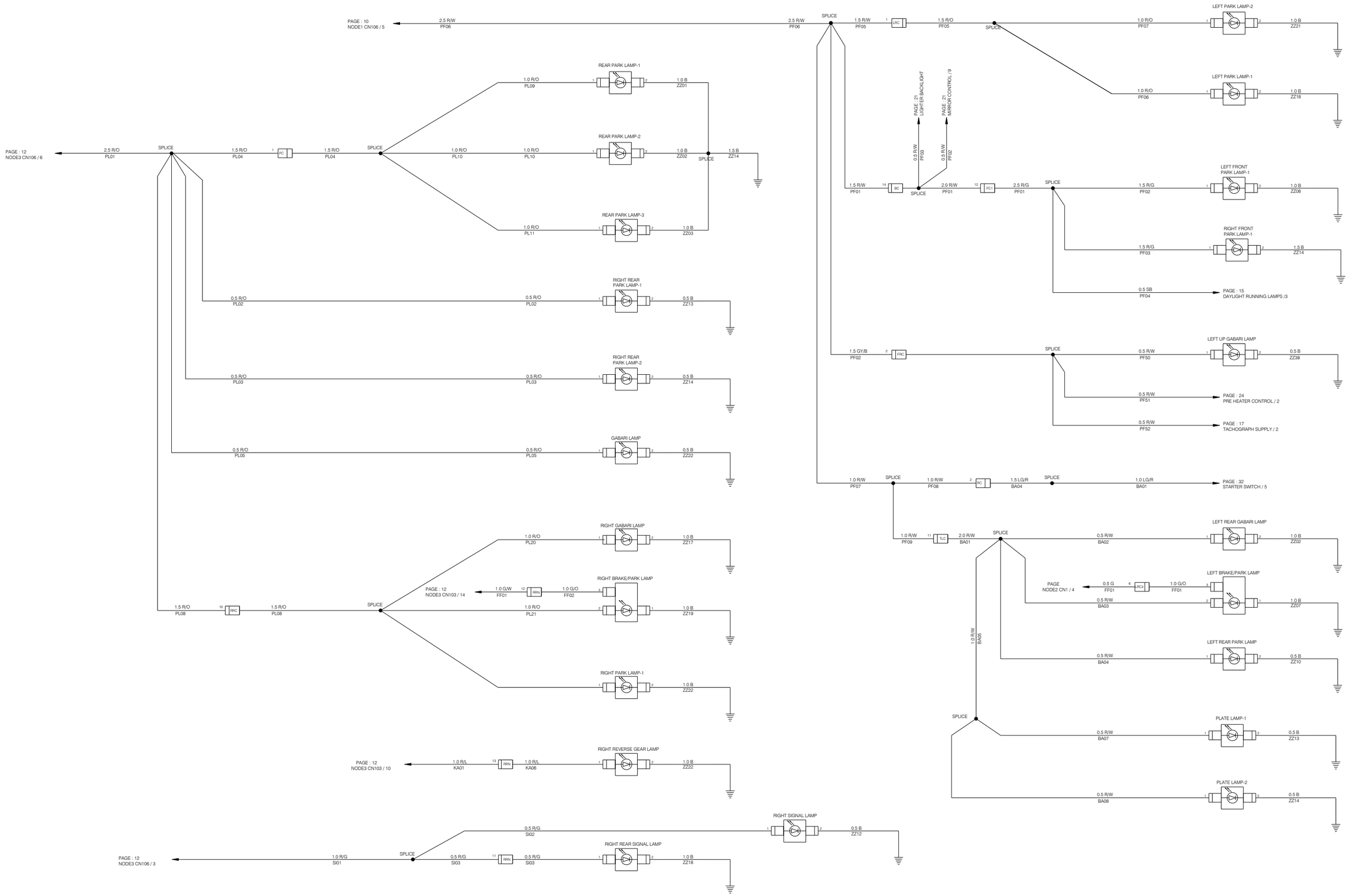
SAYFA NO / SHEET NO: 16

CITIPORT E6
PARKING LIGHTS

ISUZU ACADEMY TECH CENTER



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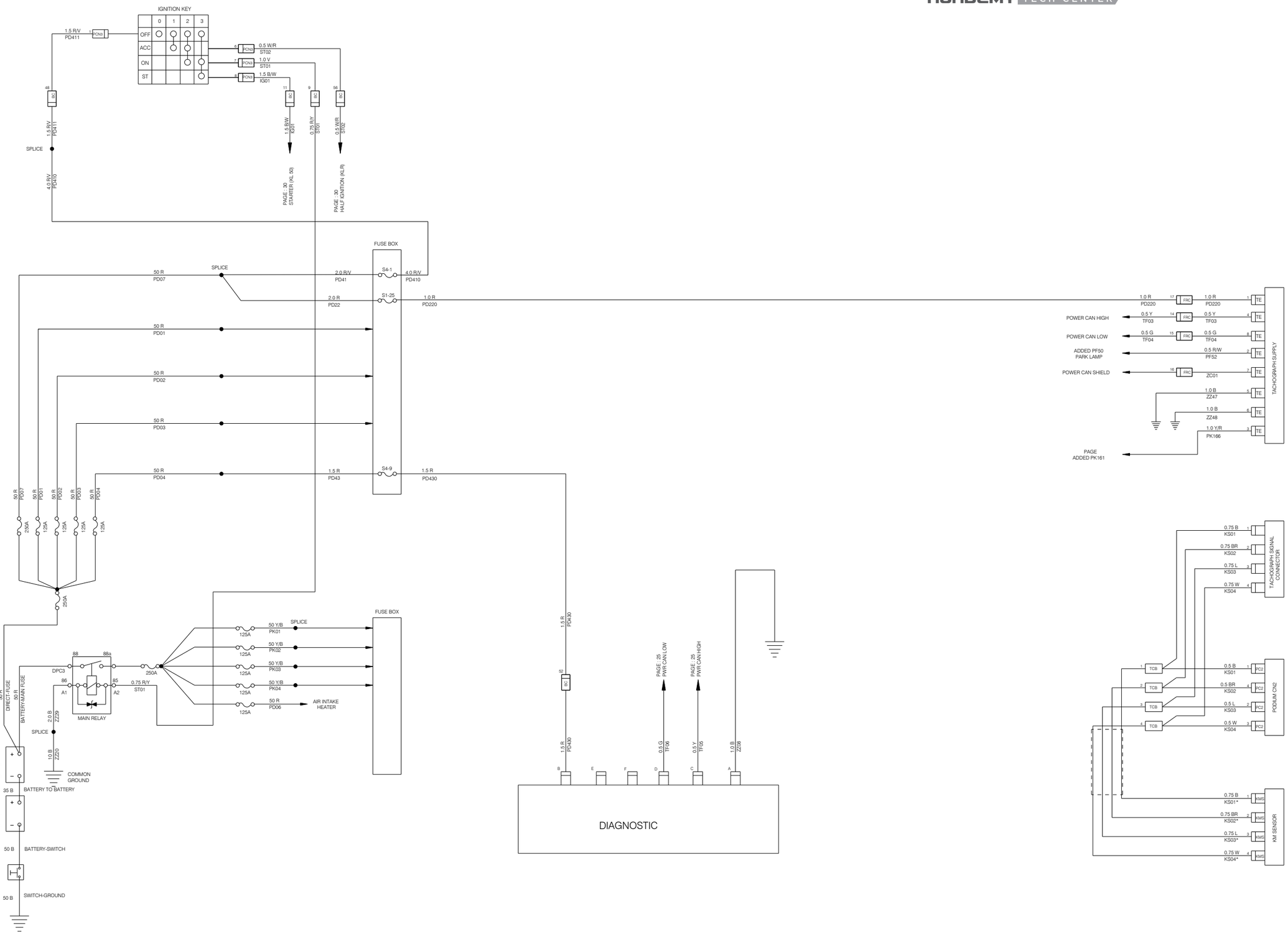
SAYFA NO / SHEET NO: 17

CITIPORT E6
TACHOGRAPH & DIAGNOSTIC

ISUZU ACADEMY TECH CENTER



*DESCRIPTION : IF VEHICLE HAS TACHOGRAPH, *MARKED CABLES GO TO TACHOGRAPH. OTHERWISE, * MARKED CABLES GO TO PODIUM.

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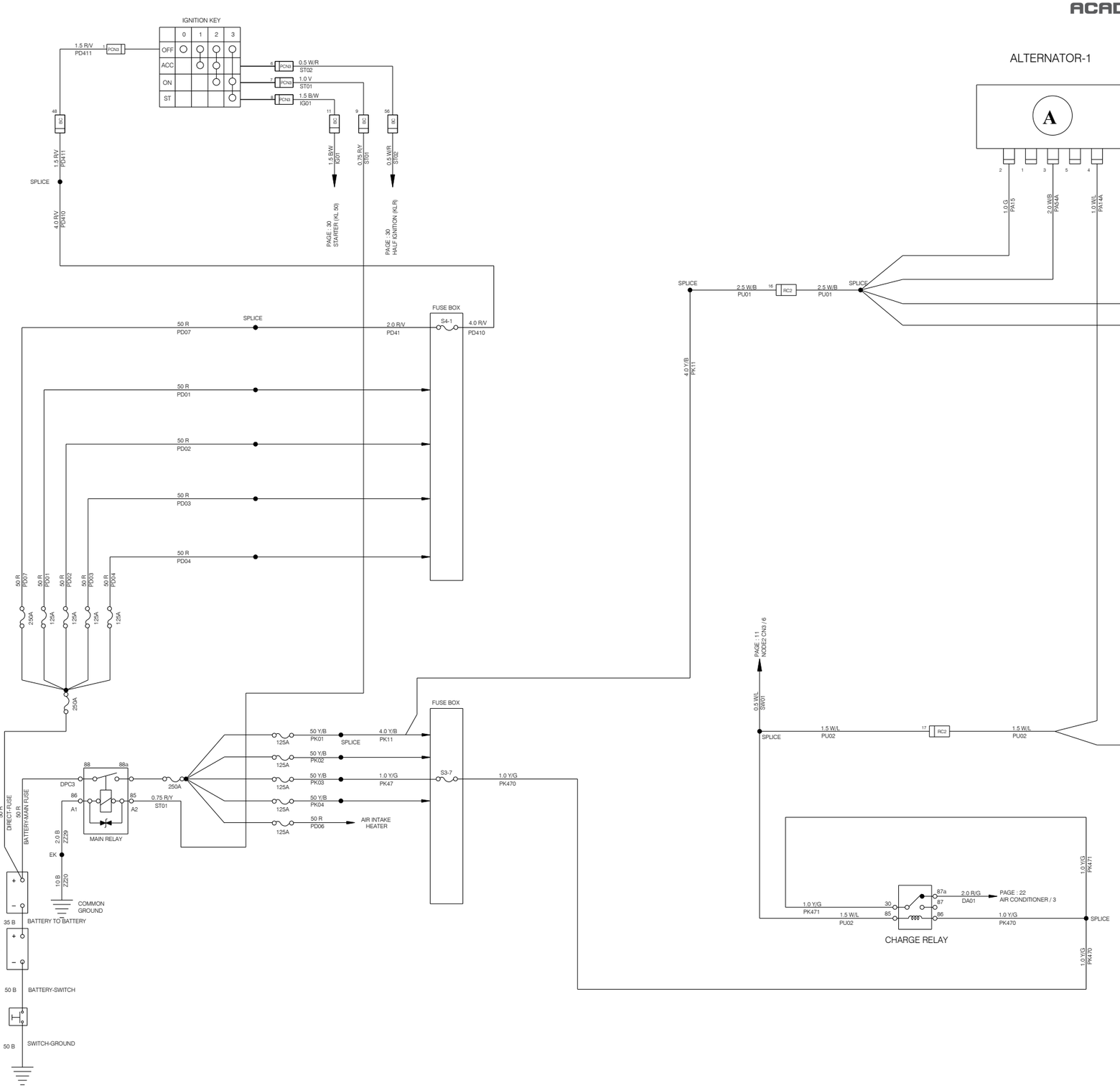
ANADOLU ISUZU
ANADOLU ISUZU OTOMOTIV SANAYI VE TICARET A.S.

SAYFA NO / SHEET NO: 18

CITIPORT E6
CHARGE SYSTEM

ISUZU ACADEMY TECH CENTER



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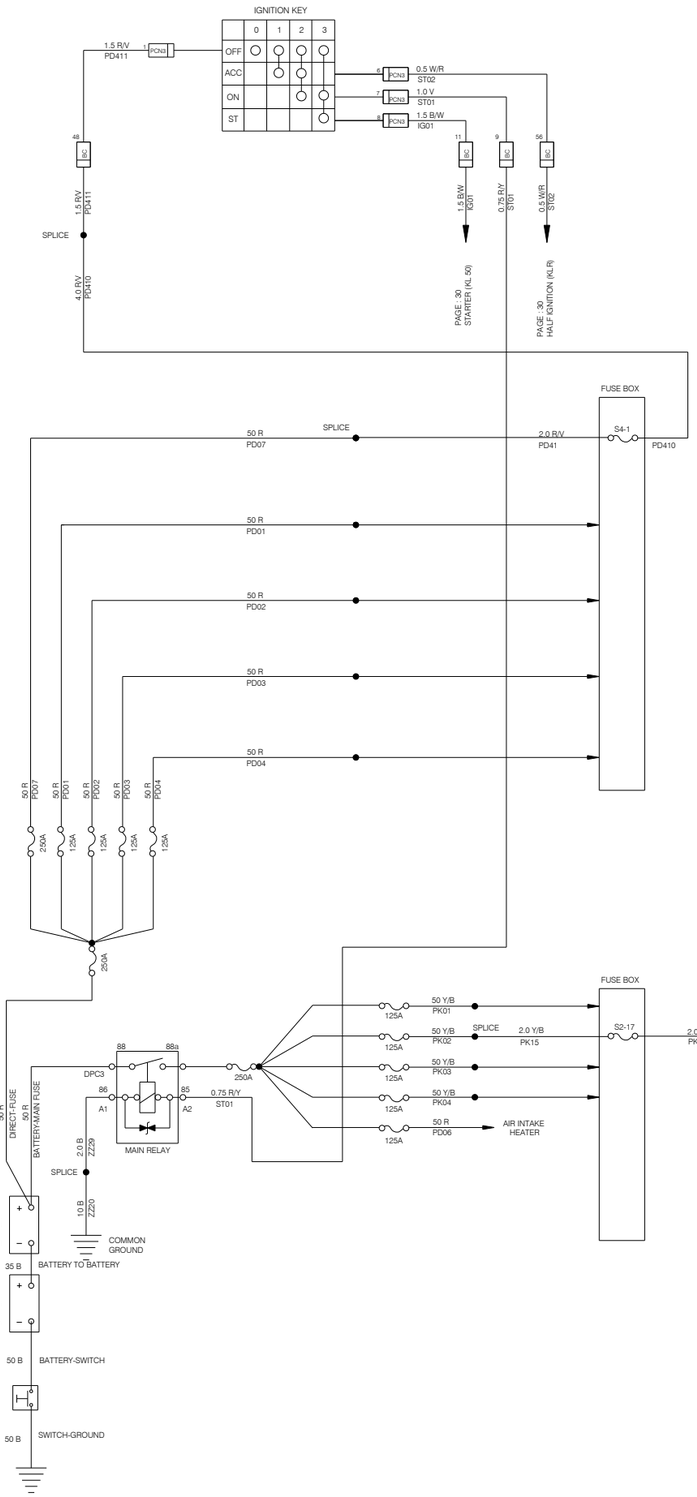
CITIPORT E6
WIPER SYSTEM



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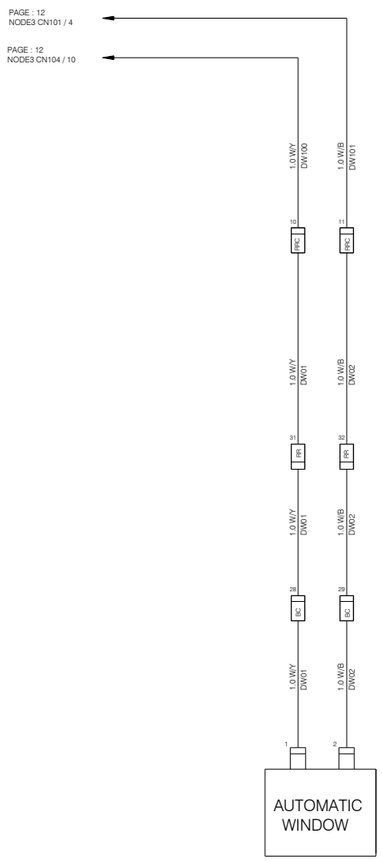
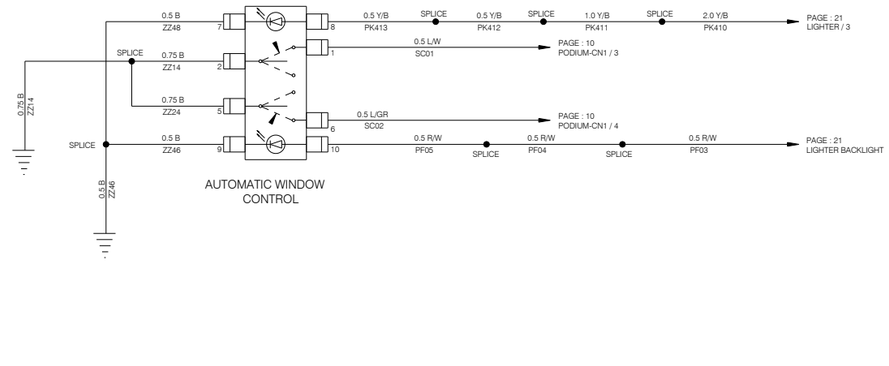
ANADOLU ISUZU
ANADOLU ISUZU OTOMOTIV SANAYI VE TICARET A.S.

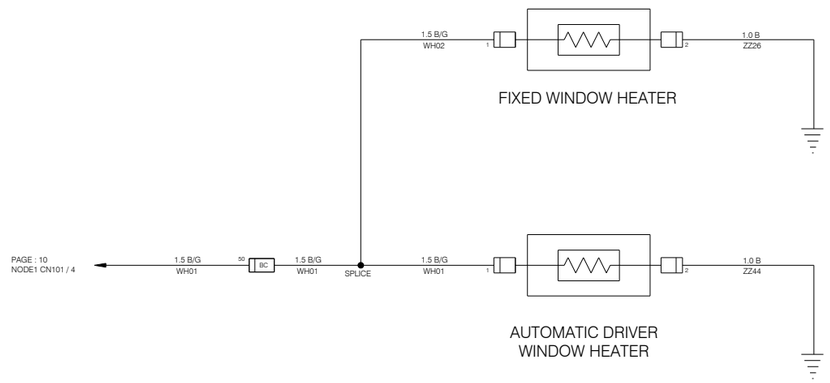
SAYFA NO / SHEET NO: 20

CITIPORT E6
AUTOMATIC DRIVER WINDOW

ISUZU ACADEMY TECH CENTER







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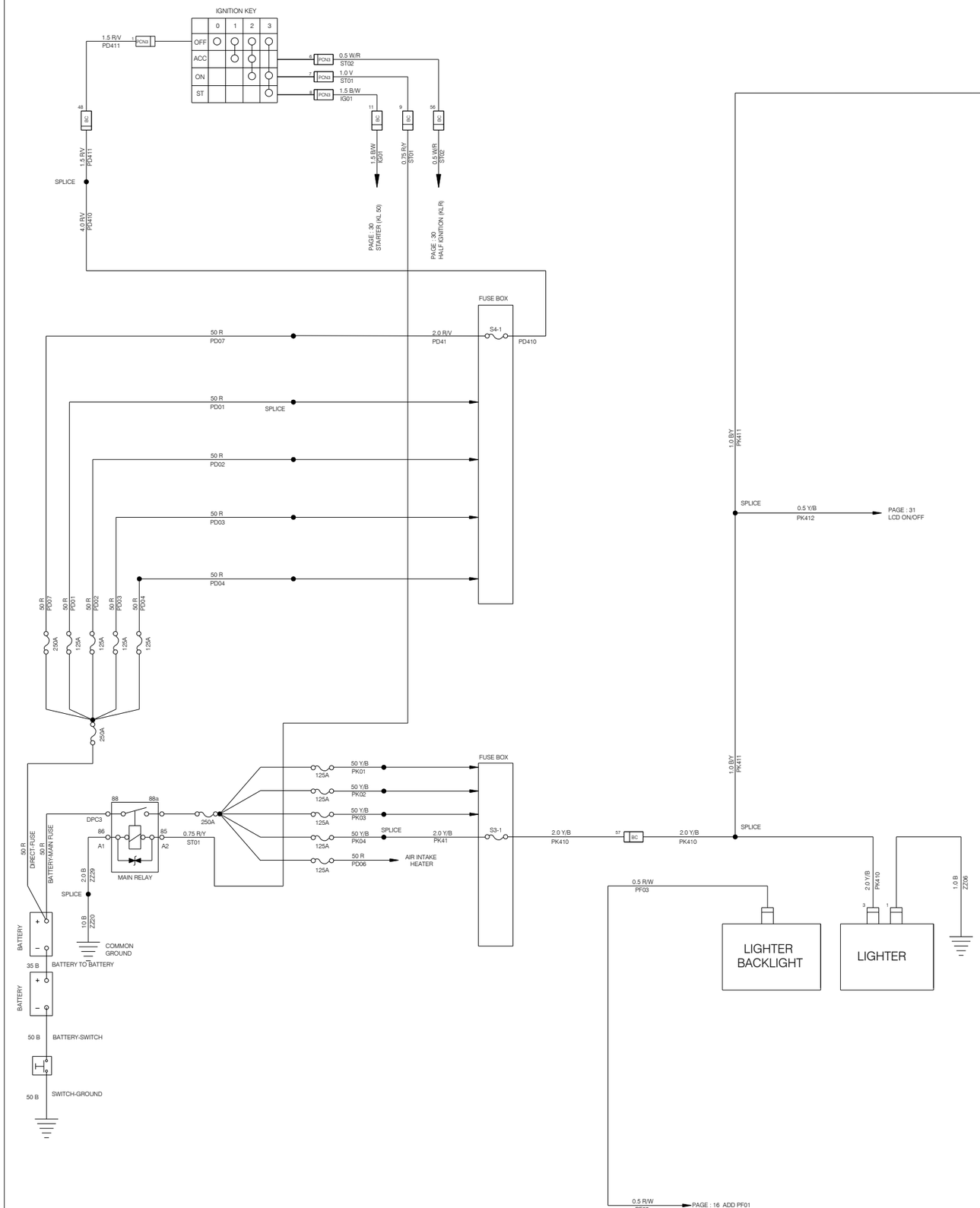
ANADOLU ISUZU
ANADOLU ISUZU OTOMOTIV SANAYI VE TICARET A.S.

SAYFA NO / SHEET NO: 21

CITIPORT E6
AUTOMATIC MIRROR & LIGHTER



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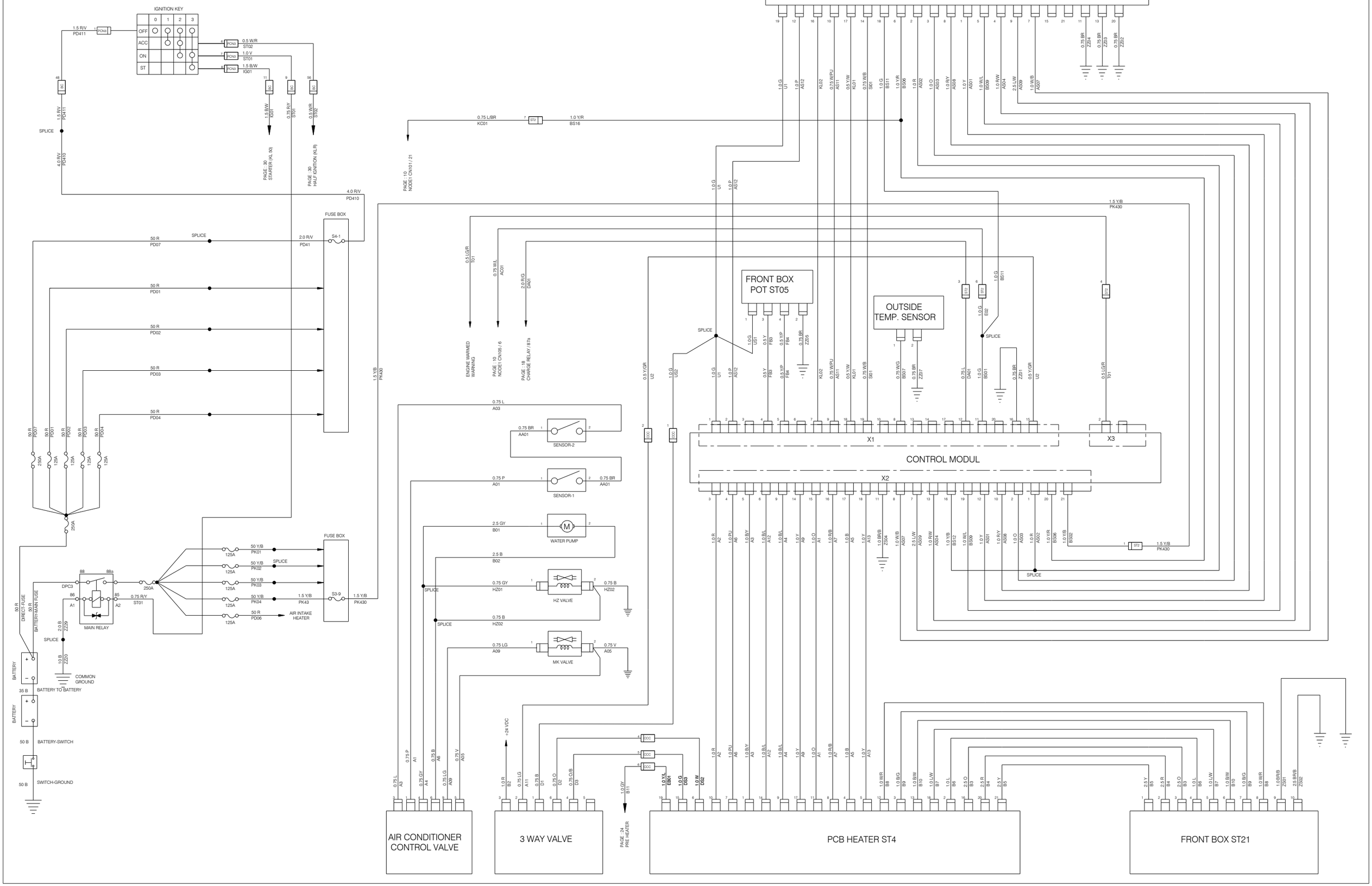
ANADOLU ISUZU
ANADOLU ISUZU OTOMOTIV SANAYI VE TICARET A.S.

SAYFA NO / SHEET NO: 22

CITIPORT E6
AIR CONDITIONER

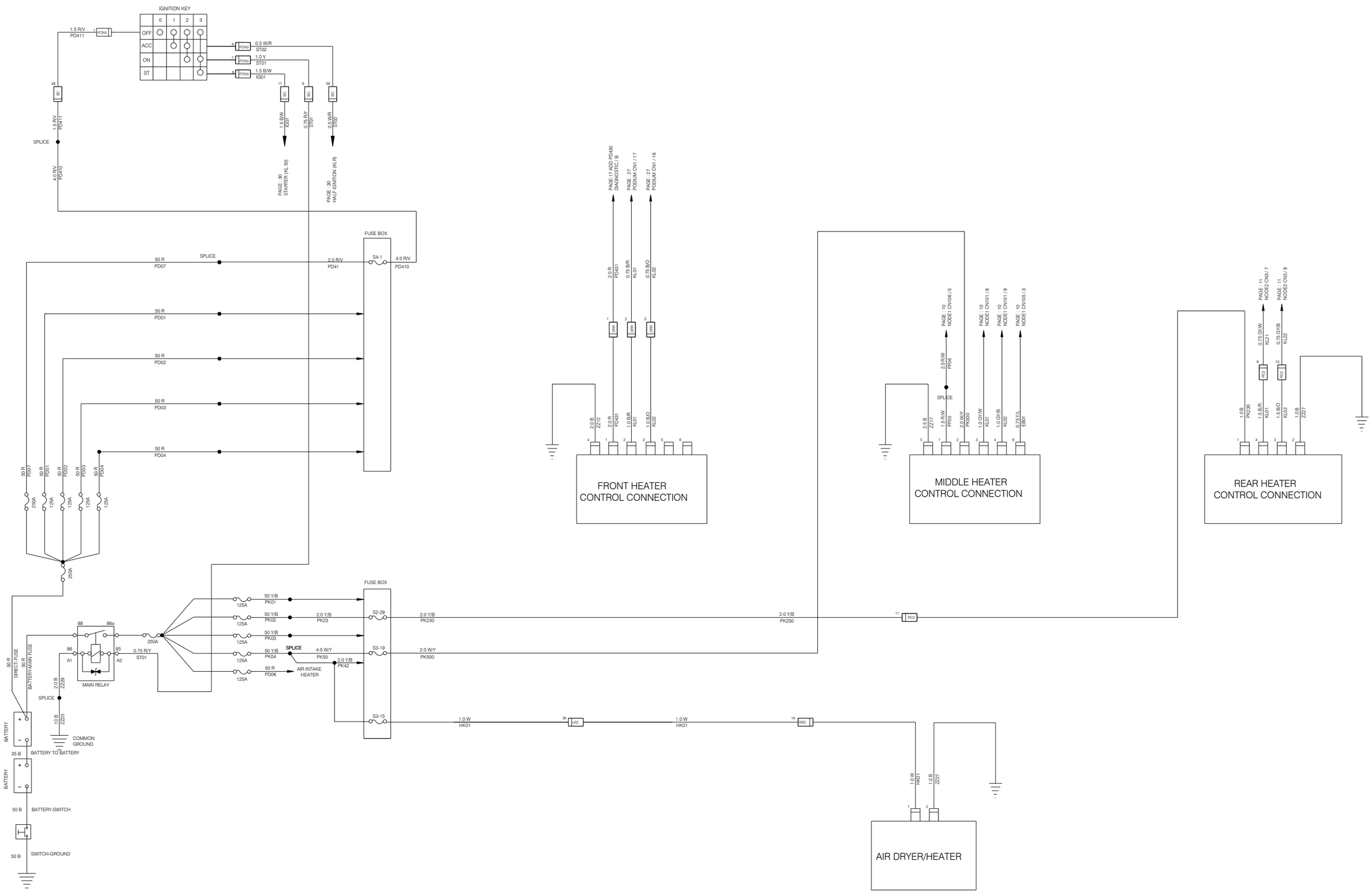


ANADOLU ISUZU
ANADOLU ISUZU OTOMOTIV SANAYI VE TICARET A.S.

BU BELGE ANADOLU ISUZU OTOMOTIV SANAYI VE TIC. AS. NIN YAZILI IZNI OLMADAN HICBIR SEKILDE KOPYALANAMAZ.THIS DOCUMENT CAN NOT BE REPRODUCED WITHOUT WRITTEN PERMISSION OF ANADOLU ISUZU OTOMOTIV SANAYI VE TIC. AS.

SAYFA NO / SHEET NO: 23

CITIPORT E6
HEATER

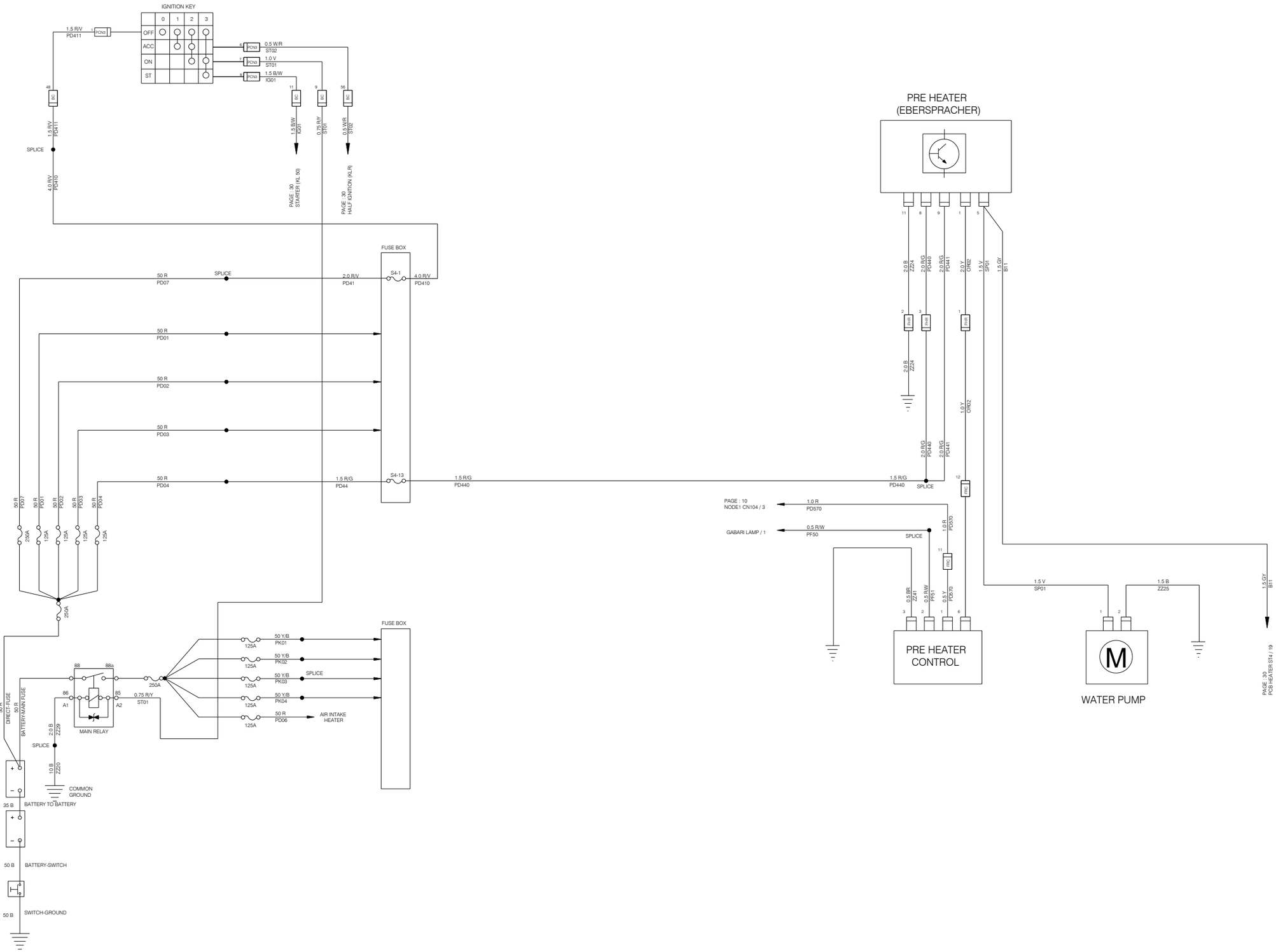


BU BELGE ANADOLU ISUZU OTOMOTIV SANAYI VE TIC. AS. NIN YAZILI IZNI OLMADAN HICBIR SEKILDE KOPYALANAMAZ.THIS DOCUMENT CAN NOT BE REPRODUCED WITHOUT WRITTEN PERMISSION OF ANADOLU ISUZU OTOMOTIV SANAYI VE TIC. AS.

ANADOLU ISUZU
ANADOLU ISUZU OTOMOTIV SANAYI VE TICARET A.S.

SAYFA NO / SHEET NO: 24

CITIPORT E6
PRE HEATER (EBERSPACHER)



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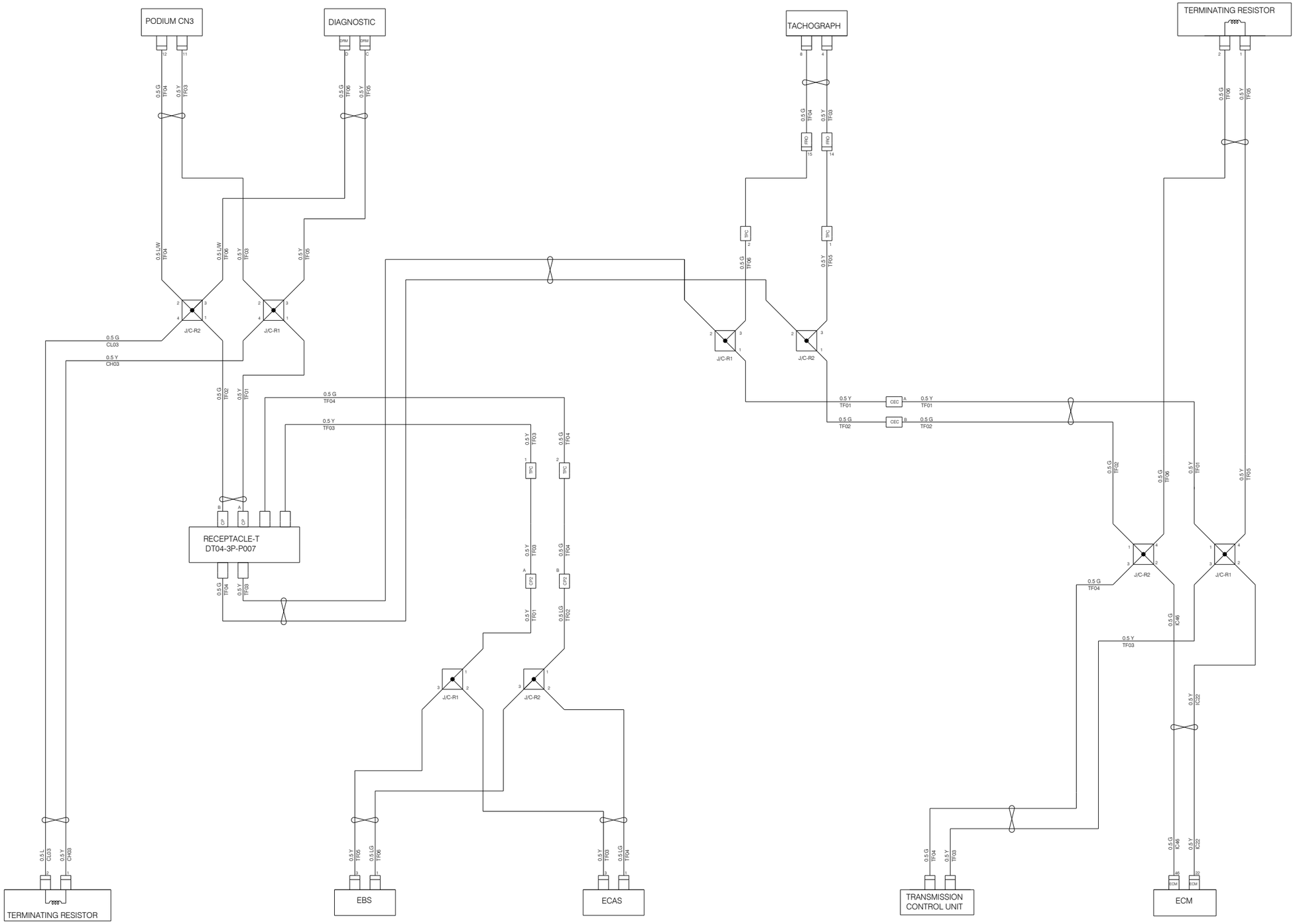
ANADOLU ISUZU
ANADOLU ISUZU OTOMOTIV SANAYI VE TICARET A.S.

SAYFA NO / SHEET NO: 25

CITIPORT E6
POWER CAN



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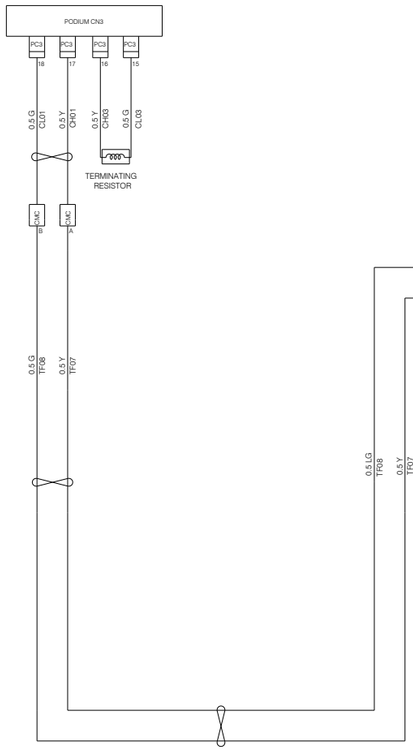
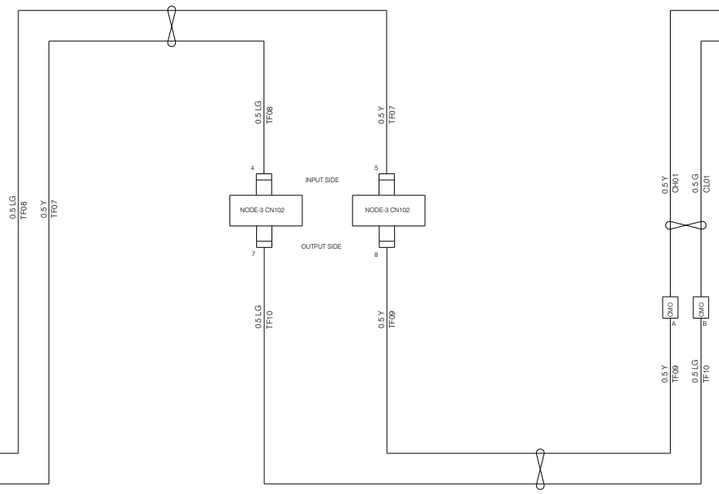
ANADOLU ISUZU
ANADOLU ISUZU OTOMOTIV SANAYI VE TICARET A.S.

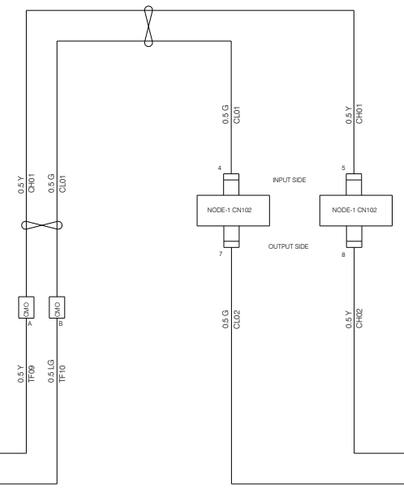
SAYFA NO / SHEET NO: 26

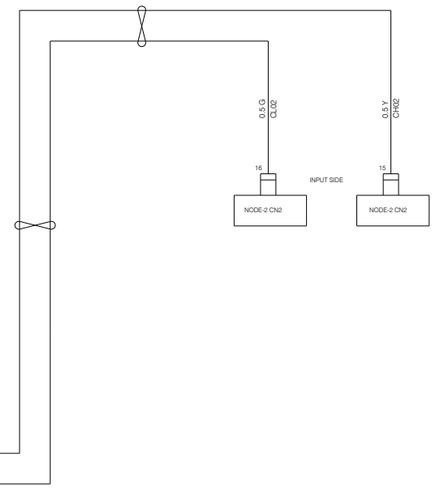
CITIPORT E6

MUX CAN









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ANADOLU ISUZU
ANADOLU ISUZU OTOMOTIV SANAYI VE TICARET A.S.

SAYFA NO / SHEET NO: 27

CITIPORT E6
PODIUM SYSTEM

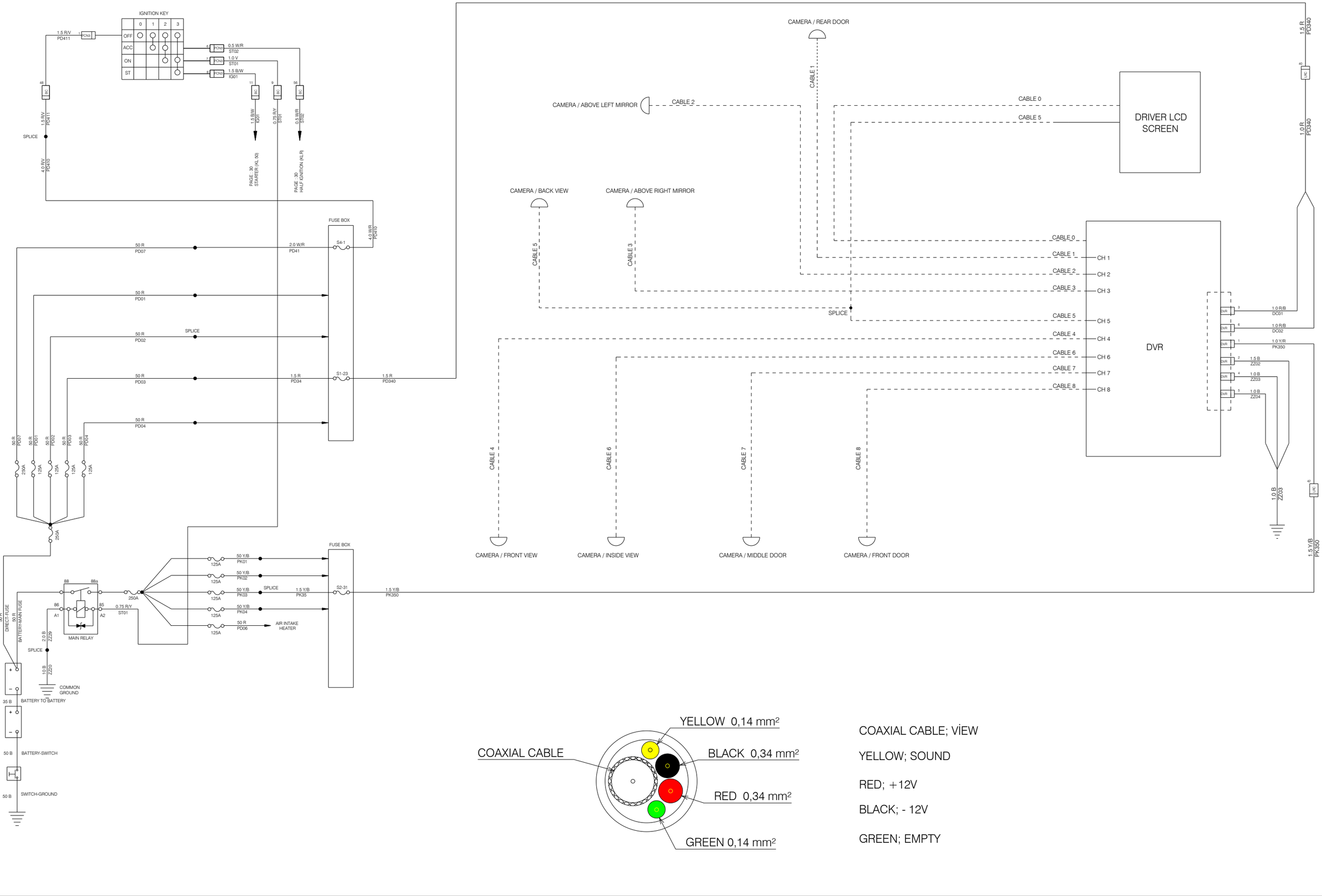
IGNITION KEY
0 1 2 3
OFF ACC ON ST
1.5 R/V PD411 — PCN3 1
0.5 W/R ST02 — PCN3 6
1.0 V ST01 — PCN3 7
1.5 B/W IG01 — PCN3 8
1.5 R/V PD411 — 48 BC
1.5 B/W IG01 — 11 BC
0.75 R/Y ST01 — 9 BC
0.5 W/R ST02 — 56 BC
PAGE : 30 STARTER (KL 50)
PAGE : 30 HALF IGNITION (KL R)
SPLICE
1.5 R/V PD412
TRANSMISSION CONTROL UNIT
1 4 5 11 3
2.0 R/L PD412
0.5 G CL02
0.5 Y CH02
0.75 B ZZ16
2.0 V/V PK441
1.5 R/V PD412 — 49 BC
2.0 Y/L PK440 — 58 BC
SPLICE
2.0 Y/L PK440
EMERGENCY SWITCH
0.5 B/L BT01
0.5 R/Y EM01
0.75 B ZZ050
FUSE BOX
50 R PD07 — SPLICE — 2.0 R/V PD41 — S4-1 — 4.0 R/V PD410
2.0 R/G PD55 — S4-7 — 1.5 R/G PD550
50 R PD01
50 R PD02
50 R PD03
50 R PD04
50 R PD07 — 250A
50 R PD01 — 125A
50 R PD02 — 125A
50 R PD03 — 125A
50 R PD04 — 125A
250A
50 Y/B PK01 — 125A
50 Y/B PK02 — 125A — SPLICE
50 Y/B PK03 — 125A
50 Y/B PK04 — 125A
50 R PD06 — 125A — AIR INTAKE HEATER
88 88a 86 85 A1 A2 MAIN RELAY
250A
0.75 R/Y ST01
50 R DIRECT-FUSE
50 R BATTERY-MAIN FUSE
2.0 B ZZ29
SPLICE
10 B ZZ50
COMMON GROUND
BATTERY
35 B BATTERY TO BATTERY
BATTERY
50 B BATTERY-SWITCH
50 B SWITCH-GROUND
FUSE BOX
S3-13 — 2.0 Y/L PK44 — 2.0 Y/L PK440
S3-17 — 2.0 Y/V PK45 — 2.0 Y/V PK450
S3-21 — 2.0 Y/R PK40 — 2.0 Y/R PK400
60 BC
PAGE : 17 KILOMETER SENSOR / 1
PAGE : 17 KILOMETER SENSOR / 2
PAGE : 17 KILOMETER SENSOR / 3
PAGE : 17 KILOMETER SENSOR / 4
0.5 B KS01
0.5 BR KS02
0.5 L KS03
0.5 W KS04
RETARDER LEVEL 3
RETARDER LEVEL 2
RETARDER LEVEL 1
2.0 V/V PK450
0.5 V/W RT01
0.5 V/GR RT02
0.5 V/B RT03
0.5 V/B RT03
0.5 V/GR RT02
0.5 V/W RT01
TRANSMISSION CAN LOW
TRANSMISSION CAN HIGH
0.5 G CL02
0.5 Y CH02
2.0 Y/L PK440
0.75 B ZZ62
0.75 B ZZ13
0.5 B/L BT01
0.5 R/Y EM01
CN2 CN6 CN7 CN4
PODIUM
CN3 CN1
2.0 R/V PD411
0.75 B ZZ03
2.0 R/Y PK400
IGNITION KEY SUPPLY
0.5 W/R ST02
1.0 V ST01
1.5 B/W IG01
HALF CONTACTS
IGNITION KEY
STARTER SWITCH
1.0 R/V PD552
0.5 Y TF03
0.5 G TF04
PAGE : 22 PWR CAN HIGH
PAGE : 22 PWR CAN LOW
0.5 Y CH60
0.5 G CL03
0.5 Y CH01
0.5 G CL01
PAGE : 26 TERMINATING RESISTOR
PAGE : 26 TERMINATING RESISTOR
PAGE : 26 CAN MUX HIGH
PAGE : 26 CAN MUX LOW
0.5 B/G LP01
0.5 L/W SC01
0.5 L/GR SC02
PAGE : 31 LCD SHUT DOWN
PAGE : 20 DRIVERS WINDOW DOWN
PAGE : 20 DRIVERS WINDOW UP
0.5 SW WK02
0.75 B/O KL02
0.75 B/R KL01
0.5 L/GR GA01
PAGE : 23 HEATER LEVEL-2
PAGE : 23 HEATER LEVEL-1
LCD BACK VIEW WARNING
1.0 R/V PD552
SPLICE
53 BC
1.5 R/G PD550

BU BELGE ANADOLU ISUZU OTOMOTİV SANAYİ VE TİC. AS. NIN YAZILI IZNI OLMADAN HİÇBİR SEKİLDE KOPYALANAMAZ.THIS DOCUMENT CAN NOT BE REPRODUCED WITHOUT WRITTEN PERMISSION OF ANADOLU ISUZU OTOMOTİV SANAYİ VE TİC. AS.

ANADOLU ISUZU
ANADOLU ISUZU OTOMOTİV SANAYİ VE TİCARET A.S.

SAYFA NO / SHEET NO: 28

CITIPORT E6
CAMERA SYSTEM



COAXIAL CABLE; VİEW

YELLOW; SOUND

RED; +12V

BLACK; - 12V

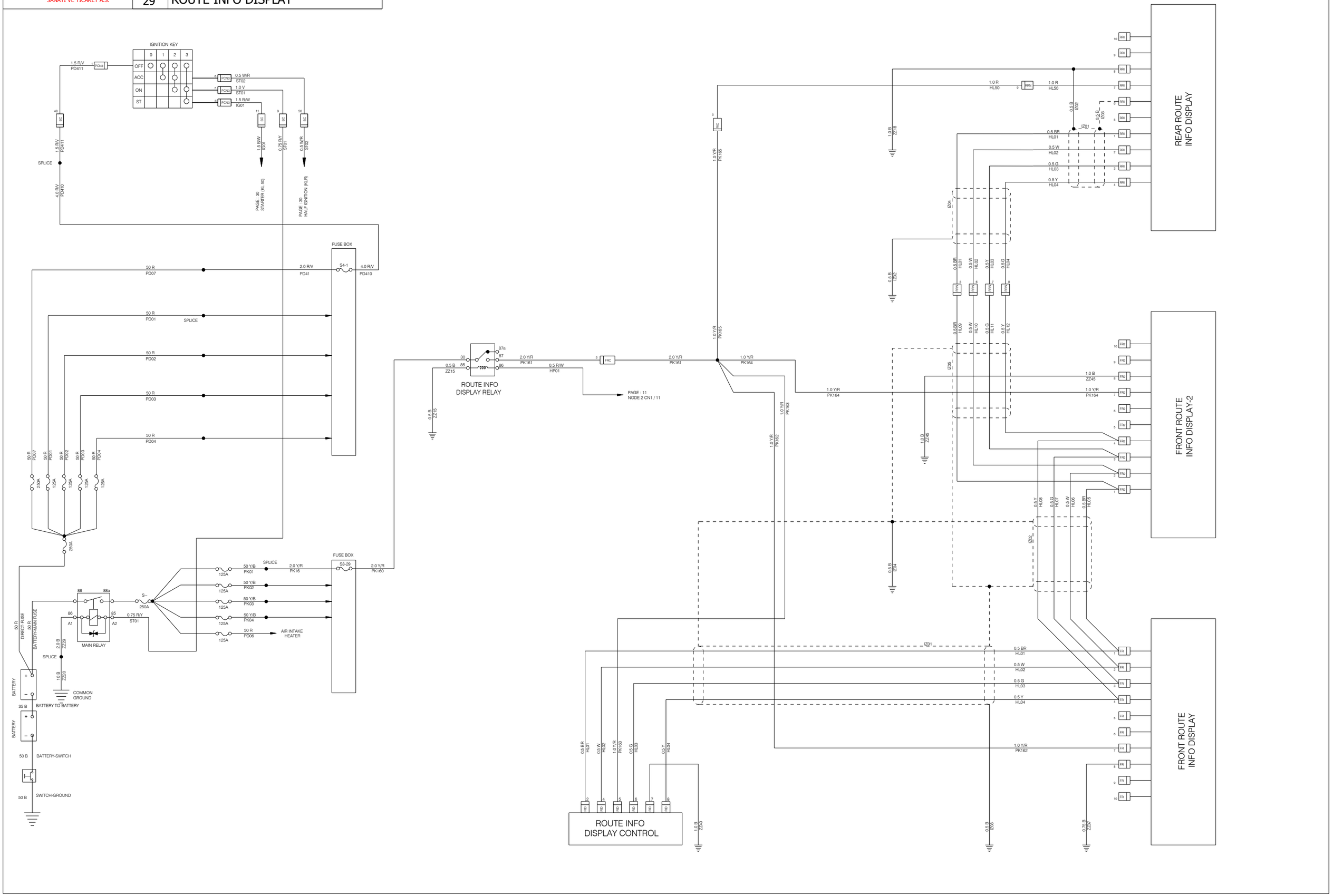
GREEN; EMPTY

ANADOLU ISUZU
ANADOLU ISUZU OTOMOTIV SANAYI VE TICARET A.S.

BU BELGE ANADOLU ISUZU OTOMOTIV SANAYI VE TIC. AS. NIN YAZILI IZNI OLMADAN HICBIR SEKILDE KOPYALANAMAZ.THIS DOCUMENT CAN NOT BE REPRODUCED WITHOUT WRITTEN PERMISSION OF ANADOLU ISUZU OTOMOTIV SANAYI VE TIC. AS.

SAYFA NO / SHEET NO: 29

CITIPORT E6
ROUTE INFO DISPLAY



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ANADOLU ISUZU
ANADOLU ISUZU OTOMOTIV SANAYI VE TICARET A.S.

SAYFA NO / SHEET NO: 30

CITIPORT E6
STARTER

IGNITION KEY
0 1 2 3
OFF ACC ON ST
1.5 R/V PD411
0.5 W/R ST02
1.0 V ST01
1.5 B/W IG01
SPLICE
4.0 R/V PD410
FUSES
50 R PD07
50 R PD01
50 R PD02
50 R PD03
50 R PD04
S4-1
S1-31
S4-3
2.0 R/V PD41
1.5 R PD36
1.0 R/Y RA03
1.0 R/Y RA13
1.5 R PD360
1.0 W/R PD360
250A
125A
DIRECT-FUSE
BATTERY-MAIN FUSE
MAIN RELAY
0.75 R/Y ST01
50 Y/B PK01
50 Y/B PK02
50 Y/B PK03
50 Y/B PK04
50 R PD06
AIR INTAKE HEATER
2.0 B ZZ29
1.0 B ZZ20
COMMON GROUND
BATTERY
35 B BATTERY TO BATTERY
50 B BATTERY-SWITCH
50 B SWITCH-GROUND

STARTER SWITCH (ENGINE ROOM)
1.0 W/R IG02
1.0 LGR BA01
1.0 LGR AY01
1.0 IC051
1.0 IC062
1.0 IC05
1.0 B ZZ16
1.0 LGR BA04
1.0 R AY001
1.0 R/Y IG04
0.75 R/Y ST11
1.0 R AY01
1.0 R/W PF08
2.0 B/W IG05
1.0 R/W PF07
2.5 R/W PF06
PAGE : 13 ECM / 5
PAGE : 10 NODE1 CN102 / 1
PAGE : 10 NODE1 CN106 / 5
ENGINE LIGHTING
2.0 R/W IG03
STARTER LOCK RELAY
2.0 B/W IG05
2.0 B/W IG76
2.0 B/W IG02
2.0 B/W IMS01
STARTER MOTOR IMS CONNECTION
0.75 IC83
1.0 IC83
PAGE : 13 ECM / 76
PAGE : 13 ECM / 83
STARTER RELAY
1.5 B/W IG01
1.0 B ZZ32
2.0 R/W IG03
1.0 R PD552
PAGE : 11 NODE2 CN1 / 17
0.5 W/R ST02
HALF IGNITION RELAY
1.0 R/Y RA13
0.5 B ZZ33
0.5 W/R ST02
1.0 Y/R RA33
PAGE : 31 AMPLIFIER / 7

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ANADOLU ISUZU
ANADOLU ISUZU OTOMOTIV SANAYI VE TICARET A.S.

SAYFA NO / SHEET NO: 31

CITIPORT E6
LCD-RADIO SPEAKER-INFO SCREENS

IGNITION KEY

	0	1	2	3
OFF	○	○	○	○
ACC		○	○	○
ON			○	○
ST				○

1.5 R/V PD411 — PCN3 pin 1
PCN3 pin 6 — 0.5 W/R ST02
PCN3 pin 7 — 1.0 V ST01
PCN3 pin 8 — 1.5 B/W IG01

48 IC — 1.5 R/V PD411 — SPLICE — 4.0 R/V PD410
11 IC — 1.5 B/W IG01 — PAGE : 30 STARTER (KL 50)
9 IC — 0.75 R/Y ST01
56 IC — 0.5 W/R ST02 — PAGE : 30 HALF IGNITION (KL R)

FUSE BOX

50 R PD07 — SPLICE — 2.0 R/V PD41 — S4-1 — 4.0 R/V PD410
2.5 R PD33 — S1-19 — 1.5 R PD330
50 R PD01 — SPLICE — 1.5 R PD61 — S4-17 — 1.0 Y/R RA02
50 R PD02
50 R PD03 — SPLICE — 1.5 R PD35 — S1-27 — 1.5 R PD350
50 R PD04

50 R PD07 — 250A
50 R PD01 — 125A
50 R PD02 — 125A
50 R PD03 — 125A
50 R PD04 — 125A
250A

TICKET READER
1 BE — 1.5 R PD330
2 BE — 1.0 Y/B PK341
3 BE

SPLICE — 1.5 Y/B PK340

AMPLIFIER
1 AMP — 0.5 G/B HP04
2 AMP — 0.5 G HP03
3 AMP — 0.5 W/B HP02
4 AMP — 0.5 B HP01
5 AMP — 1.0 B ZZ00
6 AMP — 1.0 R RA04
7 AMP — 1.5 B ZZ12
8 AMP — 1.0 Y/R RA02
9 AMP — 1.0 Y RA05
10 AMP — 1.0 B/W RZ01
4 FRC2 — SPEAKER (-)
3 FRC2 — SPEAKER (+)
1 LFC1 — 1.0 Y/R RA02

RADIO
1 RA — 0.5 W/B HP50
2 RA — 0.5 W HP51
3 RA
4 RA
1 RB — 1.0 Y RA05
2 RB — 1.0 R RA04
7 RB — 1.0 B RZ01
8 RB
5 FR2 — ANTENNA
4 FR2
12 FR2

1.0 Y RA05 — 4 RR
1.0 B/W RZ01 — 45 RR
1.0 R RA04 — 3 RR

SPEAKER
0.5 W HP50 — SH1 (+)
0.5 W/B HP51 — SH2 (-)
37 SC — 0.5 W HP50
38 SC — 0.5 W/B HP51
18 FR3 — 0.5 W HP50
19 FR3 — 0.5 W/B HP51

REAR INFO SCREEN
1.0 R PD370 — 14 RRC — 1.0 R PD370 — SPLICE — 1.0 R PD400 — 2 RRN — 1.0 R PD400 — 1 IDC
PAGE : 12 NODE3 CN106 / 2 — 0.5 G/R DL04 — 4 RRN — 0.5 G/R DL04 — 3 IDC
1.0 Y/B PK390 — 8 RRC — 1.0 Y/B PK390 — SPLICE — 1.0 Y/B PK420 — 3 RRN — 1.0 Y/B PK420 — 4 IDC
1.0 B ZZ23 — 5 IDC
1.0 Y/B PK390
1.0 R PD370

FRONT INFO SCREEN
1.5 R PD350 — 41 LRC — 1.0 R PD350 — SPLICE — 1.0 R PD360 — 2 ID
PAGE : 10 NODE1 CN101 / 6 — 1.0 G/R DB01 — 33 LRC — 1.0 G/R DL01 — 4 ID
1.5 Y/B PK330 — 43 LRC — 1.0 Y/B PK370 — SPLICE — 1.0 Y/B PK380 — 5 ID
1.0 B ZZ06 — 6 ID

FUSE BOX
125A — 50 Y/B PK01 — SPLICE
125A — 50 Y/B PK02 — 2.0 Y/B PK34 — S2-27 — 1.5 Y/B PK340
125A — 50 Y/B PK03 — 1.5 Y/B PK33 — S2-24 — 1.5 Y/B PK330
125A — 50 Y/B PK04 — SPLICE — 2.0 Y/B PK42 — S3-5 — 2.0 Y/B PK420
125A — 50 R PD06 — AIR INTAKE HEATER

88 — 88a — 86 A1 — 85 A2 — MAIN RELAY
250A — 0.75 R/Y ST01
50 R DIRECT-FUSE — 50 R BATTERY-MAIN FUSE
2.0 B ZZ29 — SPLICE — 10 B ZZ20 — COMMON GROUND
BATTERY — BATTERY TO BATTERY — 35 B — BATTERY
50 B BATTERY-SWITCH
SWITCH-GROUND 50 B

LCD TV ON/OFF
0.75 B ZZ54 — 0.5 B ZZ47 — 7 — 8 — 0.5 Y/B PK412 — PAGE : 21 ADD PK411
2 — 0.75 B ZZ54
3 — 0.5 B/G LP01 — PAGE : 27 PODIUM CN1 / 2
0.5 B ZZ45 — 9 — 10 — 0.5 R/W PF04 — PAGE : 21 ADD PF03

LCD
1.5 Y/BR LCD01 — 29 LRC — 1.0 Y/B LCD01 — 2 LCD
1.0 B ZZ01 — 1 LCD

LCD-1
1.0 L LCD01 — 1 LCD1
2 LCD1

LCD-2
1.0 L LCD02 — 1 LCD2
1.0 B ZZ18 — 2 LCD2

LCD RELAY
2.0 Y/B PK420 — 30 — 87a — 87 — 1.5 Y/BR LCD03
0.5 B ZZ16 — 85 — 86 — 1.5 Y/GY PK481
1.5 Y/BR LCD01 — SPLICE
1.5 Y/BR LCD03 — 30 PR — 1.0 Y/B LCD03 — 12 RRC — 1.5 L LCD03 — SPLICE
1.0 L LCD01
1.0 L LCD02
PAGE : 11 NODE2 CN1 / 15

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ANADOLU ISUZU
ANADOLU ISUZU OTOMOTIV SANAYI VE TICARET A.S.

SAYFA NO / SHEET NO: 32

CITIPORT E6
GREASING TIMER & OIL REFILL

IGNITION KEY
0 1 2 3
OFF
ACC
ON
ST

1.5 R/V PD411 — PCN3 1
0.5 W/R ST02 — PCN3 6
1.0 V ST01 — PCN3 7
1.5 B/W IG01 — PCN3 8

48 — 1.5 R/V PD411 — SPLICE — 4.0 R/V PD410
11 — 1.5 B/W IG01 — PAGE : 30 STARTER (KL 50)
9 — 0.75 R/Y ST01
56 — 0.5 W/R ST02 — PAGE : 30 HALF IGNITION (KL R)

FUSE BOX
4.0 R/V PD410

50 R PD07 — SPLICE — 2.0 R/V PD41 — S4-1
50 R PD01
50 R PD02 — SPLICE — 2.0 R/V PD36 — S1-31 — 2.0 R/V PD360
50 R PD03
50 R PD04 — 2.0 R PD54 — S4-5 — 1.5 R PD540

50 R PD07 — 250A
50 R PD01 — 125A
50 R PD02 — 125A
50 R PD03 — 125A
50 R PD04 — 125A
250A

FUSE BOX
50 Y/B PK01 — 125A — SPLICE — 2.0 Y/B PK14 — S2-13 — 1.5 Y/B PK140
50 Y/B PK02 — 125A
50 Y/B PK03 — 125A
50 Y/B PK04 — 125A
50 R PD06 — 125A — AIR INTAKE HEATER

88 88a
DPC3
86 85
A1 A2
MAIN RELAY
0.75 R/Y ST01
250A

50 R DIRECT-FUSE
50 R BATTERY-MAIN FUSE
2.0 B ZZ29
SPLICE
10 B ZZ20
COMMON GROUND

BATTERY
35 B BATTERY TO BATTERY
BATTERY
50 B BATTERY-SWITCH
50 B SWITCH-GROUND

OIL REFILL
1 — 1.0 R/V PD360
3 — 1.0 Y/GY PK460
4 — 1.0 GY OM01
5 — 1.0 B ZZ13
2 — 1.0 B ZZ12
6
7
8 — 1.0 W/B SS01 — 1.0 B SS02 — OIL LEVEL

13 — 2.0 R/V PD360
14 — 1.0 Y/G PK460 — PAGE : 11 NODE2:CN1 / 1
15 — 0.5 GY OM01 — PAGE : 11 NODE2:CN1 / 18

35 — 1.0 W/B BM01 — 9 — 0.5 W/B BM01 — 1 — 0.5 B ZZ46 — 2 — PRESSURE SENSOR

PAGE : 10 NODE1:CN101 / 20
PAGE : 10 NODE1:CN101 / 17

GREASING TIMER
1 — 1.5 Y/B PK140
12 — 1.0 R/W PD540
3 — 1.0 B ZZ37
5 — 1.0 G GR01
10 — 1.0 Y GR01
2 — 1.0 W/B BM01
4 — 1.0 S/B GR01
9 — 1.0 W GR02
40 — 1.0 S/B GR01
41 — 1.0 W GR02

SELENOID
2 — 1.0 W GR02
1 — 1.0 S/B GR01

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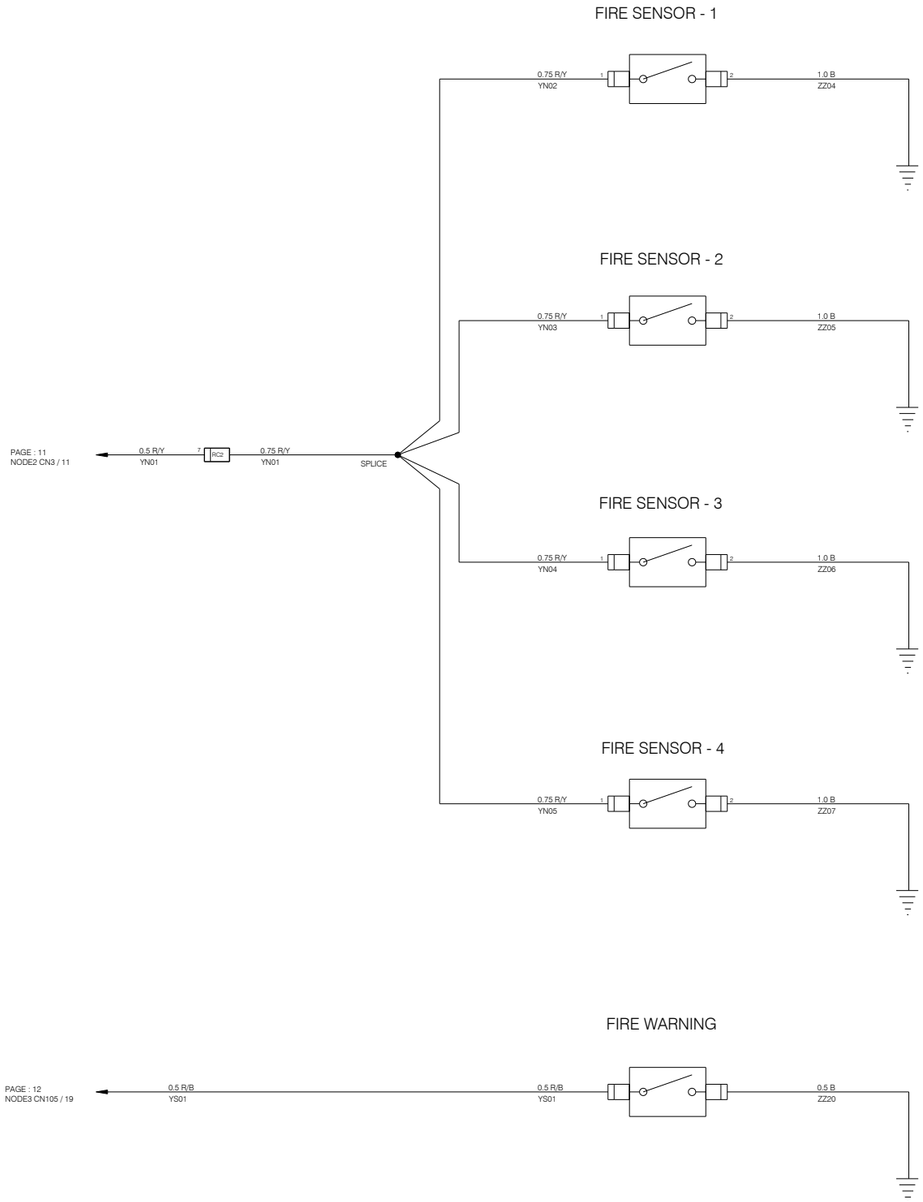
ANADOLU ISUZU
ANADOLU ISUZU OTOMOTIV SANAYI VE TICARET A.S.

SAYFA NO / SHEET NO: 33

CITIPORT E6
FIRE WARNING SYSTEM



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CITIPORT E6
ECAS SYSTEM

IGNITION KEY
OFF / ACC / ON / ST
1.5 R/V PD411
0.5 W/R ST02
1.0 V ST01
1.5 B/W IG01
SPLICE
4.0 R/V PD410
PAGE : 30 STARTER (KL 50)
PAGE : 30 HALF IGNITION (KL R)
FUSE BOX
50 R PD07
50 R PD01
50 R PD02
50 R PD03
50 R PD04
2.0 R/V PD41
4.0 R/V PD410
1.5 R PD25
1.5 R PD250
S4-1
S1-7
250A
125A
50 Y/B PK01
50 Y/B PK02
50 Y/B PK03
50 Y/B PK04
50 R PD06
AIR INTAKE HEATER
1.5 Y/B PK31
1.5 Y/B PK310
S2-15
MAIN RELAY
88 / 88a / 86 / 85 / A1 / A2
0.75 R/Y ST01
DIRECT-FUSE
BATTERY-MAIN FUSE
2.0 B Z229
10 B Z220
COMMON GROUND
BATTERY
35 B BATTERY TO BATTERY
50 B BATTERY-SWITCH
50 B SWITCH-GROUND

1.5 R PD250
2.0 R PD250
1.5 Y/B PK310
CAN L
CAN H
1.5 Y/B PK01
1.5 R PD01
0.5 LG TF04
0.5 Y TF03
2.0 B Z206
X1
ECAS ECU
X2
X3
2.5 BR JPR01
2.5 BR JPR02
0.75 BR ES04
0.75 BR ES06
0.75 B ES05
0.75 B ES03
0.75 G FAS63
0.75 R FAS62
0.75 Y FAS621
0.75 G FAS613
0.75 R FAS612
0.75 Y FAS611
0.75 BR FAS64
0.75 B ES01
0.75 BR ES02
REAR LEFT PRESSURE SENSOR ECAS
REAR RIGHT PRESSURE SENSOR ECAS
FRONT RIGHT PRESSURE SENSOR ECAS
REAR ECAS VALVE
SPLICE
0.75 BR FAS614
0.75 R FAS622
0.75 BR FAS624
0.75 G FAS613
0.75 R FAS612
0.75 Y FAS611
0.75 BR FAS624
0.75 R FAS622
0.75 Y FAS621
FRONT ECAS VALVE-1
FRONT ECAS VALVE-2

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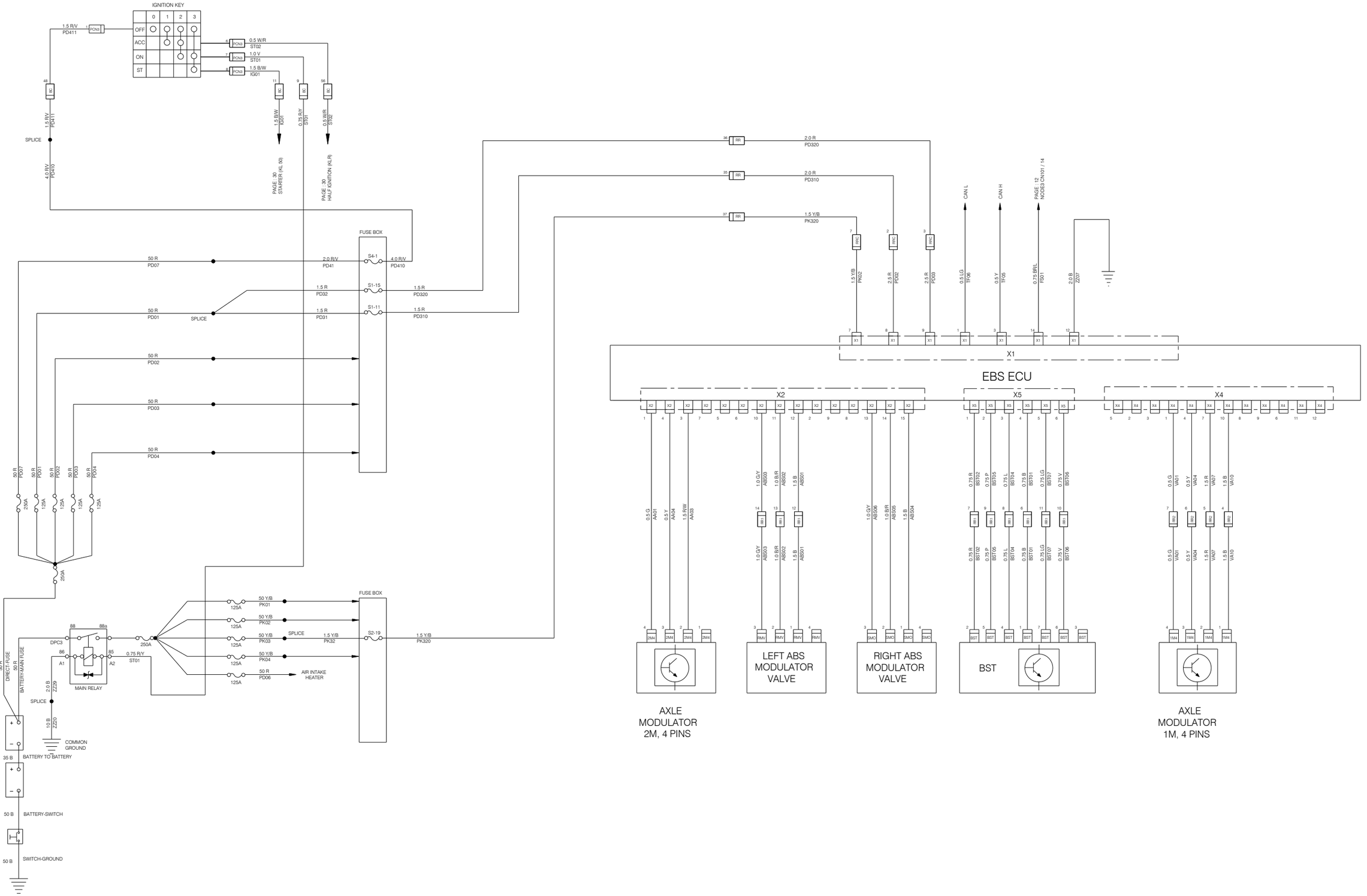
ANADOLU ISUZU
ANADOLU ISUZU OTOMOTIV SANAYI VE TICARET A.S.

SAYFA NO / SHEET NO: 35

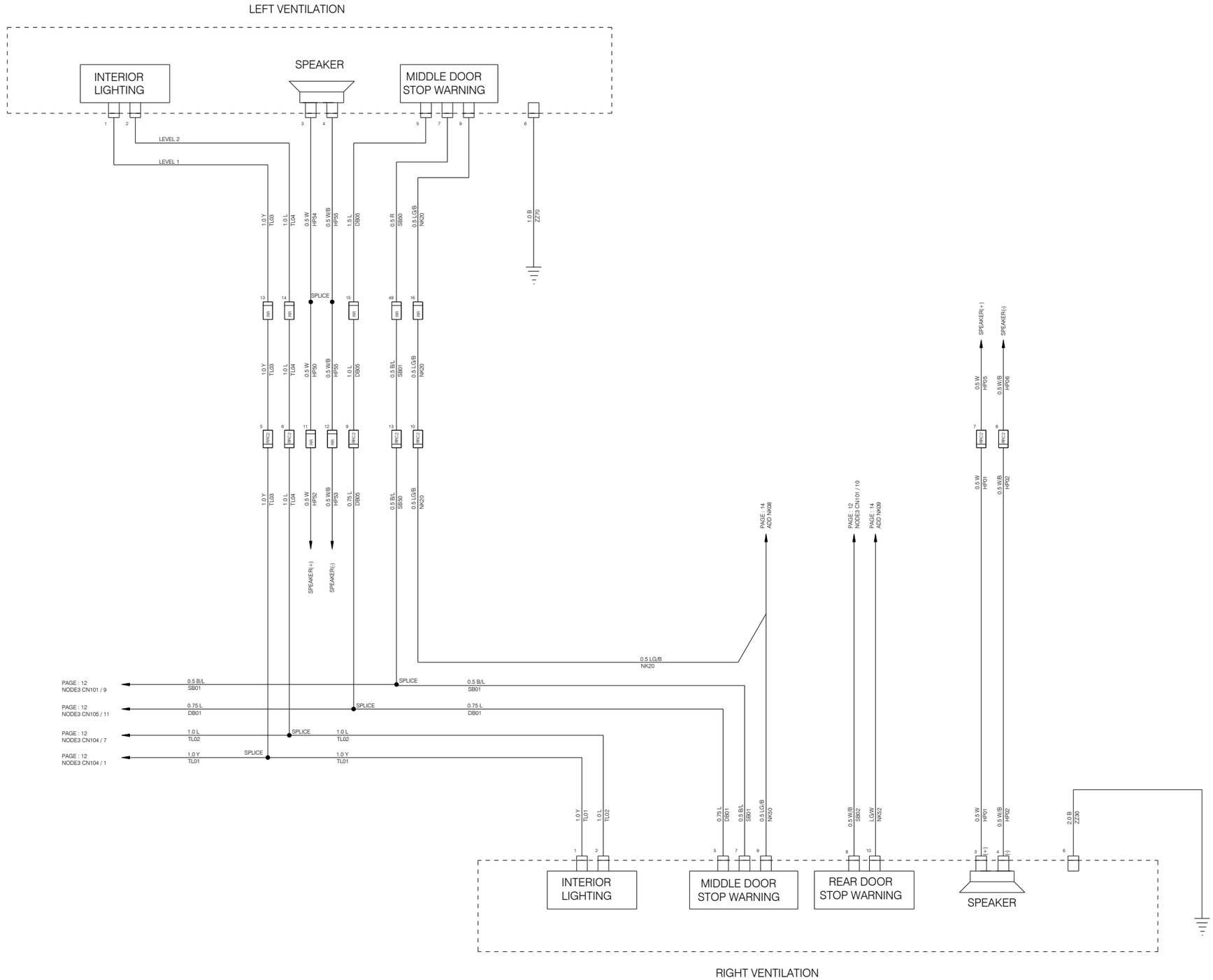
CITIPORT E6
EBS SYSTEM



BU BELGE ANADOLU ISUZU OTOMOTIV SANAYI VE TIC. AS. NIN YAZILI IZNI OLMADAN HICBIR SEKILDE KOPYALANAMAZ.THIS DOCUMENT CAN NOT BE REPRODUCED WITHOUT WRITTEN PERMISSION OF ANADOLU ISUZU OTOMOTIV SANAYI VE TIC. AS.

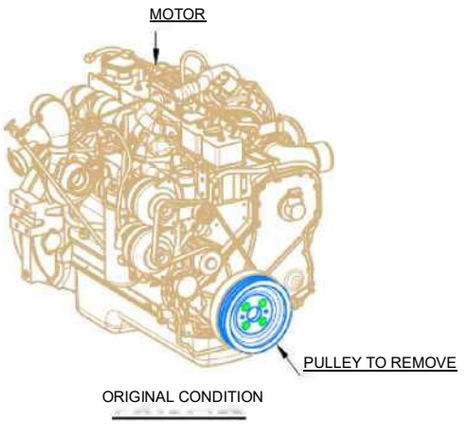
CITIPORT E6

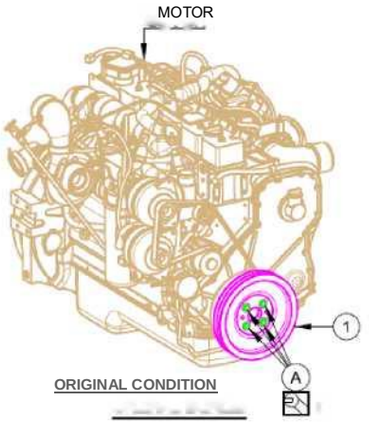
INTERIOR LIGHTING, ANNOUNCE SYSTEM, STOP WARNING



CYLINDER UPPER COVER ASSEMBLY INSTALLATION

CRANKSHAFT ASSEMBLY





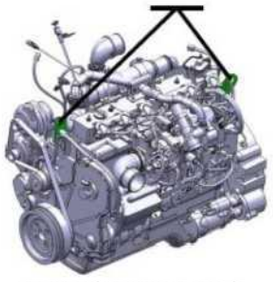
BOLTS WILL BE CROSS TORQUELED

PULLEY AND BOLTS THAT COME ON THE ENGINE WILL BE REMOVED, THE NEW PULLEY IS INSTALLED AND TIGHTEN WITH THE SAME BOLTS.

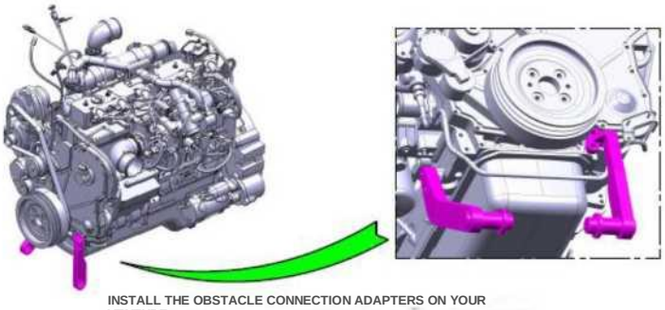
1 TORQUE ANTEDI (Nml			
PC7	8W	Ub-T	
A	77	67	87

LEAF POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER	**ADDITIONAL INFO**
1	010-001	3B76B4913'	CRANKSHAFT	1	
1	010-017	3B7046773*	CRANKSHAFT	1	CITIPORTING

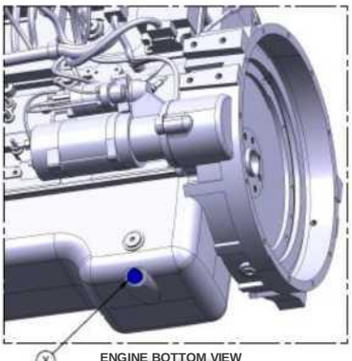
ENGINE PREPARATION PROCEDURES



LIFT THE ENGINE WITH THE HELP OF CARASCAL FROM THE POINTS SHOWN IN THE PICTURE



INSTALL THE OBSTACLE CONNECTION ADAPTERS ON YOUR VENTURE

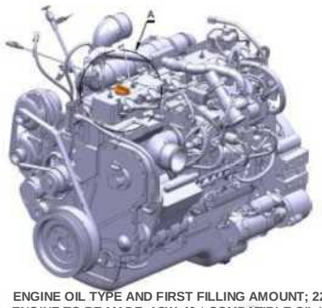


ENGINE BOTTOM VIEW
REMOVE THE PEUG SHOWN IN THE PICTURE DRAIN THE EXISTING OIL. BACK THE TAP AND TORQUE



A OS NO 31207030330C. ENGINE MOUNTING TROLLEY

PUT ON THE ENGINE MOUNTING TROLLEY BY TAKING THE ADAPTERS AS A REFERENCE



ENGINE OIL TYPE AND FIRST FILLING AMOUNT; 22 7 LT OIL CNG ENGINE TO BE MADE. 1SW-40 * COMPATIBLE OIL WILL BE USED.



ENGINE FILLING CAP

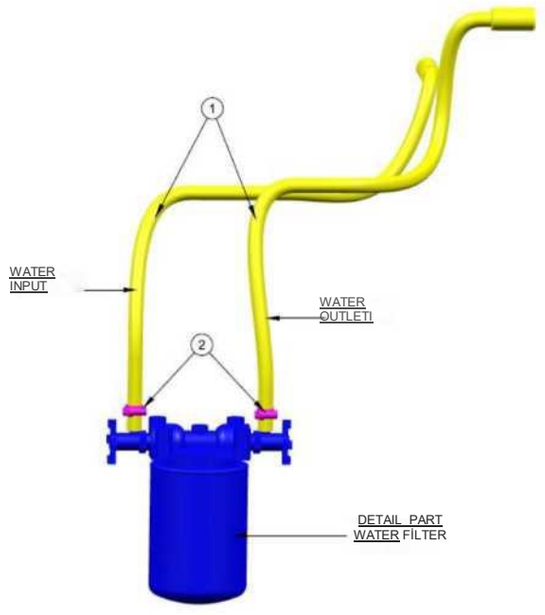


A DETAIL

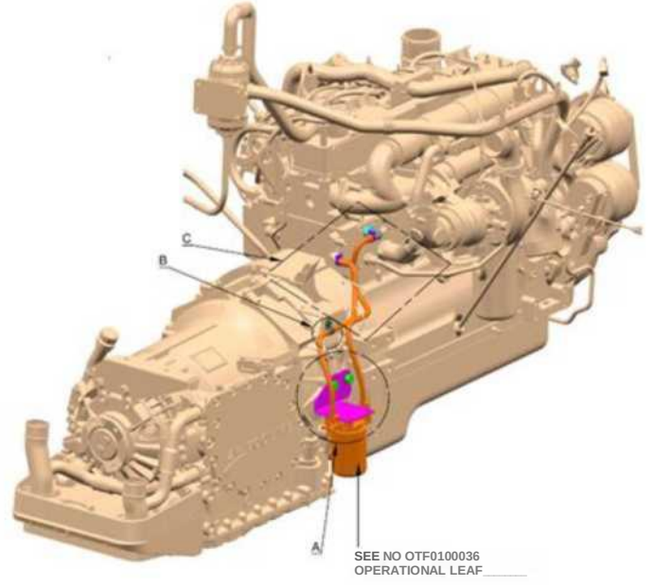
SHOWN IN THE PICTURE IN THE FILLING PROCESS USE OIL FILLING PUMP

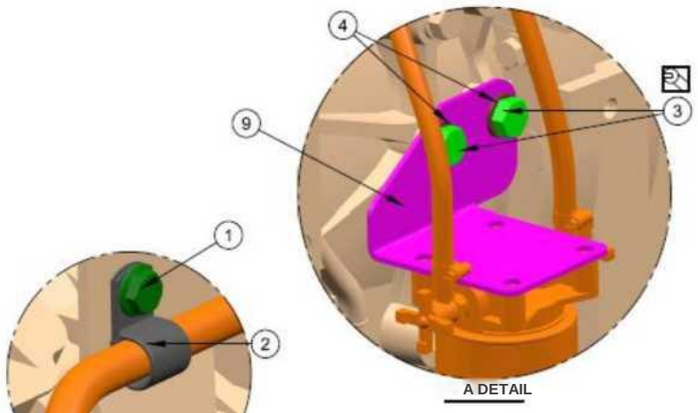
LEAF POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER	ADD.INFO
1	010-002	387621220'	MOTOR, -L9NE6D320	1	
1	Û10-001	387937641'	MOTOR. L9NE6D280	1	CITIPORT CNG

WATER FILTER INSTALLATION



LEAF POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	010 - 035	3B75294D2'	HOSE , FILTER WATER OUTLET	2
2	010 - 025	3053510168*	CLAMP . SCREW B9, 010-16. DİN3017	2

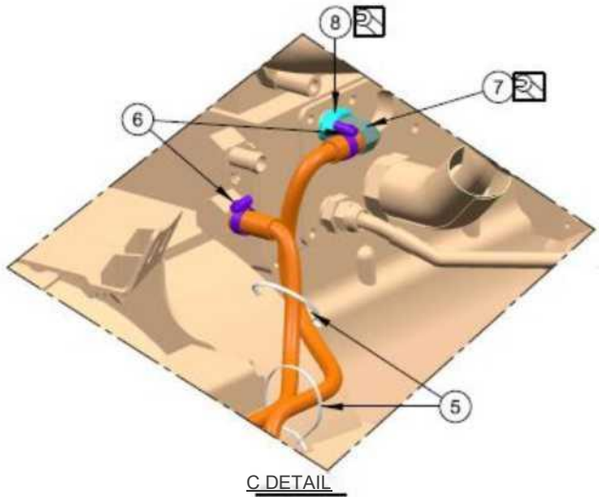




A DETAIL

B~ DETAIL

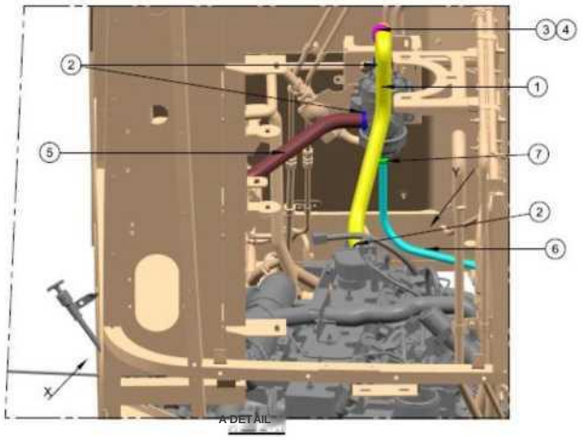
TORQUE ANTEDI (Nm)			
POSE	Std	Vır.	Max.
3	180	160	200
8	45	40	50
7	26	24	29



C DETAIL

LEAF POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	010 - 033	3001208206*	BOLT , FLN M8X1,25X20, THICK D. DIN6921	1
2	010-029	3870577461'	CLIP, D15/M8	1
3	010-027	3000416254'	BOLT , AKB M16X1.5X25, THIN D, DIN960	2
4	010-028	3010000164*	WASHER D16X3 DİN 125	2
5	01D - 015	3777714380'	CLAMP , PLASTIC EB. 04. 204_3. 6'205MM	2
6	010 - 030	3053516278'	CLAMP , SCREW B9, 016-27, DİN3Ü17	2
7	010-031	387536386'	ELBOW ADAPTER ENGINE INPUT	1
8	010-032	387536367'	ADAPTER, ENGINE INPUT	1
9	010-034	387474603'	BRACKET , WATER FILTER	1

CCV FILTER HOSES INSTALLATION



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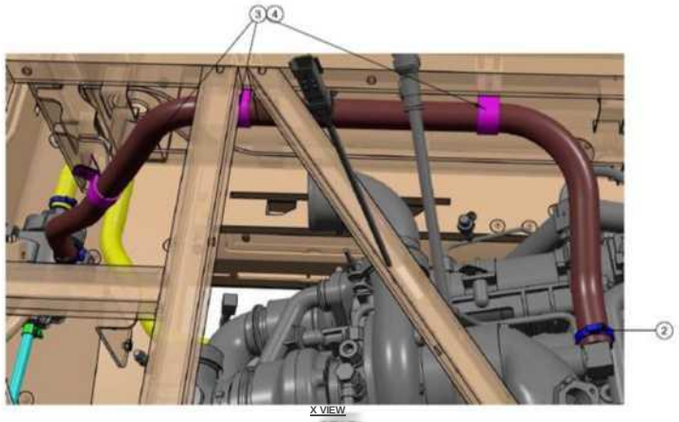
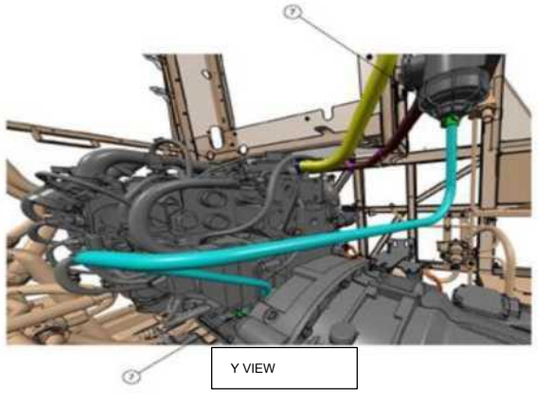


X VIEW

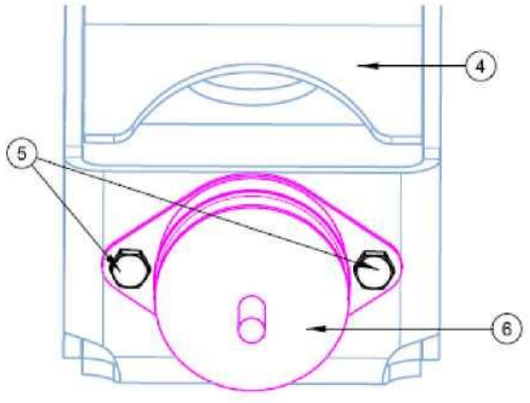


Y VIEW

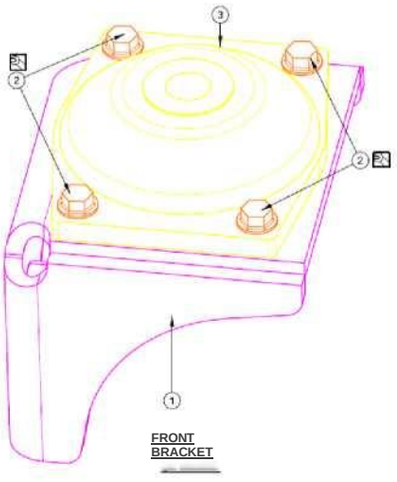
LEAF POSE	GROUP/POSE	PART NO	PART AD İ	NUMBER
1	010- 032	307536367*	ADAPTER. ENGINE INPUT	1
2	01O-4XJ7	3063632506*	CLAMP SCREW B&. O32-5C. DIN3017	4
3	010- (MS	3870123410"	CLAMP	4
4	Û1O-O26	3000110404*	BOLT. AKB M" 0X1.5X40. THICK f>. DİN 933	4
5	OIO-'MS	387045354*	BLOWBY VALVE OUTLET	1
6	010-1X14	367(345355*	HOSE . BLOWBY DRAINAGE	1
7	010- &Ù9	3053016256'	CLAMP , SCREW B12. 01&75. DİN3O17	2

ENGINE SUSPENSION SYSTEM ASSEMBLY

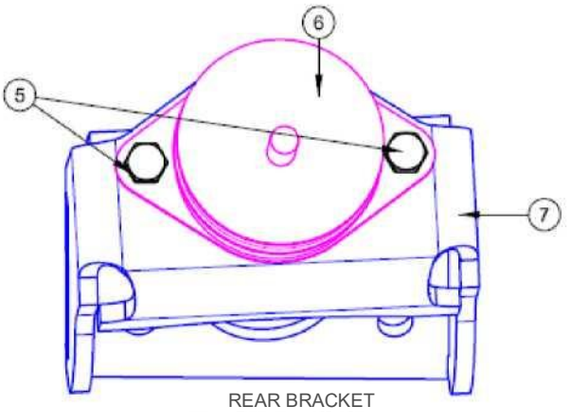
ENGINE FRONT AND REAR BRACKETS INSTALLATION



REAR BRACKET LEFT



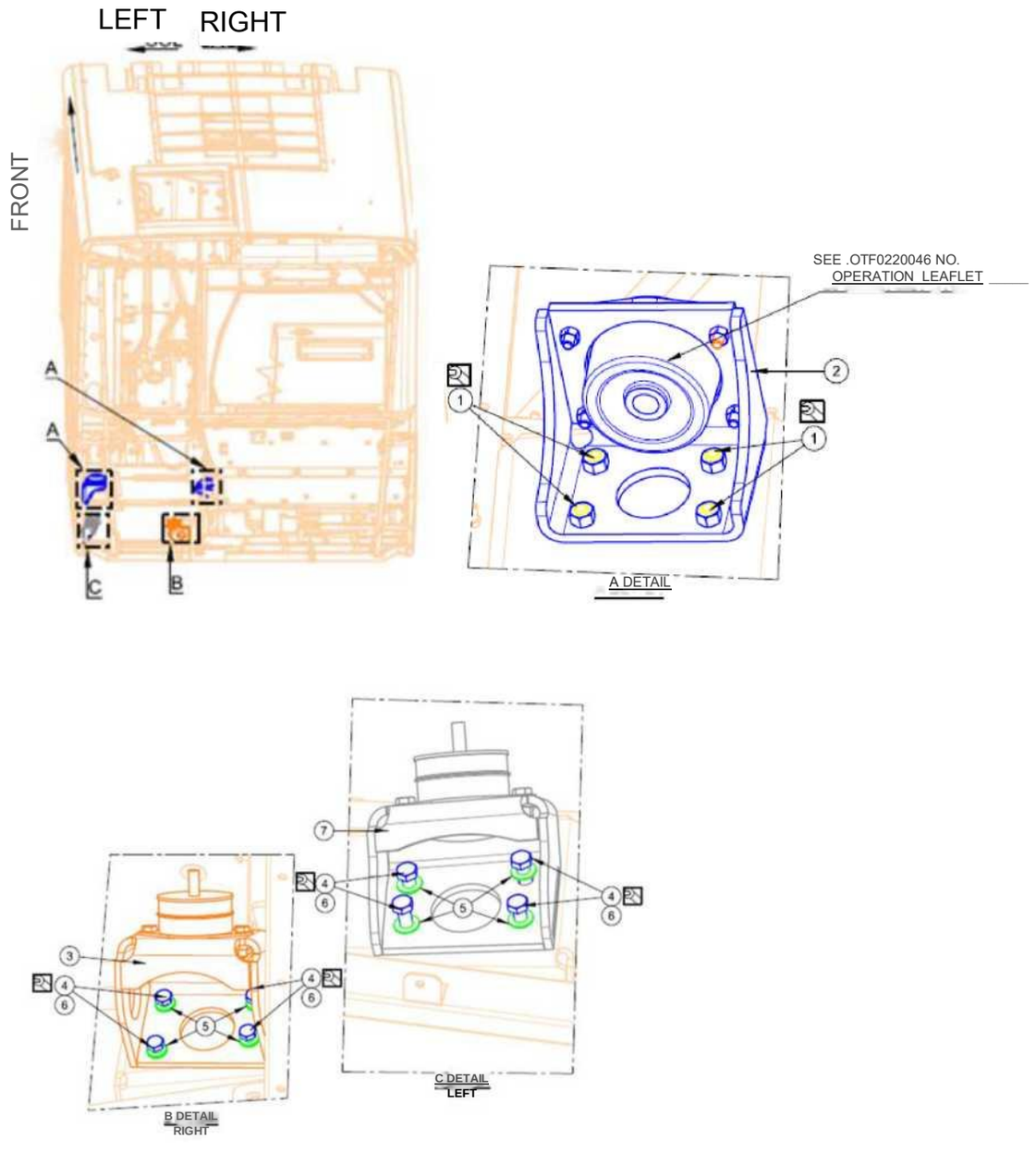
FRONT BRACKET



REAR BRACKET RIGHT

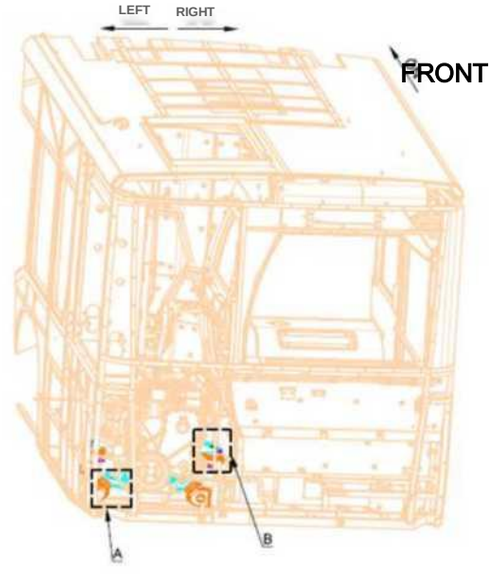
LEAFLET POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	022-025	3870457S2'	**BRACKET , ENGINE REAR BODY** ASSEMBLY	2
2	022-012	3001510404*	**BOLT , FLN M10X1,25X40, THIN** D. DIN6921	8
3	022-005	387841486*	ENGINE MOUNTING . REAR	2
4	022-019	387045794*	BRACKET , ENGINE FRONT LEFT ASSEMBLY	1
5	022-016	3000210304*	**BOLT , AKB M10X1.25X30, THIN** D. DİN961	4
6	022-003	3B703353B*	**WEDGE , CIRCULAR , MOTOR (10** 04540-01}	2
7	022 - 022	387045703*	BRACKET , ENGINE FRONT RIGHT ASSEMBLY	1

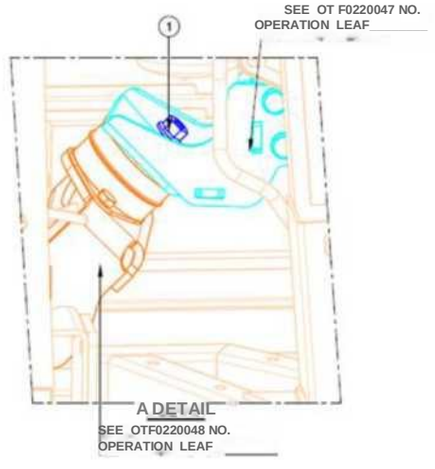
ENGINE BRACKETS INSTALLATION TO THE VEHICLE

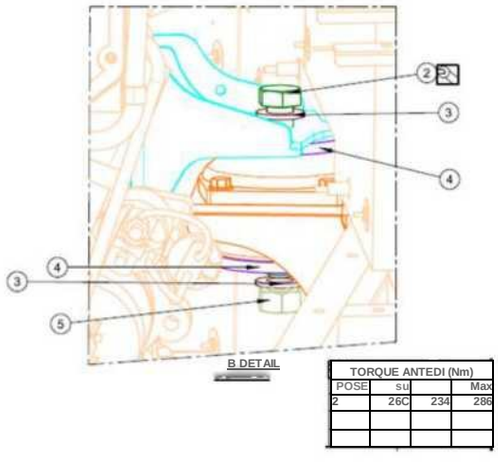


LEAF POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	022 - 025	387045792“	BRACKET , ENGINE REAR BODY ASSEMBLY	2
2	022 - 012	3001510404“	BOLT , FLN M10X1.25X40, THIN D. DIN6921	8
3	022-005	387841468“	ENGINE MOUNTING . REAR	2
4	022-019	387045794“	BRACKET . ENGINE FRONT LEFT ASSEMBLY	1
5	022 - 016	3000210304“	BOLT . AKB M10X1.25X30. THIN D. DIN961	4
6	022 - 003	387033538“	WEDGE , CIRCULAR , ENGINE (1004540-01)	2
7	022 - 022	387045793“	BRACKET , ENGINE ON RIGHT ASSEMBLY	1

MOTOR MOUNTS VEHICLE INSTALLATION



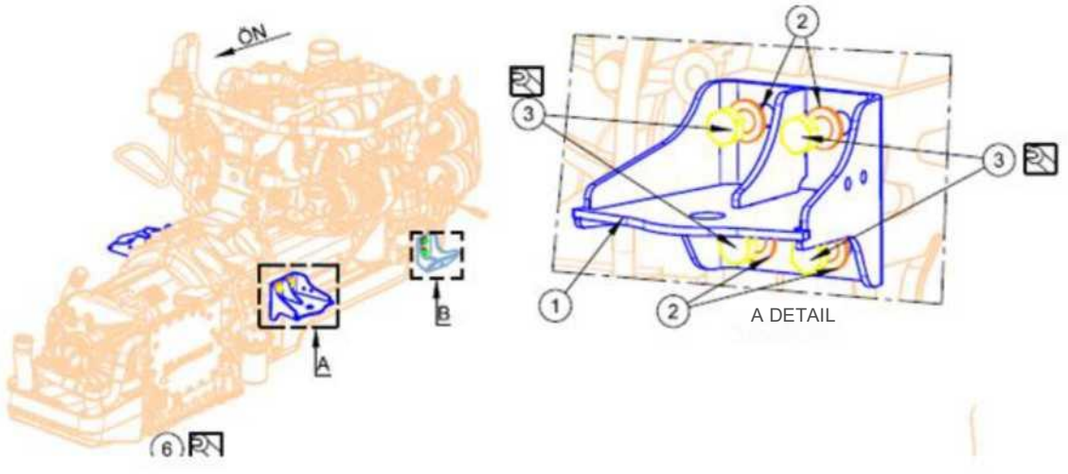


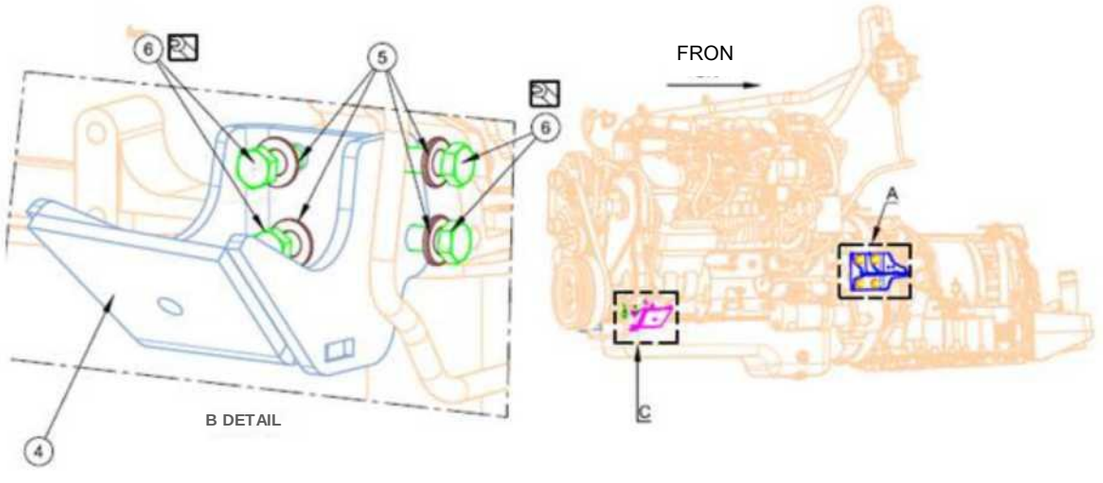


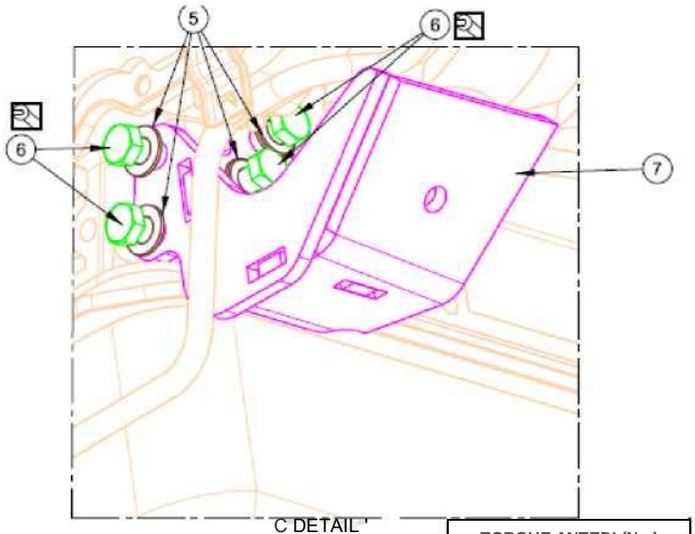
TORQUE ANTEDI (Nm)			
POSE	su		Max
2	26C	234	286

LEAFLET POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	022 - 007	3006200124*	NUT , FLN M12X1.75, THICK D. DİN6923	2
2	022 - 008	3870475570*	BOLT , M24X2X160 DİN 960	2
3	022 - 009	3010000244*	WASHER . D24X4 DİN 125	4
4	022 - 006-	387034895*	TRAY, REAR ENGINE MOUNTING	4
5	022 -010	3870475560*	NUT , M24X2 DİN 934	2

MOUNTING OF RIGHT-LEFT WEDGES ON THE ENGINE







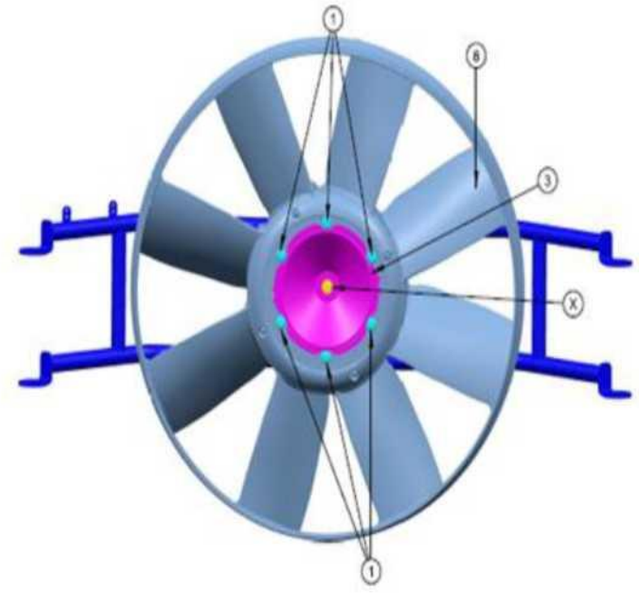
C DETAIL '

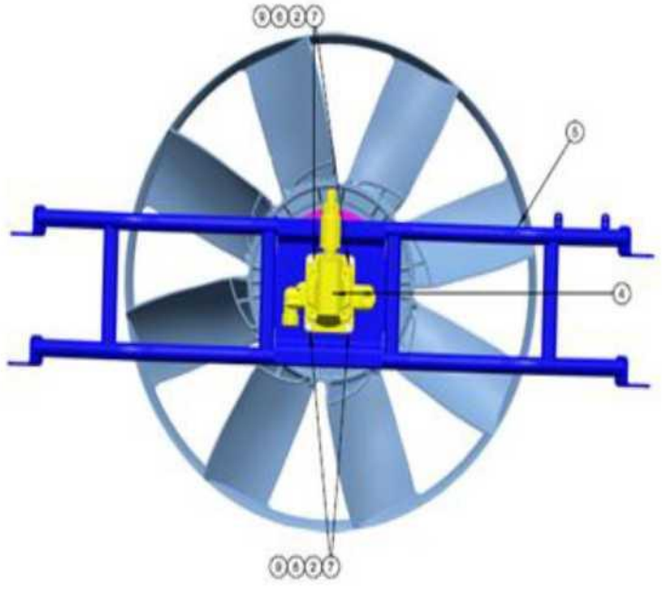
TORQUE ANTEDI (Nm)			
POSE	Std.	Mh.	Max.
3	132	**104**	160
6	B6	76	96

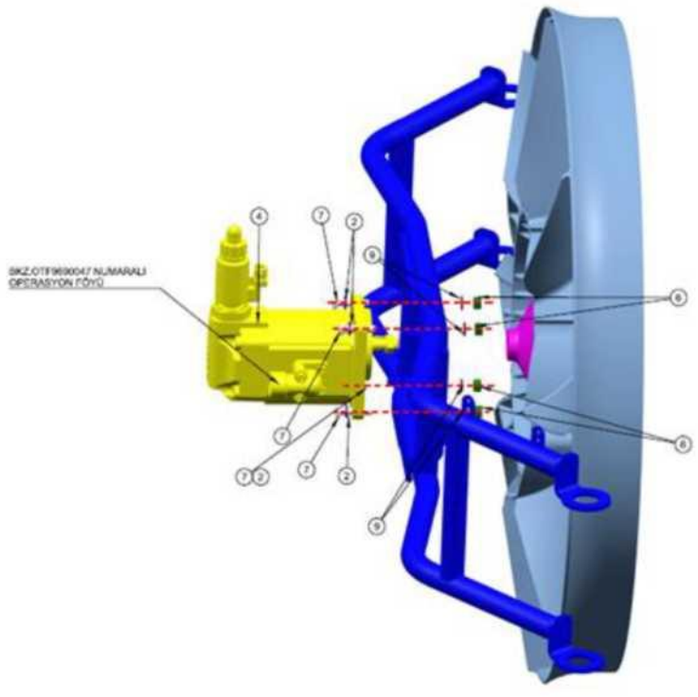
LEAFLET POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	022 - 004	3B70457B5*	BRACKET , ENGINE REAR	2
2	022 - 016	3010000164*	WASHER . D16X3 DİN 125	8
3	022-011	3000516304*	BOLT , AKB M16X2X30, THICK D. DIN933	8
4	022-002	387045766*	BRACKET . ENGINE MOUNTING FRONT RIGHT	1
5	022 - 017	30100 D0124"	WASHER . 012	a
6	022 - 015	3000512304*	BOLT, AKB M12X1,75X30, THICK D. DİN933	a
7	022 - 001	367045787*	BRACKET , ENGINE MOUNTING FRONT LEFT	1

FAN AND FAN BELT ASSEMBLY

FAN INSTALLATION



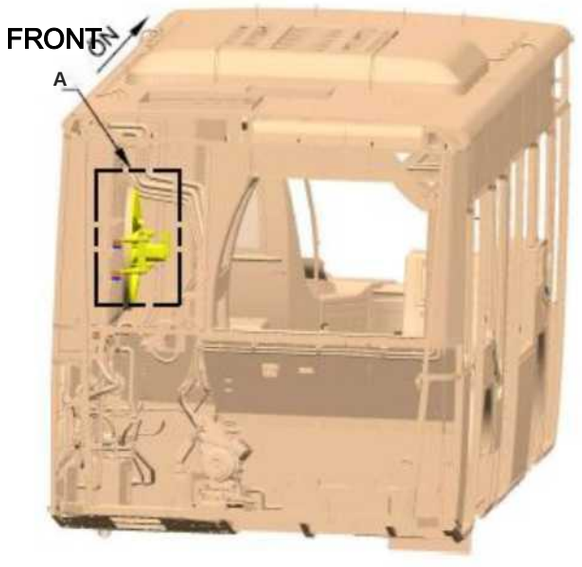


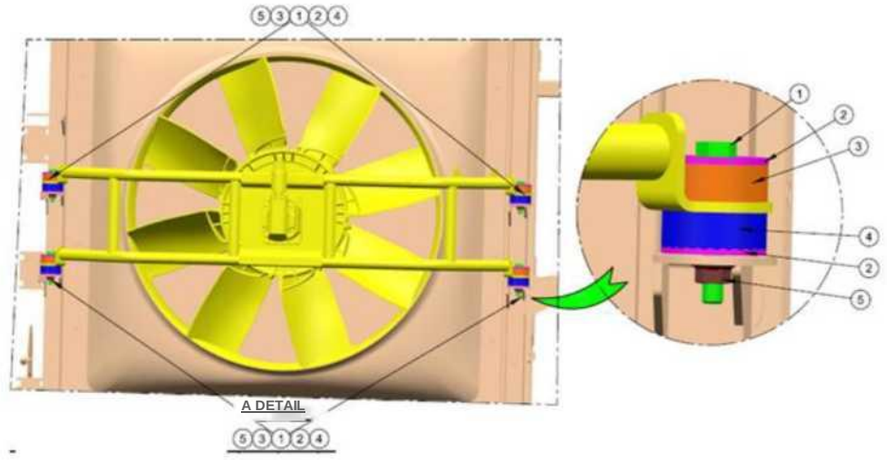


NUT SHOWN WITH X (M12X1,5) IS THE SECTOR SHAFT NUT OF THE HYDRAULIC MOTOR.

LEAF POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	033 – 033	3001308164'	BOLT , FLN MBX1.25X16. THICK D, DIN6921	6
2	033-011	3010100064*	WASHER , SPRINGY D=8 DİN 127	4
3	033 - 002	387034972'	CONNECTION PART , FAN	1
4	033-009	384301183*	MOTOR, HIDROLIK 05117250486	1
5	033-015	**384310977***	**BRACKET , ASSEMBLY**	1
6	033 -012	3005000064*	NUT , AKB M8X1.25 THICK D DIN934	4
7	033-014	**3000108354**	BOLT , AKB M8X 1,25X35. THICK D, DIN933	4
8	033-001	387034784"	FAN, RADIATOR	1
9	033-010	**3010000064**	WASHER . FLAT D=8 DIN 125	4

FAN ASSEMBLY VEHICLE ASSEMBLY

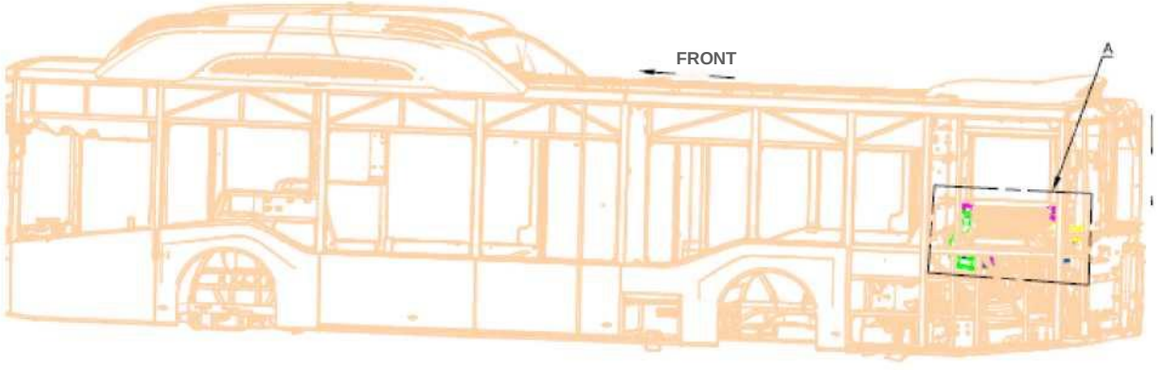


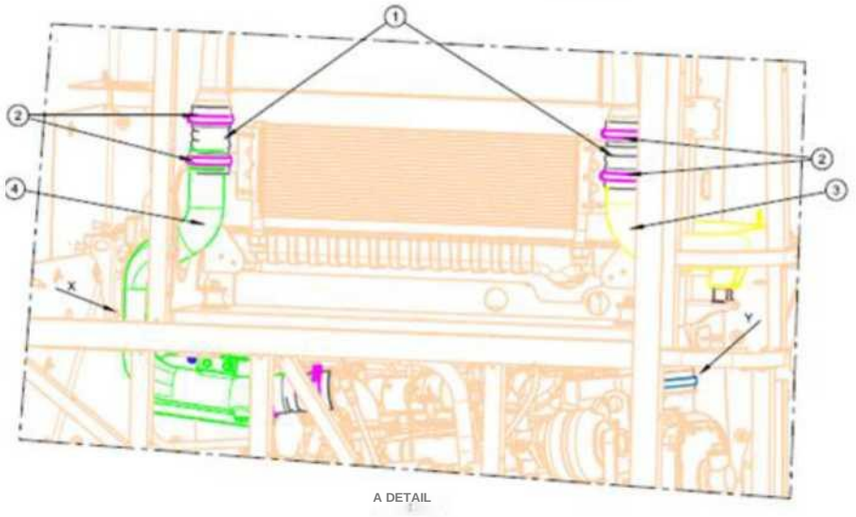


LEAF POSE	GROUP/PÖSE	PART NO	COMPONENT'S NAME	NUMBER
1	033-004	3000310704'	BOLT , AKB M10X1,5X70, THICK D. DİN931	4
2	033-013	3870476600*	WASHER. FLAT	8
3	033-008	894457277*	HANGER **KMP** EXHAUST SUPPRESSOR	4
4	033-007	894457278*	HANGER **KMP.** EXHAUST SUPPRESSOR	4
5	033-005	3005300104*	NUT , FLN&TR M10X1.5, THICK D. DİN6923	4

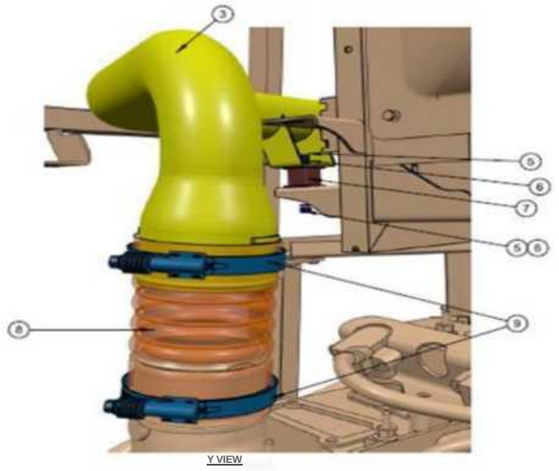
TURBOCHARGER SYSTEM ASSEMBLY

INSTALLATION OF TURBO FAN HOSES

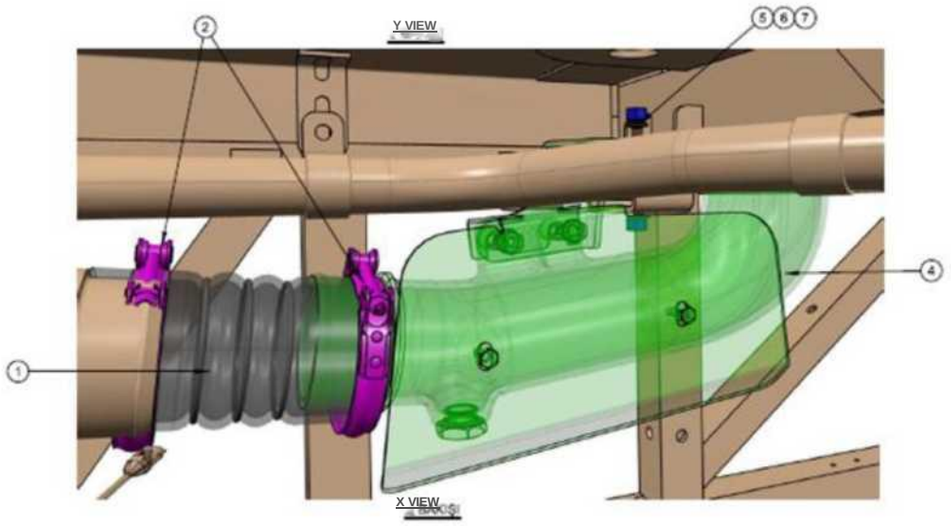




A DETAIL



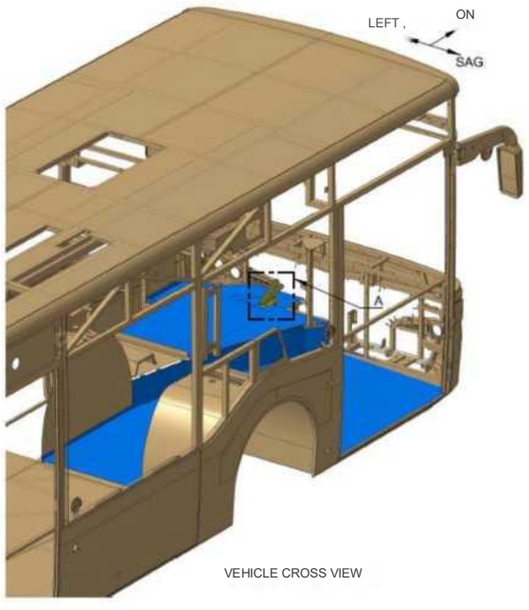
Y VIEW



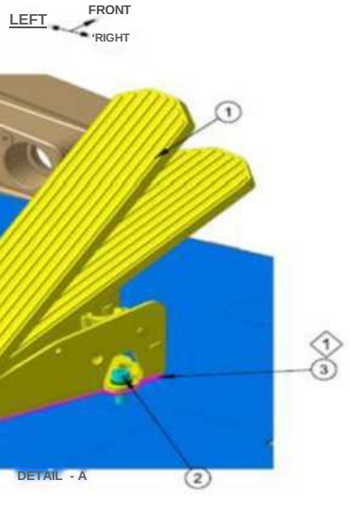
LEAF POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	036 - 006	387033564*	HOSE . INTERCOOLER SPRINGY	3
2	036 -017	3870388750*	CLAMP	6
3	036-011	**38704402***	PIPE . ASSEMBLY INTERCOOLER OUTLET 9940435	1
4	036-001	387044025*	PIPE , INTERCOOLER INPUT	1
5	036-005	3005000084*	NUT . AKB M8X1.25 THICK D. DIN934	4
6	036-003	3010000084*	WASHER, FLAT D=8 DIN 125	4
7	036-004	894158155	WEDGE AIR PIPE LOWER	2
8	036-007	387044029	HOSE , INTERCOOLER SPRINGY	1
9	036-018	3870467180	CLAMP	2

GAS PEDAL

GAS PEDAL MOUNTING



VEHICLE CROSS VIEW



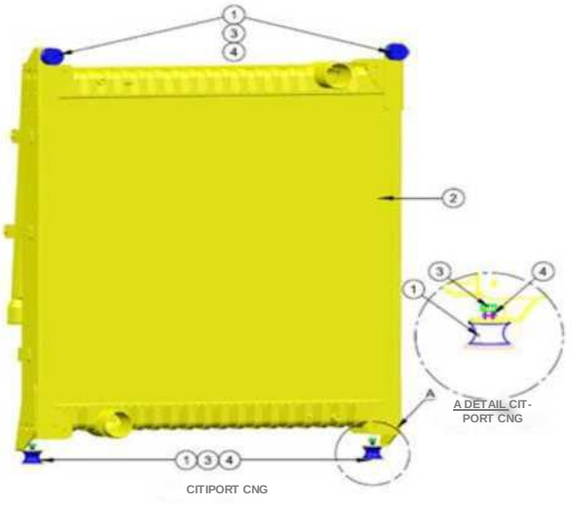
DETAIL - A

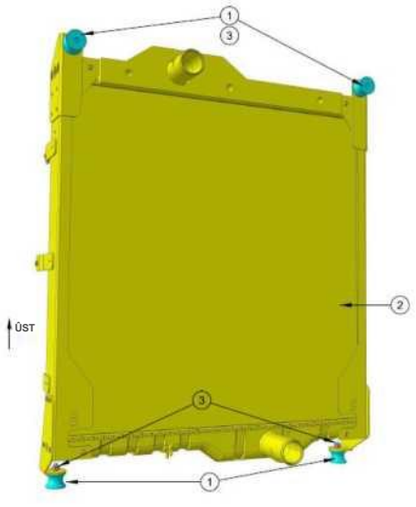
THE NUTS TO WHICH BOLTS ARE ATTACHED ARE WELDED ON THE VEHICLE.

LEAF POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	101 - 010	387040571 *	PEDAL, GAS	1
2	101 -011	3000906351*	BOLT , SLB M6X35, THICK D. DİN912	2
3	101 - 012	387052043*	PED. PEDAL. GAS	1

RADIATOR AND HOOD INSTALLATION

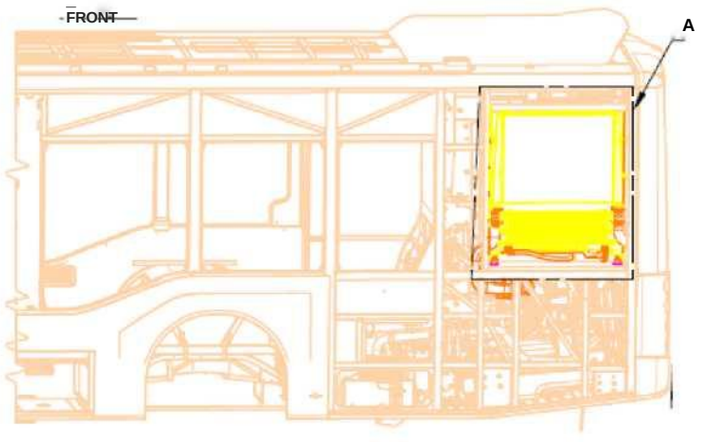
RADIATOR ASSEMBLY



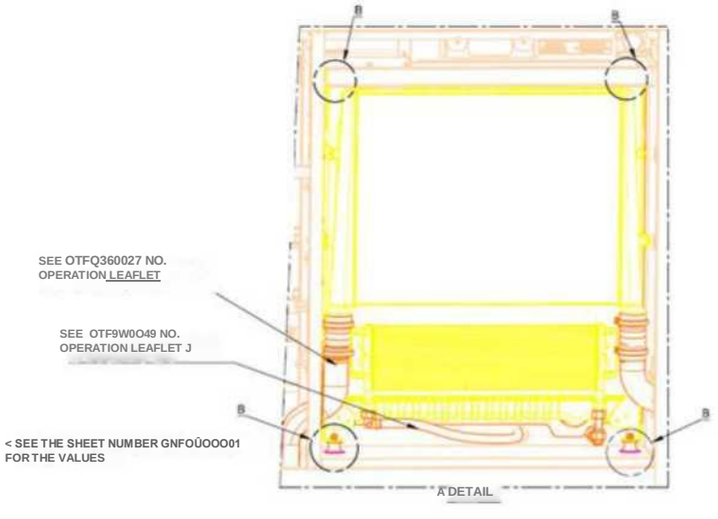


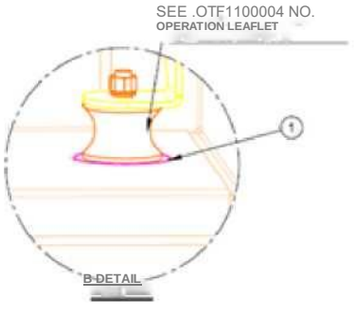
LEAFLET POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER	ADDITIONAL INFO
1	110-011	387038851"	RADIATOR MOUNTING	4	
1	110 - 003	387038851"	RADIATOR MOUNTING	4	CITIPORT CNG
2	110 - 001	387051810"	RADIATOR ASSEMBLY , INTERCOOLER, OIL COOL .	1	
2	110 - 015	387043831"	COOLING UNIT	1	CITIPORT CNG
3	110 - 007	3005000104*	NUT . AKB M10X1.5. THICK D. DIN934	4	
3	110 - 019	3005000106"	NUT . AKB M10X1, 5. THICK D, DİN934	4	
4	110 - 005	3010000084"	WASHER , FLAT D=8 DİN 125	4	CITIPORT CNG

INSTALLATION OF THE RADIATOR ASSEMBLY ON THE VEHICLE



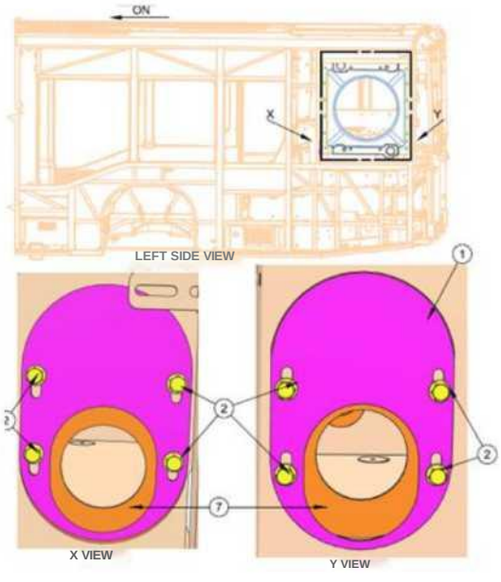
LEFT SIDE VIEW

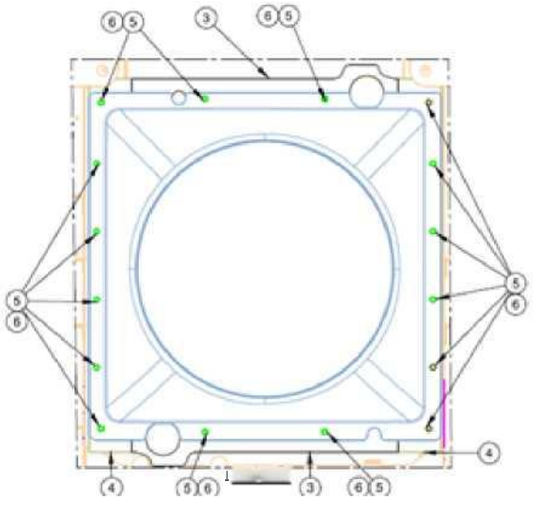




LEAF POSE	GROP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	110-002	3870360920*	WASHER	4
2				

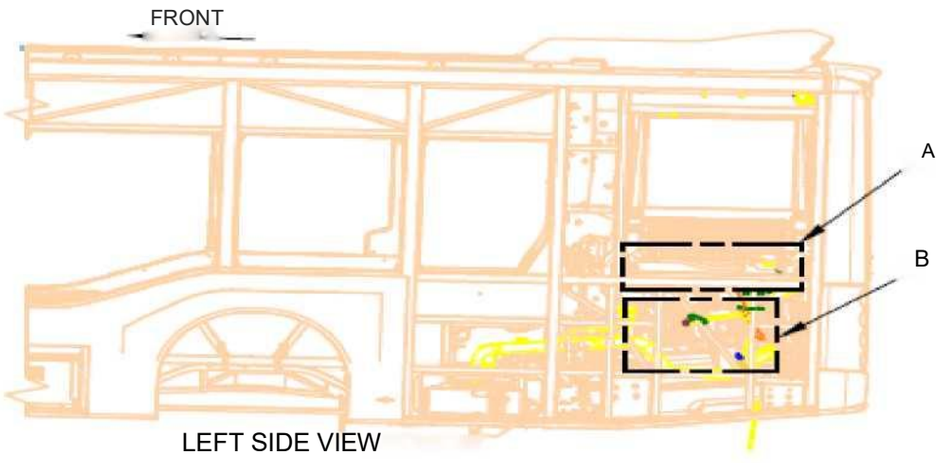
RADIATOR INSTALLATION



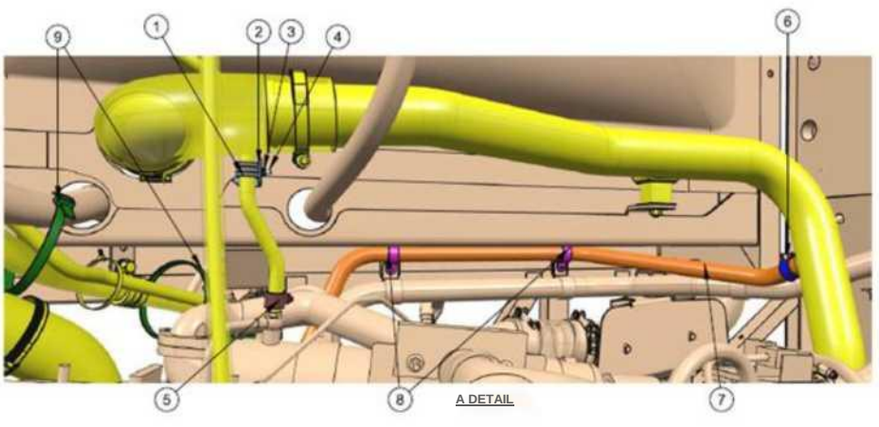


LEAFLET POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	110 - 009	387039388"	COVER, RADIATOR SACLAMA	2
2	110 - 008	3001208164*	BOLT . FLN MBX1.25X16, THICK D. DIN6921	8
3	110-011	387044482*	ISOLATION. RADIATOR	2
4	110-010	367044481*	ISOLATION. RADIATOR	2
5	110 - 004	3000108164*	BOLT . AKB M8X1.25X16, THICK D. DİN933	16
6	110 - 005	3010000084*	WASHER . FLAT D=8 DIN 125	16
7	110 - 014	387045404*	SILICON , RADIATOR	2

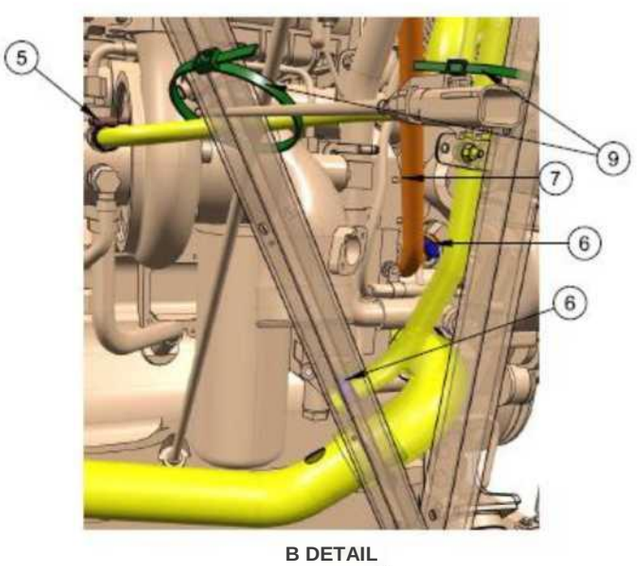
INSTALLATION OF RADIATOR HOSES INTO VEHICLES



LEFT SIDE VIEW

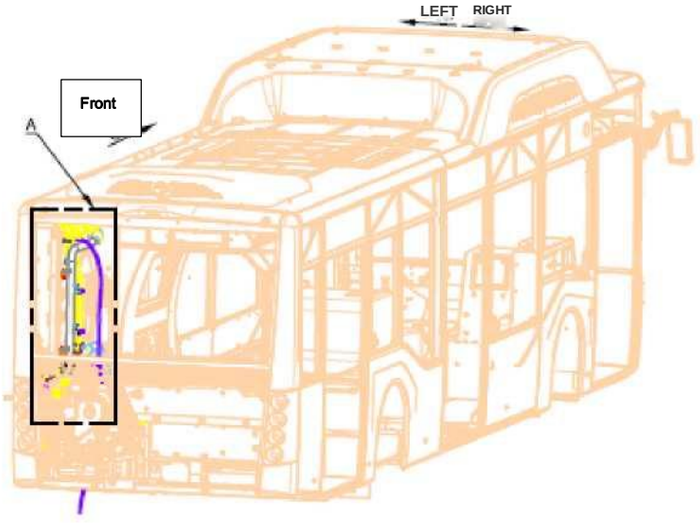


A DETAIL

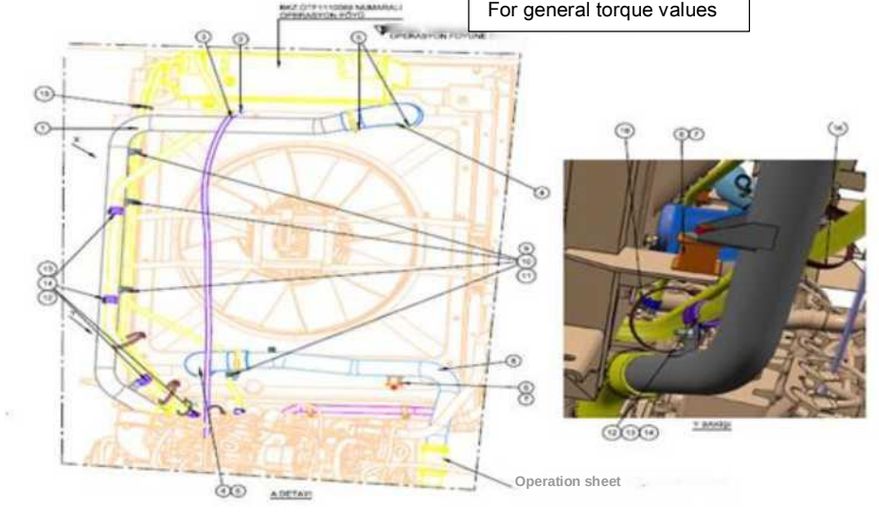


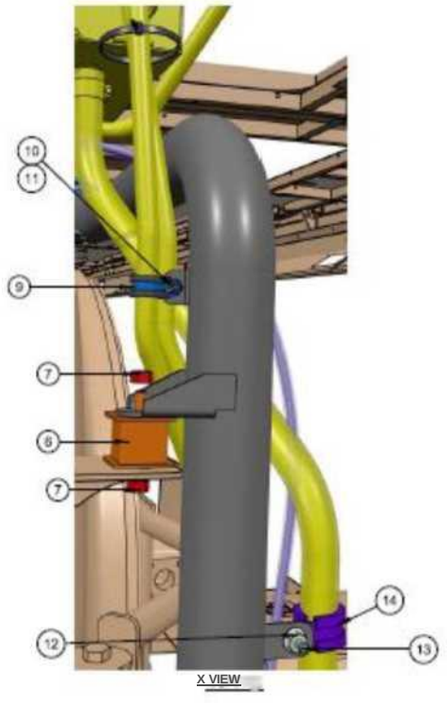
B DETAIL

LEAFLET POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	111 - 057	387036601*	CLAMP , 18/12 W4 (5318)	1
2	111 - 064	387046756*	BRACKET	1
3	111 - 058	3005000054*	WASHER . SPRINGY D=5 DİN 127	5
4	111 - 060	3005000054*	NUT . AKB M5X0.8 THICK D. DIN934	5
5	111 -018	3053016256*	CLAMP , SCREW B12 016-25. DIN3017	2
6	111 - 017	3053020326*	CLAMP , SCREW B12. 020-32, DIN3017	2
7	111 - 012	387386085*	HOSE , BYPASS	1
8	111 -020	3870175800*	CLAMP , 028	2
9	111 - 065	5097070300*	PL. STRIP CLAMP - 250	4
10	111-061	3000105164*	BOLT . AKB M5X0.8X16, THICK D. DIN933	5



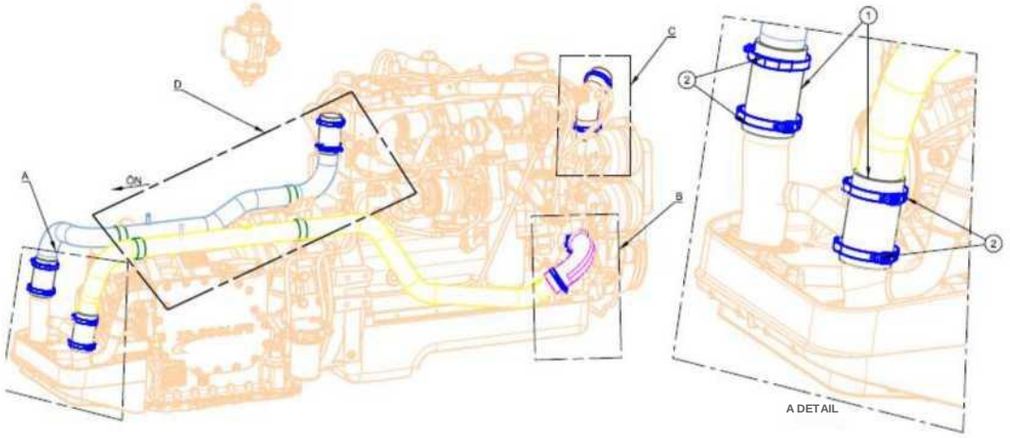
For general torque values

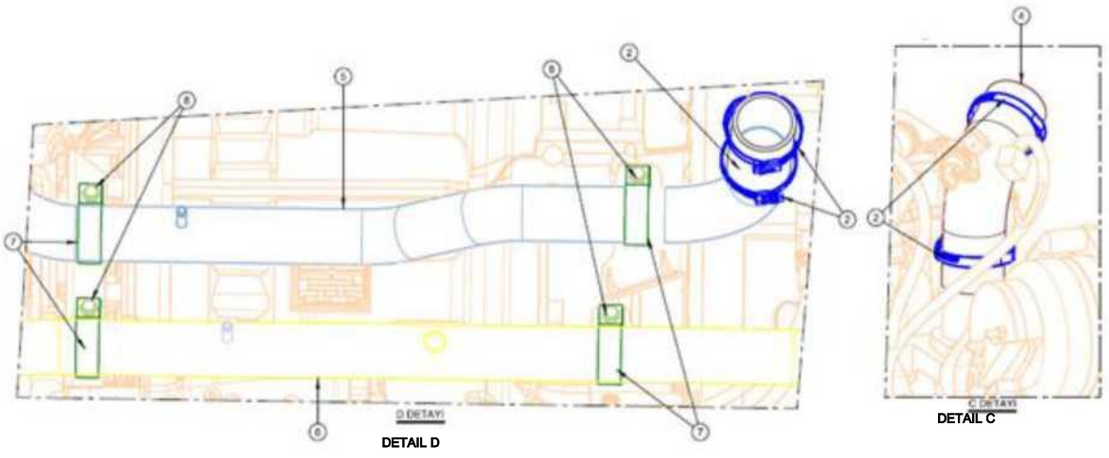




LEAF/POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	111 -026	387044252*	PIPE. ASSEMBLY ENGINE WATER OUTLET 9940436	1
2	111-046	3053512168*	CLAMP SCREW BE. 89, ø1-16 DIN 3017	2
3	111-045	384052109	HOSE EXPANSION DRAINAGE , 2625MM	1
4	111-001	387044052	HOSE , RADIATOR INPUT	2
5	111-015	387014000	CLAMP 80-80	4
6	111-014	894158155	WEDGE , AIR PIPE LOWER	3
7	11-022	3005000084	NUT . AKR M8X 1,25 THICK D. DIN934	6
8	111 -030	387044928*	PIPE , ASSEMBLY RADIATOR OUTLET 9940438	1
9	111-057	3870366010	CLAMP . 18/12 W4 (6318)	8
10	111 - 060	3005000054'	NUT , AKB M5XD.B, THICK D U. HINM*	5
11	111-061	30M105164'	BOLT , AKB M5X0,8X16, THICK D. DIN933	5
12	111-023	3005800084'	NUT , FLN&TR M8X1.25 THICK D, DIN6923	9
13	111-024	3001208254	BOLT , FLN M8X 1.25X25, THICK D. DİN6921	9
14	111-016	3870394290*	CLAMP ø29	S
15	111-019	37JJ70W50*	PLASTIC CLAMP L350 MM	2
16	111-065	5007070300*	PL. STRIP CLAMP - 250	6

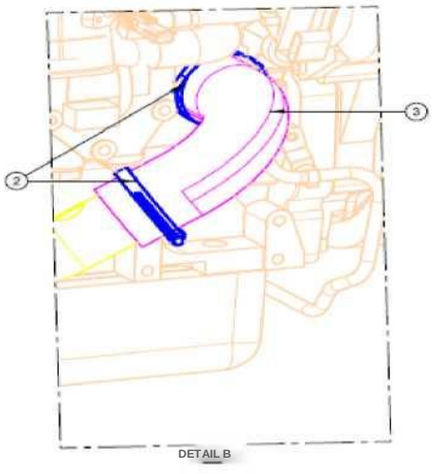
INSTALLATION OF RADIATOR HOSES ON THE ENGINE





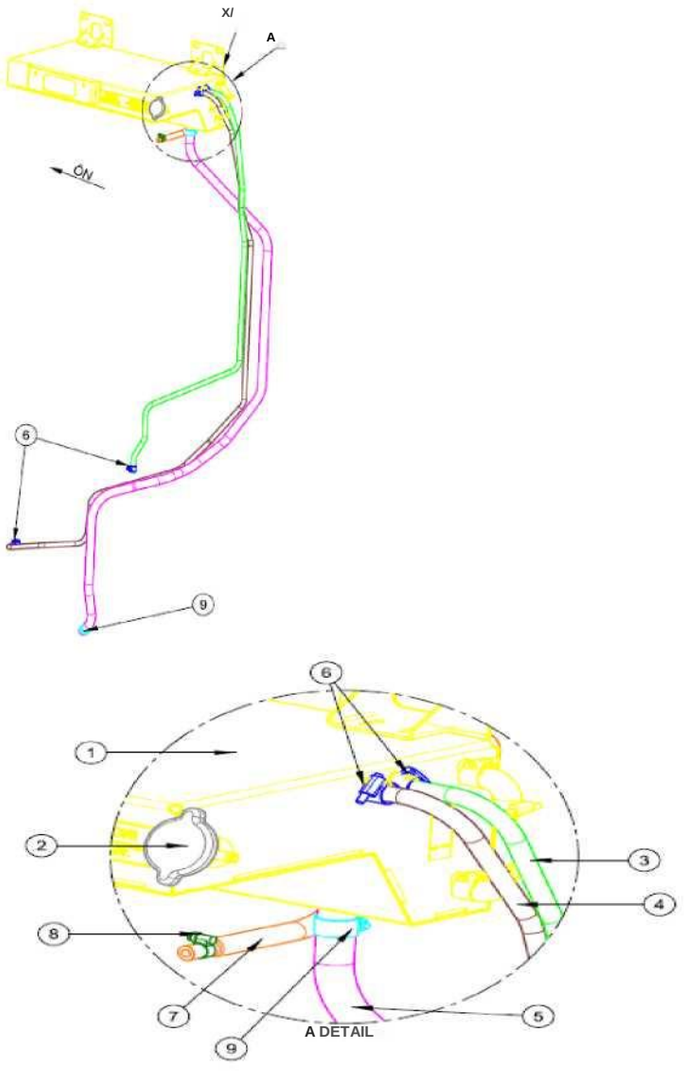
DETAIL D

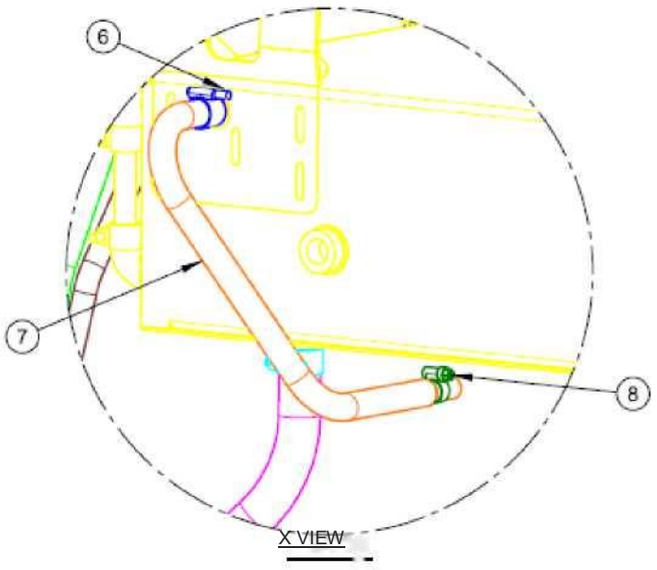
DETAIL C



LEAF POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	111-004	3a7Ol45&r	HOSE RADIATOR OUTLET PIPE CONNECTION	4
2	111 -015	WTO140WT	CLAMP 80-80	10
3	111-003	**347OW375***	**HOSE ENGINE WATER INPUT**	1
4	111 - 002	334336370"	HOSE ENGINE WATER OUTLET	1
5	111-034	347045931*	**PIPE KMP. TRANSMISSION INPUT**	I
6	111 -037	397D4*Û&S^{J}	PIPE KMP ENGINE INPUT	1
7	**111-005**	MM 36170*	**CLAMP Ø60**	4
S	111 -024	3001203254*	BOLT , FLN M8X 1,25X56. THICK D, din 6921	4

EXPANSION TANK HOSES INSTALLATION

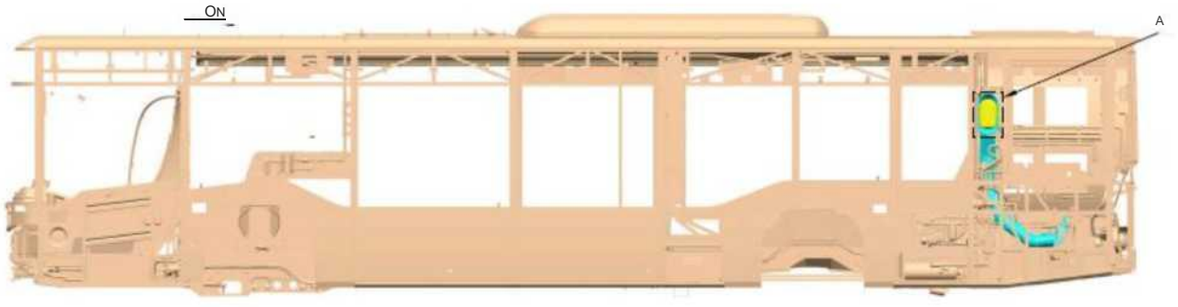


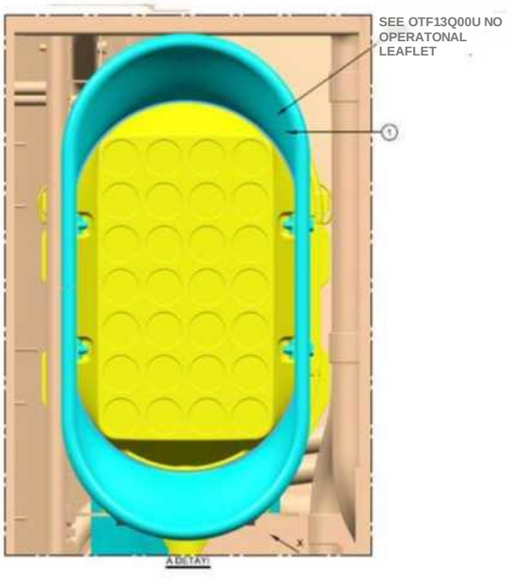


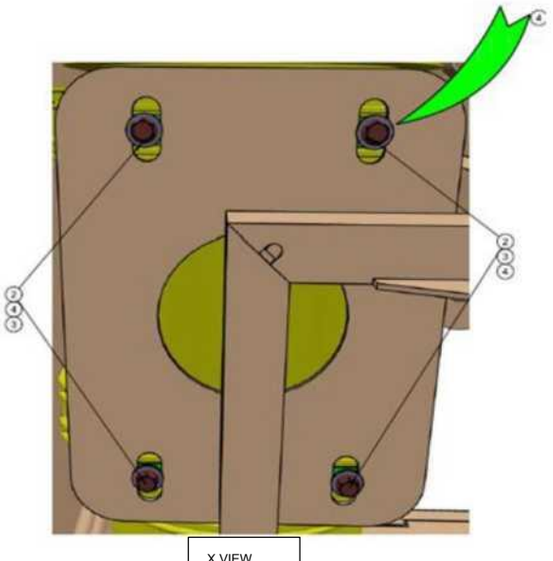
LEAFLET POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	111-042	3B70441D1'	TANK KMP, EXPANSION	1
2	111-006	387039036*	COVER, EXPANSION TANK 1 BAR	1
3	111-013	387044425*	HOSE. EGR VENTILATION	1
4	111-010	387044426*	HOSE. ENGINE VENTILATION	1
5	111-009	387044473"	HOSE .RADIATOR VENTILATION.	1
6	111-018	305301625601	CLAMP , SCREW B12. Ø16-25, DİN3017	5
7	111-009	387044473*	HOSE .RADIATOR VENTILATION.	1
8	111-067	3053512208*	CLAMP , SCREW B9, Ø12-20, DIN3017	1
9	111-017	3053020326*	CLAMP . SCREW B12 Ø20-32, DIN3017	2

AIR FILTER

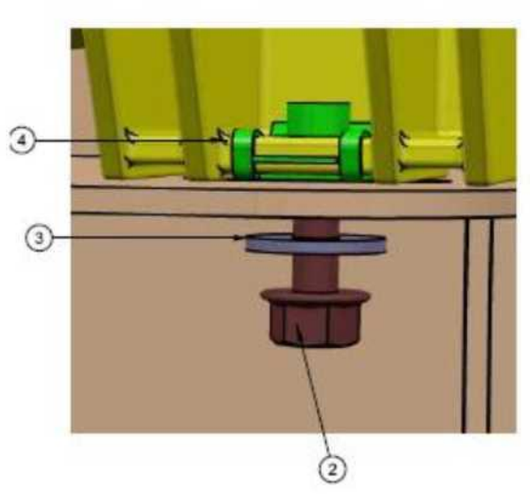
AIR FILTER INSTALLATION



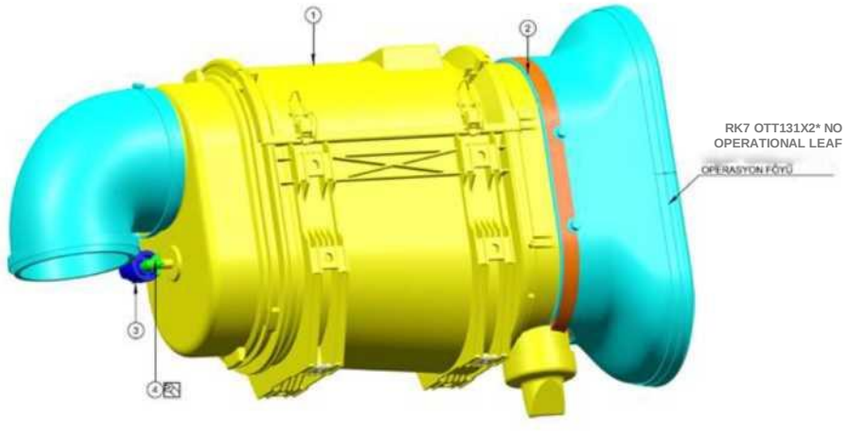




X VIEW

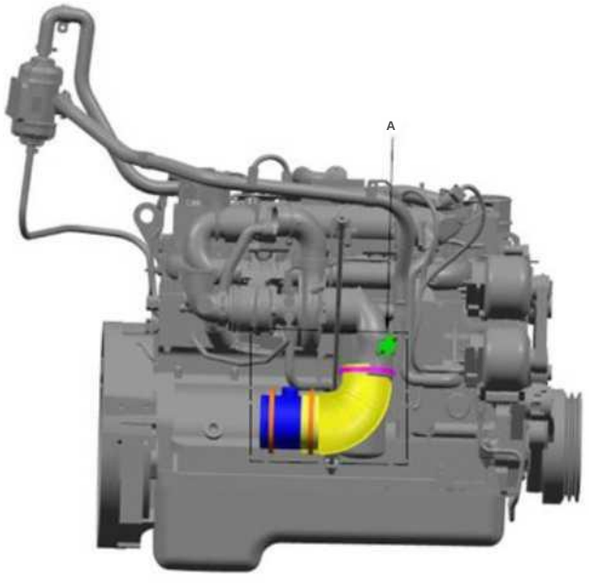


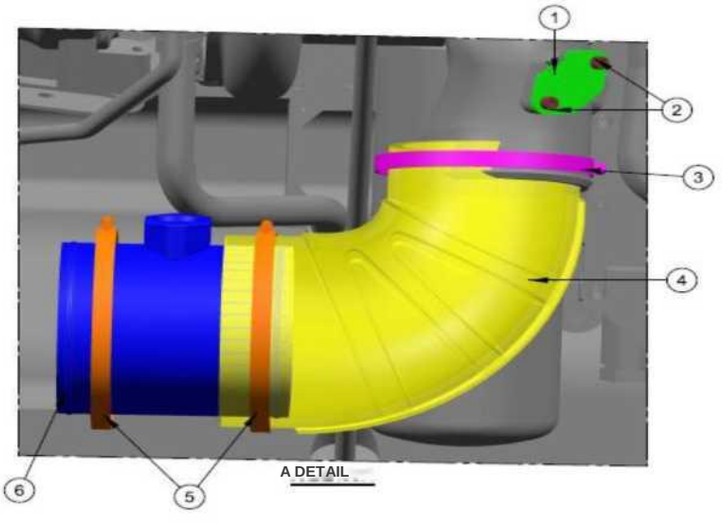
LEAF/POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	ADLİ
1	130-005	M705B&ZT	FILTER SUCTION AIR	1
2	130-013	3Ö012&a2ÛS*	BOLT , FLN M8X 1X20, THICK D DIN6921	4
3	130-012	3011100054*	WASHER FLAT D6 DIN 9021	4
4	130-10	3670387940*	METRIC SCREW CLIP, M6X1.	4



LEAFLET POSE	GROUP.'POSE	PART NO	COMPONENT'S NAME	NUMBER
1	130-005	387056320"	FILTER, SUCTION, AIR	1
2	130-011	387027859*	TAPE, ADHESIVE SEAL 5X19.	1M
3	130-006	367059502*	INDICATOR, LIMITER	1
4	130-009	387371438*	INDICATOR, LIMITER.	1

INSTALLATION OF AIR SUCTION HOSE ON THE MOTOR

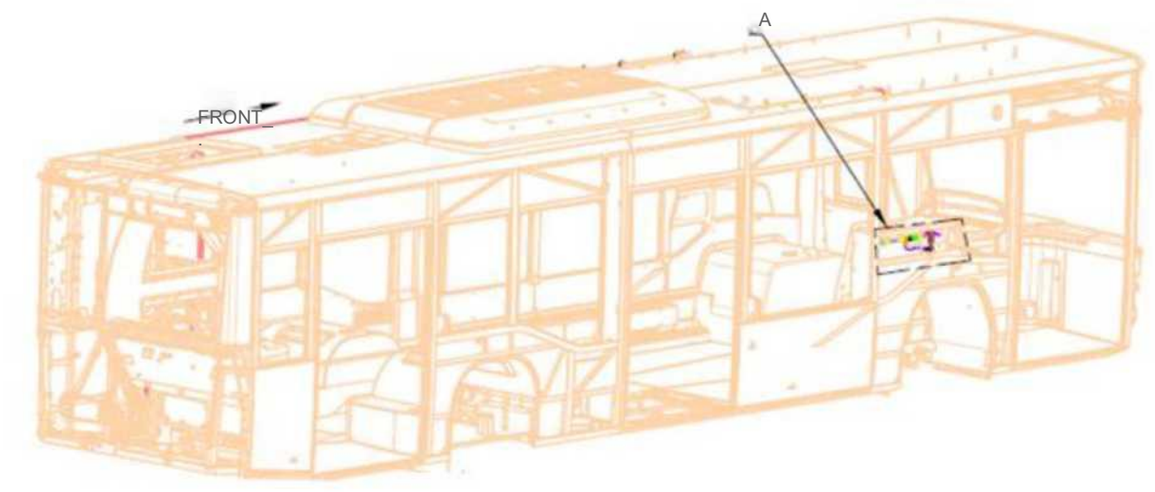


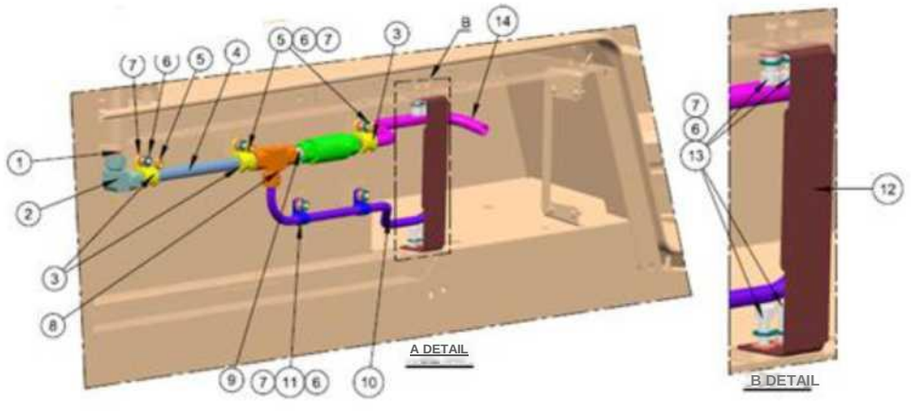


LEAFLET POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	PIECE
1	131 - 022	3B705O734'	PLATE, AIR SUCTION BRACKET	1
2	131 - 020	3000906153*	BOLT . SLB M6X15. THICK D. DİN912	2
3	131 - 007	3053001100*	CLAMP , SCREW B12 ø110-130 DIN3Ü17	1
4	131 - 001	387044272*	HOSE. AIR SUCTION	1
5	131 - 006	3053001306*	CLAMP . SCREW B12. ø130-150. DİN3017	2
6	131 - 029	3B70543SO*	ADAPTER. AIR SUCTION KMP	1

FUEL PIPES ALL

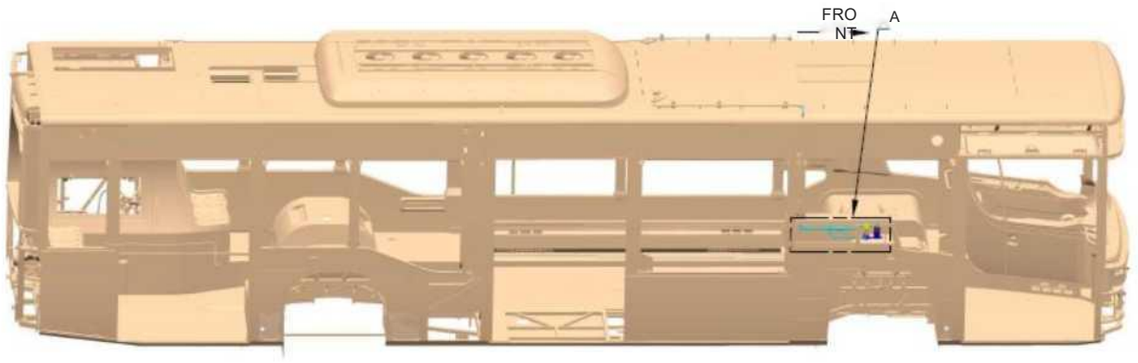
RIGHT FUEL FILLING PIPE INSTALLATION

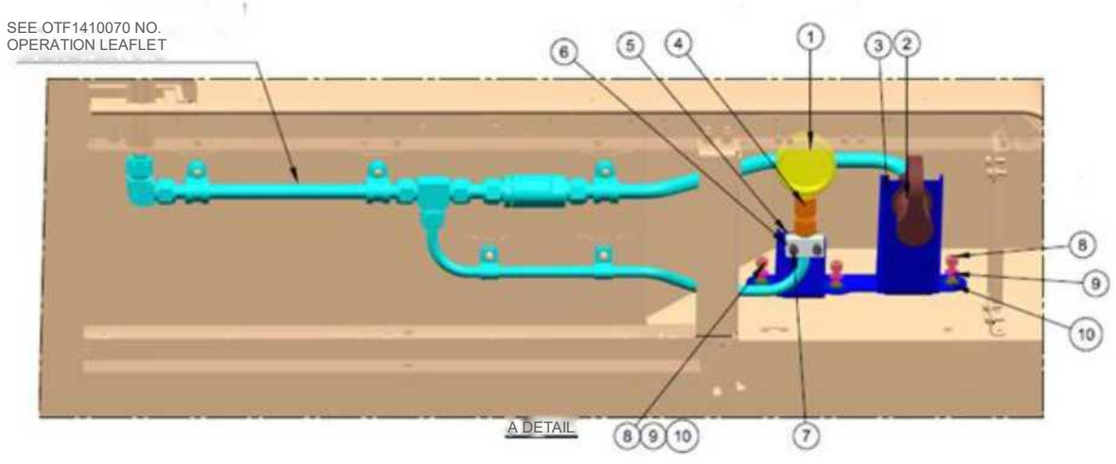




LEAF POSE :	GROUP/POSE	PART. NO	COMPONENT'S NAME	NUMBER
1	141 - 001	384327977*	PIPE . CNG	1
2	141 - 001	387673904*	BRACKET FITTING Ø16 (DK I OK/DI - 16M-S)	1
3	141 - 074	3870402910-	CLİPS. Ø16 M8	3
4	141 - 013	387044255*	PIPE CNG	1
5	141 - 170	3005100084"	NUT . AKB M8X1 THIN D. DIN934	5
6	141 - 088	3010100084"	WASHER . SPRINGY D=8 DİN 127	9
7	141 - 068	3010000084*	WASHER , FLAT 0 = 8 DİN 128	9
8	141 - 018	387680374'	CONNECTION. 10-12-10 (DK- LOK/DTR16M 16M	1
9	141 - 017	387933319*	PIPE CNG	1
1O	141 - 019	387044257*	PIPE CNG	1
1 -i	1141 - 075	3870359810*	CLIP , Ø12	2
12	141 - 026	387044261"	BRACKET . LİD STAY	1
13	141 - 066	3000908254"	BOLT , SLB M8X25 THICK D. DIN912	4
14	141 - 014	387044256*	PIPE . CNG	1

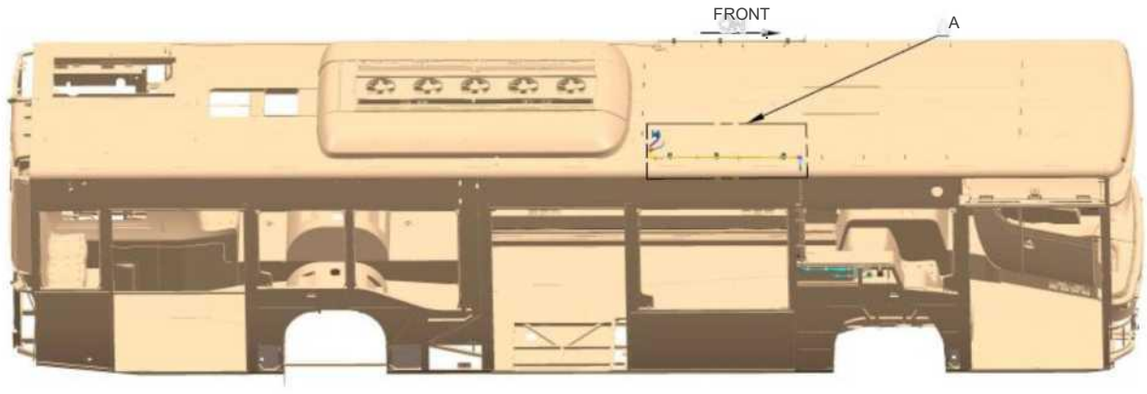
RIGHT FUEL FILLING NOZZLE AND INDICATOR INSTALLATION

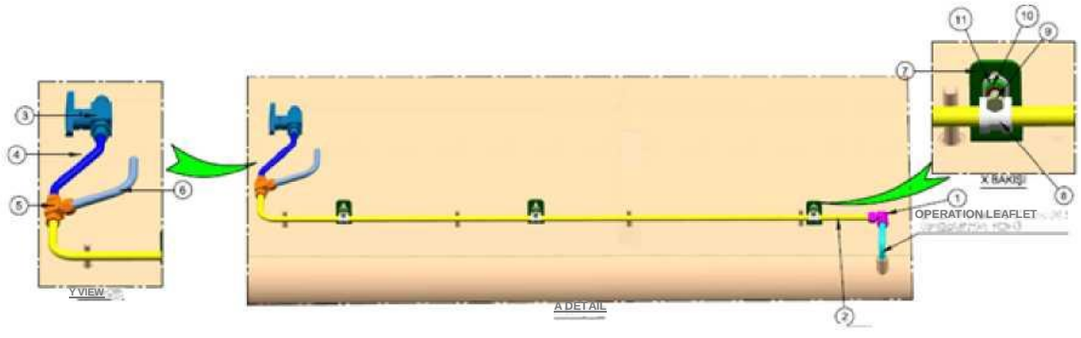




LEAFLET POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	141-024	387033640*	GAUGE, FUEL PRESSURE	1
2	141-015	387895017*	NGV2 FILLING NOZZLE (Ptec-B37G3)	1
3	141-022	387044260*	BRACKET . CNG FILLING NOZZLE	1
4	141-023	387905627*	INDICATOR CONNECTOR (DK-LOK/DCF12M	1
5	141-020	387044258*	CLAMP , PIPE	1
6	141-021	387044259*	CLAMP , PIPE	1
7	141 - 069	3000906304*	BOLT , SLB M6X30, THICK D, DIN912	2
8	141-066	3000908254*	BOLT , SL B M8X25 THICK D. DIN912	3
9	141-088	3010100084'	WASHER . SPRINGY D=8 DİN 127	3
10	141-069	3010000084'	WASHER . FLAT D-8 DİN 125	3

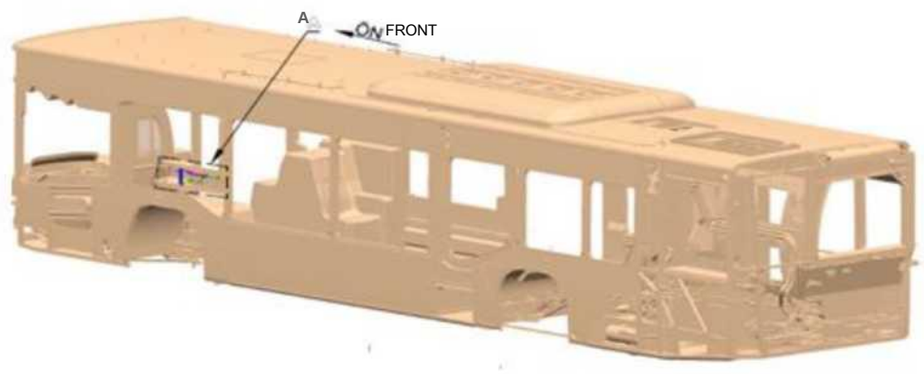
RIGHT TOP FUEL PIPES INSTALLATION

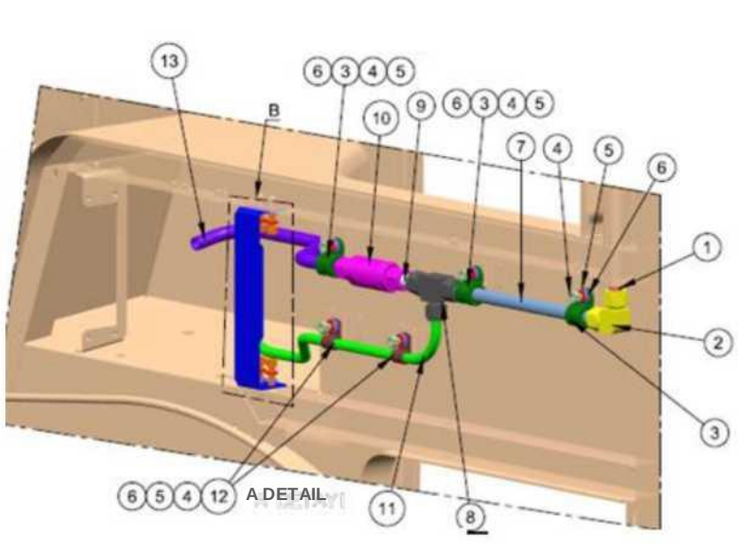


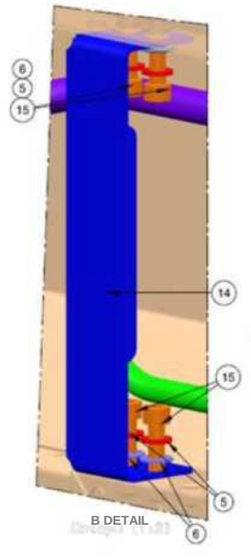


LEAFLET POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	141 -001	387673904*	BRACKET FITTING Ø16 (DK-LOK/DL- 16M-S)	1
2	141 - 084	387925053*	PIPE CNG	1
3	141 - 064	367678136*	Ø16 VALVE, MANUAL CLOSING(DK-LOK/VCH86-D	1
4	141 - 012	387925057*	PIPE . CNG	1
5	141 -003	387673905*	T CONNECTION , 16-16-16 (DK-LOK/DT-16M)	1
6	141 - 011	387925052*	PIPE . CNG	1
7	141 -074	3870402910*	**CLIP, Ø16 M8**	3
8	141 - 092	384328526*	BRACKET , FUEL LINE	3
9	141 - 168	3000108254*	BOLT , AKB M8X1.25X25. THICK D, DIN933	3
10	141 -086	3010100084'	WASHER . SPRINGY D=8 DİN 127	3
11	141 -OE8	3010000084'	WASHER . FLAT D=8 DİN 125	3

LEFT FUEL FILLING PIPES INSTALLATION

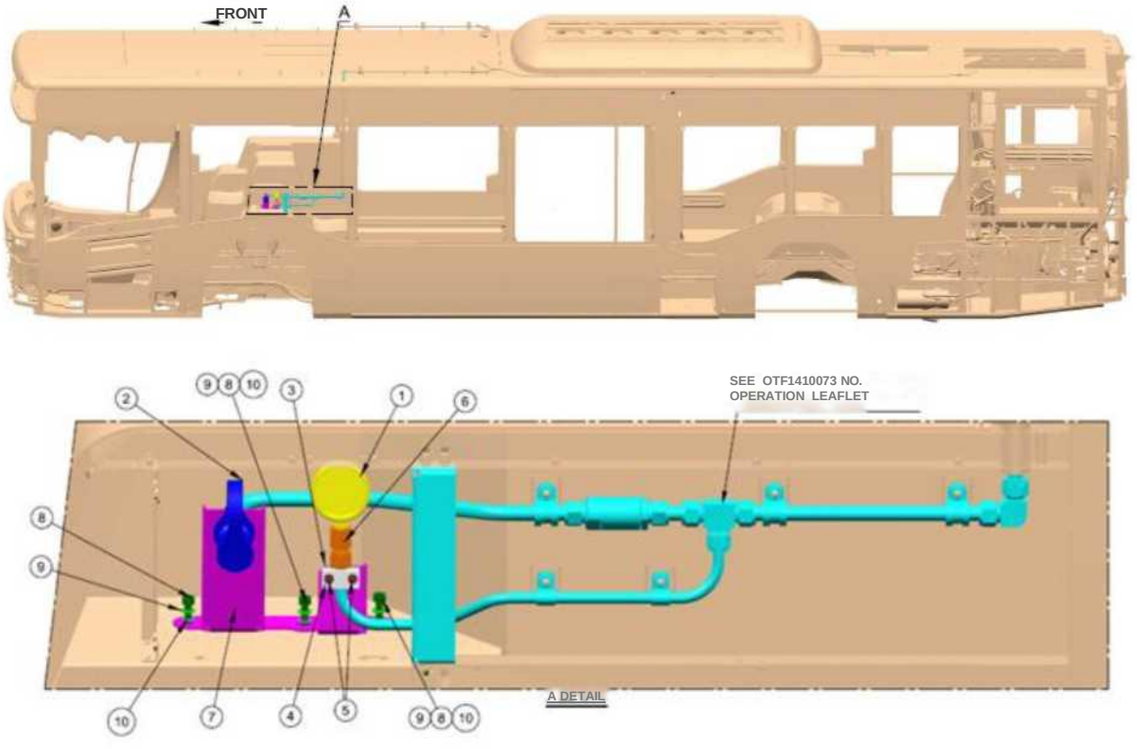






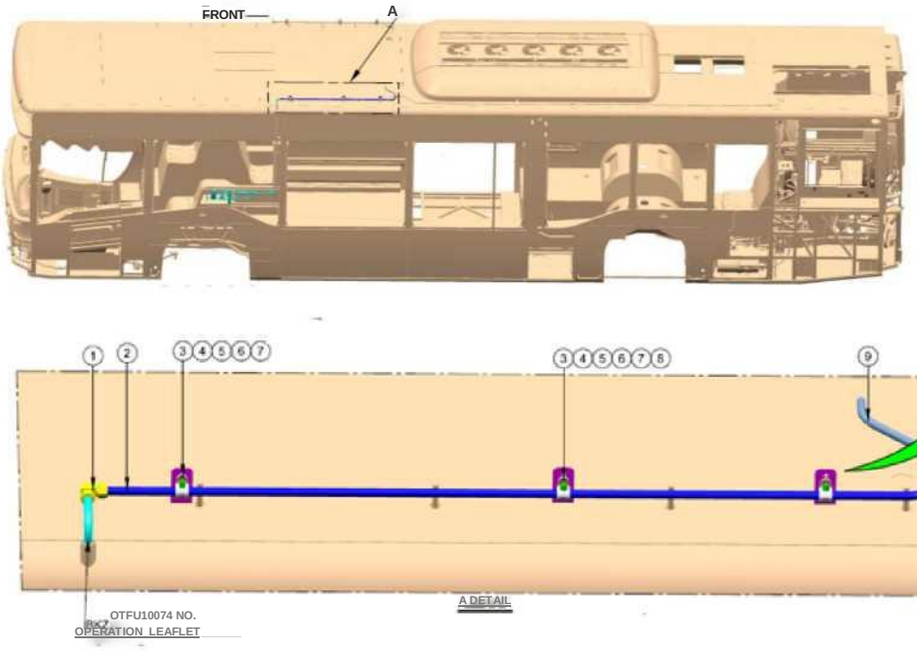
LEAF POSE	GROUP-POSE	PART . NO	COMPONENT'S NAME	NUMBER
1	14 1 - 061	384327977"	PIPE . CNG	1
2	14 1-001	387673904*	BRACKET FITTING Ø16 (OK I OK/DI - 16M-SJ	1
3	14 1 - 074	3870402910'	CLIP , Ø16 M8	3
4	14 1-170	3005100084*	NUT . AKB M8X1 THIN D. DIN934	5
5	14 1 - 088	30101**00084"**	WASHER . SPRINGY D=8 DİN 127	9
6	14 1 - 088	3010000084"	WASHER . FLAT D=8 DİN 125	9
7	14 1-013	387044255*	PIPE CNG	2
8	11 -4 1-018	387680374"	T CONNECTION, 16-12-16 (DK-LOK/DTR16M-1I6M-	1
9	14 1-017	387933319'	PIPE CNG	1
10	14 1 -016	387033647"	SAFETY VALVE . FUEL PRESSURE	1
11	14 1 - 028	387044263"	PIPE . CNG	1
12	14 1 - 073	3870359810'	CLIP , Ø12	2
13	14 1 - 0213	387044264*	PIPE . CNG	1
14	14 1 - 026	387044261'	BRACKET, LİD STAY	1
15	14 1 - 066	3000908254*	BOLT . SLB M8X25. THICK D. DIN912	4

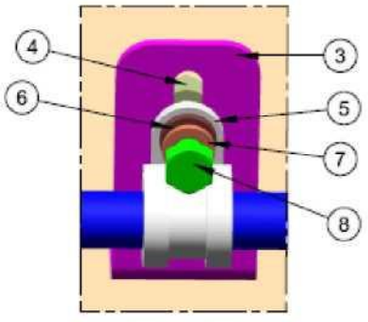
LEFT FUEL FILLING NOZZLE AND INDICATOR INSTALLATION



LEAFLET POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	141 - 024	387033640*	GAUGE, FUEL PRESSURE	1
2	141 -015	387895017*	NGV2 FILLING NOZZLE (Ptec-B37G3)	1
3	141 - 020	387044258*	CLAMP , PIPE	1
4	141 - 021	387044259*	CLAMP . PIPE	1
5	141 - 069	3000906304*	BOLT . SLB M6X30. THICK D. DİN912	2
6	141 - 023	387905627*	INDICATOR CONNECTOR (DK-LOK/DCF12M	1
7	141 - 027	387044262*	BRACKET . CNG FILLING NOZZLE	1
8	141 - 066	3000908254*	BOLT , SI B M8X25, THICK D. DIN912	3
9	141 - 088	3010100084*	WASHER . SPRINGY D=8 DİN 127	3
10	141 - 068	3010000084*	WASHER . FLAT D=8 DİN 125	3

LEFT TOP FUEL PIPES INSTALLATION

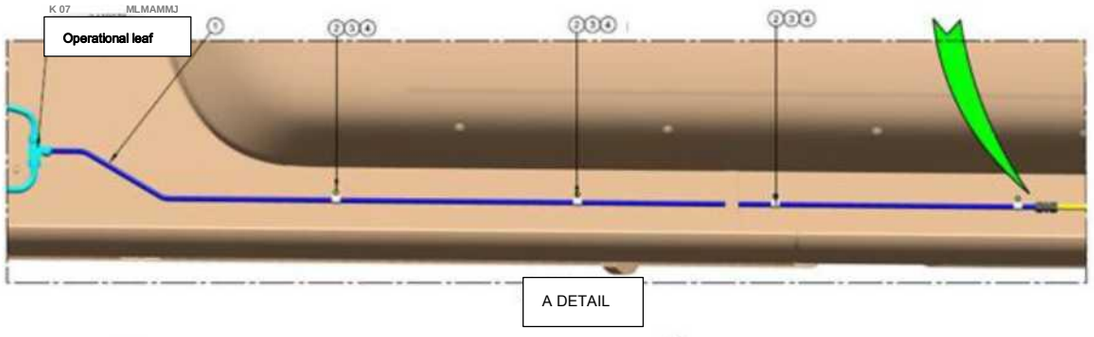


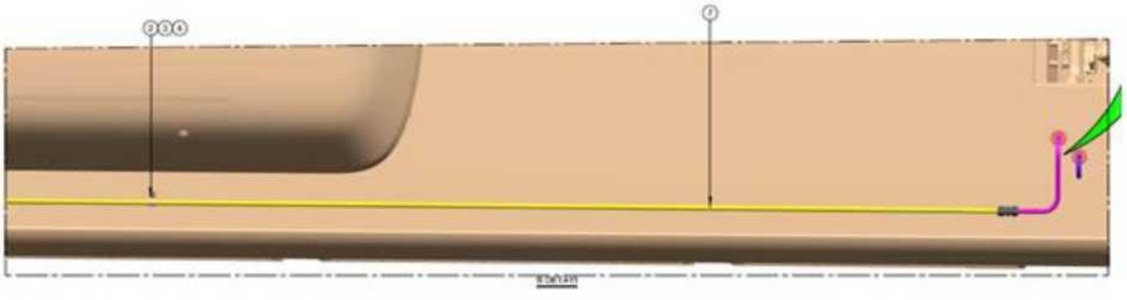


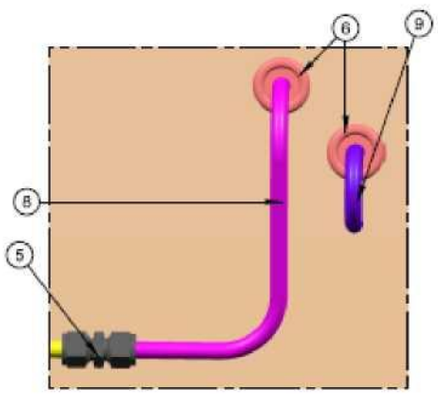
LEAF POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	141 - 001	387673904*	BRACKET FITTING (016 (DK-LOK/DL- 1I6M-S)	1
2	141 - 062	3B7923957*	PIPE :CNG	1
3	141 - 092	384328526*	BRACKET . FUEL LINE	3
4	141 -170	3005100084*	NUT , AKB M8X1 THIN D. DIN934	3
5	141 - 074	387040291 "	CLIP , Ø16 MÖ	3
6	141 - 068	3010000084*	WASHER . FLAT D=8 DİN 125	3
7	141 - 088	3010100084*	WASHER . SPRINGY D=8 DİN 127	3
8	141 -186	3000108254*	BOLT , AKB M 8X1.25X25, THICK D. DIN933	3
9	141 - 086	387923958*	PIPE , CNG	1
10	141 - 018	3876B0374"	T CONNECTION , 16-12-16 (DK- LO K.-DTR 1 EM—1 6 M-	1

LEFT SIDE FILLING PIPES INSTALLATION



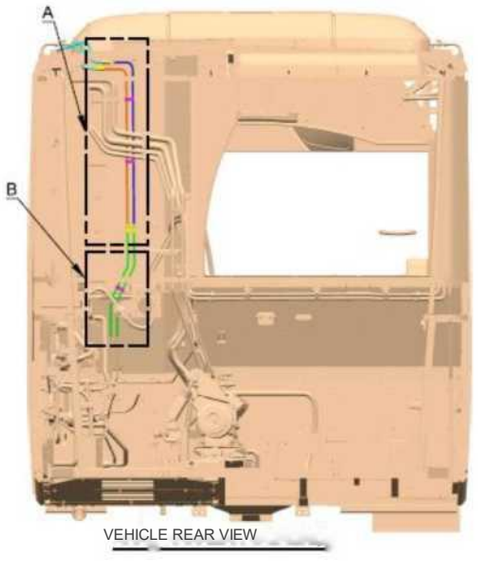


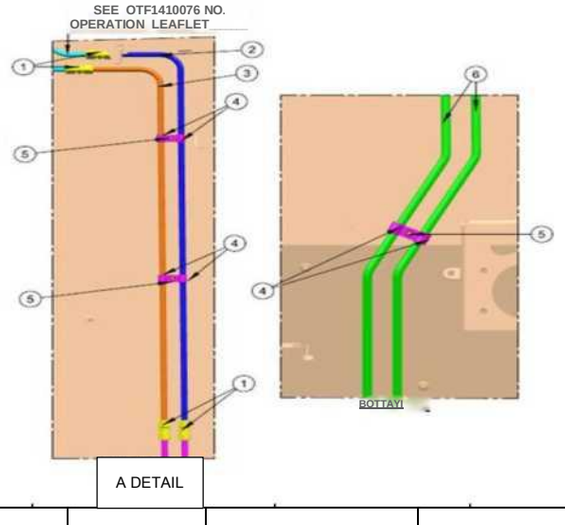




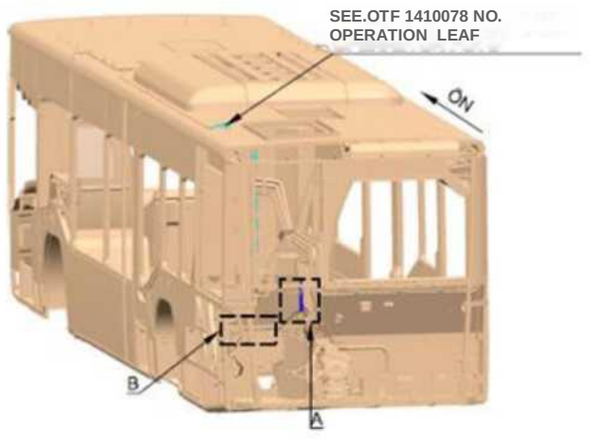
LEAF POSE	GROUP/ POSE	PART NO	COMPONENT'S NAME	NUMBER
1	141 - 106	397925054*	PIPE CNG	1
2	141 - 075	3870359816*	CLIP Ø12	6
3	141-082	3011100054	WASHER A5	5
4	141 - 076	3005000054'	NUT , AKB V5X0.8, THICK D. DIN934	5
5	141-006	387673900*	PIPE COUPLING FLAT Ø12 (DK-LOK/DU- 12M)	2
6	141 - 050	387025671	GROMMET	2
7	141 -107	387687733	PIPE, CHG	1
8	141 - 184	387918046	PIPE ,CNG	1
9	141 - 185	307923191*	PIPE , CNG	1

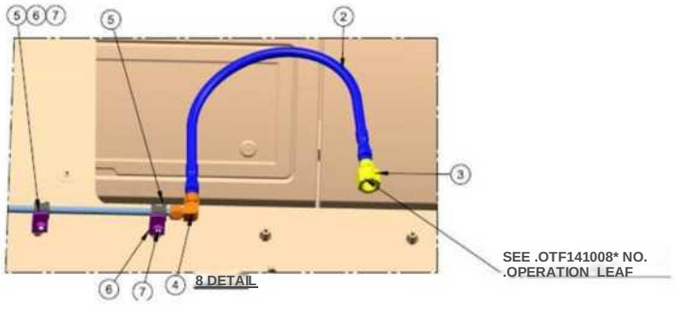
REAR FUEL PIPES INSTALLATION

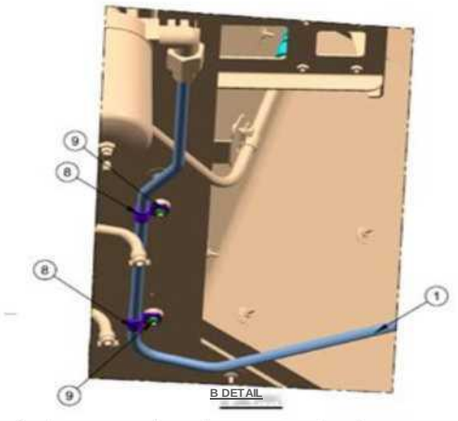




LEAFLET POSE	GROUP,'POSE	PART NO	COMPONENT'S NAME	NUMBER
1	141 -008	3B7S739D0'	PIPE COUPLING . FLAT ø12 (DK-LOK/DU 12M)	4
2	141 - 007	3B7806497*	PIPE CNG	1
3	141-043	387807127*	PIPE CNG	1
4	141-075	3870359810*	CLIP , ø12	6
5	141 - 079	3005000004"	NUT . AKB M6X1, THICK D. D|N934	3
6	141 - 039	3B7790448*	PIPE . CNG	2

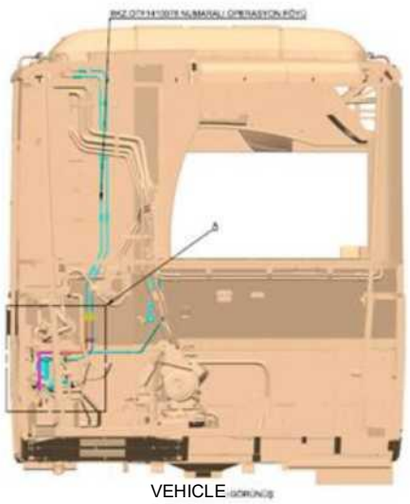




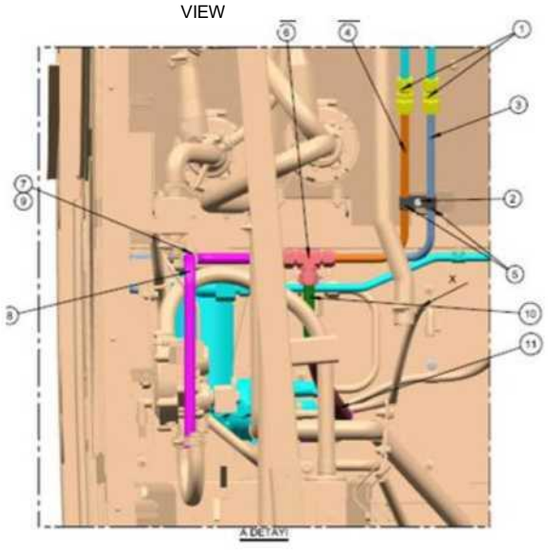


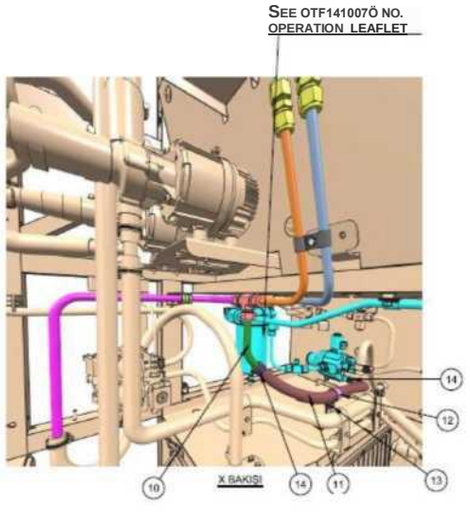
LEAF POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	141 - 038	387926533*	PIPE CNG	1
2	141 - 005	384303603'	FLEX HOSE ASSEMBLY	1
3	141 -004	387690739'	D|S| FITTINGS (DK-LOK/DCF12M- 10U)	1
4	141 -033	387673901*	BRACKET FITTING ø12 (DK-LOK/DL- 12M-S)	1
5	141 - 074	3870402910*	CLIP , ø16 M8	2
6	141 - 006	387044065'	BRACKET , HOSE	2
7	141 - 072	3000108164'	BOLT , AKB M8X1,25X16, THICK D. DIN933	2
8	141 -075	3870359810'	CLIP , ø12	2
9	141 -079	3005000064'	NUT . AKB M6X1 THICK D. DIN934	2

REAR FUEL PIPES INSTALLATION WITH PRE-HEATER

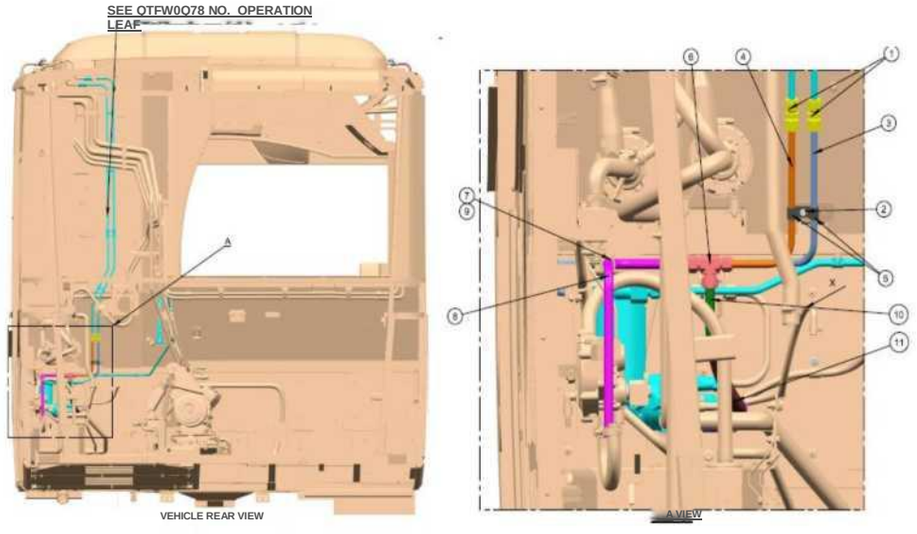


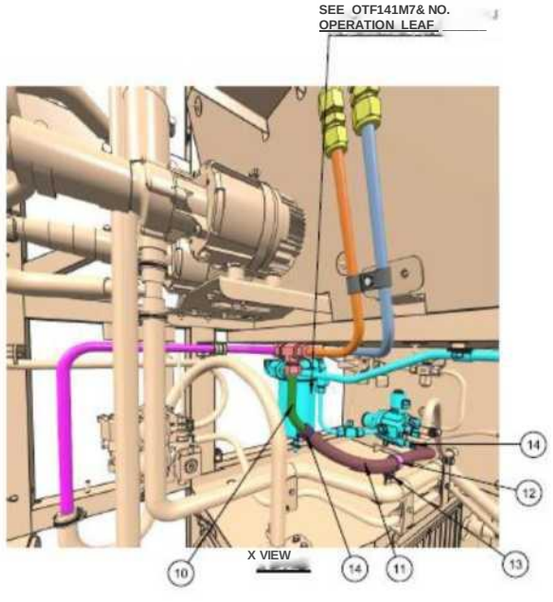
VEHICLE REAR VIEW





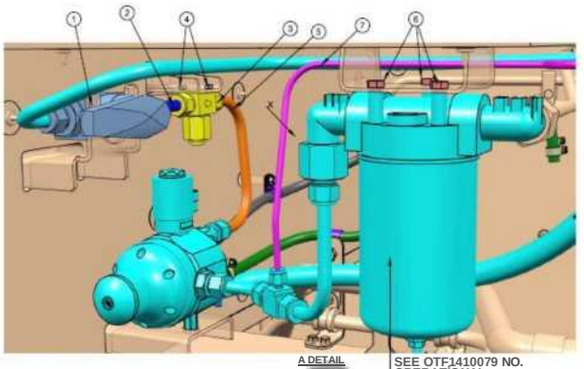
LEAFLET POSE	GROUP-POSE	PART NO	COMPONENT'S NAME	NUMBER
1	141-008	307673903*	PIPE COUPLING FLAT Ø12 DK-LOK./DU 12M)	1
2	141 - 080	3000106164'	BOLT, AKB M6X 1X16. THICK D . DIN933	1
3	1411 - 044	387910047*	PIPE CNG	1
4	141 - 193	387918045"	PIPE CNG	1
5	141-075	3870360810	CLIP , Ø12	2
6	141 - 192	387905629	T CONNECTION (DKJLQK/DTR12M 16M-16M	1
7	141-187	3870402910	CLIP , Ø16 M8	1
8	141 - 195	307923192"	PIPE CNG	1
9	141-079	3005000064	NUT . AKB M8X1. THICK DIN 034	1
10	141 - 197	307935913*	PIPE . CNG	1
11	141 - 198	367936914*	HOSE . CNG	1
12	141 - 143	307040452"	CLAMP	1
13	141 - 141	3001206206*	BOLT . FLH MBX1.25X2Û, THICK DİİN6921	1
14	141-185	3053516276'	CLAMP SCREW D9. Ø16-27 DIN 3017	2

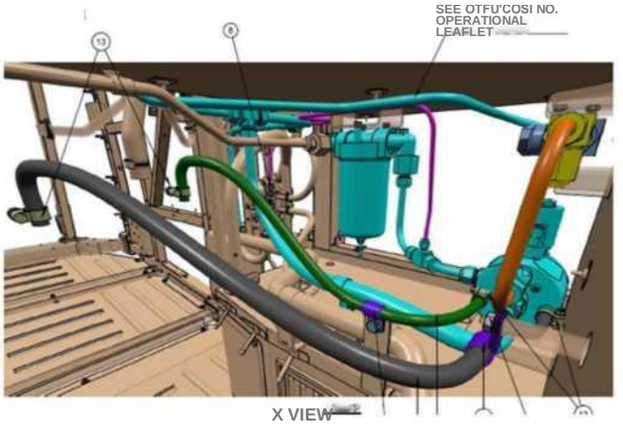




LEAF POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	1411 - 008	387673900*	PIPE COUPLING FLAT Ø12 (DK-LOK/DU- 12M)	1
2	1411 -080	3000106184*	BOLT . AKB M6X1X18, THICK D. DIN933	1
3	141 - 044	387018047*	PIPE CNG	1
4	141 - 193	387818045*	PIPE CNG	1
5	141 - 075	3B703&Oai<F	CLIP . Ø12	2
6	1411 - 192	387605629'	T CONNECTION (DK-LOK/DTR12M-16M-16M	1
7	14 11 - 187	3870402910*	CLIP ,. Ø16 IM8	1
8	141 - 195	387623162*	PIPE CNG	1
9	1411 -079	3005000064'	NUT , AKR M6X1. THICK D, DİN934	1
10	141 - 197	387635613*	PIPE , CNG	1
11	1411 - 138	307935914*	HOSE . CNG	1
12	1411 - 143	387040452*	CLAMP	1
13	141 _ 141	3001200206'	BOLT. FLN M8X 1.25X20. THICK D. DİİN6921	1
14	141 - 185	3053516276*	CLAMP SCREW 89. Ø16-27DIN3017	2

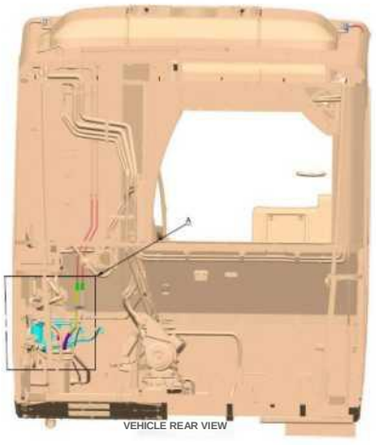


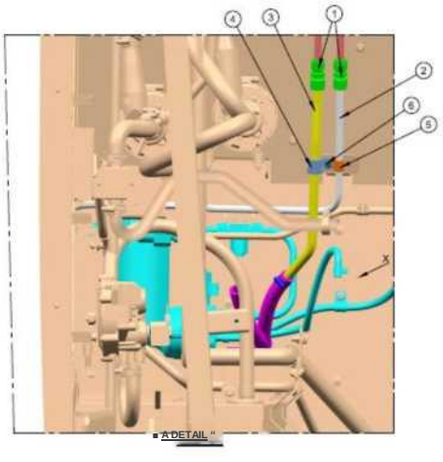


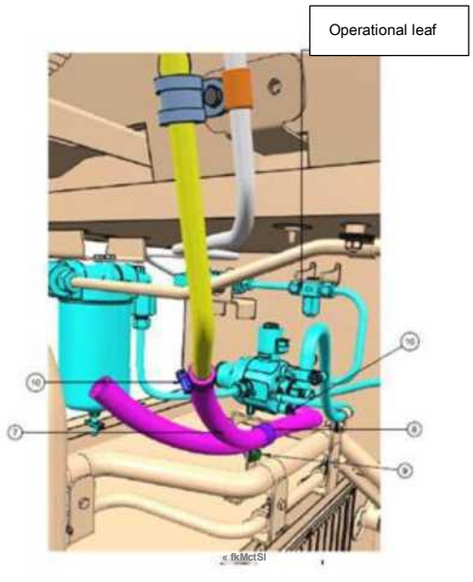


LEAF POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	141-034	387670400*	Ø12 VALF. MANUAL SHUTDOWN (DK-LOKVCH86-D	1
2	141-036	387033317*	PIPE CNG	1
3	141-035	387680375*	TEE FILTER LOK-LOK/V78C-O-12M-S)	1
4	141-077	3000105104*	BOLT . AKB M5X0.8X10. THICK D. DIN933	2
5	141-134	387817674*	PIPE CNG	1
6	141-102	3B7Û341021*	BOLT , 25MM	3
7	141-196	387926534'	PIPE CNG	1
S	141-191	387782534*	FLAT PIPE COUPLING . :6mm Tu» ODxM12x1.0)	1
9	141-054	387932710*	HOSE . REGULATOR	1
10	141-053	387832700*	HOSE REGULATOR	1
11	141-075	3670359610*	CLIP . Ø12	2
12	141-140	3005800064*	NUT FLN&TR M6X1. THICK D. DIN6923	1
13	141-142	3053510168*	CLAMP SCREW I B0. 0*0-16 DİN3017	4

REAR FUEL PIPES INSTALLATION WITHOUT PREHEATER

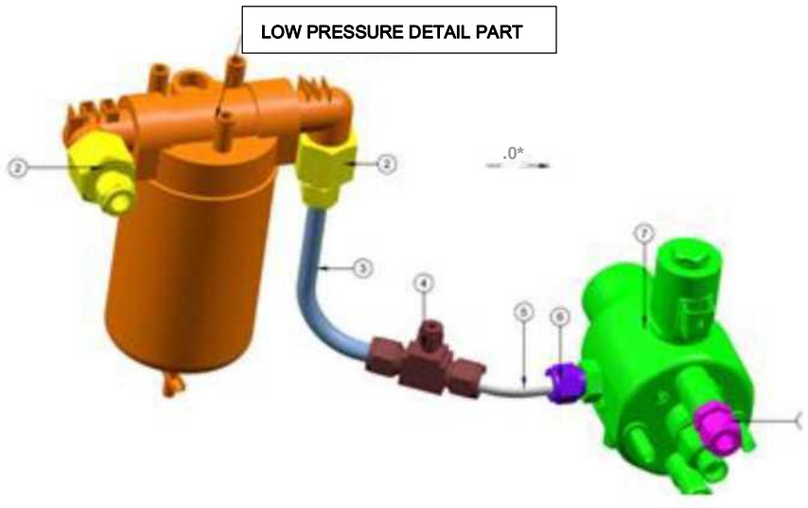






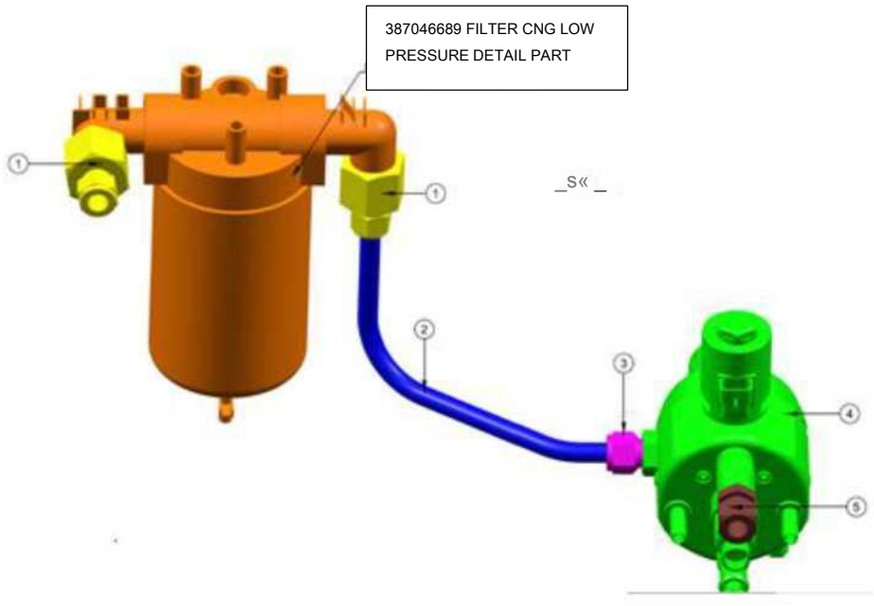
LEAFLET POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	141 -008	387673900*	PIPE COUPLING FLAT 012 (DK-LOK4XJ-12 M}	2
2	141-044	387018047*	PIPE CNG	1
3	141-202	38431MS1*	PIPE CNG	1
4	1411 - 204	387040231*	CLIP Ø16 M8	1
5	141-075	3870359810"	CLIP, Ø12	1
6	141-080	30C01M164*	BOLT . AKB M6X1X16, THICK D. DINM933	1
7	141 -198	387936914*	HOSE . CNG	1
S	141-143	387040452"	CLAMP	1
9	141-141	3001208206'	BOLT . FLN M8X1.25X20, THICK D. DIN8921	1
10	141-201	3053516278*	CLAMP SCREW 89. Ø16-27. DIN3017	1

FUEL SYSTEM REGULATOR ASSEMBLY WITH PRE-HEATER



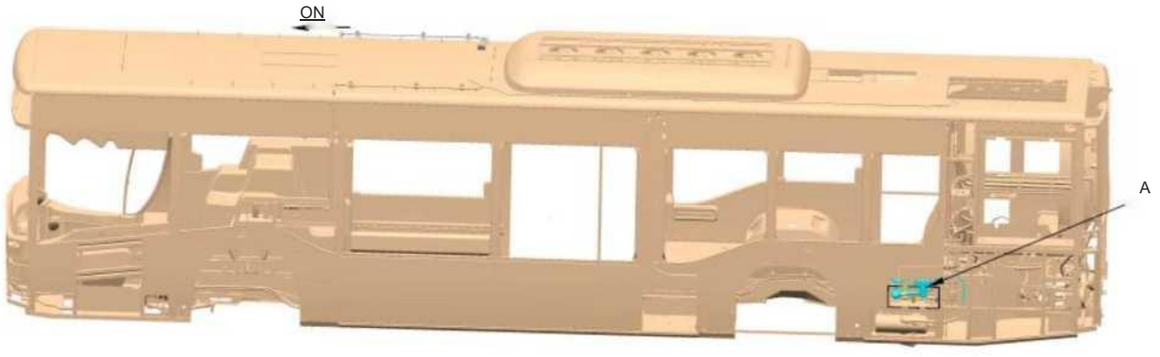
LEAFLET POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	141-130	3B77DB618*	REGULATOR INPUT (DK-LOK/DMCS12M-6U)	1
2	141 - 004	387600739*	FEMALE| FITTINGS (DK-LOK/DCF12M- 10U)	2
3	141-200	387936961*	PIPE CNG	1
4	141 - 190	367660373*	T CONNECTION , 12-6-12 MM (DK-LOK/DTR12M-12	1
5	141- 199	3B7936960*	PIPE CNG	1
6	141 - 132	3B788B710*	REGULATOR OUTLET (DK- LOK/DMGS12M-8U)	1
7	141-032	367563551*	REGULATOR. HIGH PRESSURE (BLACKSTONE-SAN	1

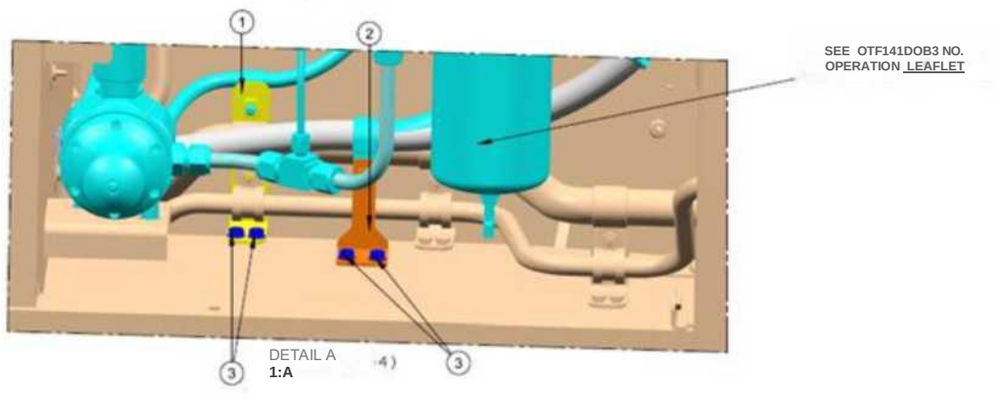
FUEL SYSTEM REGULATOR COMPLETE ASSEMBLY WITHOUT PRE-HEATER



LEAFLET POSE	GROUP/'POSE	PART NO	COMPONENT'S NAME	NUMBER
1	141 -004	387600739*	FEMALE| FITTINGS (DK-LOK7DCF12M-10U)	1
2	141 - 203	384310459*	PIPE QNG	1
3	141 - 132	387868710*	REGULATOR OUTLET (DK-LOK/DMCS12M-8U)	1
4	141-032	387563551*	REGULATOR HIGH PRESSURE(BLACKSTONE-SAN	1
5	141 - 130	38770861B*	REGULATOR INPUT (DK- LOK/DMGS12M-6U)	1

REAR FUEL PIPES BRACKETS INSTALLATION

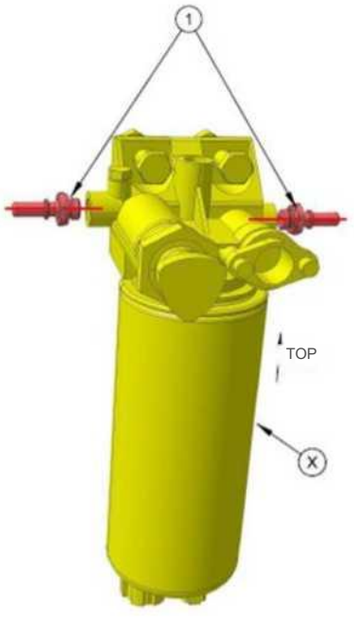




LEAF/ POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	141-133	387935919'	BRACKET , PIPE CONNECTION	1
2	141-056	387935915*	BRACKET , HOSE HOLDER	1
3	141-071	3001206166*	BOLT , FLN M6X1X16, THICK D. DIN6921	4

SEDIMENTER

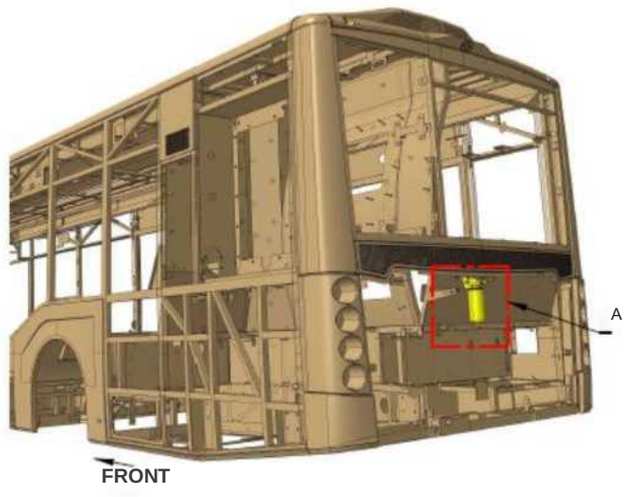
SEDIMENTER INSTALLATION

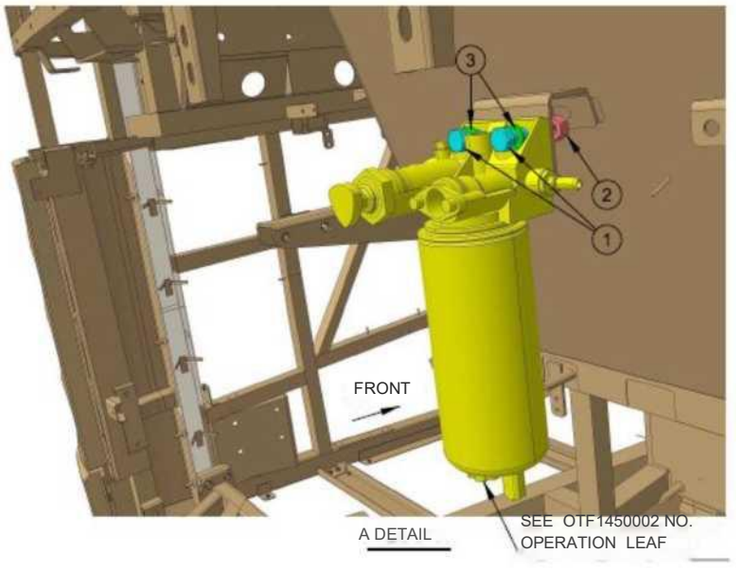


X THE FUEL FILTER SHOWN BY X IS COMBINED WITH THE ENGINE KIT

LEAF POSE	GROUP,'POSE	PART NO	COMPONENT'S NAME	NUMBER
1	145-005	387037021'	SPIGOT, SEDIMENTER	2

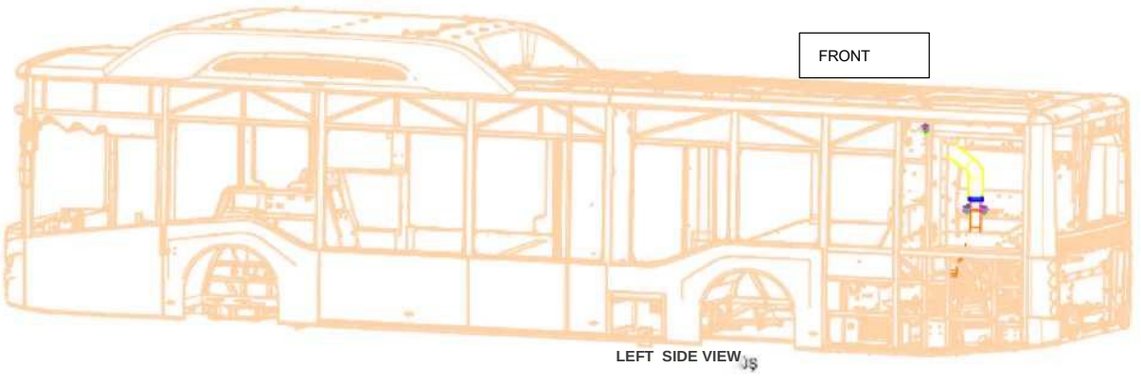
FUEL FILTER INSTALLATION



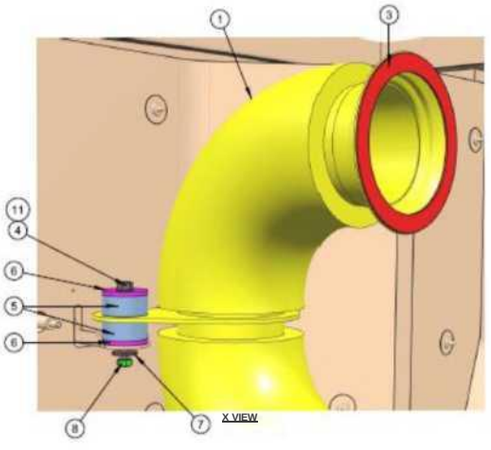


LEAF POSE	GROUP.'POSE	PART NO	COMPONENT'S NAME	NUMBER
1	145-007	3000112504'	BOLT . AKB M12X1,75X50, THICK D. DİN933	2
2	145-009	3005000124*	NUT , AKB M12X1,75 THICK D, DIN934	2
3	145-008	3010100124*	WASHER , SPRINGY D=12 DİN 127	2

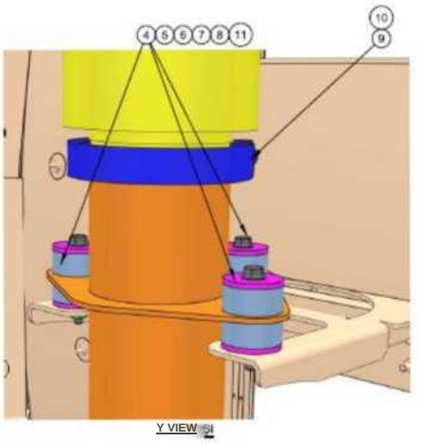
EXHAUST SYSTEM INSTALLATION



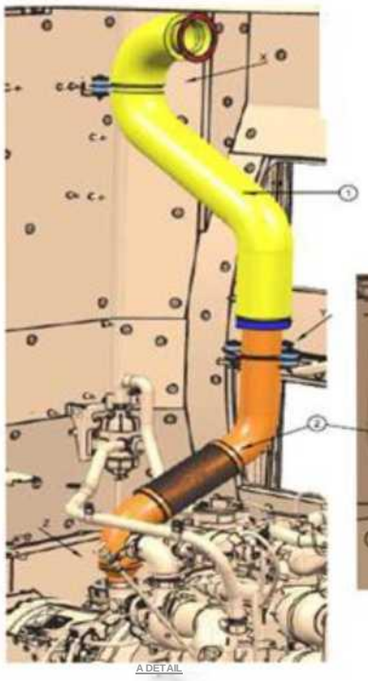
LEFT SIDE VIEW



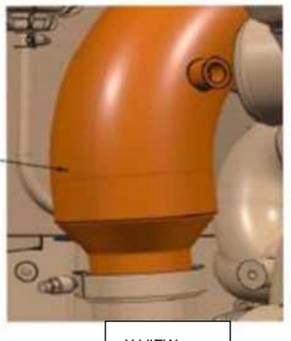
X VIEW



Y VIEW

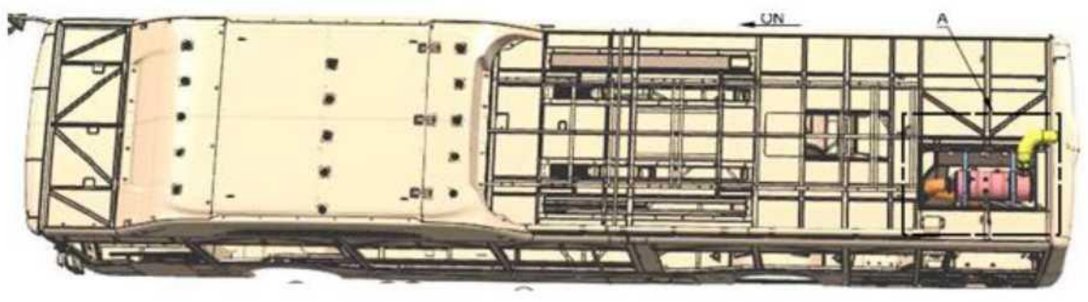


A DETAIL

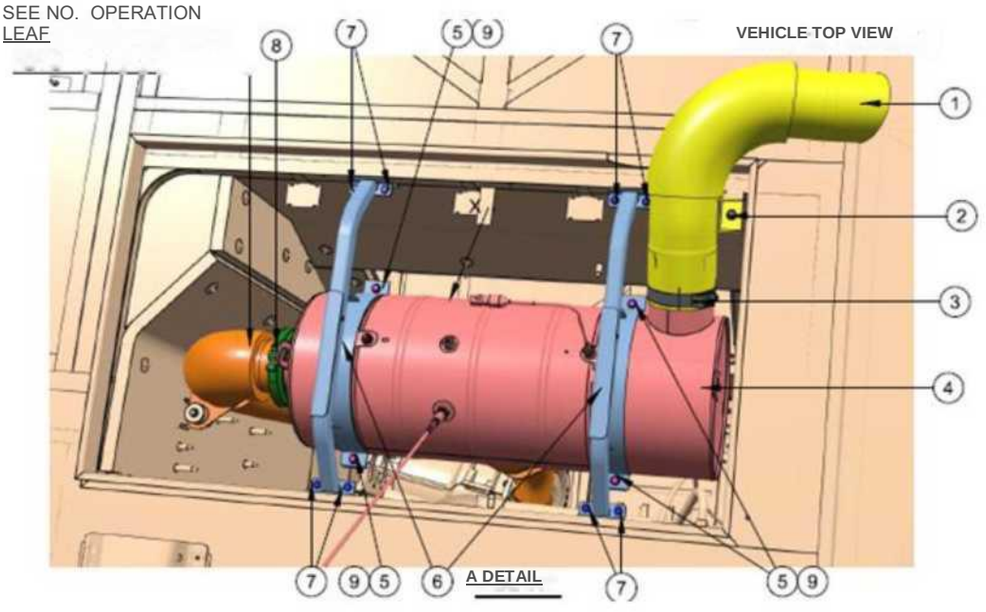


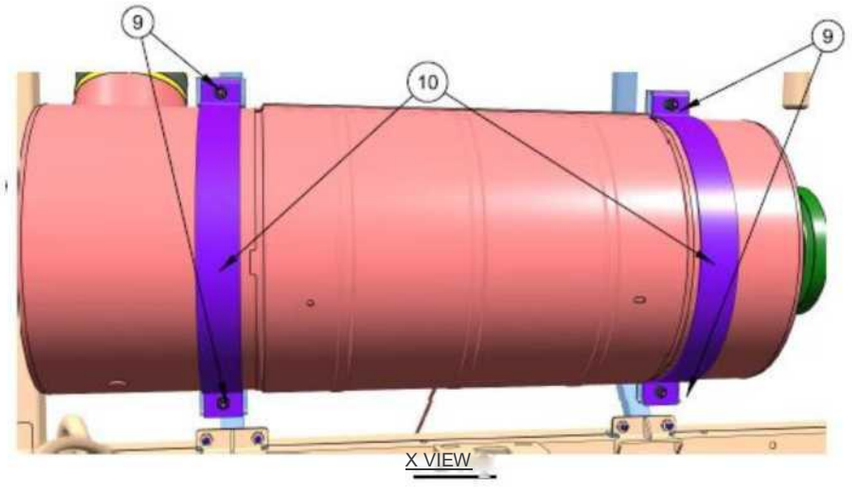
X VIEW

LEAF POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	150-020	347925715*	PIPE ASSEMBLY , SILENCER INPUT	1
2	150-023	387044231*	PIPE ASSEMBLY . EXHAUST ENGINE OUTPUT	1
3	150-007	387935918*	GASKET EXHAUST	1
4	150-044	3001208708	BOLT , FLN M8X1.25X70, THICK D. DIN6921	4
5	150-003	387034024	WEDGE . METAL EXHAUST (000 51 641)	8
6	150-004	3870340400	WASHER, WEDGE METAL	8
7	150-040	3011100066	WASHER FLAT D=8 DIN9021	4
8	150-041	3005000066"	NUT .AKB M8X1.25 THICK D. DIN934	4
9	150-030	3870519710*	CLAMP EXHAUST 99682	1
10	150-006	387043951*	GASKET, EXHAUST 78842	1
11	150-005	387034039*	SIGN METAL WEDGE	4



SEE NO. OPERATION
LEAF

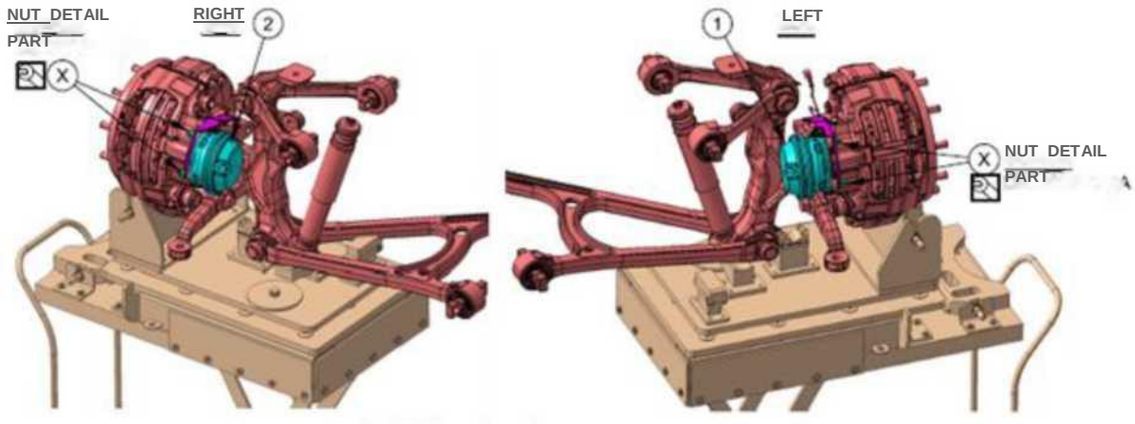




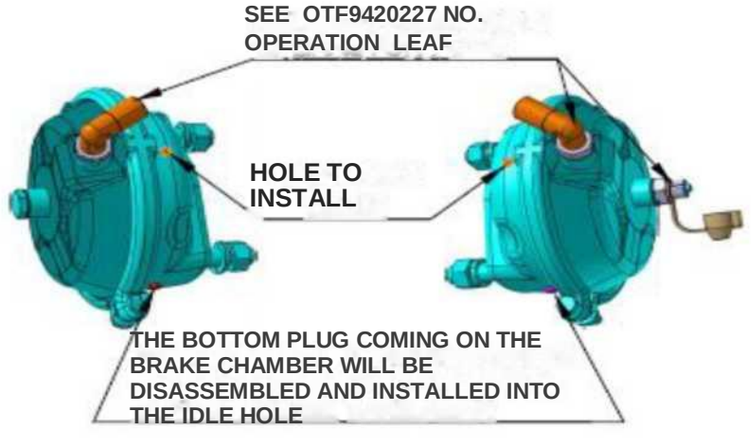
LEAFLET POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	150-017	3B7722462*	PIPE ASSEMBLY . SUPPRESSOR OUTLET	1
2	150-014	3001210254*	BOLT , FLN M10X1.5X25 THICK D. DIN6921	
3	150-029	3870467000*	CLAMP , SCR OUTLET	1
4	150-001	3876180900*	EXHAUST PROCESSING SYSTEM A057U872	1
5	150-042	3001208254*	BOLT . FLN M5X1.25X25, THICK D. DİN6921	4
6	150-032	3B7925701*	BELT ASSEMBLY, SUPPRESSOR HANGER	2
7	150-043	3001208206*	BOLT , FLN M8X1.25X2D THICK D. DIN6921	8
8	150-031	367825296*	CLAMP , CUMMINS A029E742	1
9	150-041	3005000086*	NUT , AKB M0X1.25, THICK D. DİN934	8
10	150 -	3B7725160'	BELT, SUPPRESSOR HANGER	2

FRONT BRAKE

FRONT BRAKE CHAMBERS INSTALLATION



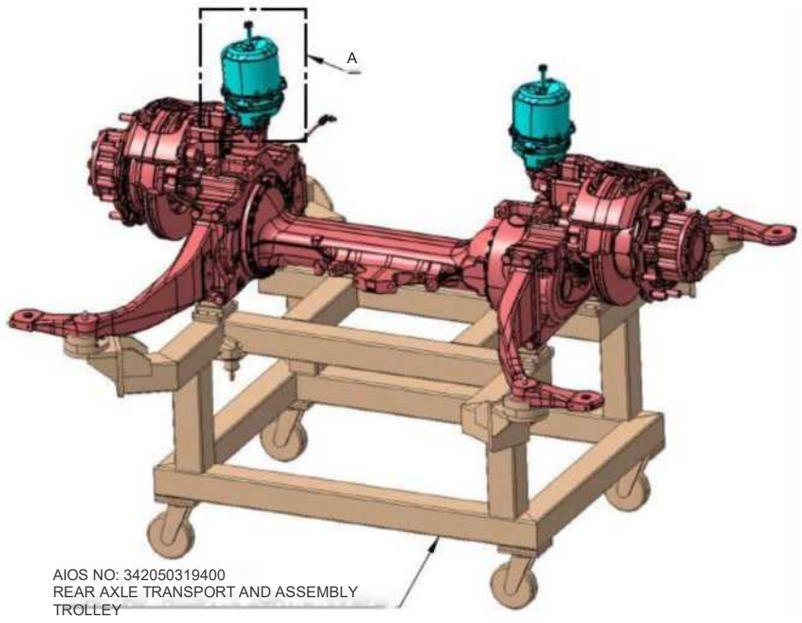
DETAILED PARTS (NUT AND WASHER) ON THE BRAKE GUARD
WILL BE REMOVED AND REASSEMBLED ON THE FRONT AXLE

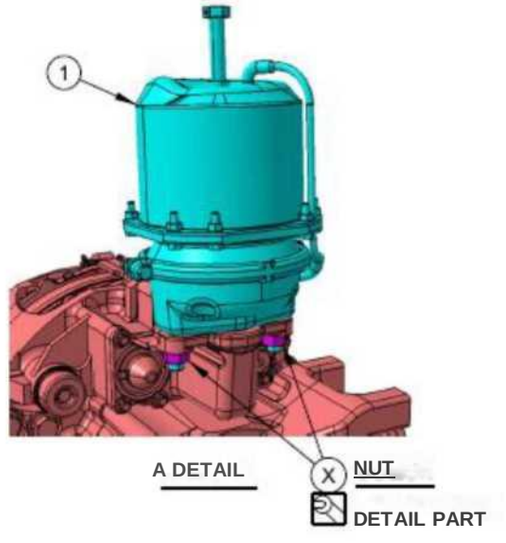


LEAF POSE	GROUP/'POSE	PART NO	COMPONENT'S NAME	NUMBER
1	301 -001	387038777'	BRAKE GUARD, FRONT RIGHT	1
2	301-0D2	387038778*	BRAKE GUARD, FRONT LEFT	1

REAR BRAKE

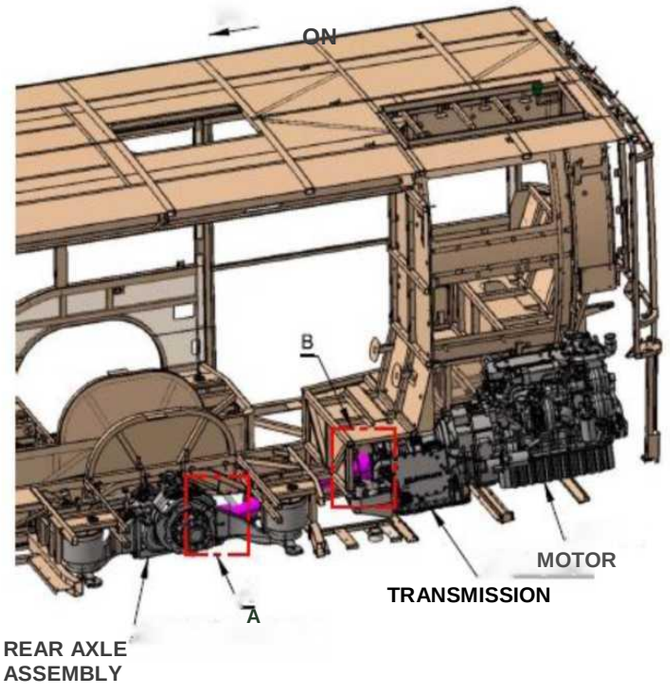
REAR BRAKE BLOWERS INSTALLATION

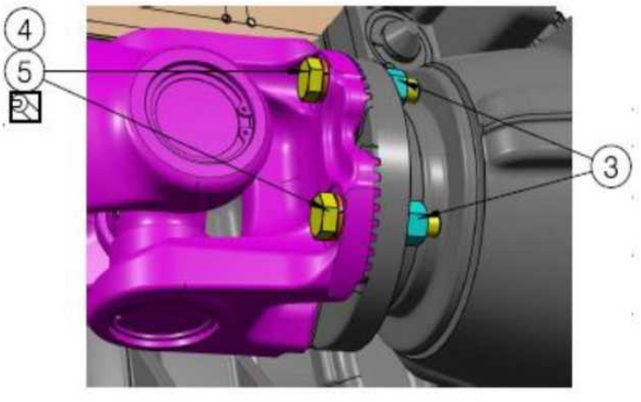




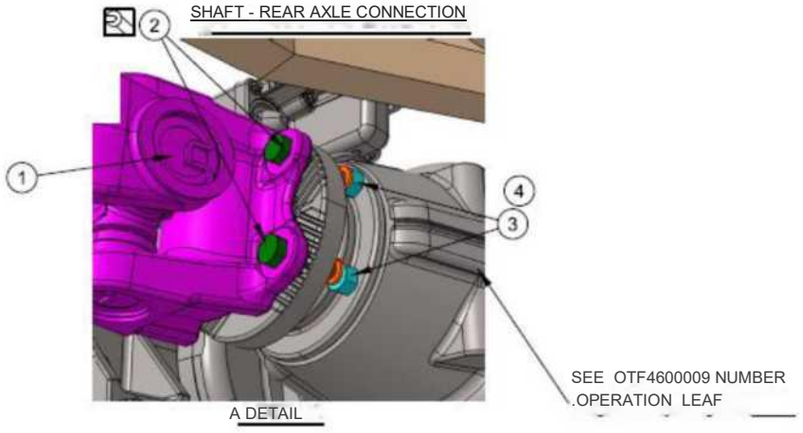
LEAFLET POSE	305-001	PART NO	COMPONENT'S NAME	NUMBER
1	305-001	387323212'	BRAKE BLOWER, REAR 24x24 BREATHABLE INSIDE	2

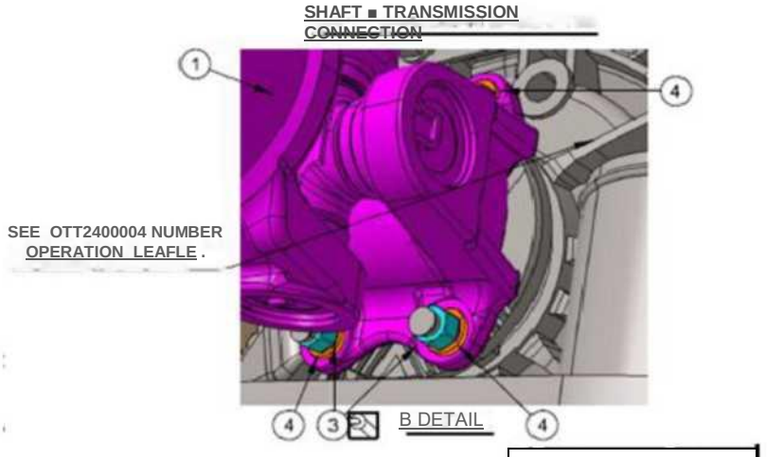
SHAFT INSTALLATION





A DETAIL
CITIPORT
CNG



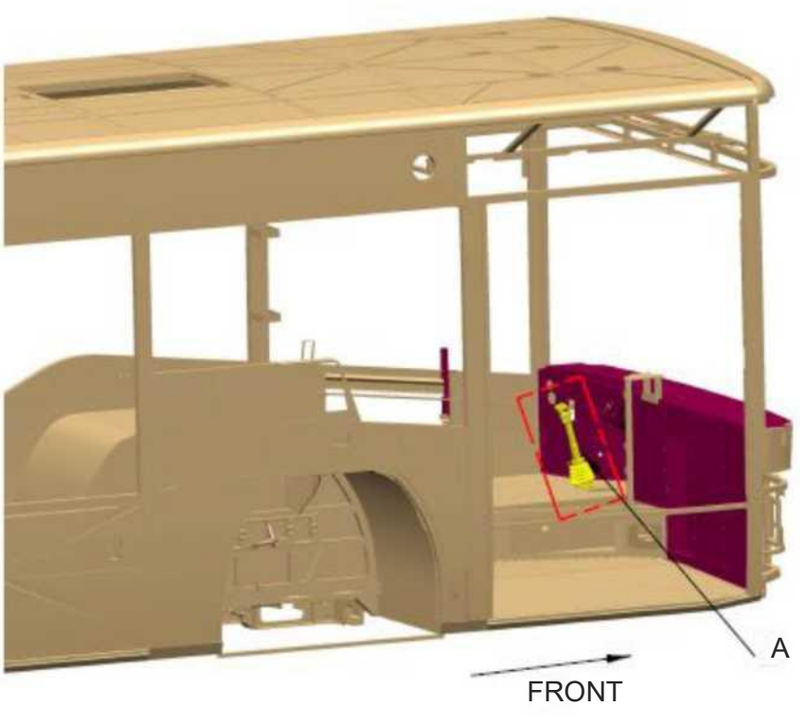


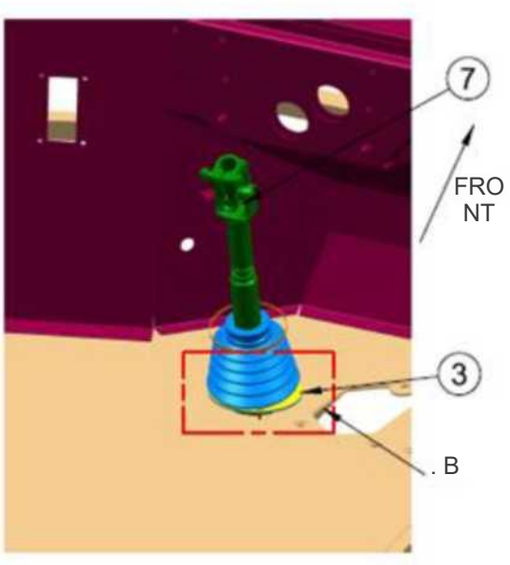
âM TORQUE ANTEDI (Nm)			
POSE	Std	M"	M.i»
3-5	105	95	114
2	105	95	114

LEAFLET POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER	ADDITIONAL INFO
1	401-001	387031751*	SHAFT CARDAN 40 SERİ	1	E6 IN MOTOR VEHICLES
1	4Q1 -001	387054719*	SHAFT CARDAN	1	E6C IN MOTOR VEHICLES
1	401 -001	387474766*	SHAFT ASSEMBLY	1	CITIPORT CNG
2	401 -002	3000812504*	BOLT , AKB M12X1.25X50, THIN D. DIN960	4	CITIPORT CNG
2	401 -028	3000812504*	BOLT , AKB M12X1,25X50, THIN D, DIN960	4	
3	401 -003	3005100124*	NUT , AKB M12X1. 25. THIN D. DIN934	8	CITIPORT CNG
3	401 - 030	3005100124*	NUT , AKB M12X1, 25, THIN D. DIN934	8	
4	401 -005	3010100124*	WASHER , SPRINGY D=12 DİN 127	8	CITIPORT CNG
4	401 -040	3010100122*	WASHER . SPRINGY D=12 DİN 127	8	
5	401 004	3000812554*	BOLT , AKB M12X1.25X55, THIN D, DIN960	4	CITIPORT CNG

STEERING SYSTEM

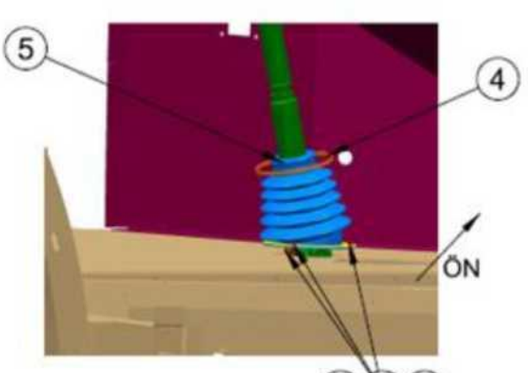
STEERING SHAFT ASSEMBLY





A DETAIL

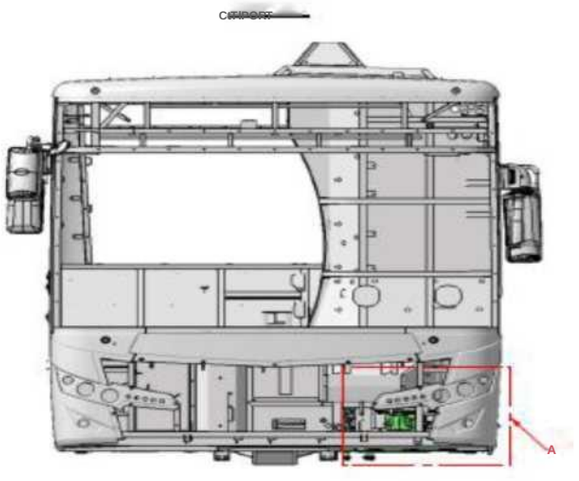
FOR GENERAL TORQUE VALUES • GNF0000001 ~ NO. SEE OPERATION LEAF

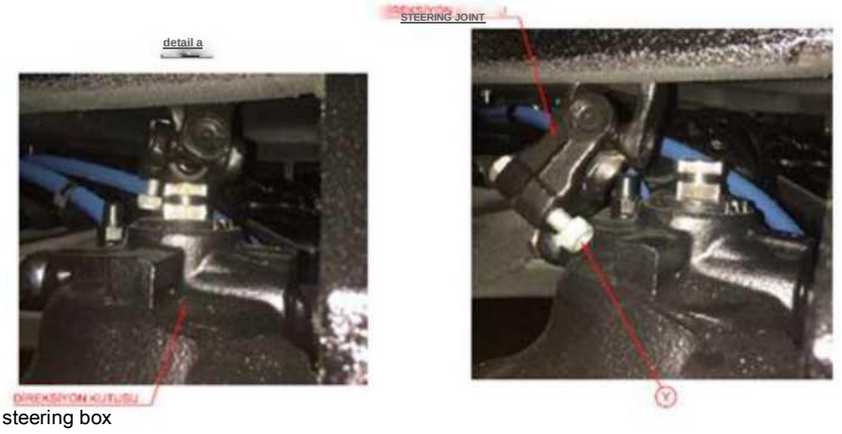


B DETAIL 6 1 2

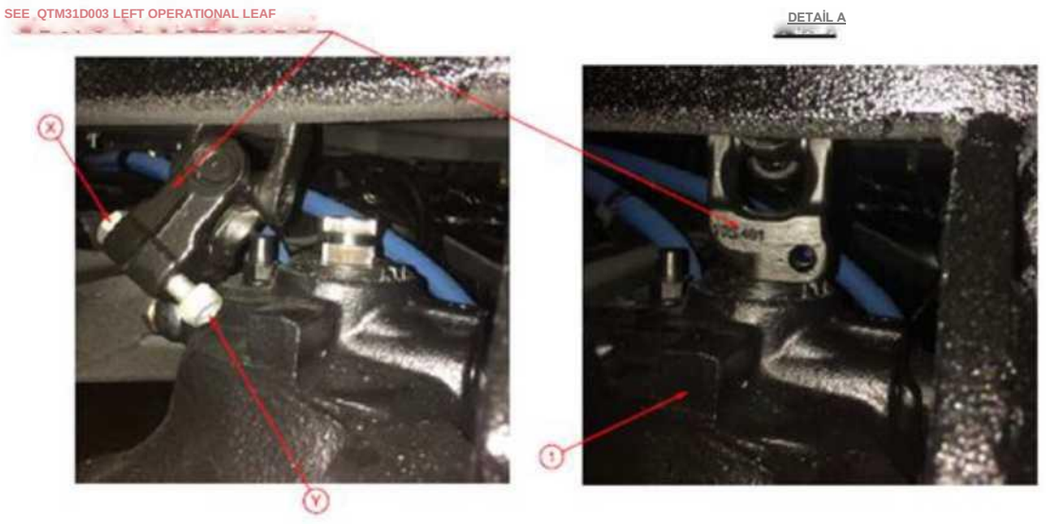
LEAFLET POSE	GROUP,'POSE	PART NO	COMPONENT'S NAME	NUMBER
1	431 - 008	3000304303'	BOLT . AKB M4X0.7X30. THICK D. DİN931	3
2	431 -009	3011100043*	WASHER. 04x012x1 DİN 9021	3
3	431 - 006	387039769*	BASE SHEET, GROMMET, STEERING SHAFT	1
4	431-010	3777705060*	PLASTIC CLAMP L 350 MM	1
5	431 - 007	3B7039770"	POLYAMID, GROMMET. STEERING SHAFT	2
6	431 - 005	387039765*	GROMMET. STEERING SHAFT	1
7	431 - 002	387032953*	STEERING SHAFT	1

INSTALLATION OF THE STEERING SHAFT TO THE STEERING BOX





steering box





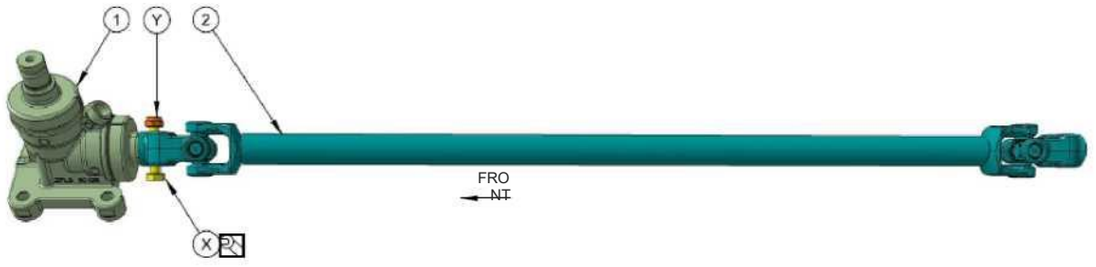
- Make sure that the gears on the steering column joint and the box match each other.

- Don't forget to mark after torquing.

- FOR OTHER OPERATIONS See NO. OTF4310003 LEAFLET

LEAF POSE	GROUP/ POSE	PART NO	COMPONENT'S NAME	PIECE	NUMBER
1	433 - 002	3871120695"	STEERING BOX	1	CİTİBUS
1	433 - 002	387M0118"	STEERING BOX	1	CITIPÖRT/CİTİPORT CNG
1	433 - 002	387 027591'	STEERING BOX	1	VİSİGO

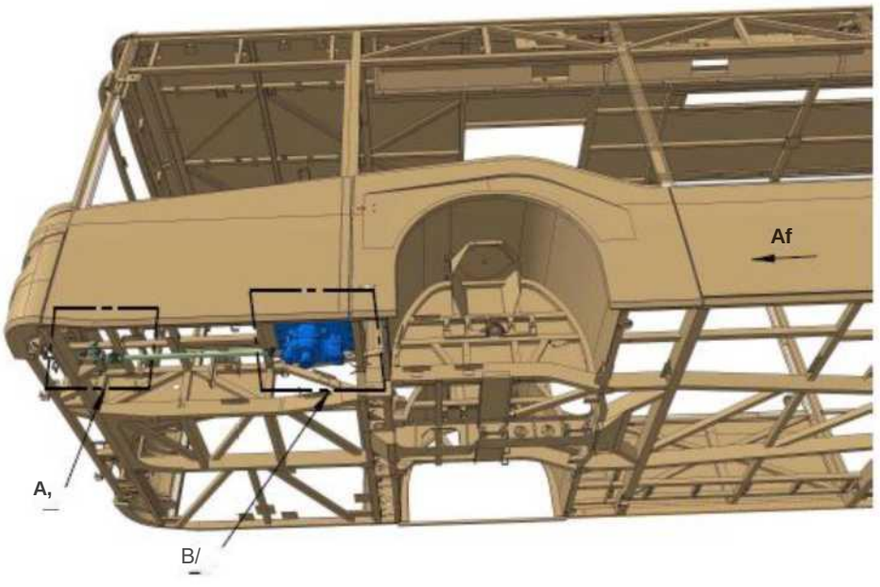
STEERING CONICAL GEARBOX AND SPINDLE PREPARATION

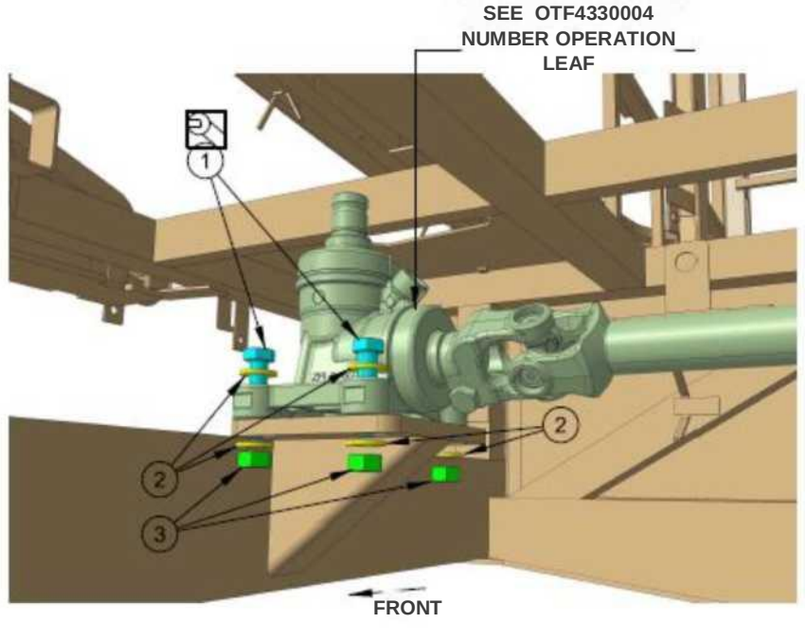


▽ (X) POSE BOLT AND (Y) POSE NUMBER NUT. (2) COMES WITH POSE STEERING SUB-SPINDLE.

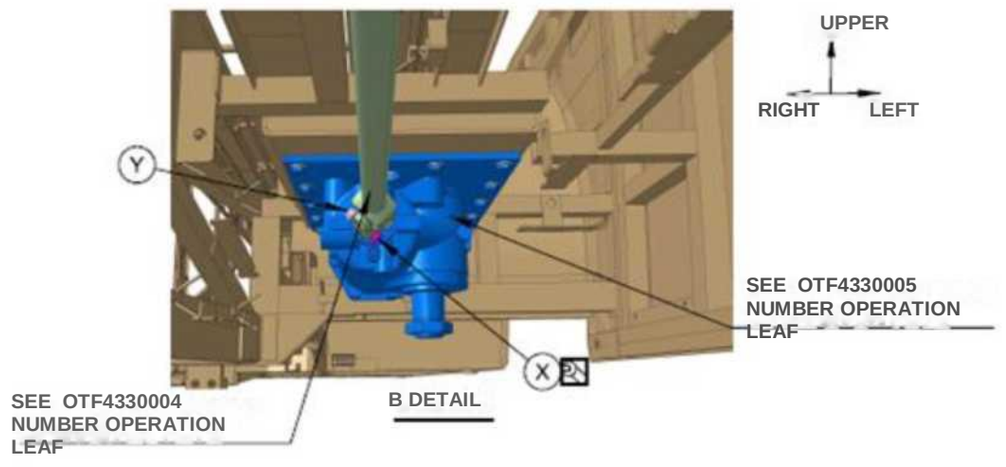
LEAF POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	433-005	3B7030340'	GEAR BOX, CONICAL	1
2	433-004	387032953*	STEERING LOWER SHAFT	1

STEERING CONICAL GEAR BOX AND SPINDLE INSTALLATION



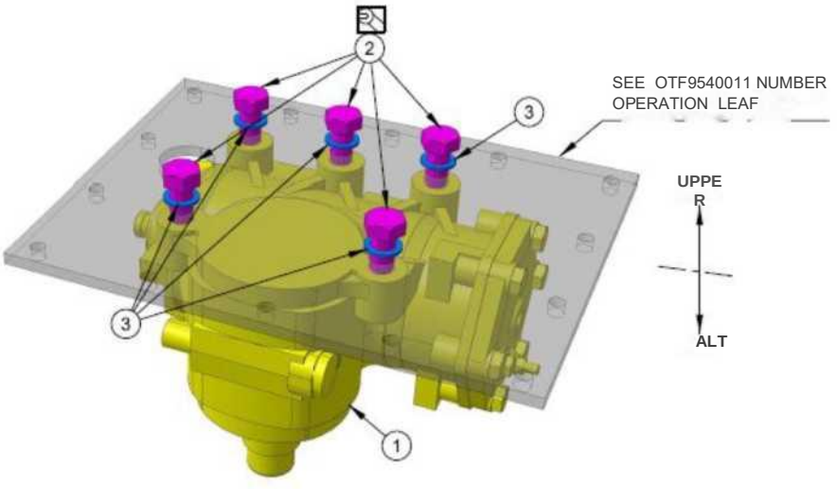


A DETAIL



LEAFLET POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	433-005	387006179001	BOLT , M12X1.75X50	4
2	433-010	301000012401	WASHER ø12	8
3	433 - 009	300500012201	NUT , AKB M12X1,75 THICK D. DIN934	4

PREPARATION FOR STEERING GEAR BOX

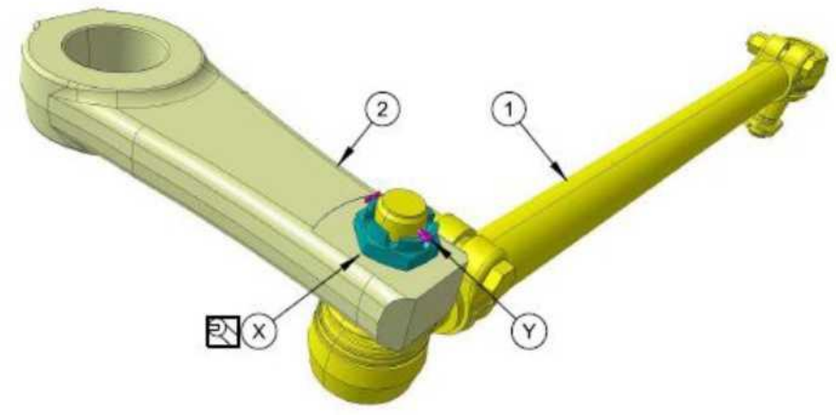




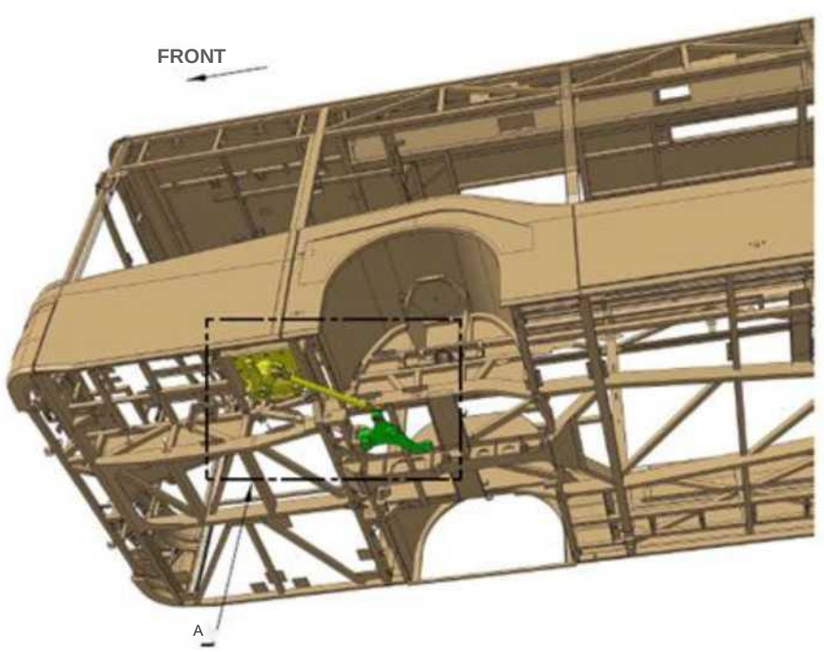
V1 TORQUE ANTEDI <Nm)			
POSE	sx		I+II
	520	500	540

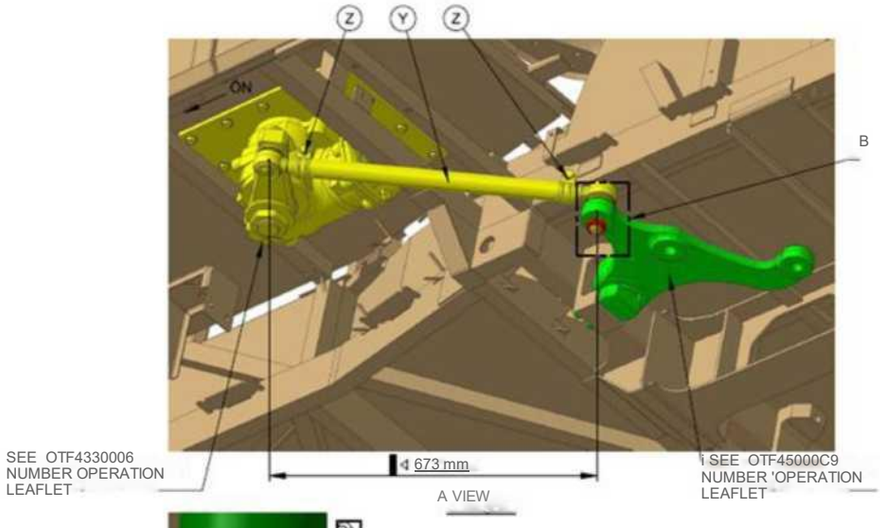
LEAFLET POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	433 - 002	387040118*	STEERING BOX	1
2	433 - 006	3000620404*	BOLT , AKB M20X1.5X40. THIN D. DİN961	5
3	433 - 007	3870396930*	WASHER . LOCKED M20	5

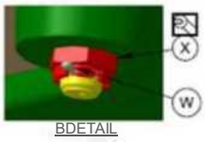
TIE ROD ASSEMBLY



LEAFLET POSE	GROUP,'POSE	PART NO	COMPONENT'S NAME	NUMBER
1	433-003	387032956*	TIE ROD	1
2	433-0D1	387034134*	STEERING ARM , 210 MM	1

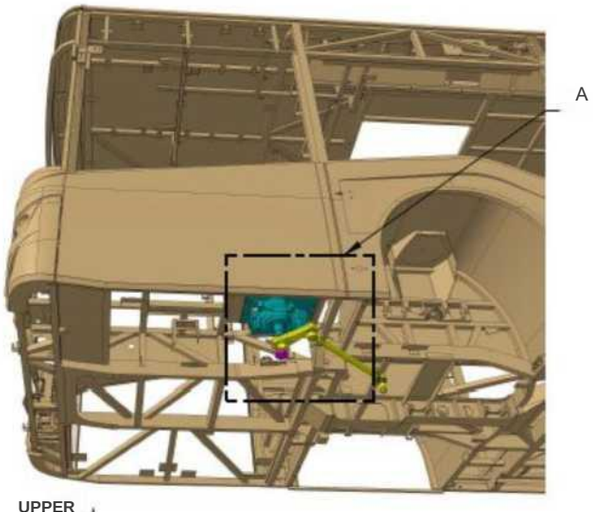


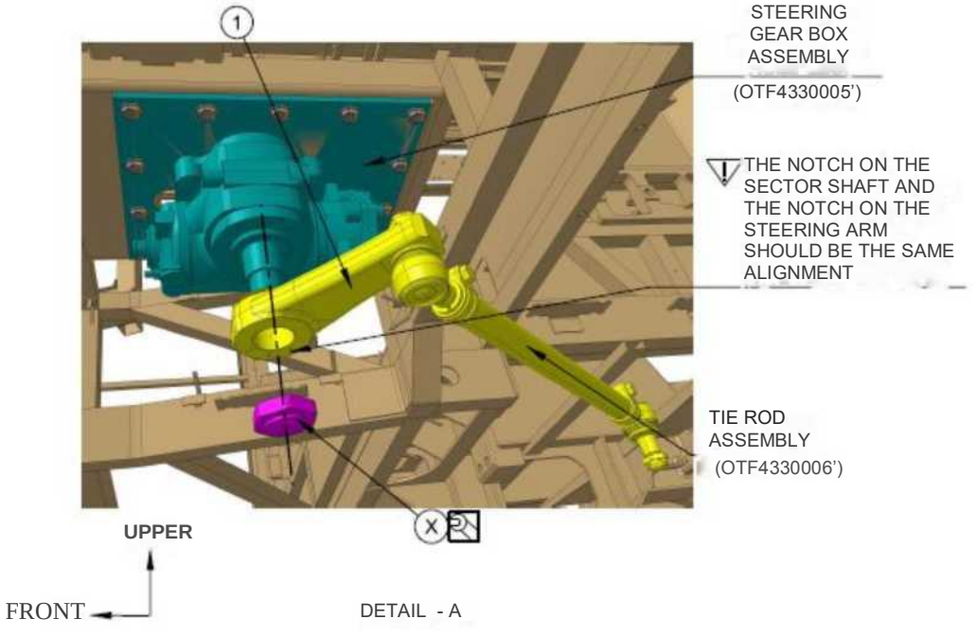




âH TORQUE ANTEDI (Nm)			
POSE	SU	Mr.	MAM
X	300	278	322

STEERİNG ARM INSTALLATION





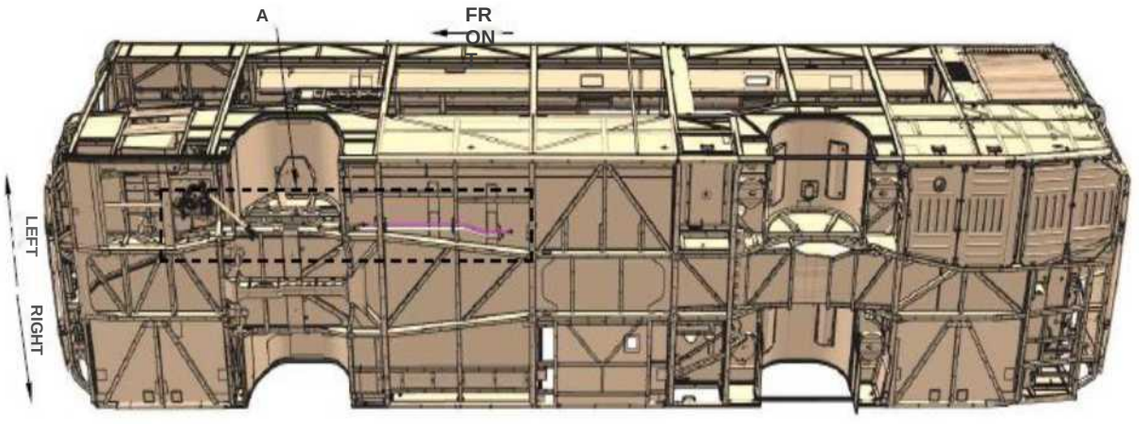
NOTE:
CLAMP THE PITMAN LEVER NO.1 TO THE SECTOR SHAFT WITH THE X NUT COMING WITH THE STEERING GEAR BOX. TORQUE STEERING HANDLES AFTER INSTALLATION.

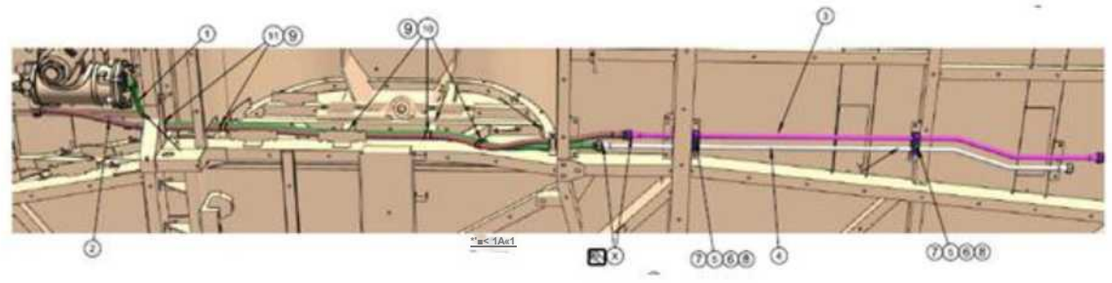
TORQUE ANTEDI (Nm)			
POSE	std	Min	Max
X	850	765	935

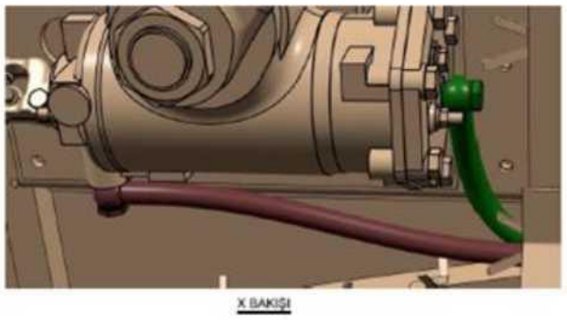
LEAFLET POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	433-001	387034134'	STEERİNG ARM . 210 MM	1

STEERING HYDRAULIC BOX

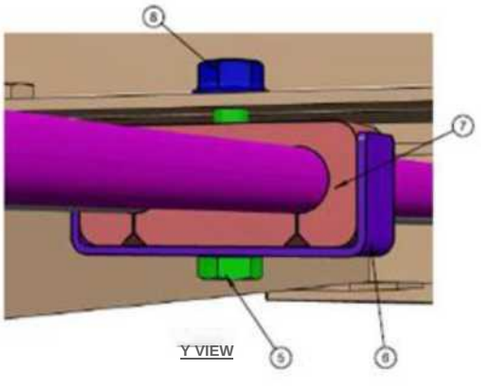
STEERING SYSTEM HOSES INSTALLATION.



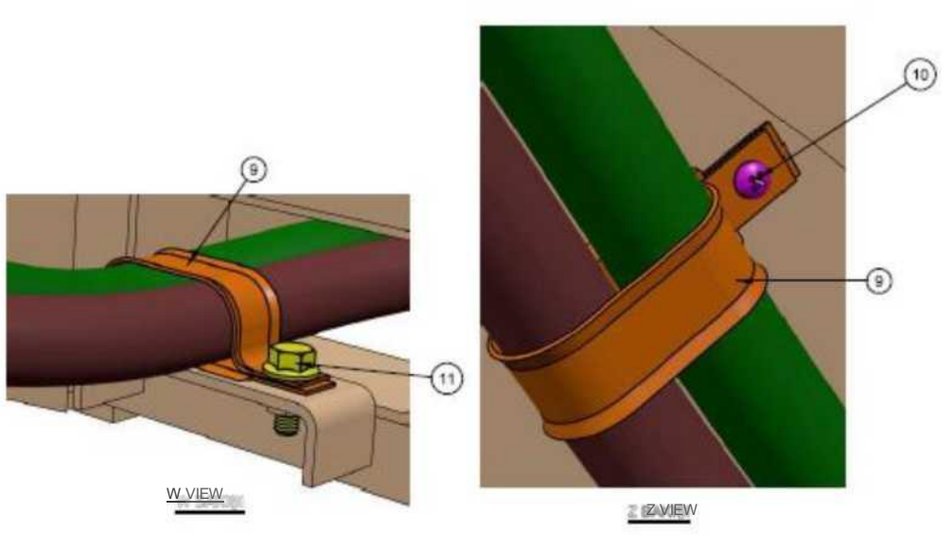




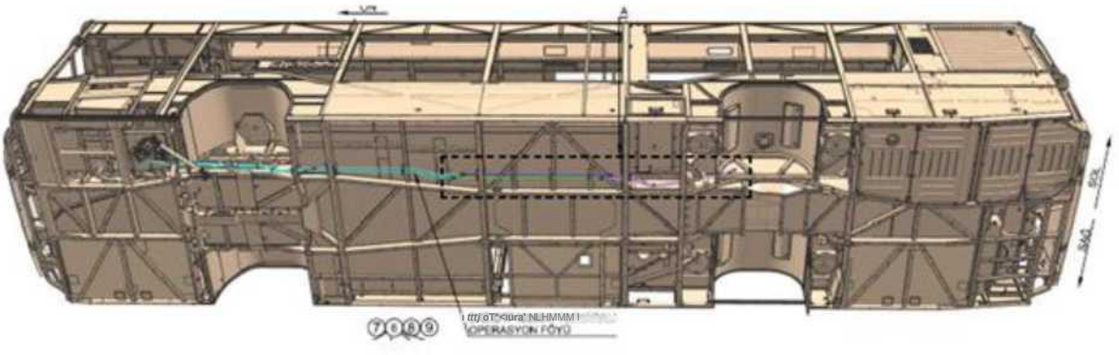
X VIEW

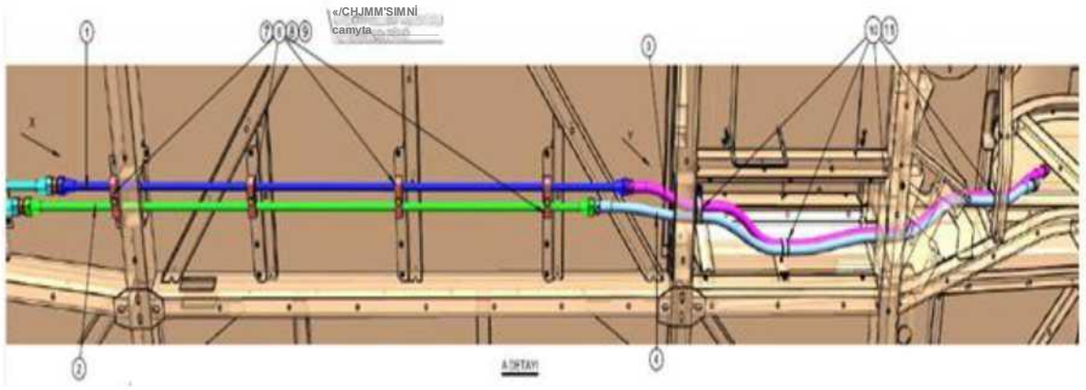


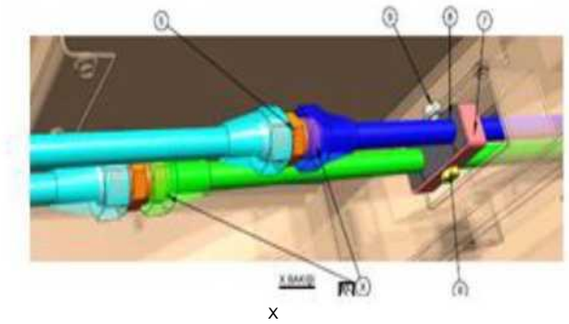
TORQUE ANTEDI (Nm)			
POSE		Min	Max
X	110	100	120



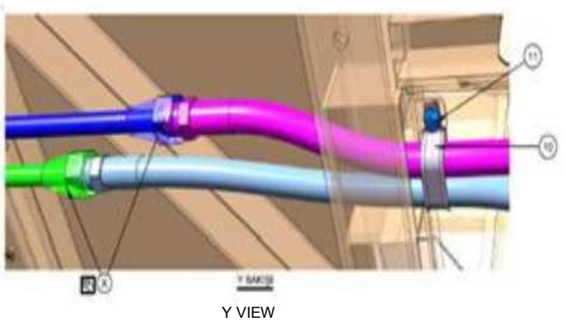
LEAFLET POSE	GROUP / POSE	PART NO	COMPONENT'S NAME	NUMBER
1	435-013	387034408	HOSE. STEERING WHEEL 01	1
2	435-110	387034410	HOSE. STEERING PRESSURE 01	1
3	435-003	387038072	PIPE STEERING WHEEL 03	1
4	435-001	387034413	PIPE . STEERING WHEEL 01	1
5	435-023	3000308454	BOLT , AKB M8X1.25X45 THICK D. DIN931	2
6	435-028	387020641	BRACKET , GROMET	2
7	435-025	387020639	GROMMET, DIR. PIPE	2
8	435-048	3005800084	NUT FLN&.TR M8X1.25 THICK D DIN 692	2
9	435-026	3873591440	CLIP ; KAL. HOSE	6
10	435-045	387031335	SHEET SCREW YSB SMART M4, 8 X 24	3
11	435-047	3001206164	BOLT FLN M6X1X16 THICK D DIN 6921	3





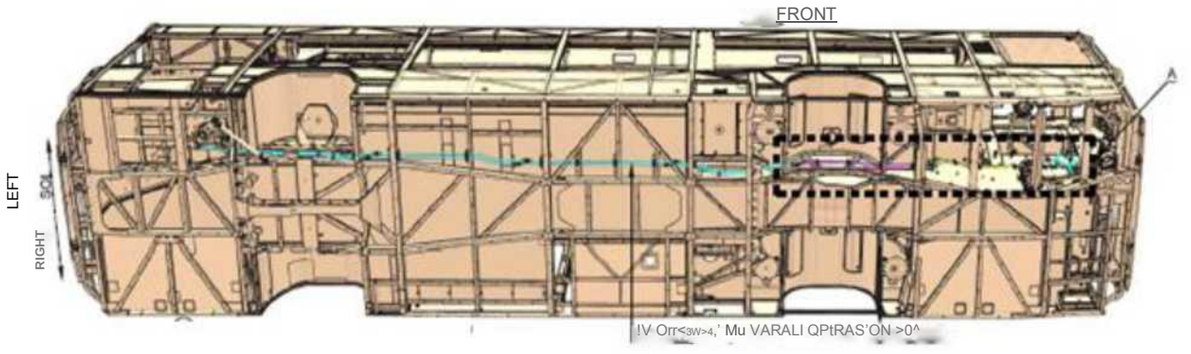


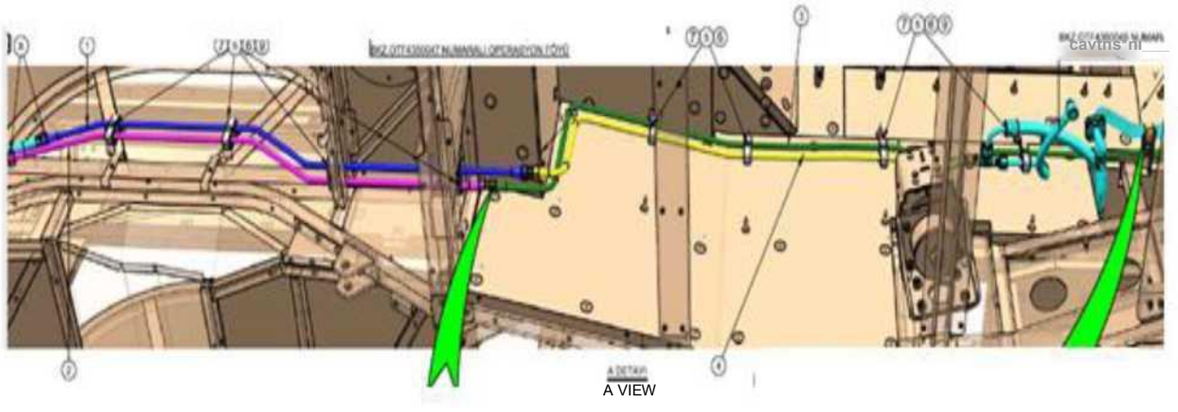
X VIEW

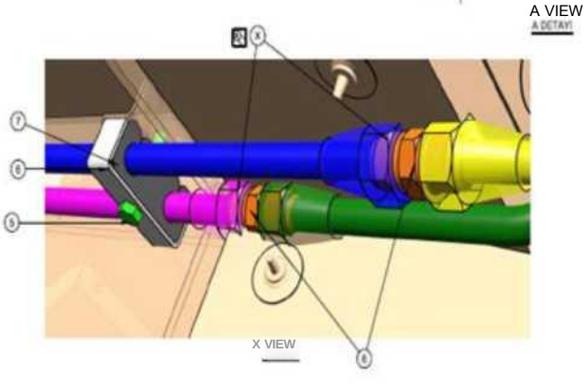


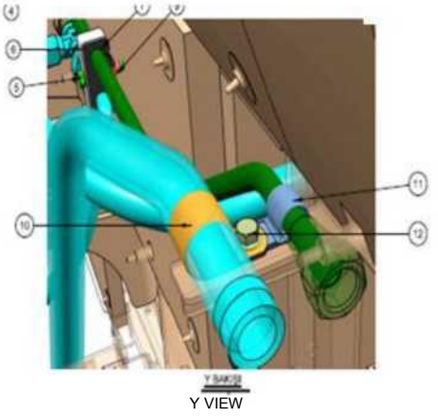
Y VIEW

	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	435-004	387038673	PIPE STEERING WHEEL 04	1
2	435-002	387034414	PIPE STEERING WHEEL 02	1
3	435-012	387038676	HOSE , STEERING WHEEL PRESSURE 02	1
4	435 -014	387038676	HOSE , STEERING WHEEL DFRONT ÜŞ 02	1
5	435 -009	387020649	ADAPTER. PIPE 12X15	2
6	435 -023	30003088454	BOLT , AKB M8X1.25X46 THİCK D. DIN 931	4
7	435 -028	387020641	BRACKET , GROWET	4
8	435 -025	387020639	GROMMET. D|R, PIPE	4
9	435-048	3005800084	NUT , FLN&TR M8X1. 26 THİCK D. DIM 692	4
10	435-026	3873591440	CLIP . KAL. HOSE	4
11	435-047	3001206164	BOLT FLN M6X1X16 THICK D DİN5921	4

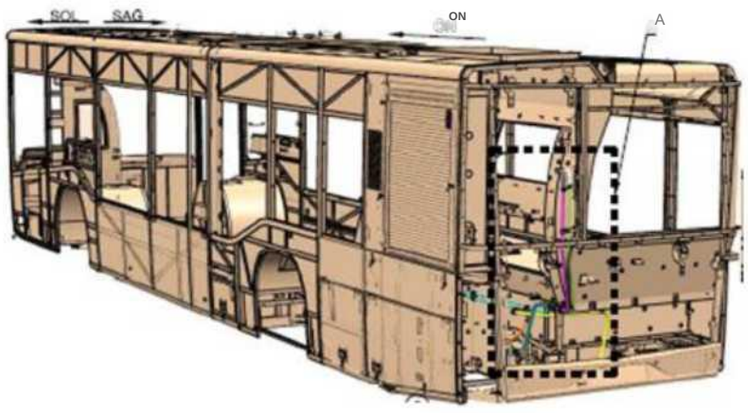

FRONT
LEFT
RIGHT
A

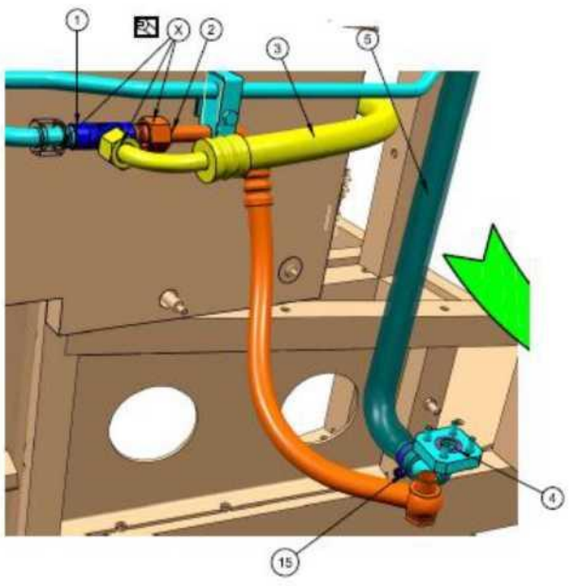

A VIEW

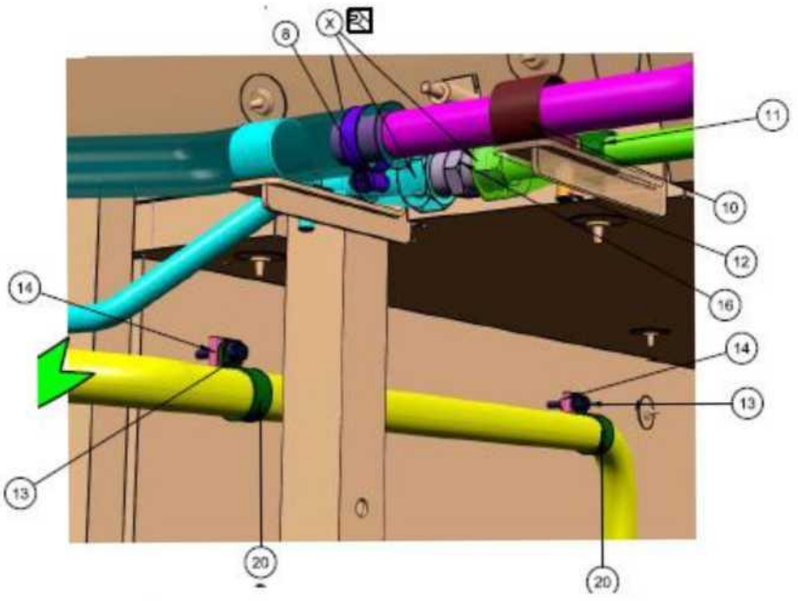

A VIEW
X VIEW


Y VIEW

LEAFLET POSE	GROUP / POSE	PART NO	COMPONENT'S NAME	NUMBER
1	435-006	387038679*	PIPE , STEERING WHEEL PRESSURE 02	1
2	435-008	387038680*	PIPE , STEERING WHEEL02	1
3	435-007	384312477*	PIPE , STEERING WHEEL04	1
4	435-005	387046051-	PIPE , STEERING WHEEL PRESSURE 01	1
5	435-023	3000300454*	BOLT , AKB M8X1.25X45. THICK D. DIN931	8
6	435-028	387020641*	BRACKET GROMMET	8
7	435-025	3370208391*	GROMMET, DIR, PIPE	8
8	435-009	387020849*	ADAPTER. BOT 12K15	1
9	435-035	387038681*	CLIP	4
10	435-031	1097009690	CLIP . SASE ENSTELASYFRONT	1
11	435-030	9095255560*	CLIP	1
12		3001208204"	CIVA I A, FLN M8X1.25X20, THICK D. DIN692	1



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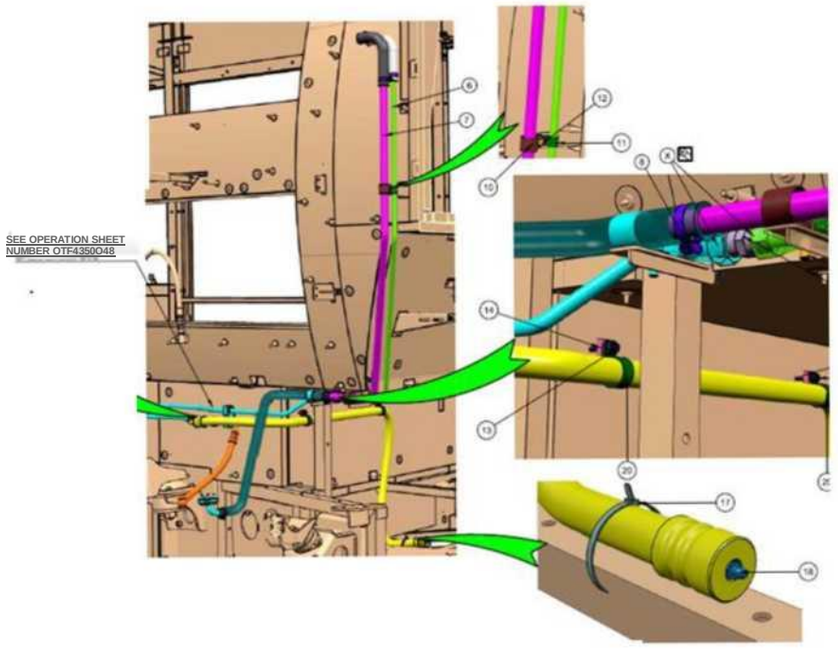
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NUMBER OTF4350048
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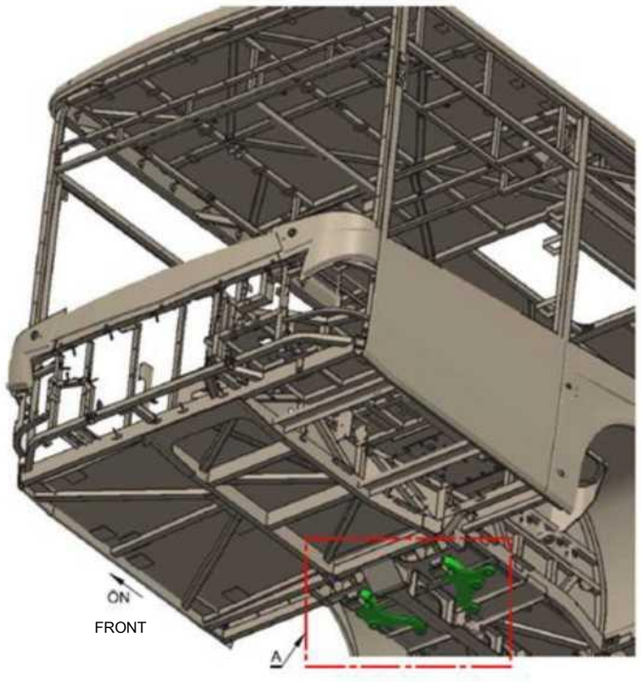
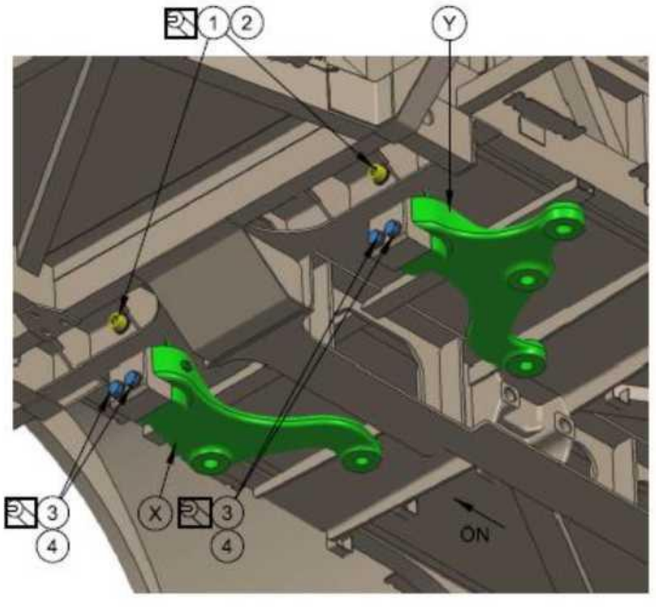
18

LEAF POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	435-020	387052997	ADAPTER M22X1.5 3XT15	1
2	435-018	384312481	HOSE STEERING WHEEL PRESSURE	1
3	435-019	387042340"	HOSE STEERING WHEEL PRESSURE	1
4	435-021	387055155"	Ö-RİNG, Ø19X2.5, HOSE KMPL, PRESSURE HAT	1
5	435-010	384312479"	HOSE , STEERING WHEEL EXTRACTION	1
6	435 - 008	384312164	PIPE . STEERING WHEEL 03	1
7	435 - 017	384311993	PIPE . STEERING WHEEL EMİS	1
8	435 - 038	3053828406*	CLAMP , SCREW B9 Ø25-40 DİN3017	2
9	435-015	387020725	HOSE . DIR. TANKI GİRİŞ	1
10	435- 031	109700969	CLIP . SASE İNSTALLATİON	2
11	435-030	9095255560*	CLIP	2
12		30012O8204*	BOLT , FLN WBX1.25X20. THICK D. D İN 5 92	2
13	435 - 041	3001206404*	BOLT . FLN M8X1X40, THICK D DIN692	2
14	435 -035	3870389810"	CLIP	2
15	435 - 039	3053520328*	CLAMP , SCREW B9 Ø20-32, DIN3017	2
16	435-009	357Û2ÛIİ49*	ADAPTER PIPE 12X16	1
17	435-042	3777706060	PLASTIC CLAMP L 350MM	1
18	435-045	947615027	RELIEF SCREW	1
19	435-016	387020734'	HOSE DIR TANK OUTPUT	1
20	435-040	387017580"	CLAMP , Ø28	2

STEERING WHEEL TIE ROD CONNECTION BRACKET ASSEMBLY





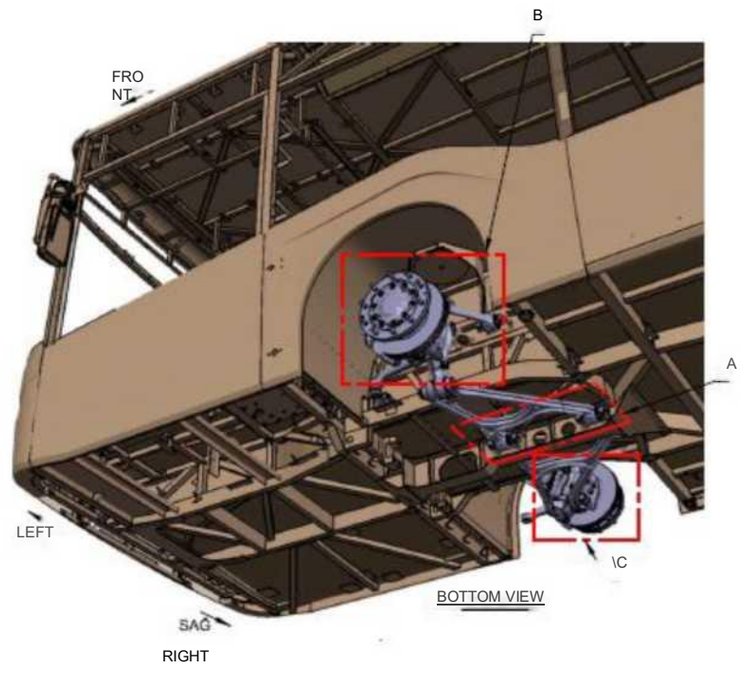
A DETAIL

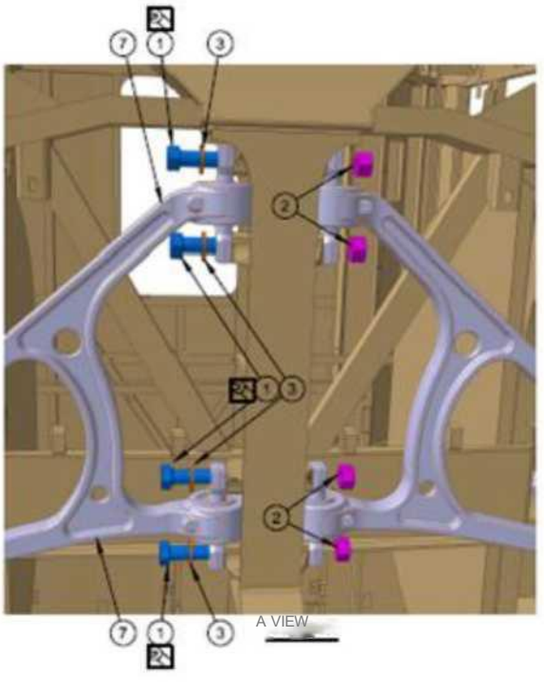
5^1 TORQUE ANTEDI (Nm)			
POSE	Std	Min	Max
1	440	396	484
3	300	270	330

LEAFLET POSE	GROUP.'POSE	PART NO	COMPONENT'S NAME	NUMBER
1	450 - 0-18	3870353170*	BOLT . IMBUS M18x1,5x110 DİN 912	2
2	450 - 019	3010000164*	WASHER. ø18, HARDENED	2
3	450-020	3000815004*	BOLT . AKB M16X1.5X100	4
4	450-021	3010000164*	WASHER . D16x3 DİN 125	4

FRONT SUSPENSION

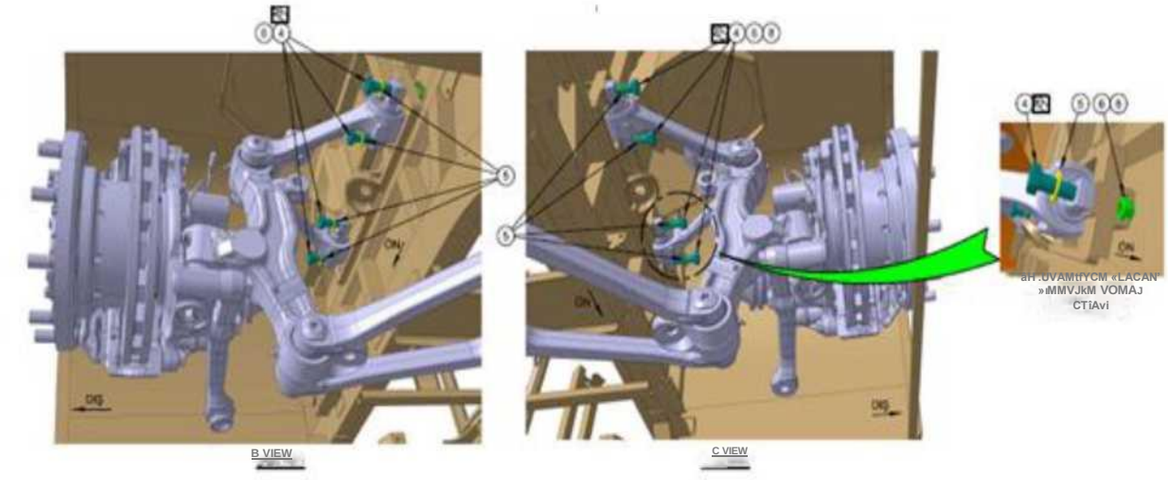
FRONT SUSPENSION SYSTEM INSTALLATION





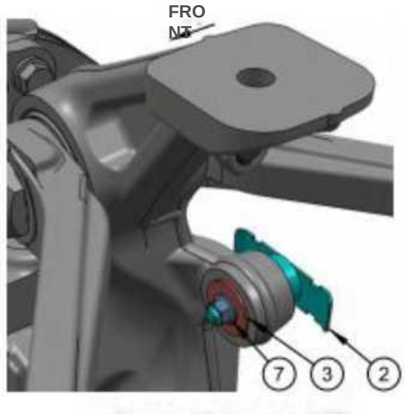


AIOS NO: 342050319500
AIOS NO: 30205027900
PLATFORM FRONT AXLE
LIFTING APPARATUS

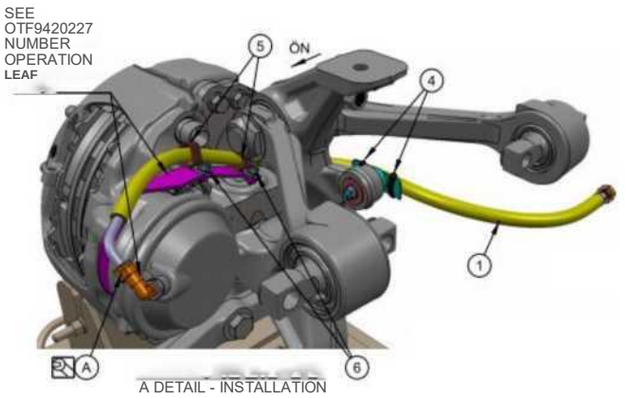


LEAFLET POSE	GROUP/POSE	PART . NO	COMPONENT'S NAME	NUMBER
1	**450-015**	3870344390	BOLT M24X 2x230 DİN 960	4
2	450 **- 017**	3870344401*	NUT , **M24X**2 D|N 934	4
3	**450- 016**	3870388940	**WASHER D24x4** DIN125/2	4
4	**450 -012**	3000820904	BOLT AKB M20X1,5X90, THIN D, D|N960	9
5	450-013	3010000204	WASHER ø20	5
6	**450-014**	3005100204	**NUT , AKB M20X1,5. THIN D, DIN934**	8
7	**450-001**	**387034726**	SUSPENSION FRONT INDEPENDENT:	1
6	**450-011**	387038282	**S|M**	8

FRONT SUSPENSION PREPARATION AND INSTALLATION



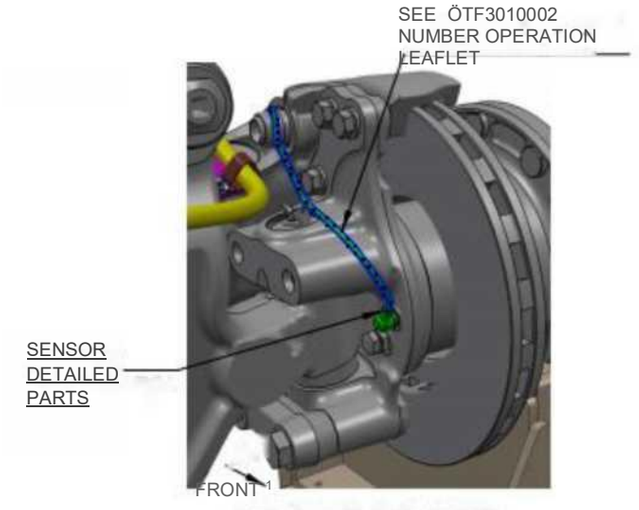
A DETAIL - INSTALLATION
STEP 1.



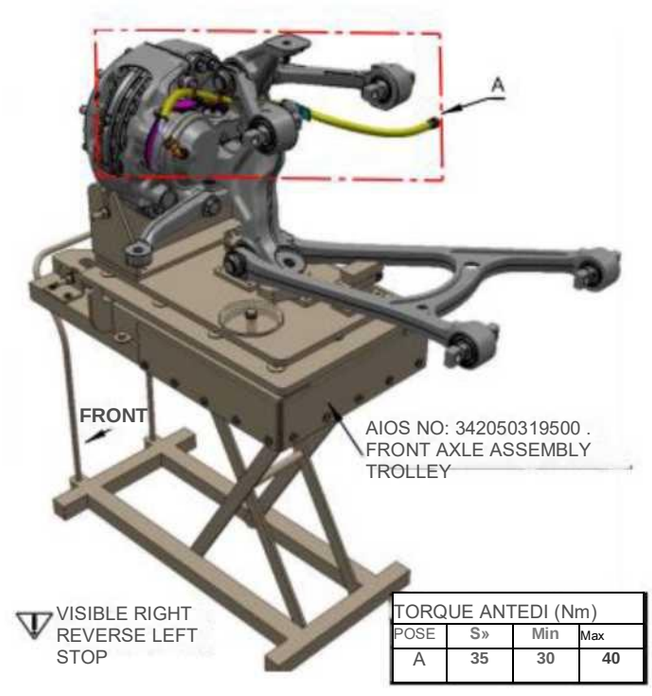
A DETAIL - INSTALLATION STEP 2.



A DETAIL - INSTALLATION STEP 3.



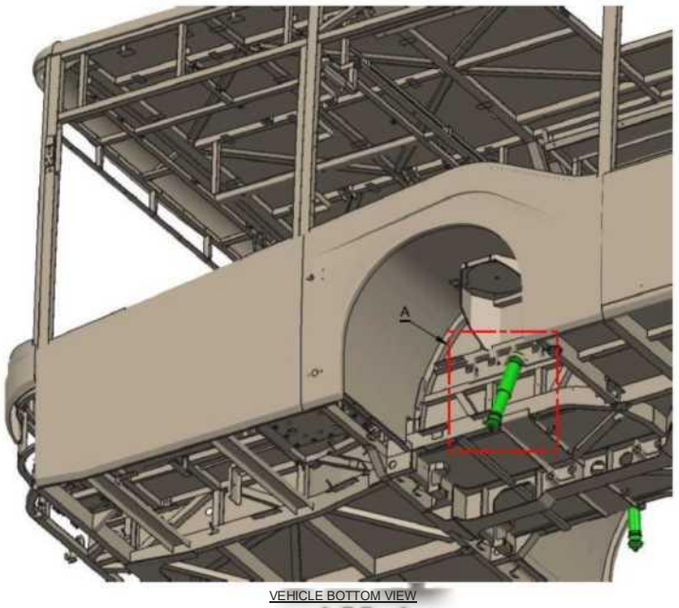
A DETAIL - INSTALLATION 4 STEPS.



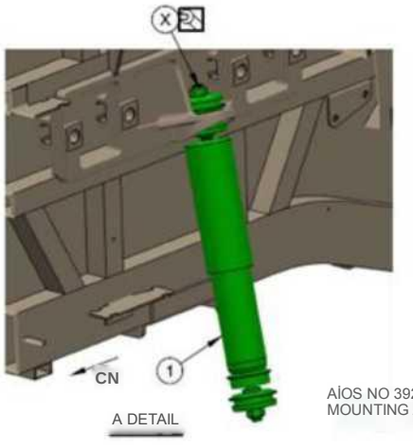
TORQUE ANTEDI (Nm)			
POSE	S»	Min	Max
A	35	30	40

LEAF POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER	ADDITIONAL INFO
1	942 - 035	387035752*	HOSE , BRAKE GUARD10 MM M18X1,5	2	
2	942 - 047	387035764*	BRACKET . FRONT BRAKE HOSE	2	
3	942 - 061	387036412*	WASHER. SPECIAL	2	
4	942 - 118	509707031*	CLAMP , PLASTIC	4	
5	942 - 131	897036333*	CLIP , EL BRAKE FRONT CABLE	4	
6	942 -155	3001208164"	BOLT , FLN M8X1.25X16, THICK D. DIN6921	4	CITIPORT CNG
6	942 -155	3001208166*	BOLT , FLN M8X1.25X16, THICK D. DIN692	4	
7	942 -159	3005800104*	NUT FLN&TR M10X1.5, THICK D. DIN6923	2	CITIPORT CNG
7	942 - 159	3005800101*	NUT FLN&TR M10X1. 5, THICK D. DİN 692	2	

FRONT RIGHT AND LEFT DAMPER INSTALLATION



VEHICLE BOTTOM VIEW



A DETAIL



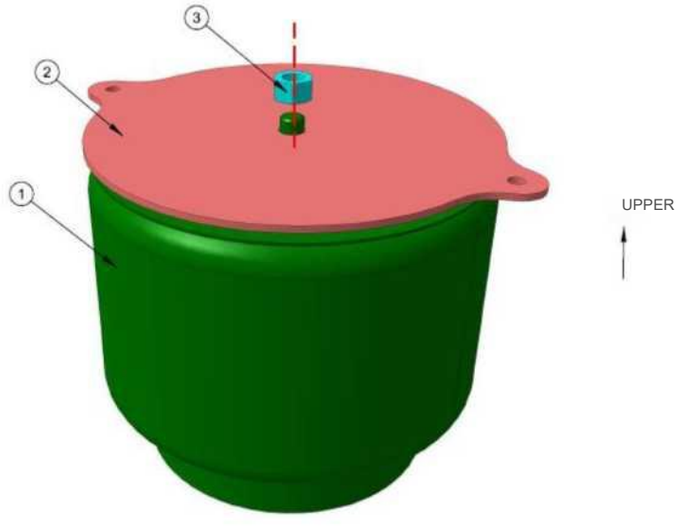
AİOS NO 3929440471000 DAMPER MOUNTING APPARATUS

RIGHT AND LEFT ASSEMBLY PROCESS IS SYMMETRICAL OF EACH OTHER

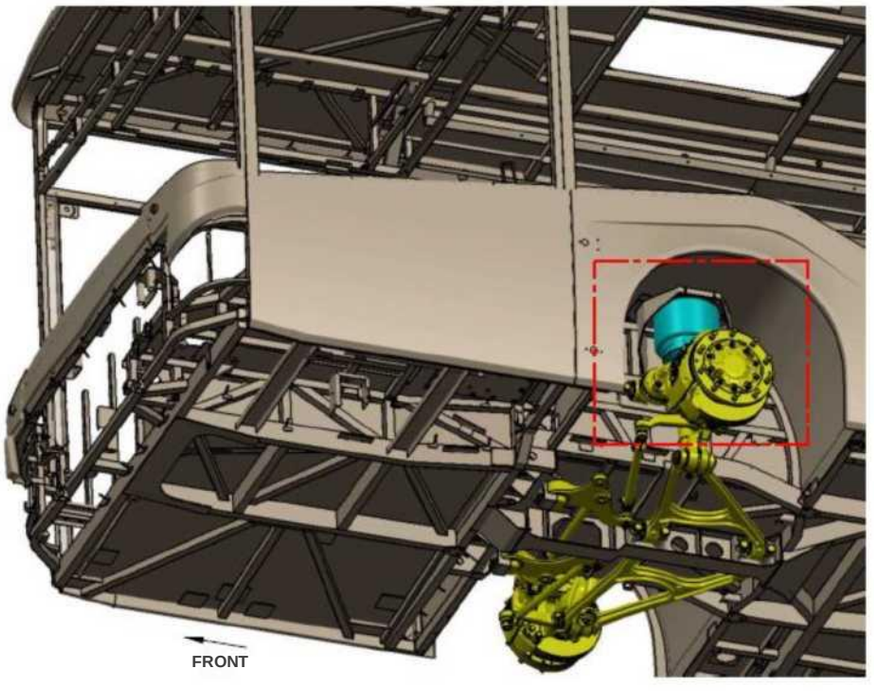
STI TORQUE ANTEDI (Nm)			
POSE	Su!	Min	Max
X	80	72	88

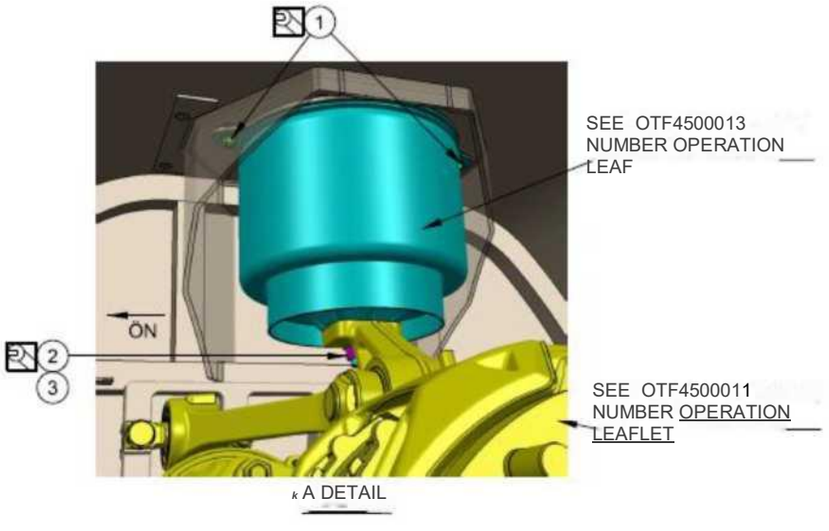
LEAFLET POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	450-006	387038087'	DAMPER, ON	2

FRONT RIGHT -LEFT AIR BELLOW PREPARATION INSTALLATION



LEAFLET POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	450-004	387034721'	AIR BELLOW, FRONT SUSPENSION	2
2	450-002	*387033896**	PLAQUE. BELLOW UPPER	2
3	450-005	*3005100184**	**NUT , AKB M18X1.5, THIN D, DIN9**34	2





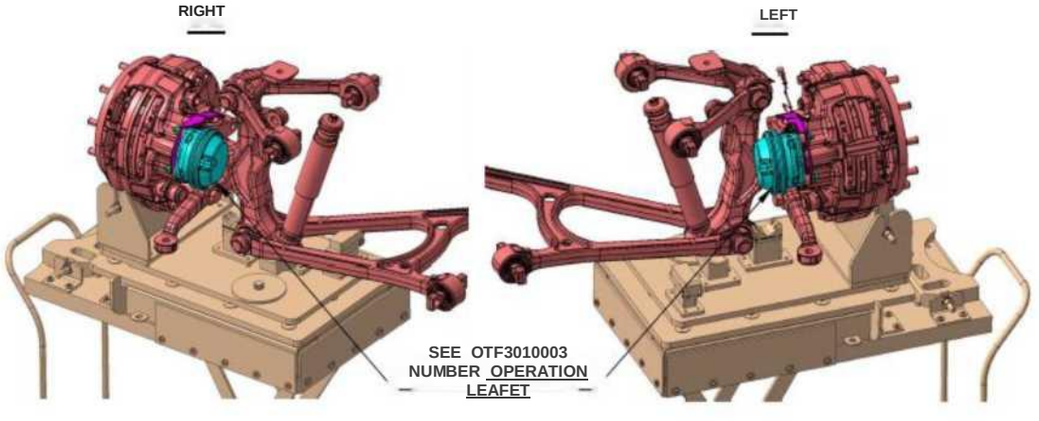
A DETAIL

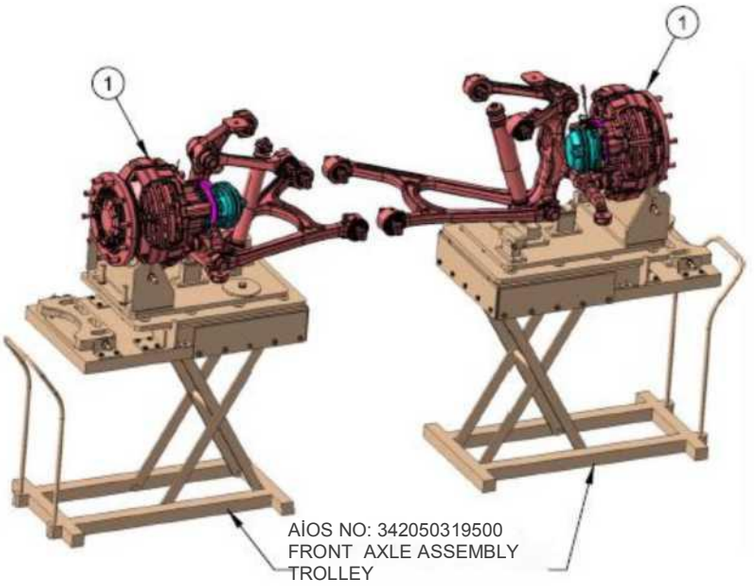
RIGHT AND LEFT ASSEMBLY PROCESS ARE SYMMETRICS OF EACH OTHER.

TORQUE ANTEDI (Nm)			
POSE	Sld	Min.	Max
1	60	54	66
2	100	90	110

LEAFLET POSE	GROUP,'POSE	PART NO	COMPONENT'S NAME	NUMBER
1	450-003	3005800104'	NUT , FLN&TR M10X1, 5, **THICK** D, DIN 6923	4
2	450-005	3005100184*	NUT , AKB M18X1.5, THIN D. DIN934	2
3	450-018	3010000164*	WASHER . ø18. HARDENED	2

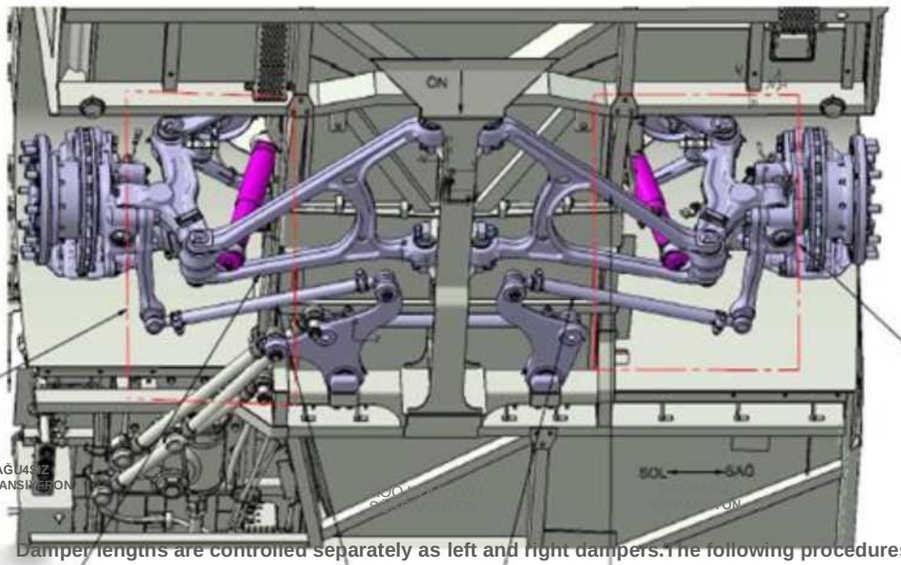
FRONT BRACKET BELLOWS INSTALLATION





LEAFLET POSE	GROUP.'POSE	PART NO	COMPONENT'S NAME	NUMBER
1	450 - 001	387034726'	SUSPENSION, FRONT INDEPENDENT (4474 075 334)	1

ADJUSTING THE FRONT BELLOW CARRIER PARALLEL



A 0

Damper lengths are controlled separately as left and right dampers.The following procedures are applied for the length differences wiTHIN the dampers (FRONT-BACK-FRONT of the front wheel). (Note: Procedures are made when the vehicle is completed and there is air in the bellows.)

1- The clamps of the back shell lower rod arm of the side with difference are loosened.

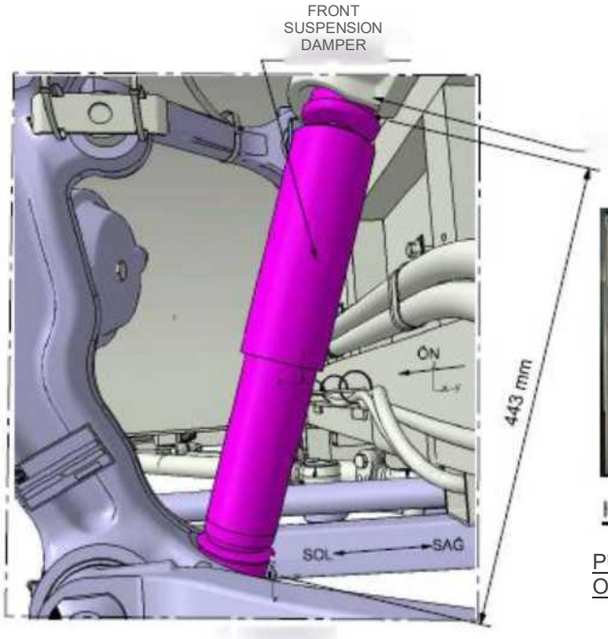
2- The rod arm is turned around its own axis until the length of the dampers and the Hunter thrust angle reach the appropriate value.

3- While this process is being done;

a- Each tipper length is 433 ± 5 mm.

b- It should be ensured that the length difference between front and rear dampers on the same side is maximum 7 mm, c- Hunter front axle thrust angle remains in the range of 0 ± 0 15 '(t0.25').

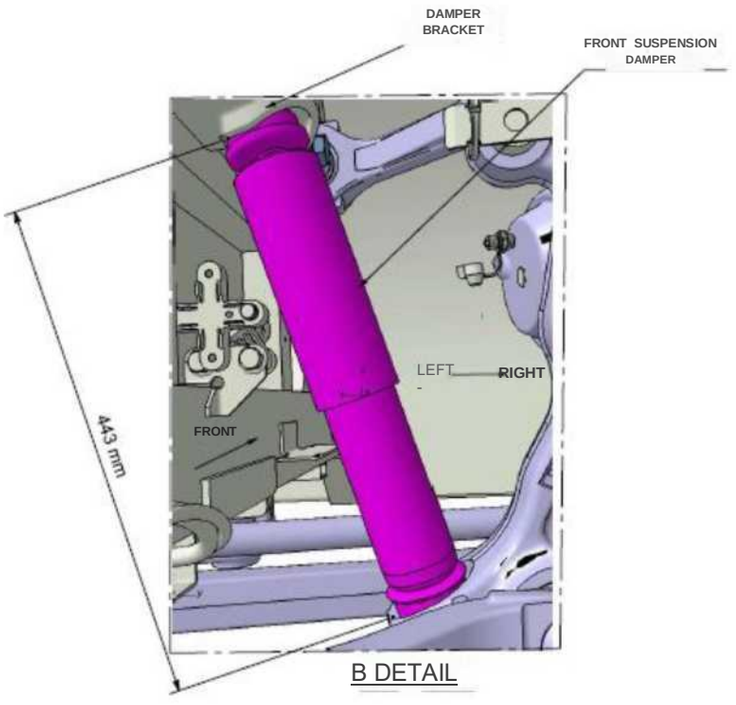
4- When the front wheel front and back are equal, the clamps are tightened with 80 ± 10 Nm.



A DETAIL



PUSH ANGLE MEASUREMENT SCREEN ON HUNTER DEVICE.

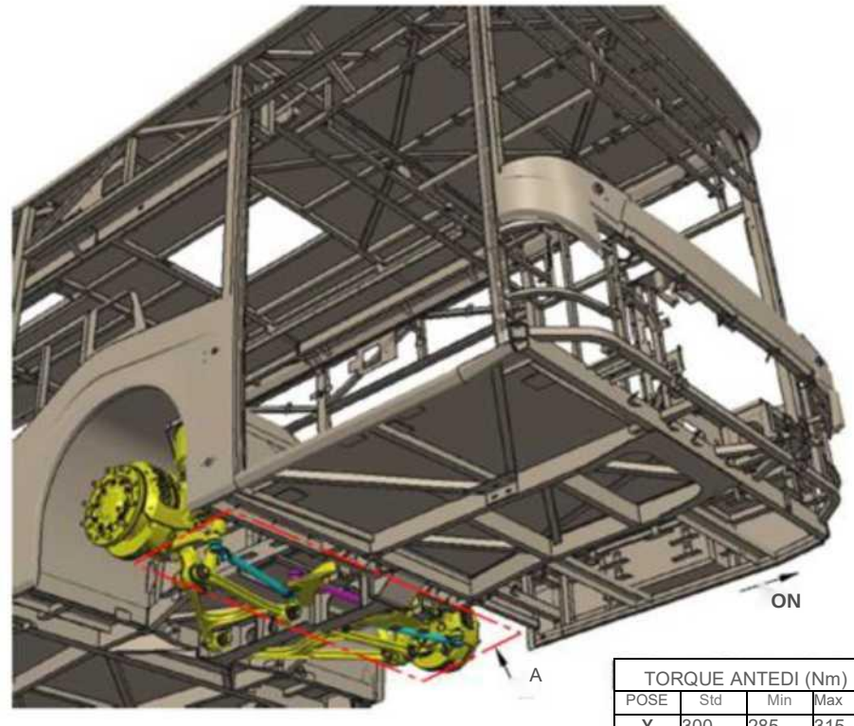


B DETAIL

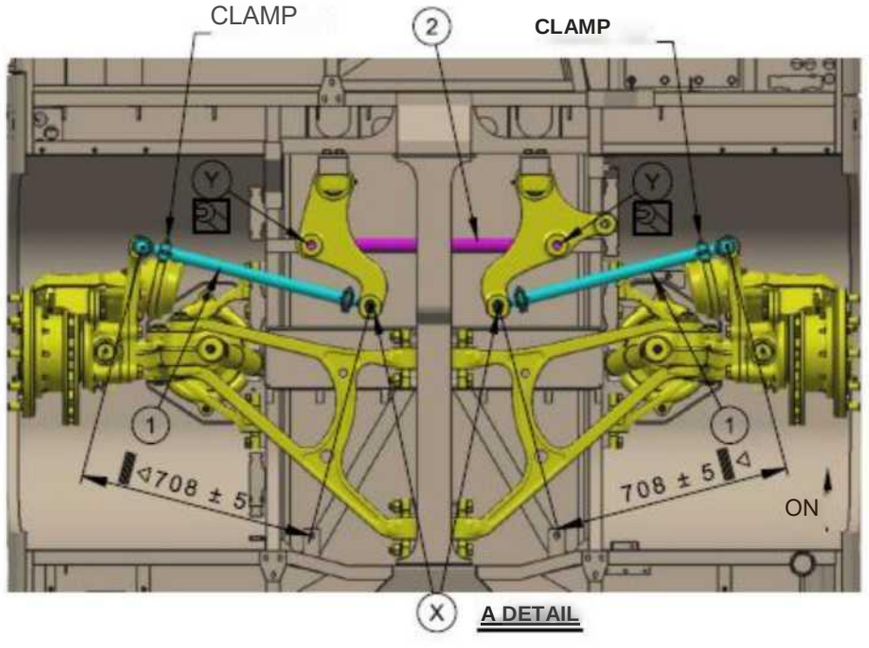
Anadolu ISUZU FRONT Layout Adjustment Values Table

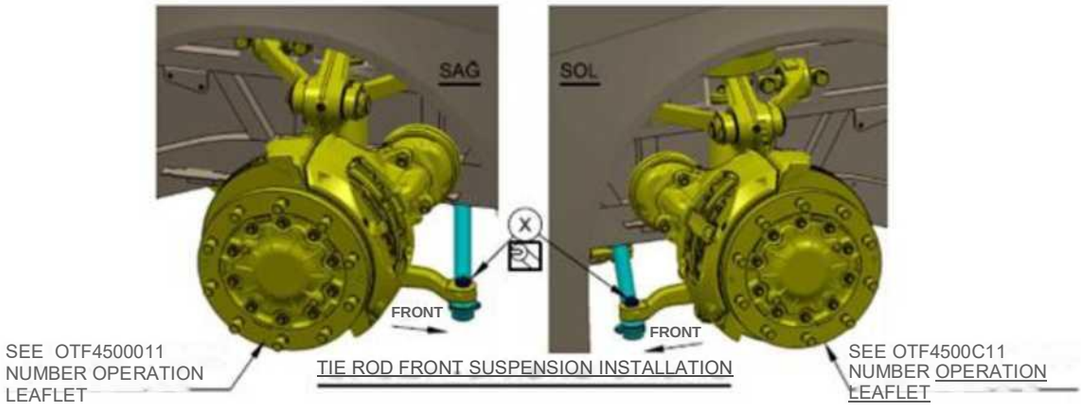
Vehicle type	Toe (mm)			Camber angle			Caster angle			Off-set radius		
	lowest	average value	highest	lowest	average value	highest	lowest	average value	highest	lowest	average value	highest
CITIBUS	0	1	2	-0'30	0'	0'30	0'30	1'30'	2'30'	9' 30	10*	10'30
VISIGO	0	1	2	-0'30	0'	0'30'	0'30	1'30'	2*30'	9'30	10*	10'30
CITIPORT	0	1	2	-0'30	0'	0'30'	2'	rso[1]	3'	8'	8*	9'

FRONT AXLE RIGHT -LEFT AND MIDDLE TIE RODS INSTALLATION

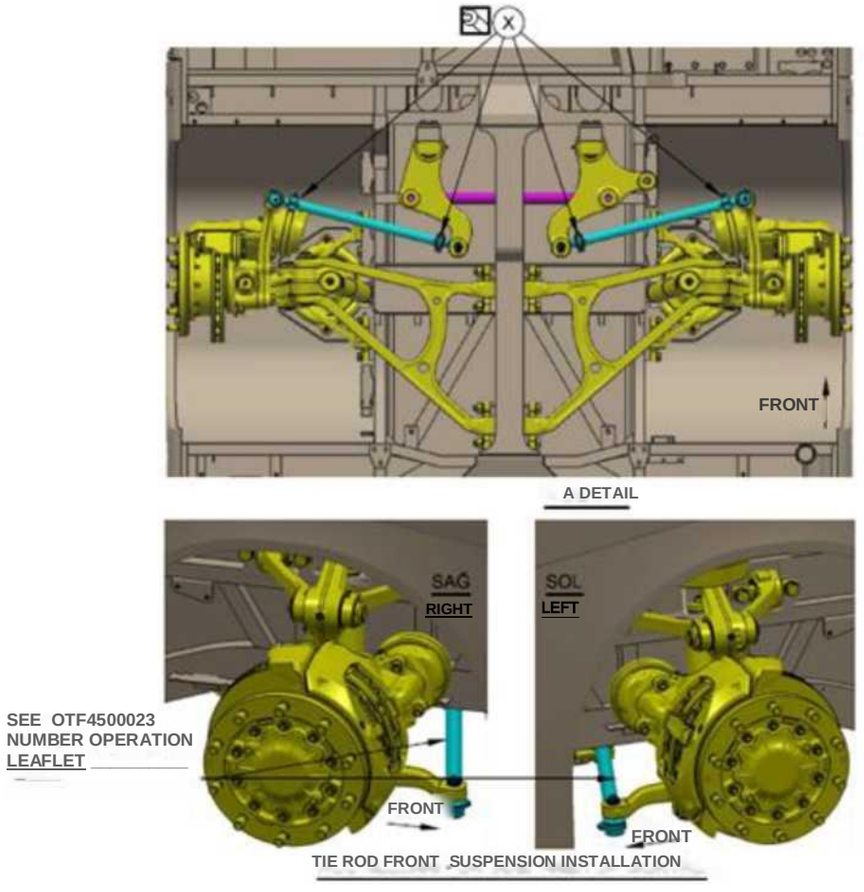


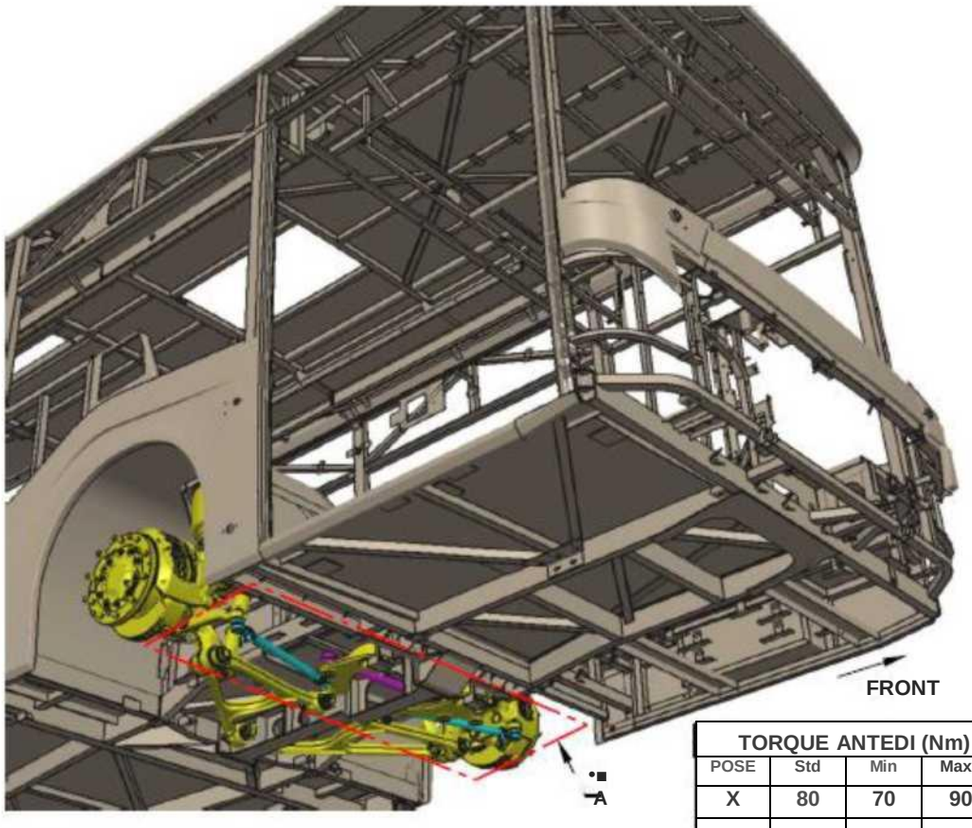
TORQUE ANTEDI (Nm)			
POSE	Std	Min	Max
Y	300	285	315
X	220	210	230





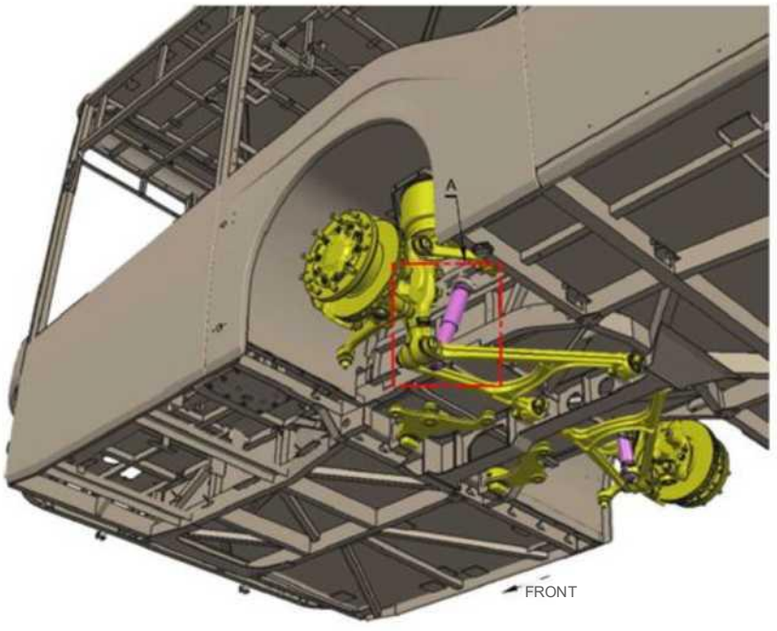
LEAFLET POSE	GROUP,'POSE	PART NO	COMPONENT'S NAME	NUMBER
1	450 - 007	387036929*	TIE ROD, WHEEL |FS	2
2	450 - 008	387036930*	TIE ROD, STEERING WHEEL SPACE |FS	1





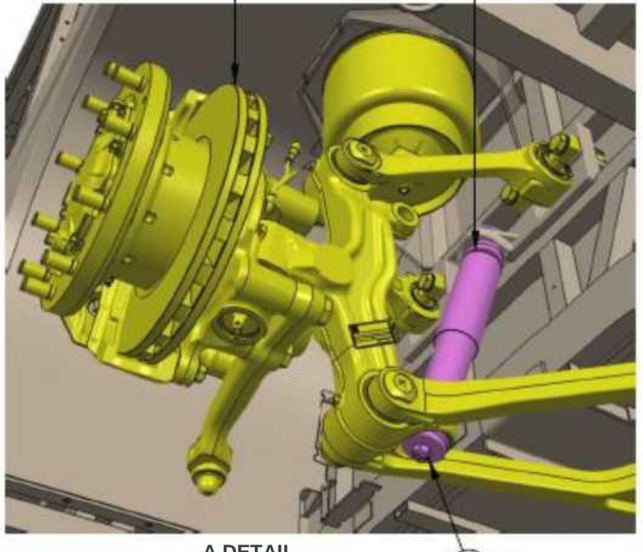
TORQUE ANTEDI (Nm)			
POSE	Std	Min	Max.
X	80	70	90

DAMPER UNDER CONNECTION INSTALLATION



SEE OTF4500011 NUMBER OPERATION LEAF

SEE OTF4500012 NUMBER OPERATION LEAF



A DETAIL

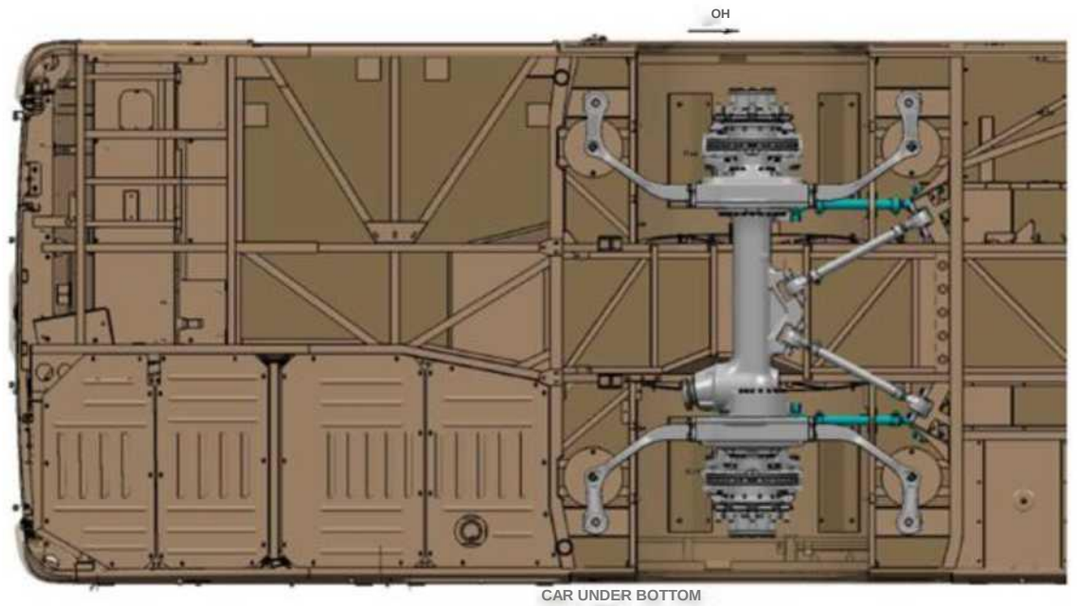
VISIBLE LEFT SYMMETRY IS RIGHT.

(X) THE NUT SHOWN WITH IT IS REMOVED, THE REAR SUSPENSION ASSEMBLY IS TIGHTENED AGAIN AFTER IT IS INSTALLED.

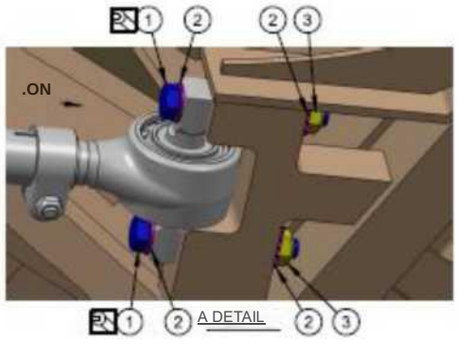
TORQUE ANTEDI (Nm)			
POSE	SW	Min	Max
X	110	105	115

REAR SUSPENSION

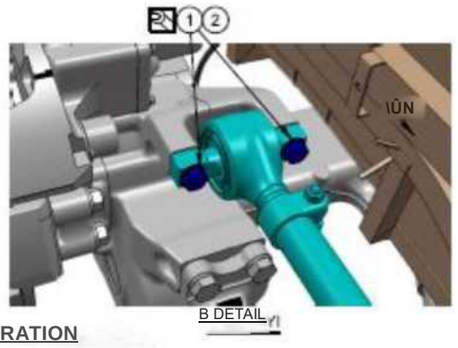
REAR SUSPENSION INSTALLATION



CAR UNDER BOTTOM VIEW

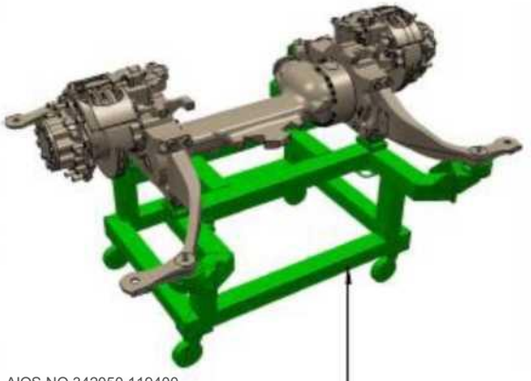


A DETAIL



B DETAIL

OPERATION LEAFLET



AIOS NO 342050.119400
REAR AXLE CARRYING AND ASSEMBLY TROLLEY.

UNDERVIEW OF THE VEHICLE

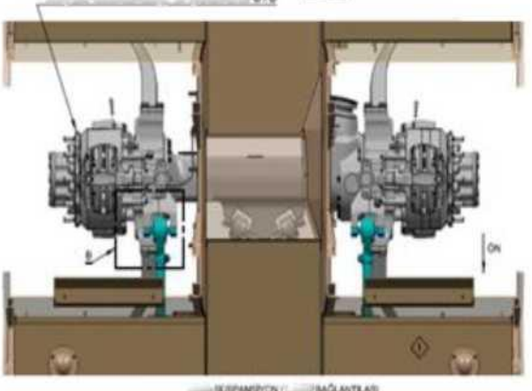
SEE OPERATION SHEET NO. OTF4600011



REAR SUSPENSION BASE CONNECTION (INTERIOR BOTTOM VIEW)

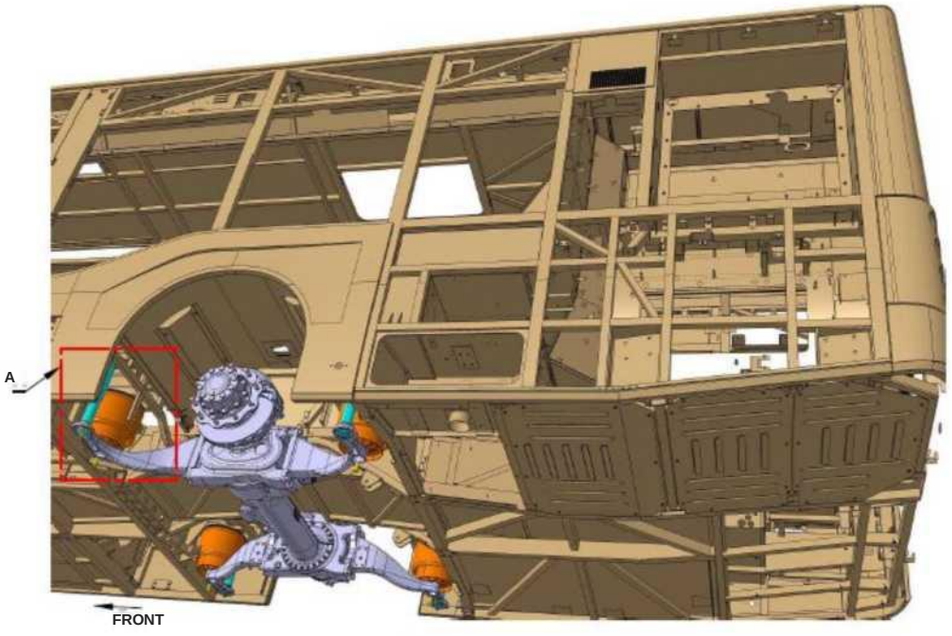
B DETAIL

SEE OTF-OPERATION SHEET NO 4600015.

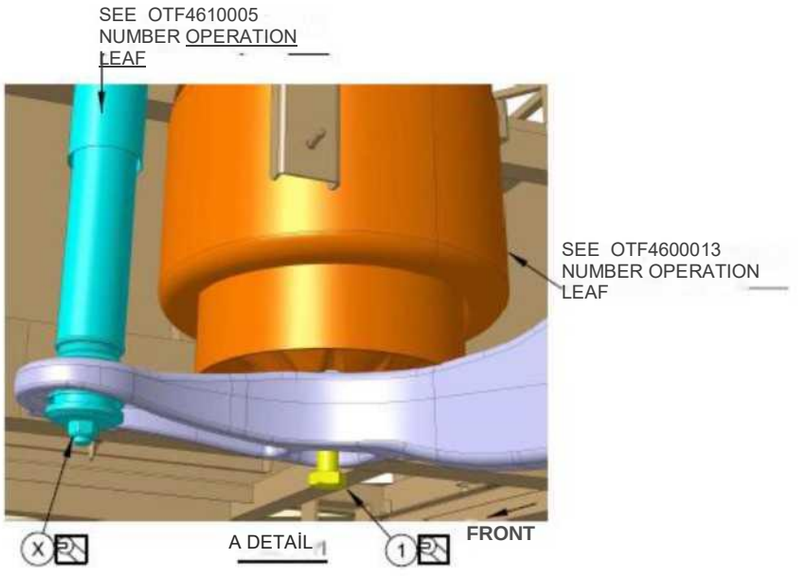


REAR SUSPENSION CONNECTIONS (INTERIOR OVERVIEW)

LEAFLET POSE	GROUP/ POSE	PART NO	COMPONENT'S NAME	NUMBER
1	460-040	3870349864"	**BOLT , M16X1.5K' 30, DİN 96D**	4
2	460 -041	3010000104*	WASHER , ø18. HARDENED	8
3	460 - 049	3870300824"	NUT M18X1.5, DİN 980/V	4



VEHICLE BOTTOM VIEW



! (X) I THE NUT SHOWN WITH IT IS DISASSEMBLED, IT IS TIGHTENED AGAIN AFTER THE REAR SUSPENSION ASSEMBLY IS INSTALLED.

OPERATION IS THE SAME IN OTHER ASSEMBLIES.

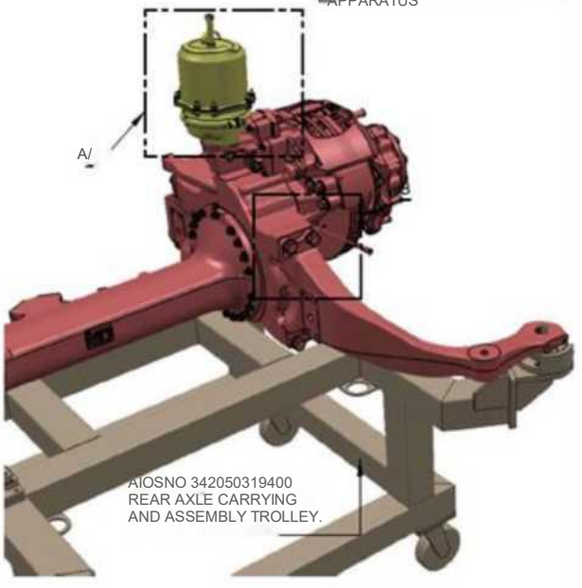
TORQUE ANTEDI (Nm)			
POS	STD.	Min.	Max.
1	110	105	115
X	110	105	115

LEAFLET POSE	GROUP,'POSE	PART NO	COMPONENT'S NAME	NUMBER
1	460 - 031	3000618404'	BOLT , AKB M 18X 1.5X40, THIN D. DİN961	4

REAR SUSPENSION PREPARATION AND INSTALLATION



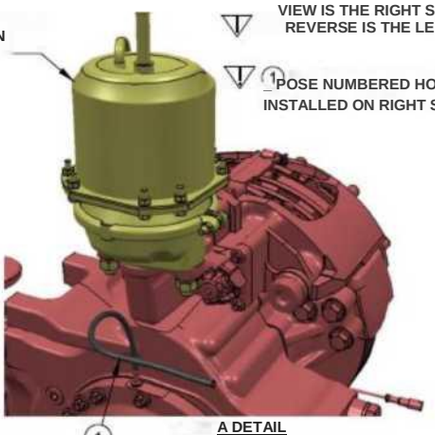
AIOSNO 3935450502100
STABILIZER IRON TIGHTENING APPARATUS



SEE OTF3050002 NUMBER OPERATION LEAF

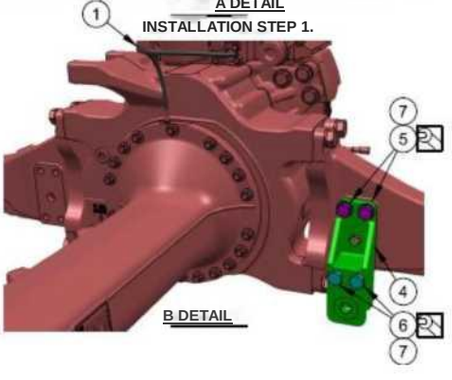
VIEW IS THE RIGHT SIDE, THE REVERSE IS THE LEFT SIDE

1 POSE NUMBERED HOSE WILL BE INSTALLED ON RIGHT SIDE ONLY.



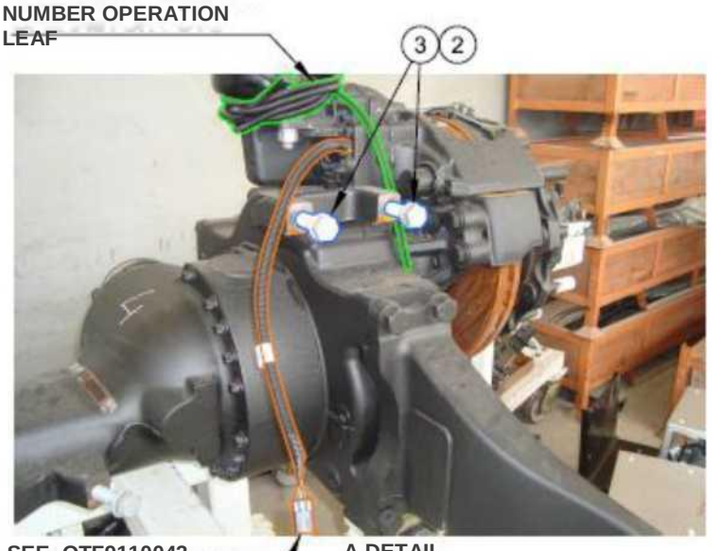
A DETAIL

INSTALLATION STEP 1.



B DETAIL

SEE ÖTF3050005
NUMBER OPERATION
LEAF



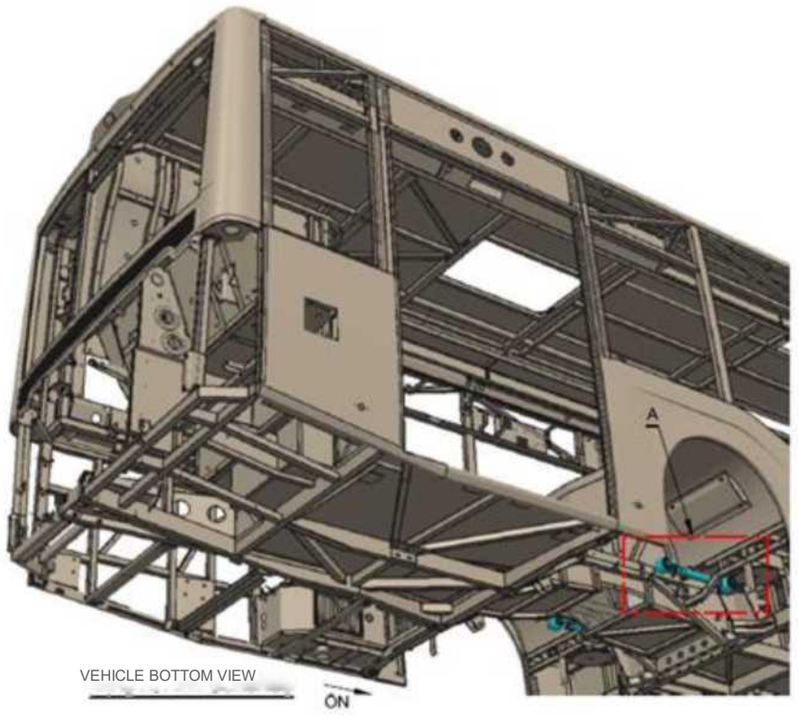
SEE OTF9110043
NUMBER OPERATION
LEAF

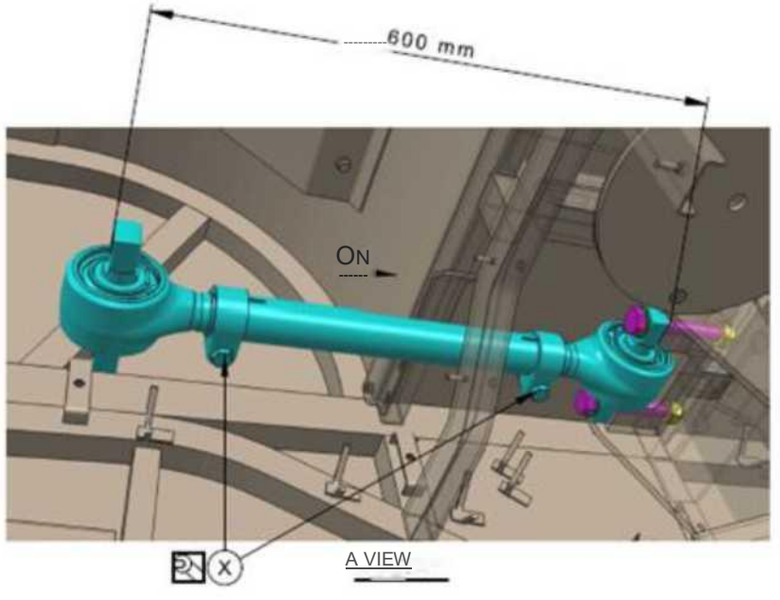
A DETAIL
INSTALLATION STEP 2.

TORQUE ANTEDI (Nm)			
POSE	Ski	Min.	Max.
6	287	250	310
5	287	250	310

LEAFLET POSE	GROUP.'POSE	PART NO	COMPONENT'S NAME	NUMBER
1	460 - 002	306232040*	HOSE , AXLE VENTILATION	1
2	460 - 041	3010000184*	WASHER ø18, HARDENED	4
3	460 - 045	3000618607*	BOLT , AKB M18X1. 5X60 THIN D. DIN961	4
4	460-060	387040782*	BRACKET . STABILIZER	2
5	460 - 065	3000616404*	BOLT , AKB M16X1. 5X40, THIN D. DİN961	4
6	460 - 066	3000816004*	BOLT , AKB M16X1. 5X100	4
7	460 - 70	3010000164*	WASHER . D16x3 DİN 125	8

REAR SUSPENSION L-ROT INSTALLATION

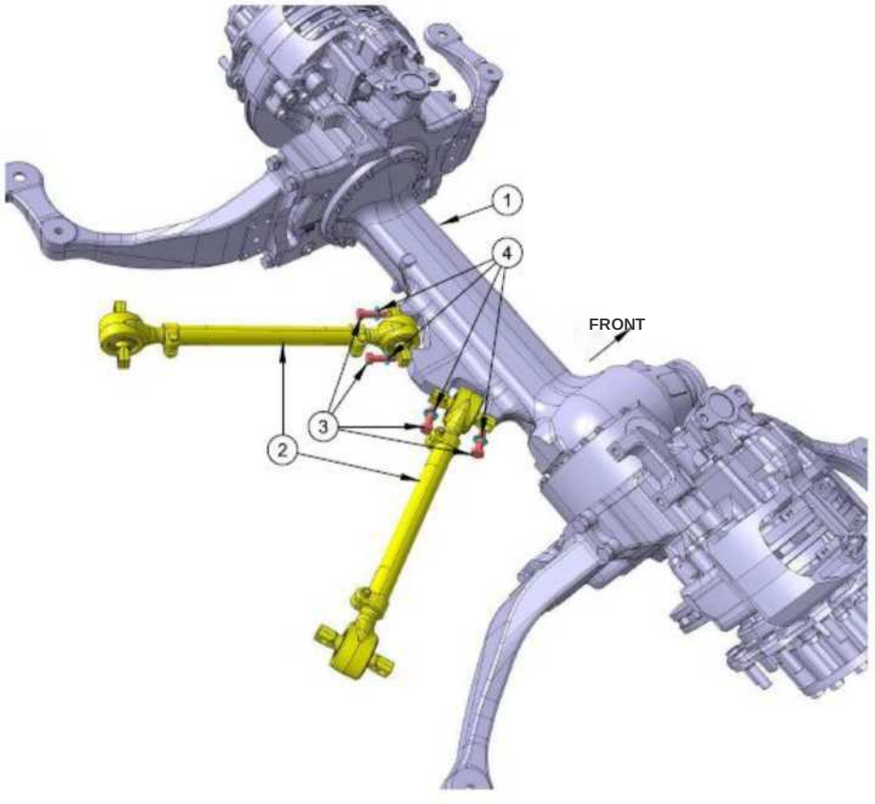


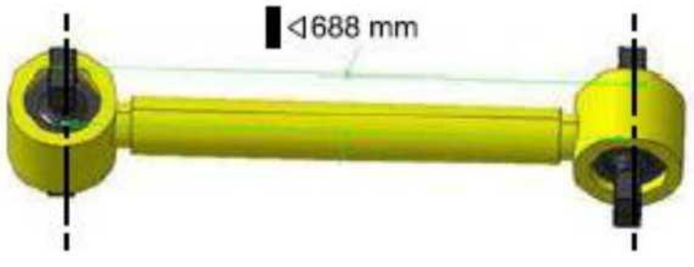


TORQUE ANTEDI (Nm)			
POSE	SM	Min	Max.
X	75	70	80

LEAFLET POSE	GROUP.'POSE	PART NO	COMPONENT'S NAME	NUMBER
1	460-035	387036932*	L-ROD	2
2	460 - 040	3070349864*	BOLT , M18X1.5X130 D|N 960	4
3	460-041	3010000184*	WASHER . ø18. HARDENED	8
4	460-049	3870300624*	NUT , M18X1.5, DIN 980/V	4

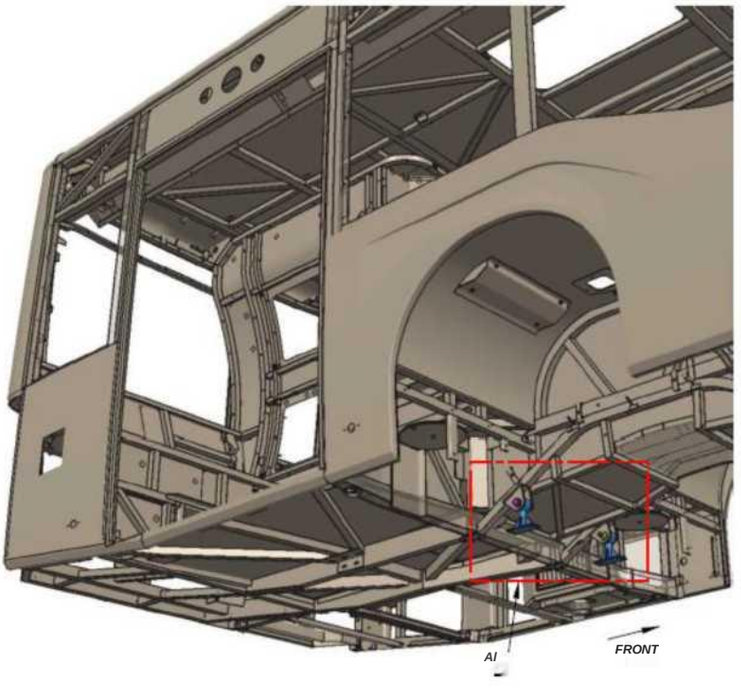
REAR LOWER V TIE ROD ASSEMBLY

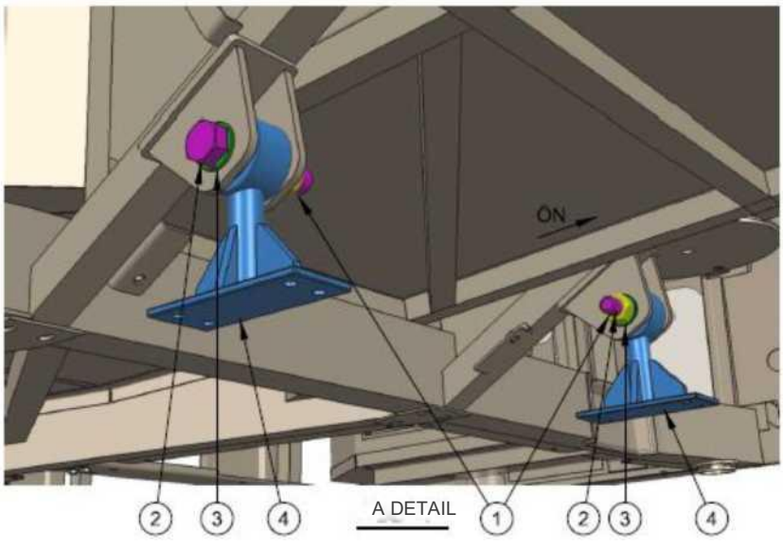




LEAFLET POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	460 - 001	387034735*	AXLE ASSEMBLY REAR	1
2	460 - 034	387036931*	V-ROD	2
3	460-045	3000618607*	BOLT , AKB M13X1.6X60, THIN D. DIN961	4
4	460-041	3010000184*	WASHER . ø18. HARDENED	4

STABILIZER HANGER ARM INSTALLATION

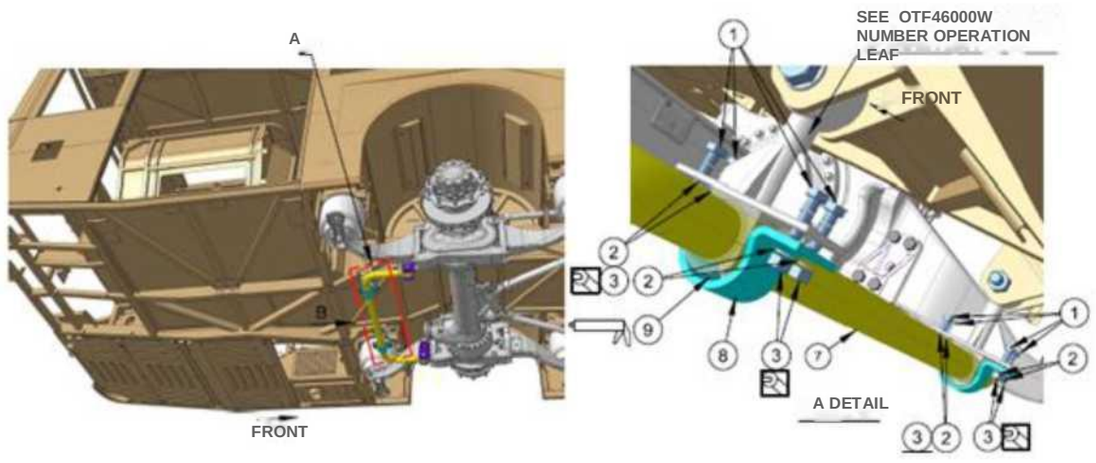


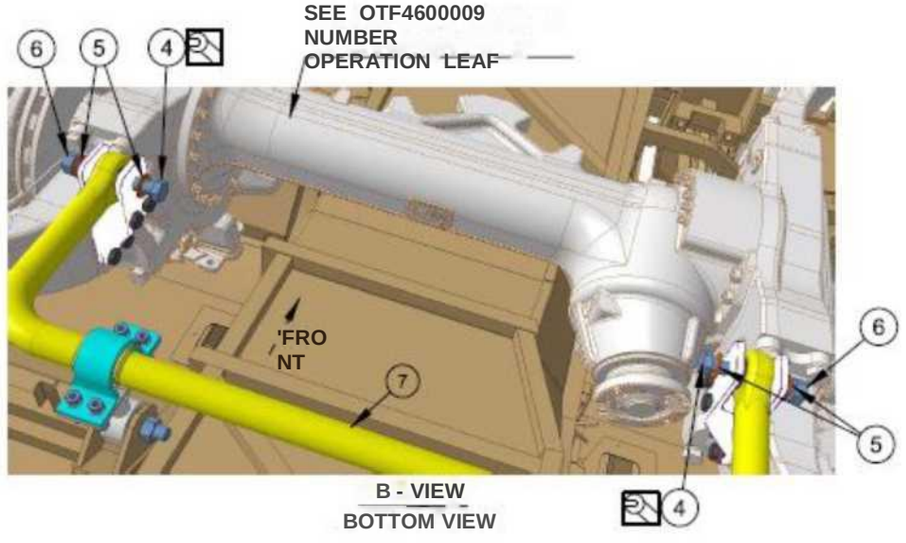


RIGHT AND LEFT ASSEMBLY PROCESS ARE SYMMETRICS OF EACH OTHER..

LEAFLET POSE	GROUP,'POSE	PART NO	COMPONENT'S NAME	NUMBER
1	460-014	300510020401	NUT , AKB M20X1.5, THIN D, DİN934	2
2	460-085	300082000401	BOLT , AKB M20X1.SX10D, THIN D. DIN960	2
3	460 - 307	301000020401	WASHER . ø20	4
4	460-075	387034880*	HANGER ARM STABILIZER ASSEMBLY	2

STABILIZER REAR BEND RADIUS MOD INSTALLATION





PROPOSED GRES:
BP ENERGREASE LC2 (or Equivalent)

FOR GENERAL TORQUE VALUES SEE NO. GNF0000001*
GENERAL OPERATION LEAFLETS.

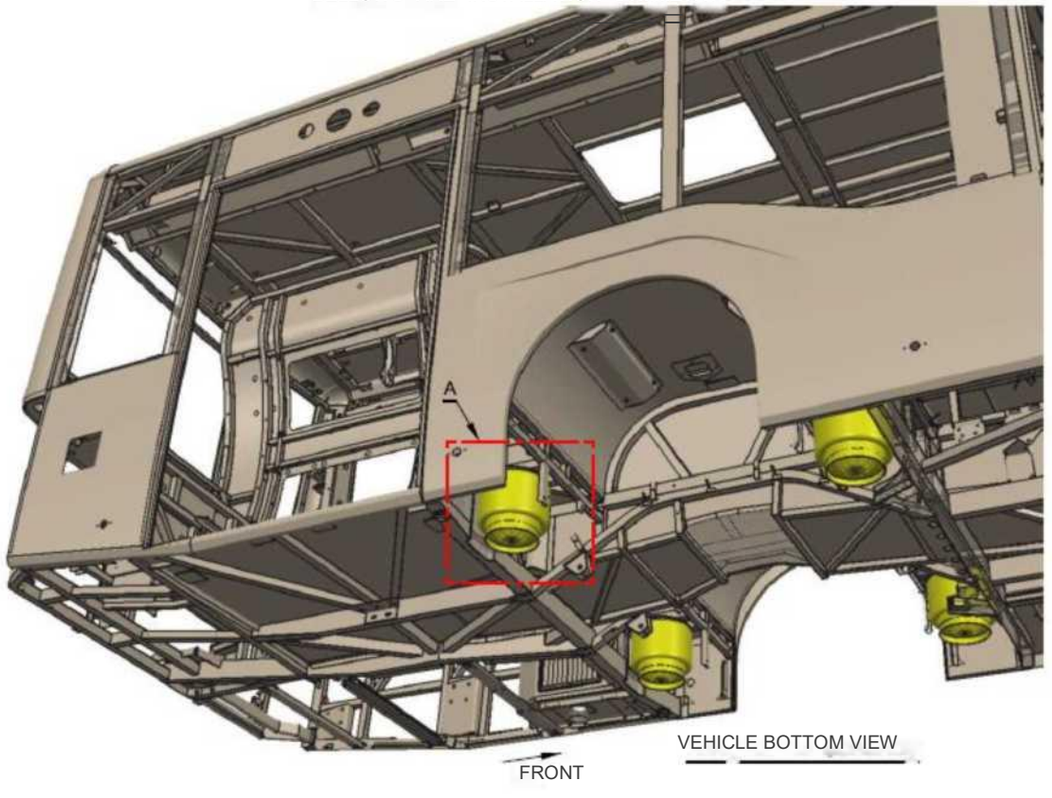
GREASE WILL BE APPLIED BETWEEN THE STABILIZER REAR BUSHING (14 POSE) AND THE STABILIZER ARM (12 POSE)

TORQUE ANTEDI (Nm)			
POSE	Sid	Min.	Max.
4	560	**504**	616
3	**60**	54	66

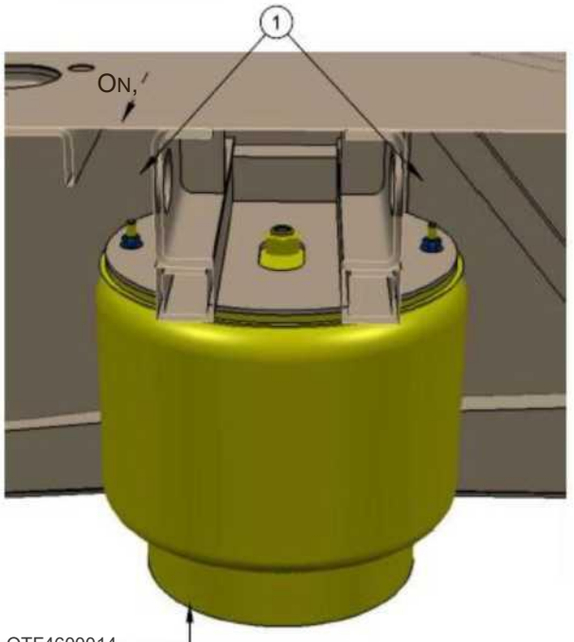
LEAFLET POSE	GROUP,'POSE	PART NO	COMPONENT'S NAME	NUMBER
1	460 - 110	300051035401	BOLT . AKB M10X1.5X35, THICK D, DİN933	8
2	460 - 120	301090010401	WASHER . SPRINGY D=100 DİN 137	8
3	460 - 115	300500010401	NUT , AKB M10X1.5, THICK D. DIN934	**8**
4	460-094	300062000401	BOLT . AKB M20X1.5X100, THIN D. DIN960	2
5	460 - 307	301000020401	WASHER , ø20	4
6	460 - 014	300510020401	NUT . AKB M20X1.5, THIN D. DİN934	2
7	460 - 091	387021620*	STABILIZER ASSEMBLY . REAR ø45	1
8	460 - 095	387023454*	BRACKET , STABILIZER BUSHING HOLDER	2
9	460-105	387023250'	BUSHING, STABILIZER REAR	2

REAR SUSPENSION BELLOWS INSTALLATION

REAR RIGHT BELLOW INSTALLATION IS DESCRIBED IN DETAIL A. OTHER THREE BELLOWS ARE INSTALLATION SYMMETRY.

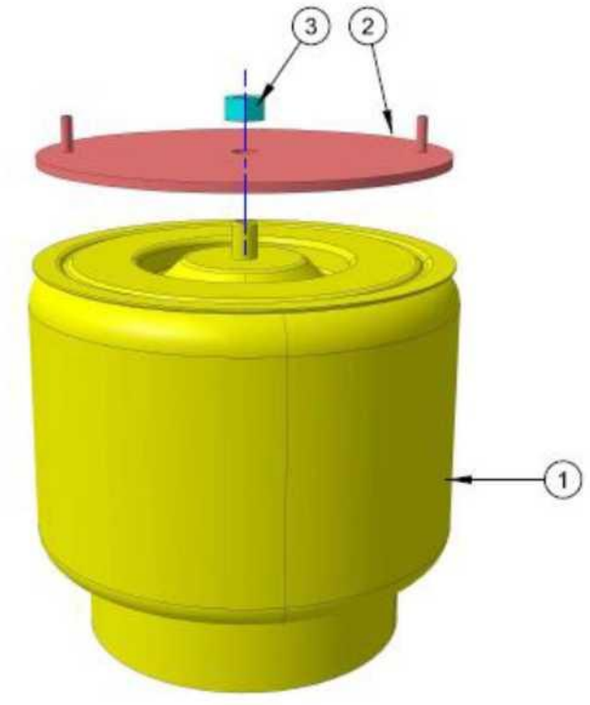


REAR RIGHT BELLOW INSTALLATION IS DESCRIBED IN DETAIL A. OTHER THREE BELLOWS ARE INSTALLATION SYMMETRY



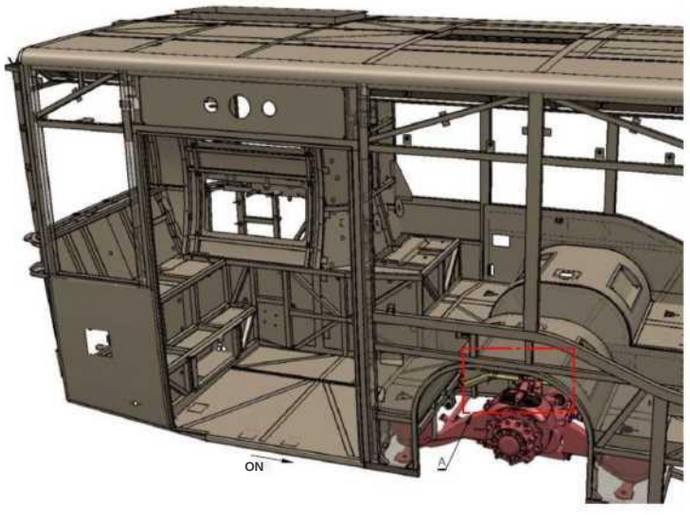
LEAFLET POSE	GROUP.'POSE	PART NO	COMPONENT'S NAME	NUMBER
1	460-033	3006700034'	NUT , FLN M8X1.25, THICK D, DİN6923	8

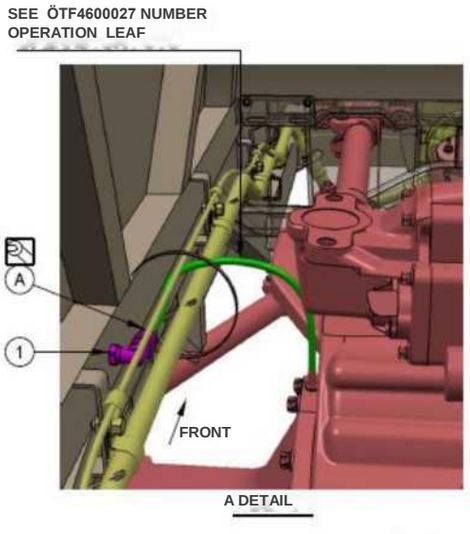
REAR BELLOW ASSEMBLY



LEAFLET POSE	GRUP.'POSE	PART NO	COMPONENT'S NAME	NUMBER
1	460-030	3005100184'	NUT , AKB M18X1.5, THIN D. DİN934	4
2	460-032	387034417*	PLATE. SPRING CONNECTION	4
3	460-025	387034728*	AIR SWITCH, REAR SUSPENSION	4

REAR AXLE VENTILATION HOSE INSTALLATION

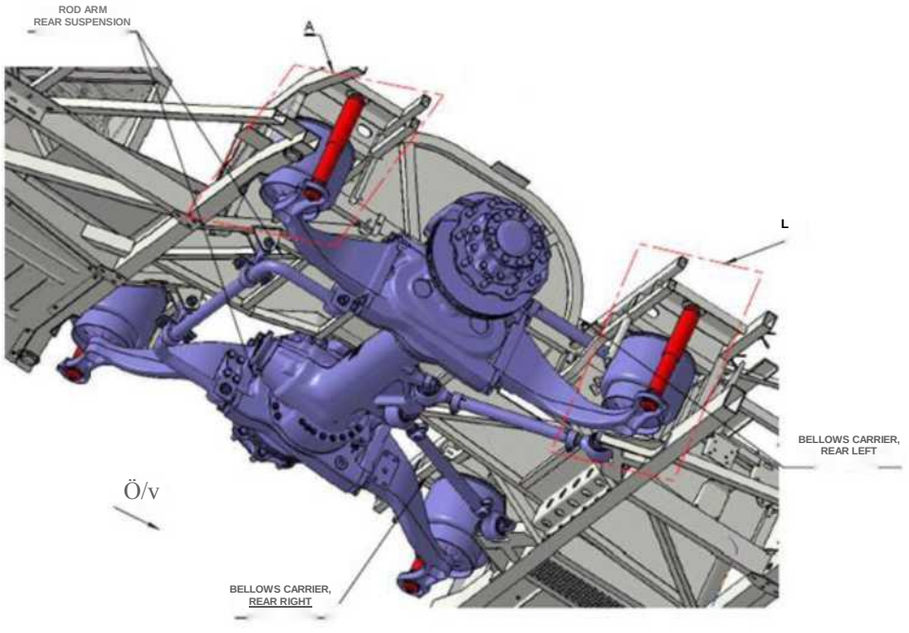




2^ TORQUE ANTEDI (Nm)			
POSE	Std	Min	Max.
A	42,5	37,5	47,5

LEAFLET POSE	GROUP./POSE	PART NO	COMPONENT'S NAME	NUMBER
1	460-308	387046649*	BRACKET, P, I. R, M12-T8 TK	1

ADJUSTING THE BELLOW HOLDER PARALLEL



Damper lengths are controlled separately as LEFT and RIGHT dampers..
The following procedures are applied for the length differences of the dampers (REAR WHEEL FRONT REAR). (Note: Operations are carried out when the vehicle is completed and there is air in the bellows.)

1- Clamps of the rod of the rear shell of the difference side are loosened.

2- Rod arm is rotated in its own axis until the length of the dampers and Hunter thrust angle reach the appropriate value.

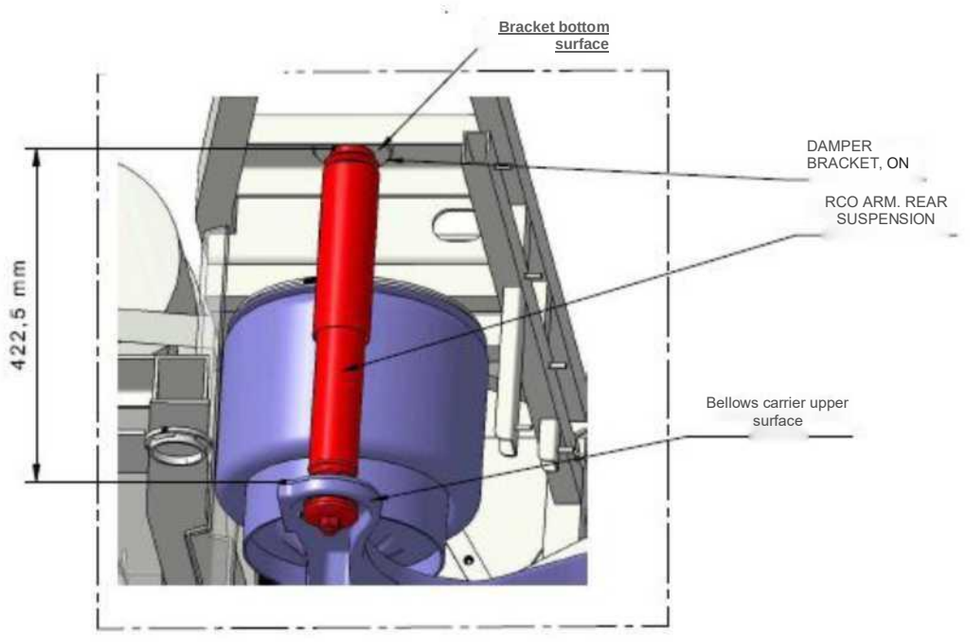
3- While this process is being done;

a- The length of each damper is 422.5 ± 5 mm,

b- Maximum length difference between FRONT -REAR dampers on the same side is 7 mm.

c- Hunter rear axle thrust angle should be RIGHT to stay in the range of 0 ± 0.15 '(± 0.25 ").

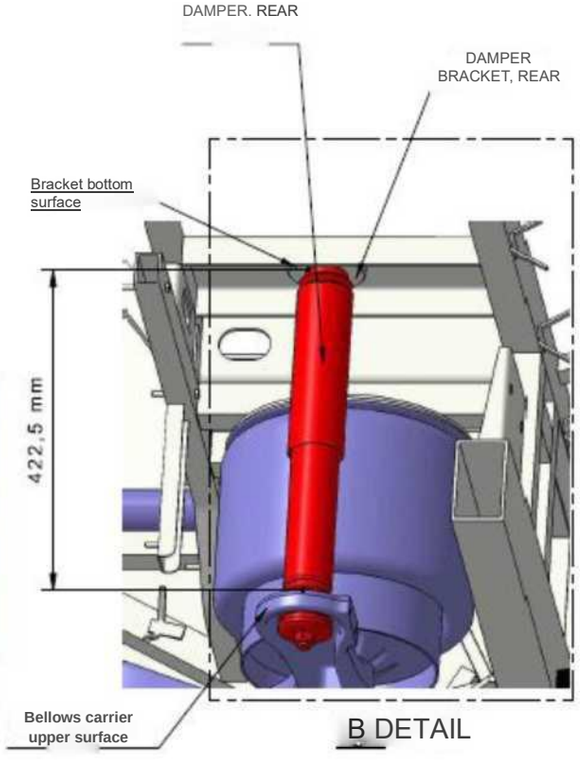
4- When rear wheel front-rear is equal, clamps are tightened with 80 ± 10 Nm.



A DETAIL

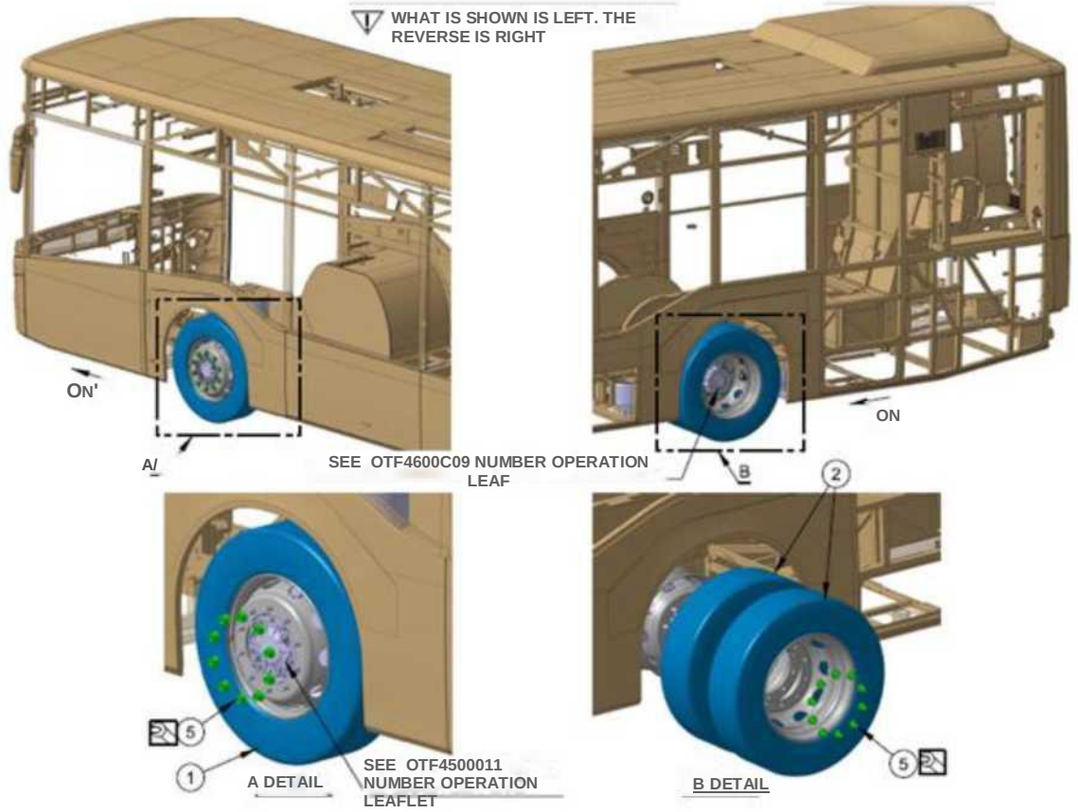


Thrust angle measurement display on Hunter device

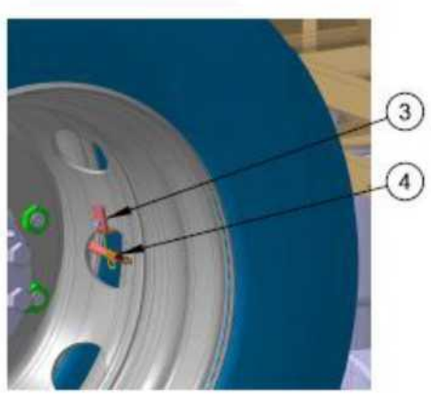


B DETAIL

TIRE AND WHEEL ASSEMBLY



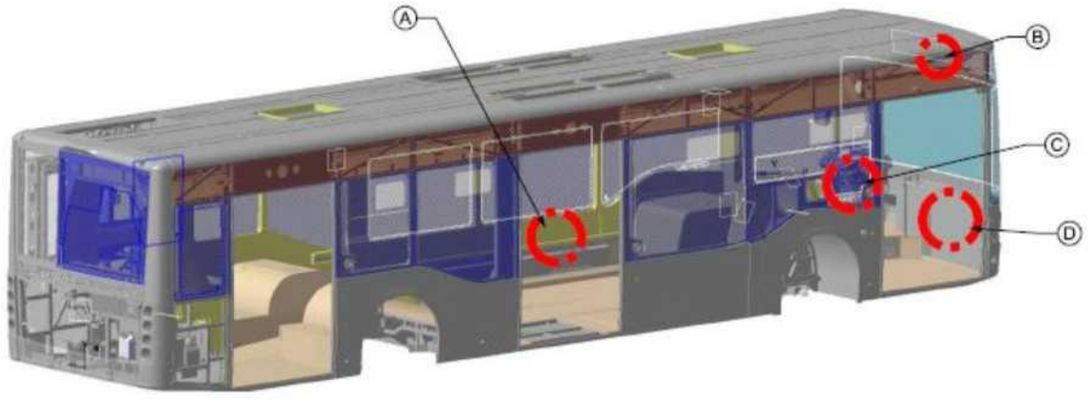
AFTER THE REAR AXLE WHEEL AND TIRES ARE INSTALLED, THE BRACKET OF THE VALVEEXTENSION ON THE INNER TIRES AND THE INTERIOR AND EXTERIOR TIRE VALVES WILL BE INSTALLED ON THE EXTERIOR TIRE.



TORQUE ANTEDI (Nm)			
POSE	Sto	Mın.	Max.
5	600	570	630

LEAFLET POSE	GROUP,'POSE	PART NO	COMPONENT'S NAME	NUMBER
1	480-002	3B7050893*	TIRE ASSEMBLY BALANCE, 275/70 R22, 5	2
1	480-002	387057445*	TIRE **KMP,** DRAWBAR **BALANCE,** 275/70 R22.5	2
2	480-007	387050274*	TIRE ASSEMBLY , 275/70 R22. 5	**4**
2	480-007	387057444*	TIRE **KMP,** DRAWBAR . 275/70 R22.5	2
3	480-011	387035319*	CLIP , VALVEHOSE	2
4	480-012	397058273*	VALVE EXTENSION . ADAPTER PIPE	2
5	480-014	387034425*	NUT . STUD M22X1. 5 DİN 74361	40

LABELS

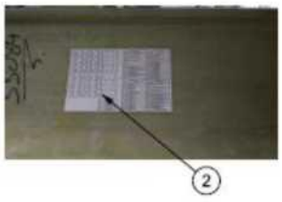




FRONT

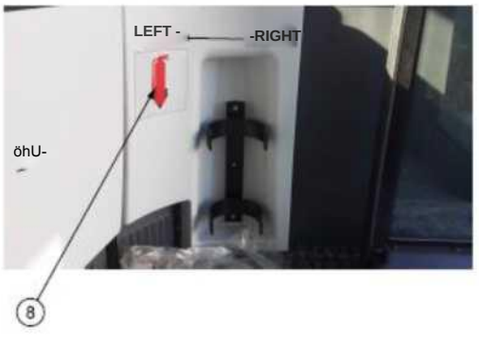


A DETAIL





C DETAIL





FRONT VIEW D DETAIL



B DETAIL

A DETAIL





A DETAIL

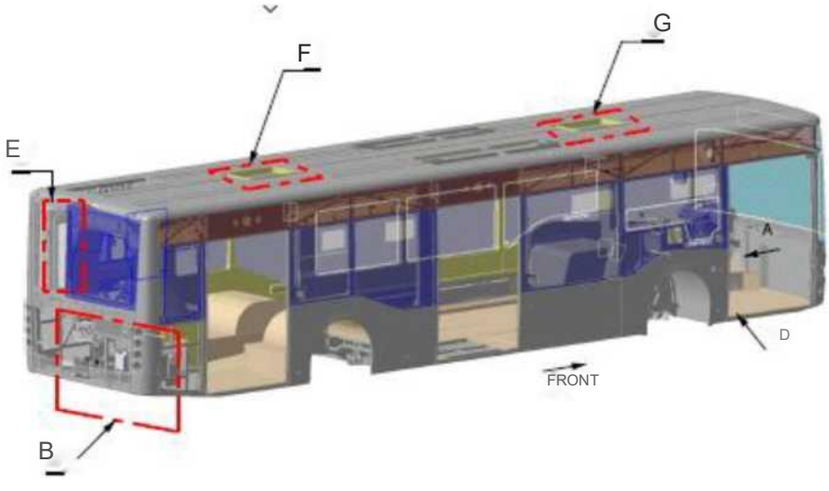
ATTENTION!
WHEN THE FIRE WARNING LENS IS LIT OR FIRE WARNING ALARM IS ON, IMMEDIATELY PULL THE VEHICLE TO A SAFE PLACE, STOP THE ENGINE AND EVACUATE THE VEHICLE.



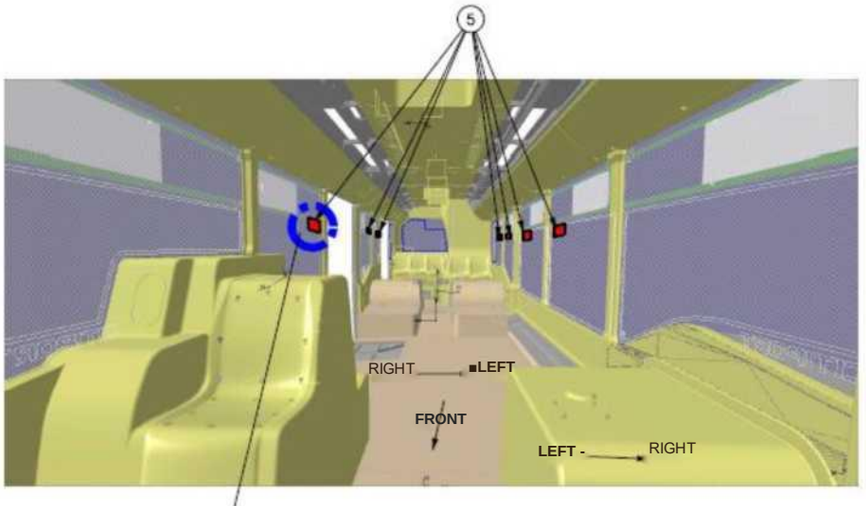


ATTENTION!

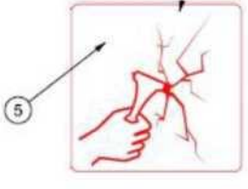
LEAF/POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	710 - 000	377770746	LABEL **TURBO WARNING** TURKISH BUS	1
1	710 - 000	377771242	LABEL **TURBO WARNING FRENCH**	1
1	710-000	307001034	LABEL **TURBO WARNING ENGLISH**	1
1	710-000	387481051	LABEL . TURBO WARNING ROMANIAN	1
2	710-007	iaTnSo-ı ıı*	LABEL **INSURANCE ENGLISH**	1
2	710-007	30 TG 55122*	LABEL, INSURANCE FRENCH	1
2	710 - 007	IHTPSSi ISC*	LABEL INSURANCE ENGLISH	1
2	710-007	3O7«3931i=O"	LABEL INSURANCE ENGLISH	1
2	710.007	387481039	LABEL. INSURANCE BOX	1
3	710-011	3070304*0*-	LABEL. EMERGENCY SWITCH TR	
3	710-011	MTOKEO"	LABEL. EMERGENCY SWITCH ENGLISH	
3	710-011	SJIfflMhC.f*	LABEL. EMERGENCY SWITCH FR	
3	710-011	307003060"	LABEL. EMERGENCY SWITCH ENGLISH	1
3	710-011	307903430°	LABEL. EMERGENCY SWITCH TURKISH	1
3	710 - 011	3a7aD34£Z'	LABEL. EMERGENCY SWITCH FRENCH	1
3	710-011	KT4MBT	LABEL. EMERGENCY SWITCH Romanian	1
4	710 - 017	307055130°	LABEL WHEELCHAIR WARNING TR	i
4	710-017	3070341 Mr	LABEL WHEELCHAIR WARNING ENG	1
4	710-017	907334140°	LABEL WHEELCHAIR WARNING FR	1
4	710 - 017	3OT4BSHS4*	LABEL WHEELCHAIR WARNING ROMAN	1
5	710-018	307034141*	LABEL WHEELCHAIR WARNING	1
6	710-021	jirawnr	LOW CAPABILITY PASSENGER	1
7	710 - 050	207034ı ı*-	LABEL. FIRE WARNING TR	1
7	710-050	3073 35110*	LABEL, FIRE WARNING. ING	1
7	710 -050	MJEK I 1K[B]	LABEL, FIRE WARNING FR	1
7	710-050	307454055*	LABEL, FIRE WARNING ROMANIAN	1
8	710-252	3O7O(H<2^	LABEL. FIRE EXTINGUISHING	1
9	710 -255	307050091**	LABEL 26 PEOPLE. CNG	1
9	710-295	saTawazz*	LABEL, 27 PEOPLE . CNG	1
9	710 -255	33TP39 I3<T	LABEL .27 PEOPLE CNG	1
9	710-255	3070+3222"	LABEL, 28 PEOPLE	1

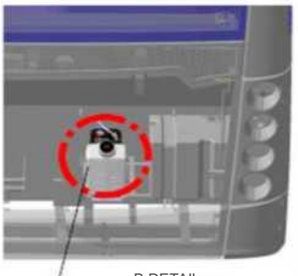






A VIEW

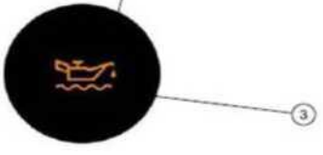




B DETAIL



C DETAIL





FRONT DOOR USTU



MIDDLE DOOR TOP



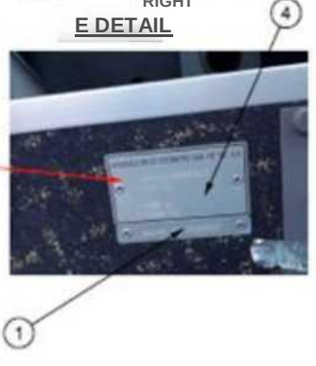
REAR DOOR TOP



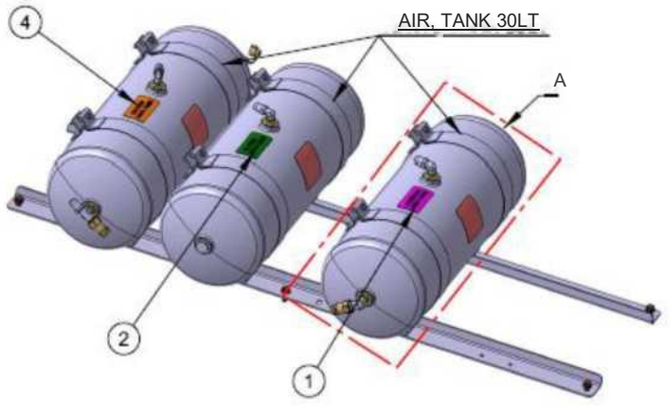
E DETAIL

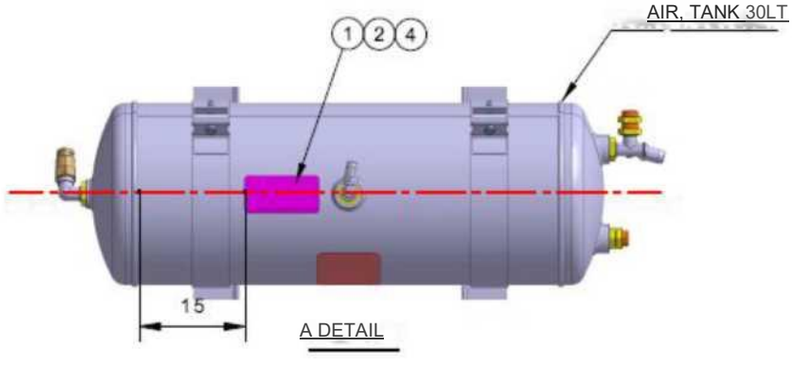


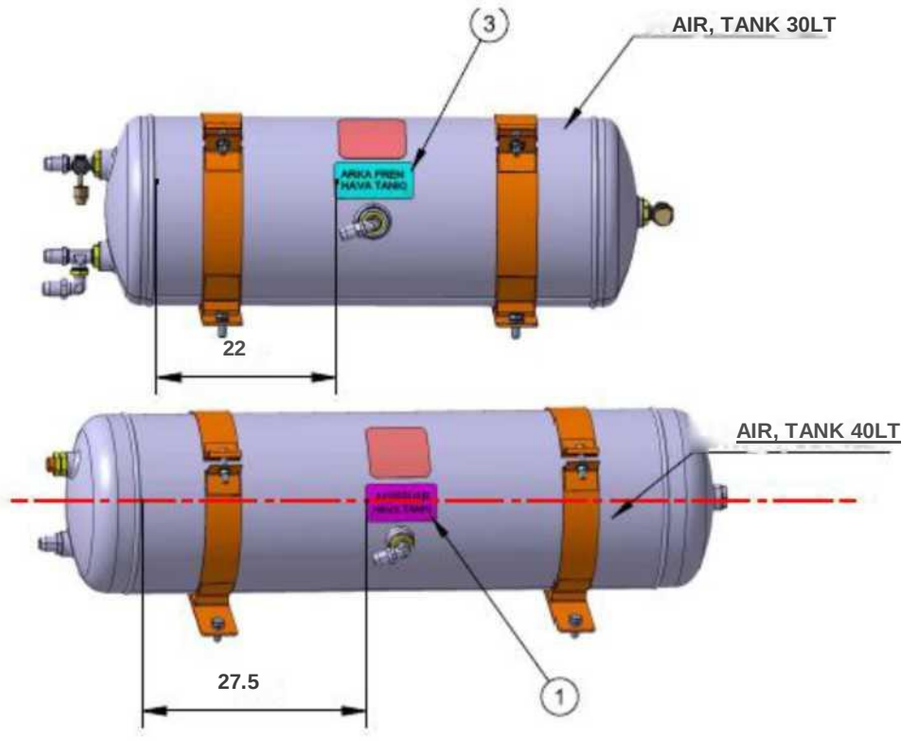
D VIEW



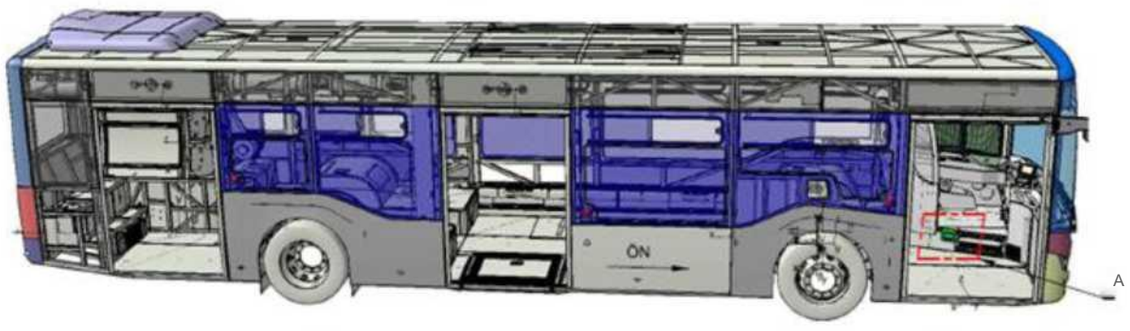
FÛT POSE	GROUP POSE	PART NO	COMPONENT'S NAME	NUMBER
1	710-009	377772111"	PLATE ENGINE NO	1
2	710-010	387562034'	LABEL. HID FAN RESERVOIR , FR	1
2	710-010	387046541*	HYDRAULIC FAN SYSTEM RESERVOIR	I
2	710-010	387489852'	LABEL, HYDRAULIC FAN SYSTEM RESERVOIR	1
3	710-015	387046542	LABEL. AUTOMATIC OIL COMPLETION	I
4	710-210	377772088'	INTRODUCTION OF VIN PLATE	1
4	710-210	387012581*	PLATE. MODEL NO	1
5	710-250	337027099'	LABEL, EMERGENCY EXIT WINDOW	9
6	710-253	M7041M3'	LABEL. EMERGENCY OUTLET DOOR FAUCET	3
7	710-270	387024818'	LABEL, PRE-HEATER BATTERY CABINET	1
7	710-270	387033774*	LABEL, PRE-HEATER . BATTERY CABINET FR	1
7	710-270	387489860'	LABEL, PRE-HEATER , BATTERY CABINET ROMANIAN	1
8	710-360	387040911*	LABEL. AKU SWITCH WARNING TÜRKISH	1
8	710-380	337041004'	LABEL, AKU SWITCH WARNING ENGLISH	1
8	710-360	387489881*	LABEL, BATTERY SWITCH WARNING ROMANIAN	1
8	710-360	337041005	LABEL, BATTERY SWITCH WARNING FRENCH	1

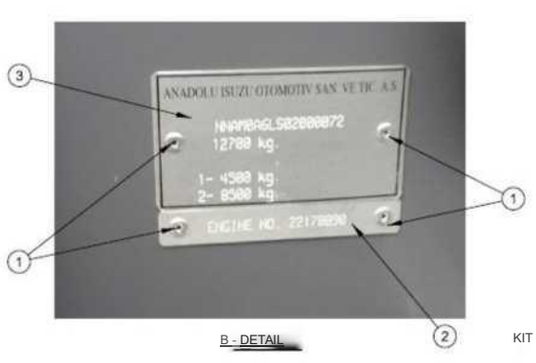




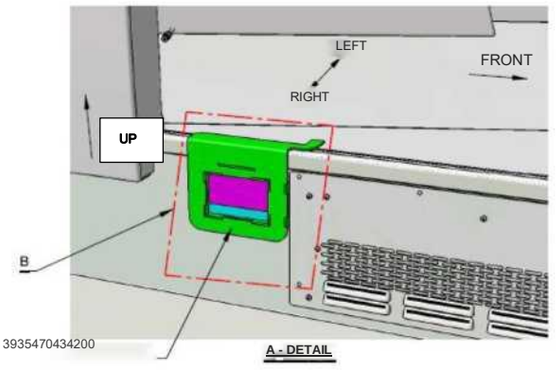


LEAF POSE	GROUP,'POSE	PART NO	COMPONENT'S NAME	NUMBER
1	710 - 100	387054452*	LABEL, ACCESSORY AIR TANK	2
1	710-100	387489856*	LABEL, ACCESSORY AIR TANK . ROMANIAN	2
2	710 - 101	387054453*	LABEL, HAND BRAKE AIR TANK	1
2	710 - 101	387439857*	LABEL, HAND BRAKE. AIR TANK , ROMANIAN	1
3	710- 102	387054454*	LABEL, REAR BRAKE AIR TANK	1
3	710-102	387489858*	LABEL, REAR BRAKE. AIR TANK , ROMANIAN	1
4	710-103	387054455*	LABEL, FRONT BRAKE AIR TANK	1
4	710 - 103	387489859*	LABEL, FRONT BRAKE. AIR TANK . ROMANIAN	1





B - DETAIL



KIT NO 3935470434200

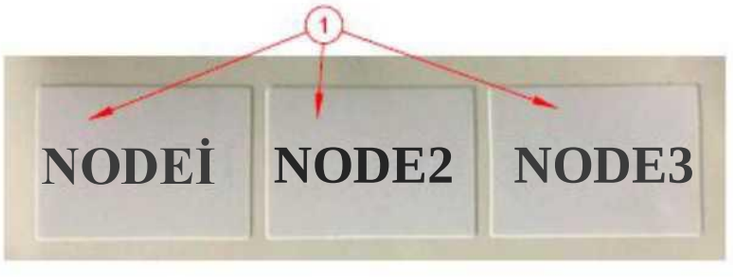
A - DETAIL

LEAF POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	710-005	302520510'	POP RIVET	4
2	710-009	377772111'	PLATE. ENGINE NO	1
3	710-210	377772068'	INTRODUCTION VIN PLATE	1
3	710-200	377772068	PLATE, MODEL NO	1

VEHICLE INTERIOR VIEW



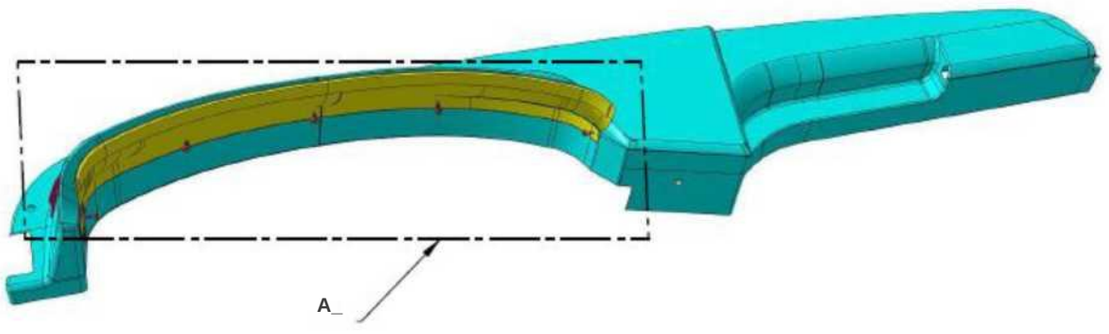


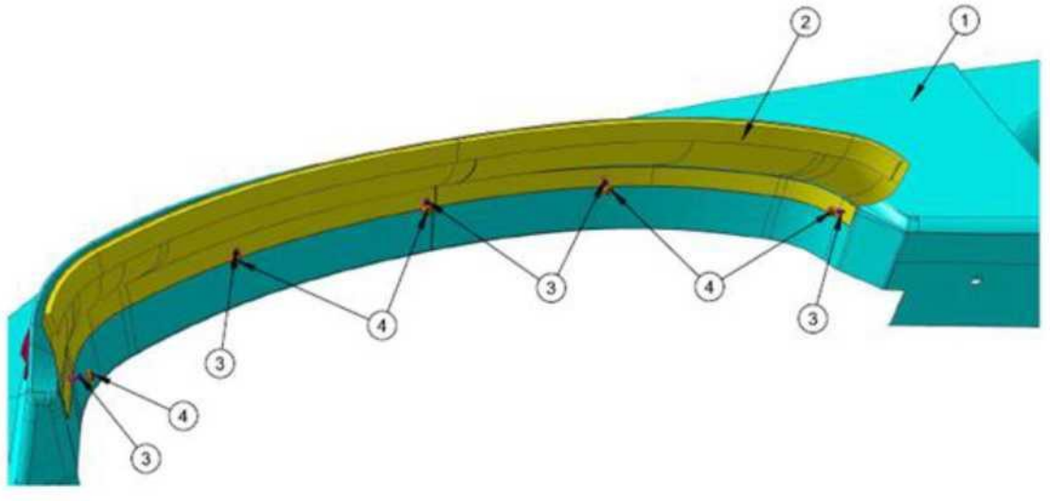


LEAFLET POSE	GROUP.'POSE	PART NO	COMPONENT'S NAME	NUMBER
1	**710- 120**	307039112*	LABEL, MULTIPLEX	**1**

TORPEDO INSTALLATION

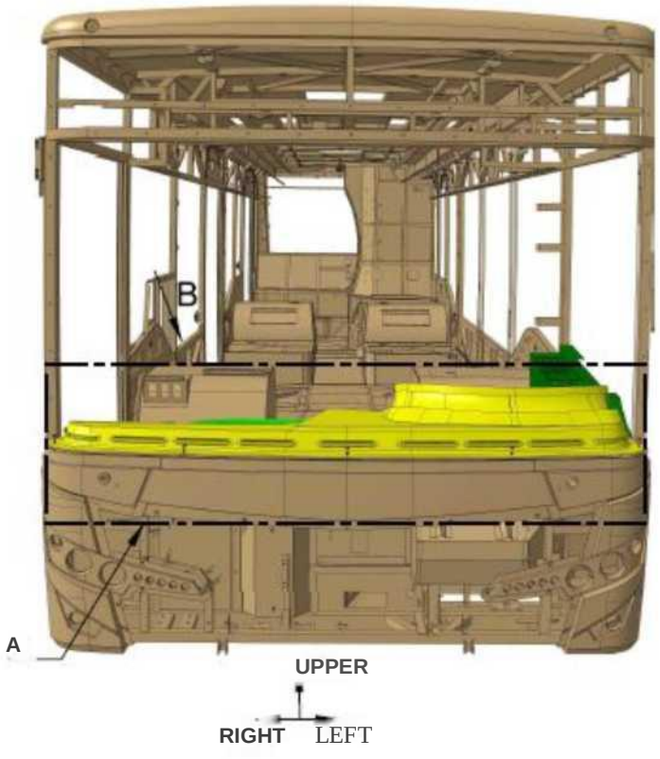
TORPEDO UPPER ASSEMBLY INSTALLATION

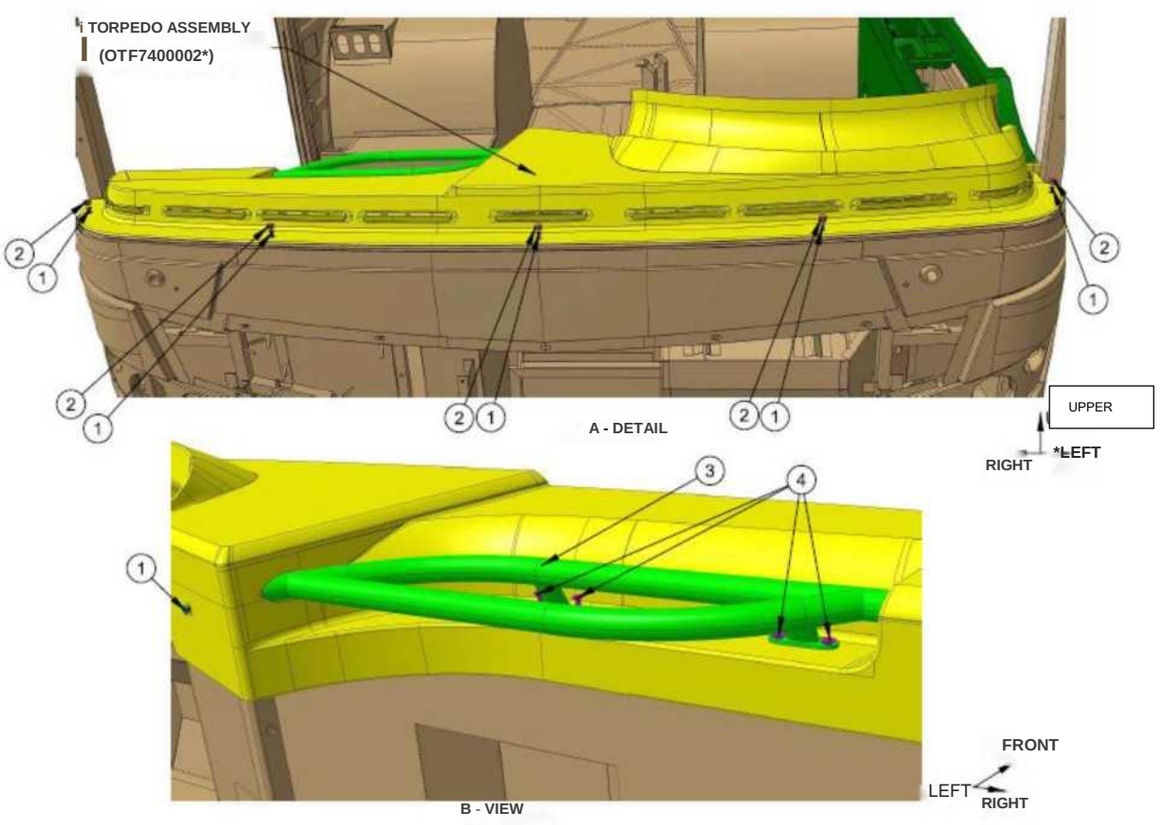




LEAFLET POSE	GROUP,'POSE	PART NO	COMPONENT'S NAME	NUMBER
1	740-010	387033035'	TORPEDO, UPPER ASSEMBLY	1
2	740-005	387039022*	FABRIC TORPEDO CLOSURE	1
3	740-021	3017942192*	SCREW . LENTIL TOWEL HEAD 4.2	5
4	740 - 056	387026601*	ABS SCREW COVER, DARK GREY	5

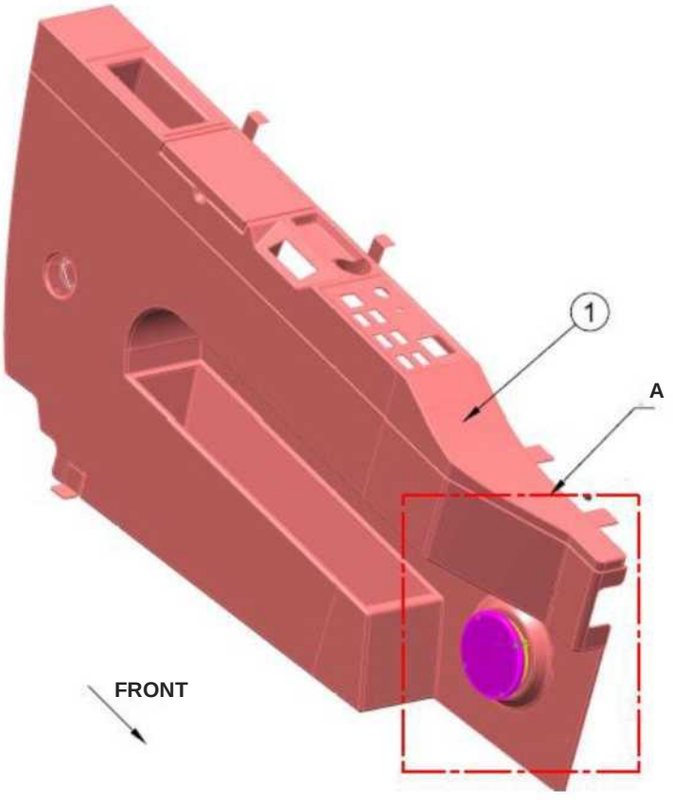
FRONT TORPEDO ASSEMBLY INSTALLATION

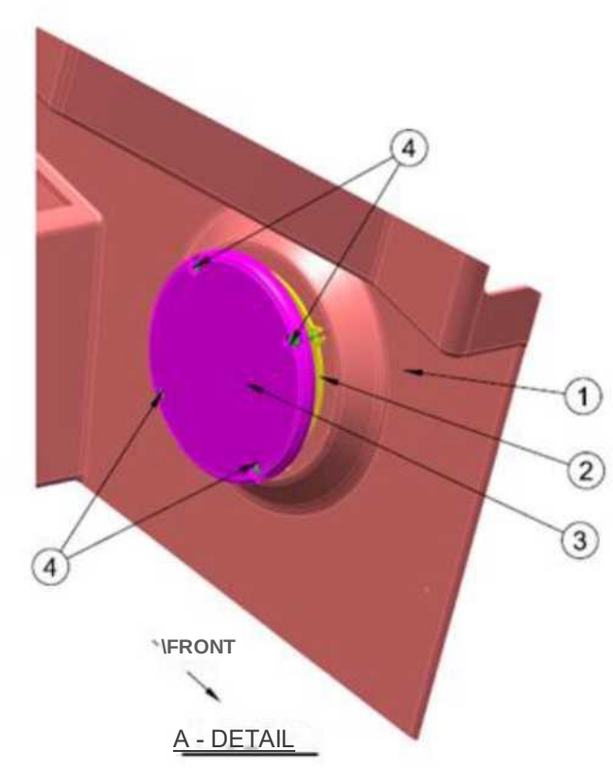




LEAFLET POSE	GROUP.'POSE	PART NO	COMPONENT'S NAME	NUMBER
1	740 - 022	301904219"	SCREW 4.2x19 DİN 7981 YELLOW	6
2	740 - 057	387001882"	STOPPER	5
3	740 - 048	387035133'	HANDLE , 12 M TORPEDO	1
3	740-048	387055899*	HANDLE , TORPEDO	1
3	740 - 048	387058756*	HANDLE . TORPEDO. RAL 1003	1
3	74Û - 048	387040402*	PILLBOX TORPEDO, STAINLESS	1
4	740 - 090	3017006163"	SCREW SIX CORNER CUTTED (M6x16)	4

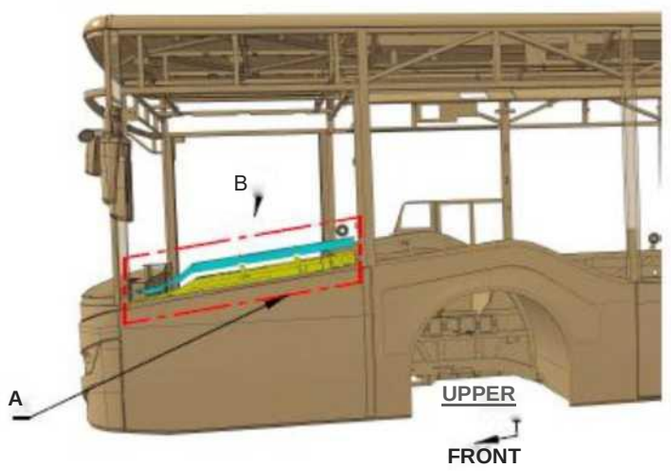
DRIVER SIDE ABS SHUTDOWN INSTALLATION

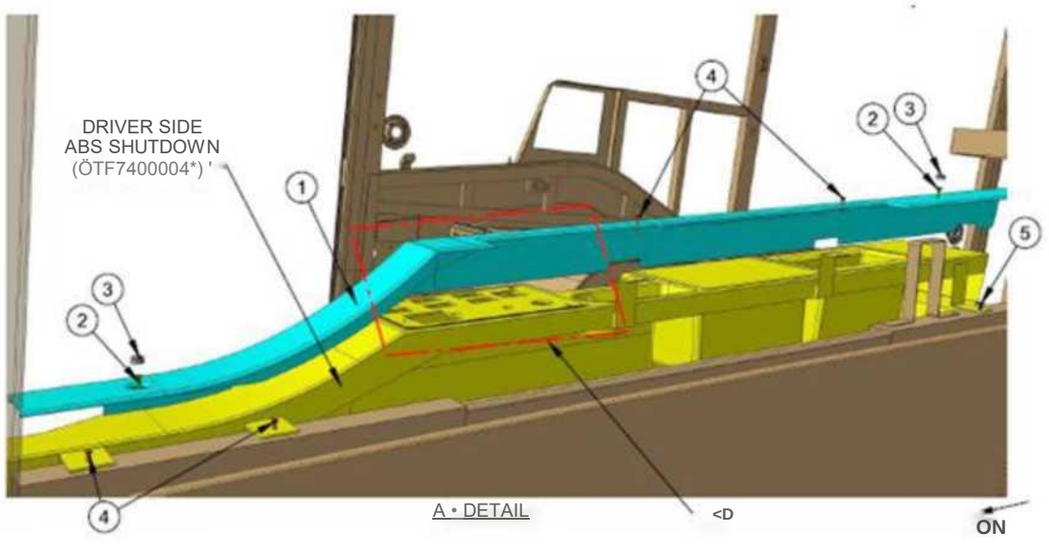


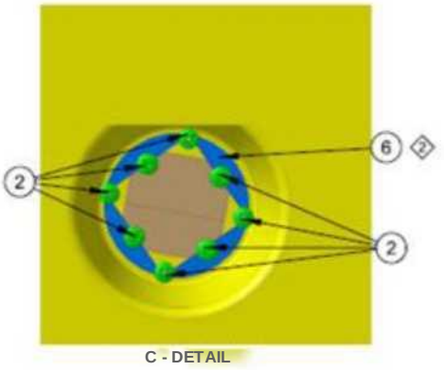


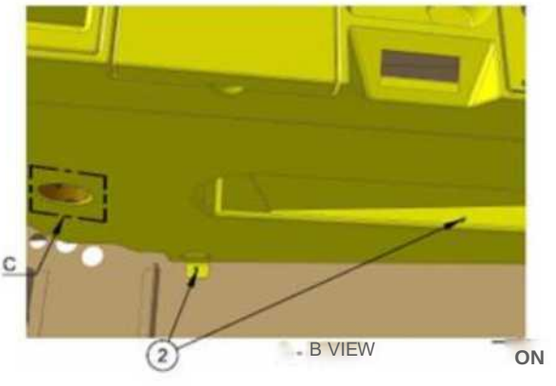
LEAFLET POSE	GROUP.'POSE	PART NO	COMPONENT'S NAME	NUMBER
1	740-001	3B7042387'	DRIVER CONSOLE **ASSEMBLY .** WITH SPEAKERS	1
1	740-001	387939570*	DRIVER CONSOLE **ASSEMBLY ,** WITH SPEAKERS	1
1	740-001	307362610*	DRIVER CONSOLE **ASSEMBLY**	1
1	740-001	367056176*	DRIVER CONSOLE **ASSEMBLY**	1
1	740-001	3B7603256-	DRIVER CONSOLE **ASSEMBLY**	1
2	740 - 070	3B70D4923*	SPEAKERS , VISATON FR 12	1
3	740-071	307004924*	SPEAKERS COVER	1
4	740-021	301794219*	SCREW, LENTIL TOWEL HEAD 4.2	4

DRIVER SIDE ABS SHUTDOWN INSTALLATION



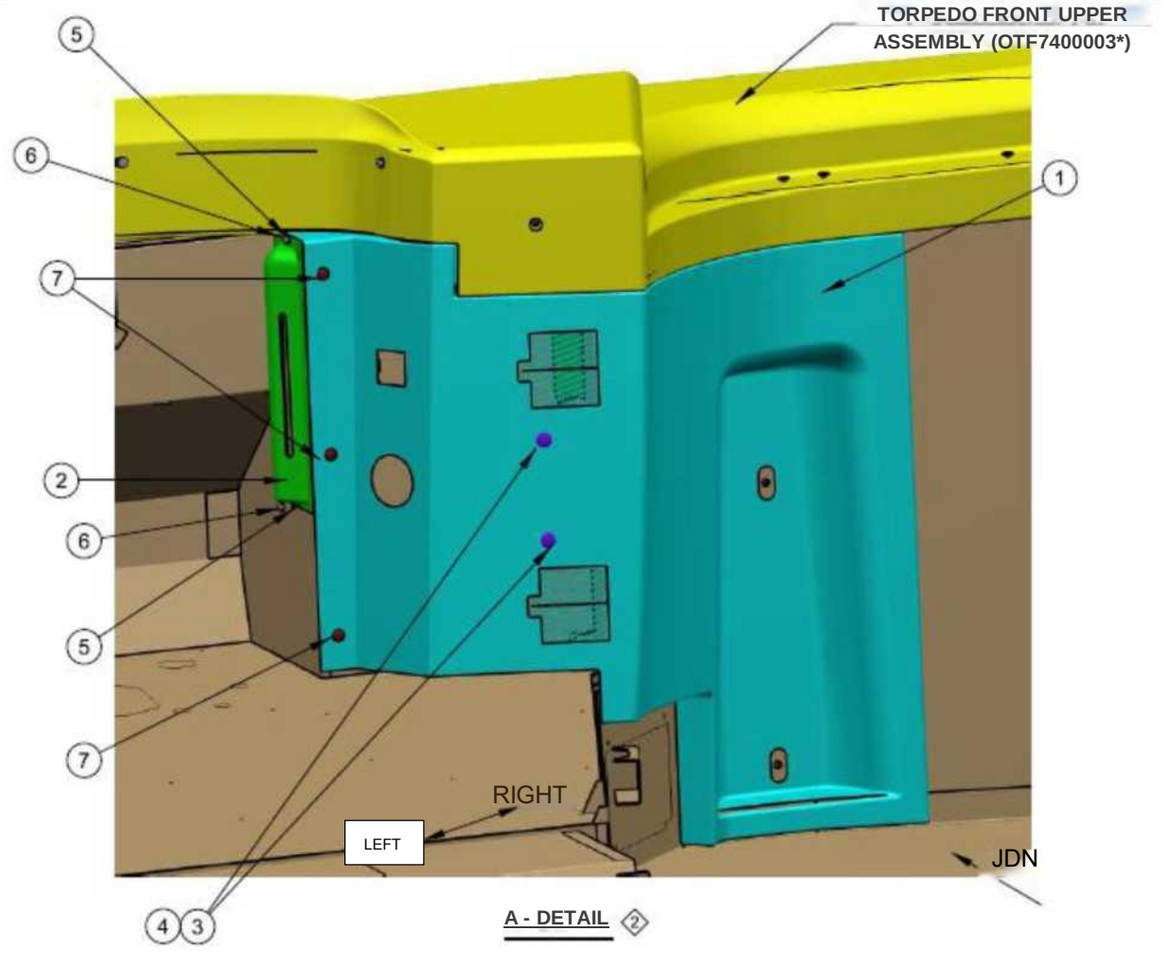


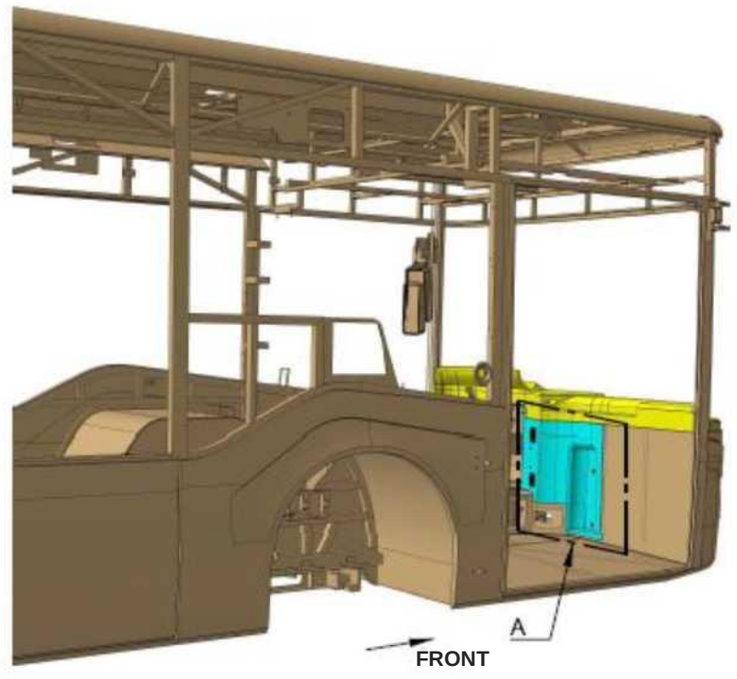




LEAF POSE	GROUP,'POSE	PART NO	COMPONENT'S NAME	NUMBER
1	740-005	387034770*	ABS, SIDE OF WINDOW	1
1	740-005	367373364*	ABS. SIDE OF WINDOW	1
1	740-005	387060618*	ABS. SIDE OF WINDOW	1
1	740-005	367603361*	ABS. SIDE OF WINDOW	1
2	740-021	301704219*	SCREW, LENTIL TOWEL HEAD 4,2	12
3	740 -056	3B7026601*	ABS SCREW COVER. DARK GREY	2
4	740 - 055	3D1S13519'	SCREW	4
5	740 - 022	3019042196'	SCREW , 4.2X19 DIN 7981 YELLOW	1
5	740 – 068	301904219"	SCREW 4. 2x19 DIN 7981 YELLOW	1
6	740 - 080	387045279*	BRACKET , DIAGNOSTIC	1

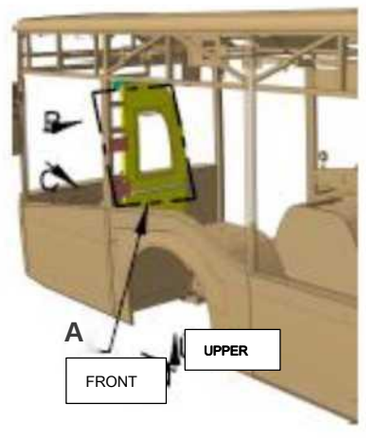
TORPEDO FRP FRONT CLOSURE INSTALLATION

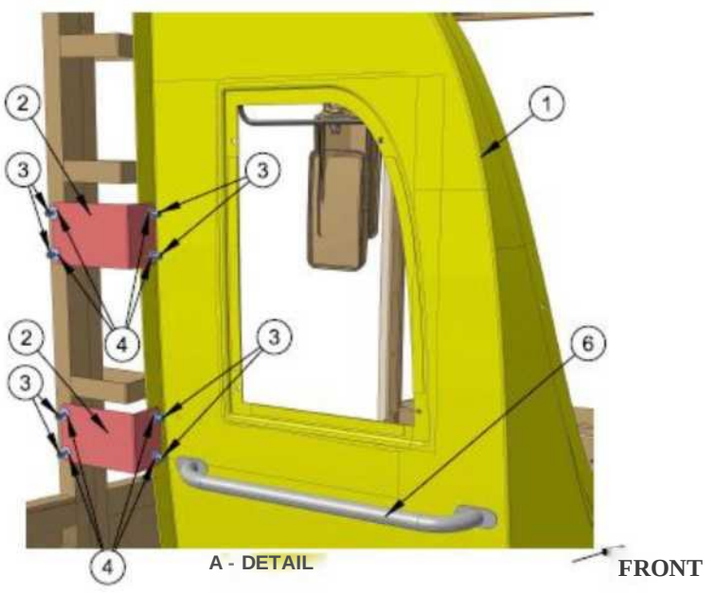


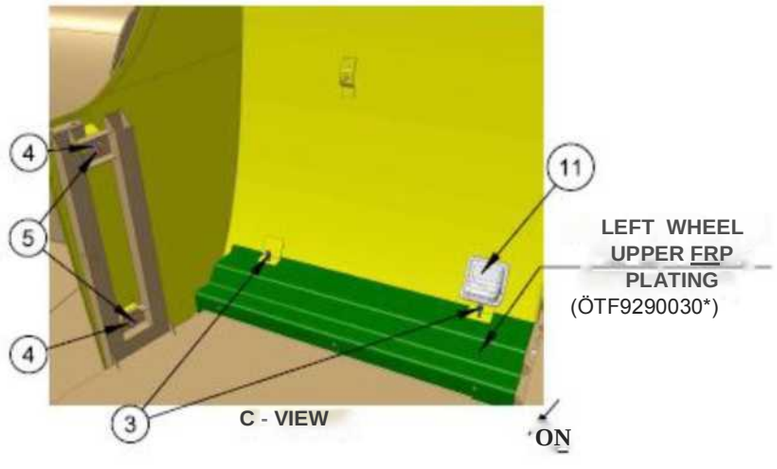


LEAF POSE	GROUP,'POSE	PART NO	COMPONENT'S NAME	NUMBER
1	740-013	3B7033036*	FRP, TORPEDO FRONT CLOSURE	1
1	740-01Ö	387603207*	TORPEDO UPPER ASSEMBLY	1
2	740-041	387034762'	ABS. RIGHT STAND BLOW	1
2	740 - 041	387603364*	ABS. RIGHT STAND BLOW	1
3	740-093	367015504*	CLOSING, HEADLIGHT PLASTIC	2
4	740-022	3019042196*	SCREW, 4,2X19 DİN 7981 YELLOW	2
4	740-068	301904219*	SCREW 4.2x19 DİN 7961 YELLOW	2
5	740-021	301794210*	SCREW, LENTIL TOWEL HEAD 4.2	5
6	740 - 056	387026601*	ABS SCREW COVER, DARK GREY	5
7	740 - 063	387022025*	CLIP , PANEL HOLDER , NATURAL	3

DRIVER CABIN INSTALLATION





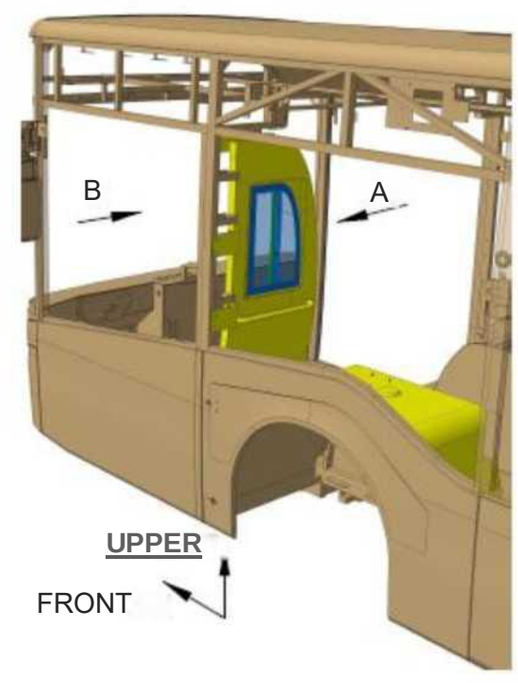




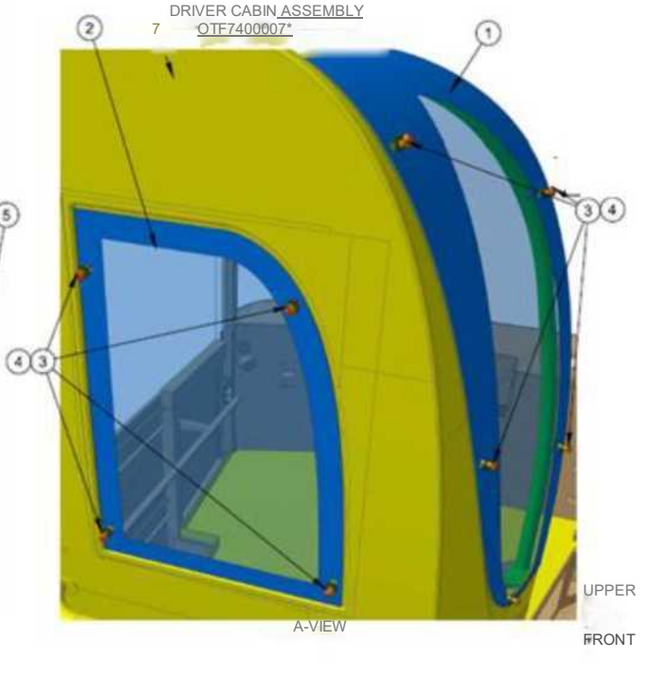
B - VIEW

LEAF PÜZ	QRUP.POSE	PART NO	COMPONENT'S NAME	NUMBER
1	740 - 015	337034772"	DRIVER CABIN	1
1	740-015	387457677"	DRIVER CABIN	1
1	740 - 045	387603151"	DRIVER CABIN	1
2	740 - 040	387034804"	BRACKET . SIDE CONNECTION	2
3	740 - 027	3000908154	BOLT , SLB M8X15 THICK D DIN912	10
4	,740 - 016	3011100086'	WASHER FLAT D=8 DIN 9021	14
5	740 - 054	3005400084*	NUT FLN&TR M8X 1.25 THICK D. DİN 6923	12
6	740 - 051	337035480*	PILLBOX , REAR CABIN	1
6	740-051	387058755*	PILLBOX , REAR CABIN, RAL 1003	1
6	740-051	337058755'	PILLBOX , REAR CABIN, RAL 1003	1
6	740-051	337040401'	PILLBOX CABIN	1
7	740 - 046	337034770'	BRACKET , DRIVER CABIN UPPER CONNECTION	1
7	740 - 046	387462929"	BRACKET , DRIVER CABIN UPPER CONNECTION	1
8	740 - 053	387035510"	ABS, CONNECTION CLOSURE	2
9	740 - 050	387035473"	HANGER	1
10	740 - 020	3005800064'	NUT FLN&TR M6X1, THICK D. DIN6923	4
11	740 - 07S	387603383'	ABS DRIVER CABIN LOWER CONNECTION	2

DRIVER CABIN WINDOW INSTALLATION



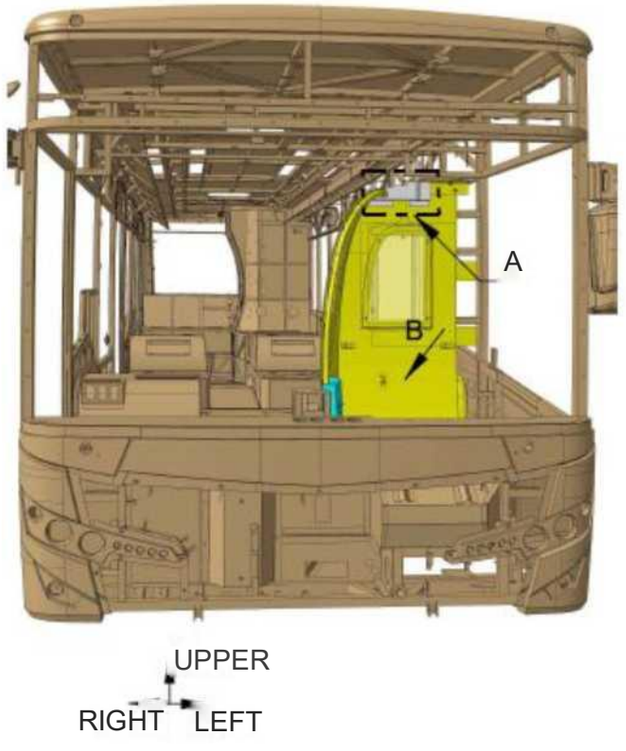


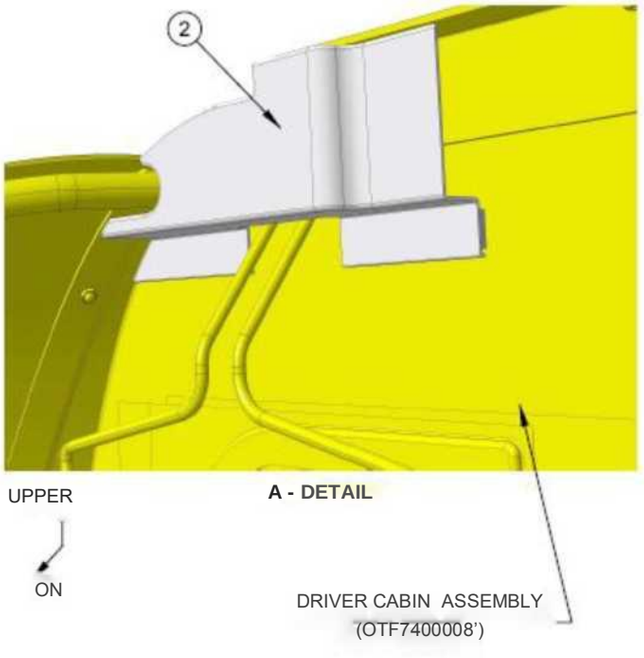


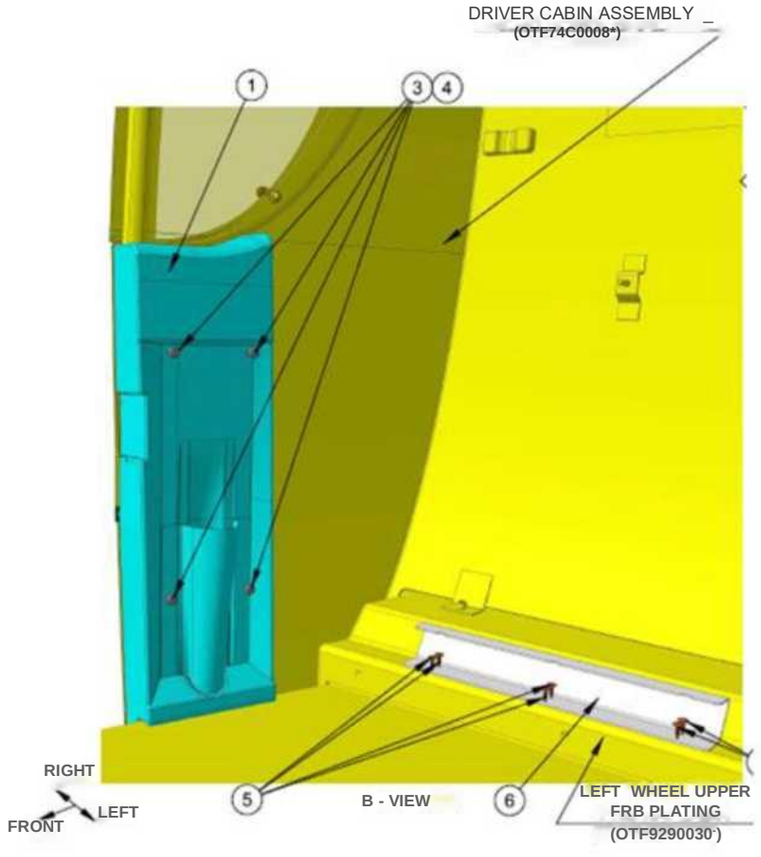
LEAFLET POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	740 - 039	387034781*	WINDOW. DRIVER CABIN SIDE	1
2	740-038	387034780*	WINDOW DRIVER CABIN	1
3	740-018	3015008303*	SCREW M8X30 DIN 7986	9
3	740-018	301500820*	SCREW M8x20 DIN 7986	9
4	**740/017**	387006137"	GUSSET. SPECIAL	9
5	740-019	3008600086"	NUT , PL, EMN, MS, THICK D, DİN985	9
5	740-019	3007000036*	NUT . FLN MSX1.25. THICK D. DIN1587	9
6	740/049	367035479*	PILLBOX , CABIN WINDOW	1
7	740/054	3005800084*	NUT . FLN&TR M8X1.25 THICK D. DIN 6923	5
8	740/016	3011100086'	WASHER . FLAT D=8 DİN 9021	2

E

ABS AND UMBRELLA INSTALLATION IN THE DRIVER CABIN

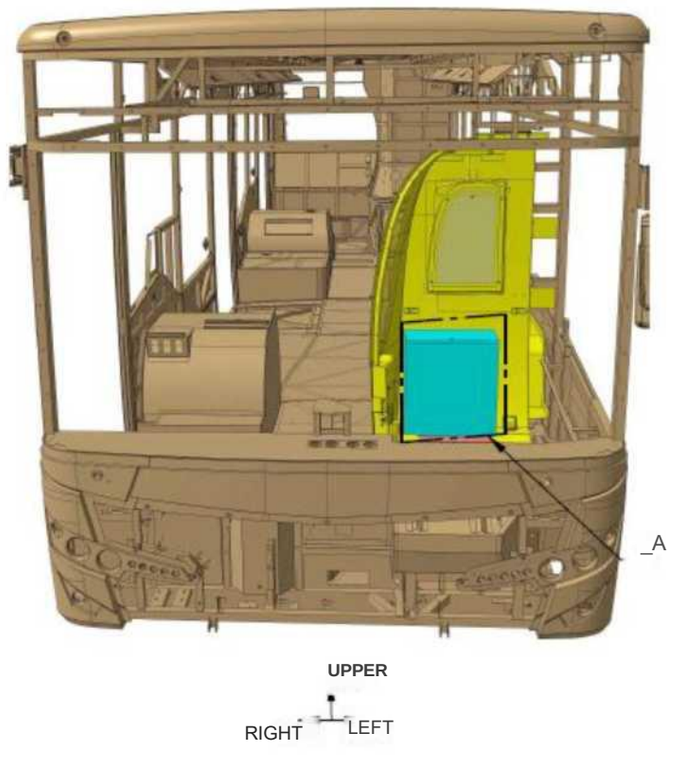


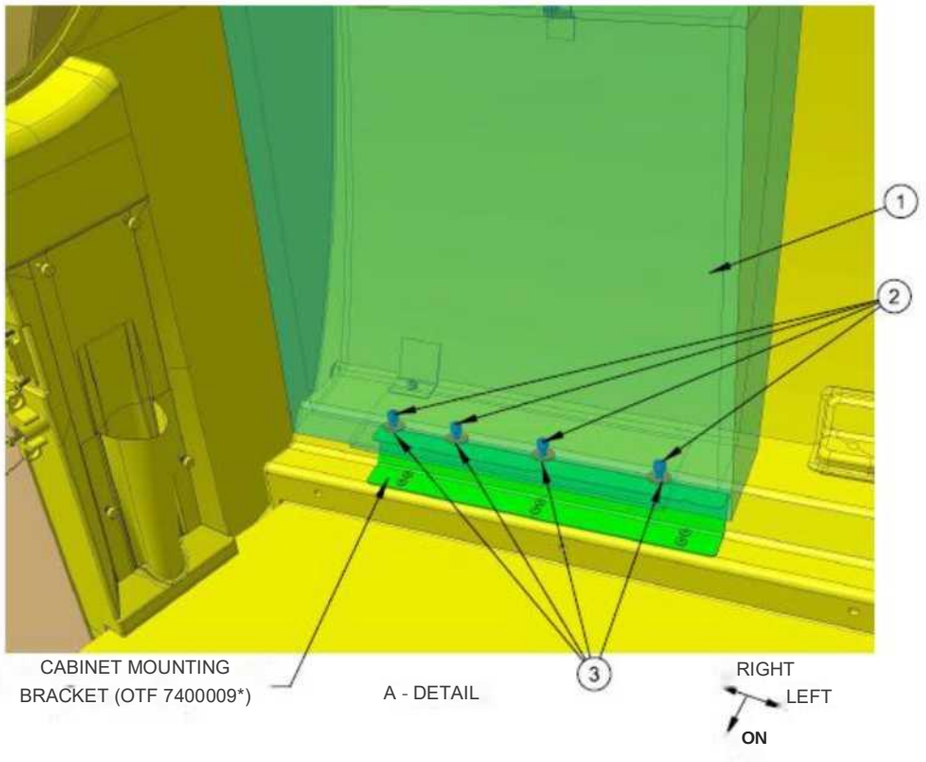




LEAFLET POSE	GROUP,'POSE	PART NO	COMPONENT'S NAME	NUMBER
1	740 - 042	3B7034777'	ABS, UMBRELLA STAND	1
1	740 - 042	387603382*	ABS, UMBRELLA STAND	1
2	740-045	387034775*	ABS. DRIVER CABIN	1
2	740 - 043	387603340*	ABS. DRIVER CABIN	1
3	740-021	301704219*	SCREW. LENTIL TOWEL HEAD 4.2	4
4	740 - 056	387026601-	ABS SCREW COVER, DARK GREY	4
5	740 - 022	3019042196*	SCREW. 4.2X10 DİN 7981 YELLOW	6
5	740-068	301904219*	SCREW 4.2x19 DİN 7981 YELLOW	6
6	740 - 067	387044682*	BRACKET . CABINET BOTTOM	1

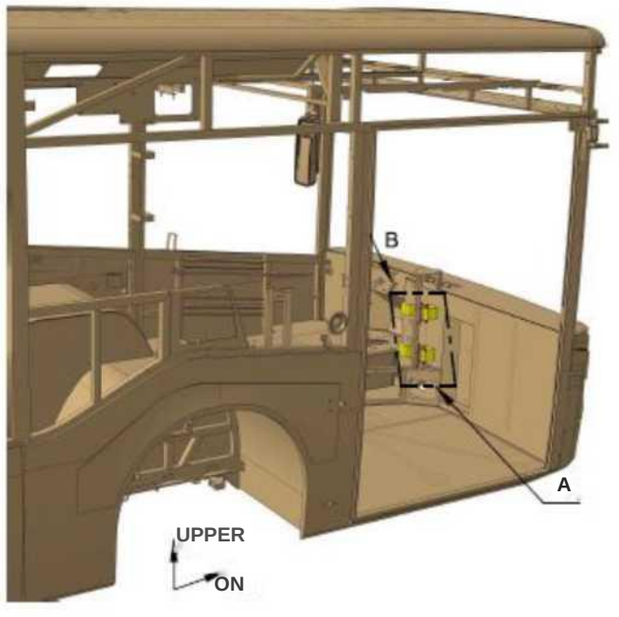
REAR DRIVER CABINET INSTALLATION

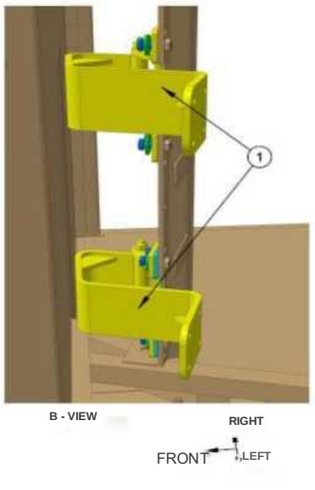


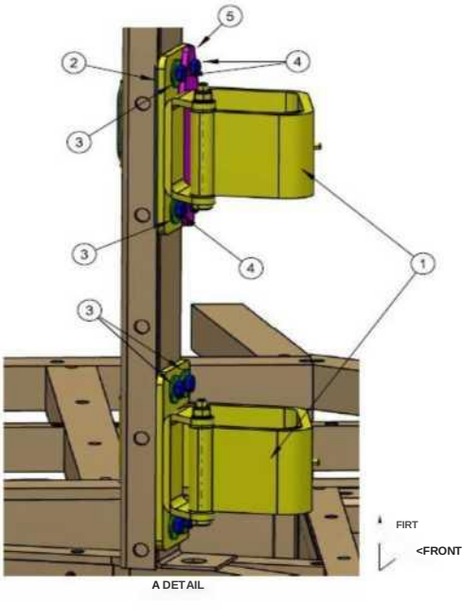


LEAFLET POSE	GROUP,'POSE	PART NO	COMPONENT'S NAME	NUMBER
1	740 - 066	387041296*	CABINET, BACK OF DRIVER	1
2	740 - 072	30152064011*	WIX6 SCREW	4
3	740-073	390990471*	SPECIAL WASHER	4

TORPEDO DOOR HINGE INSTALLATION

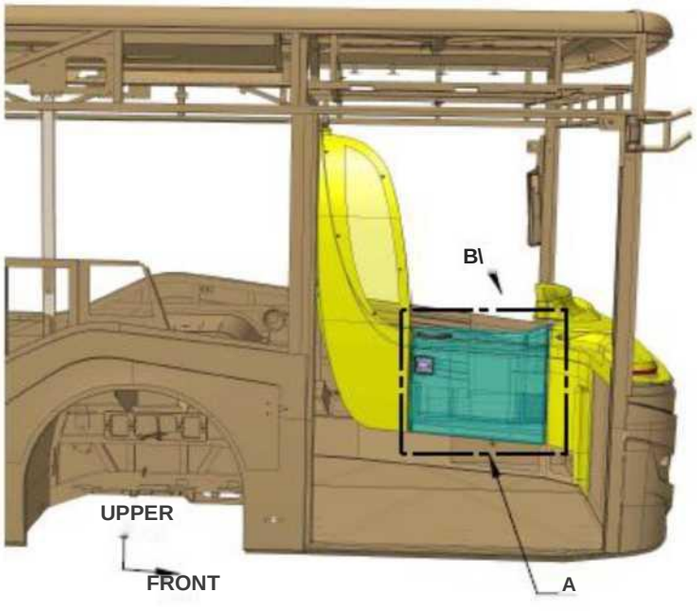


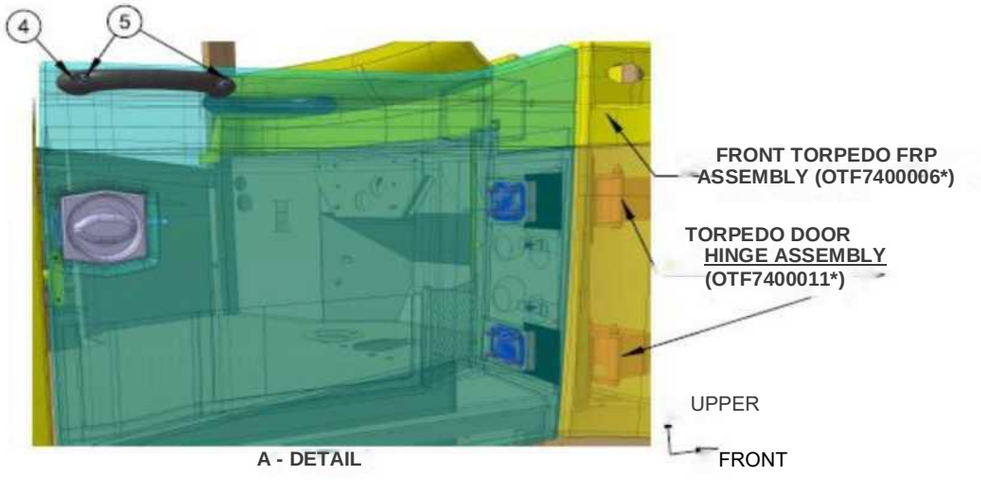


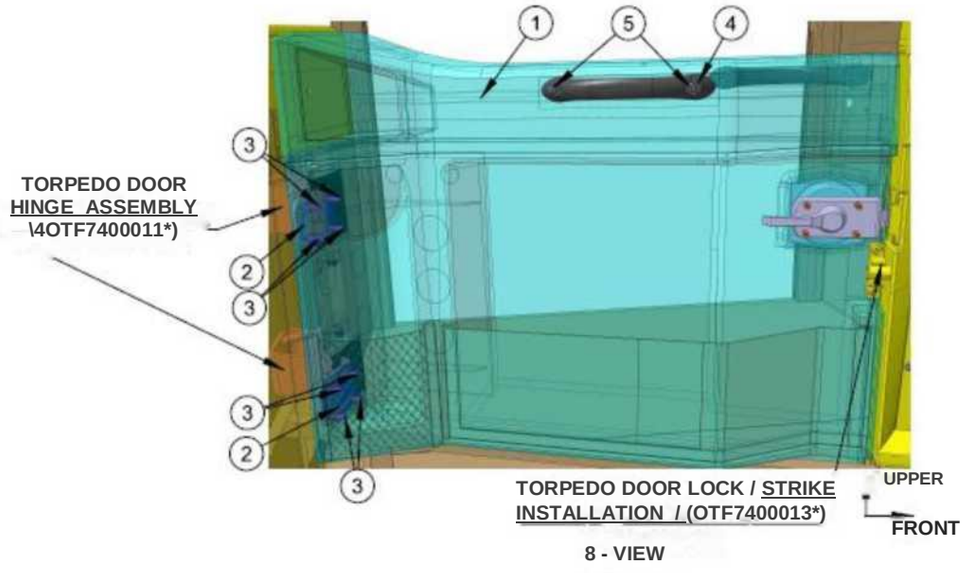


LEAFLET POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	740/029	387034009''	HINGE, DRIVER DOOR	2
2	740/083	387050979*	SİM, CITIPORT DRIVER DOOR, RIGHT	4
3	740/016	30111D0086*	WASHER . FLAT D=8 **DİN** 9021	**8**
4	740/024	3000108304*	BOLT . AKB M8X1.25X30, THICK D. DIN933	8
5	740/026	387052222*	BRACKET , HINGE STOPPING	1

FRP TORPEDO DOOR MOUNTING



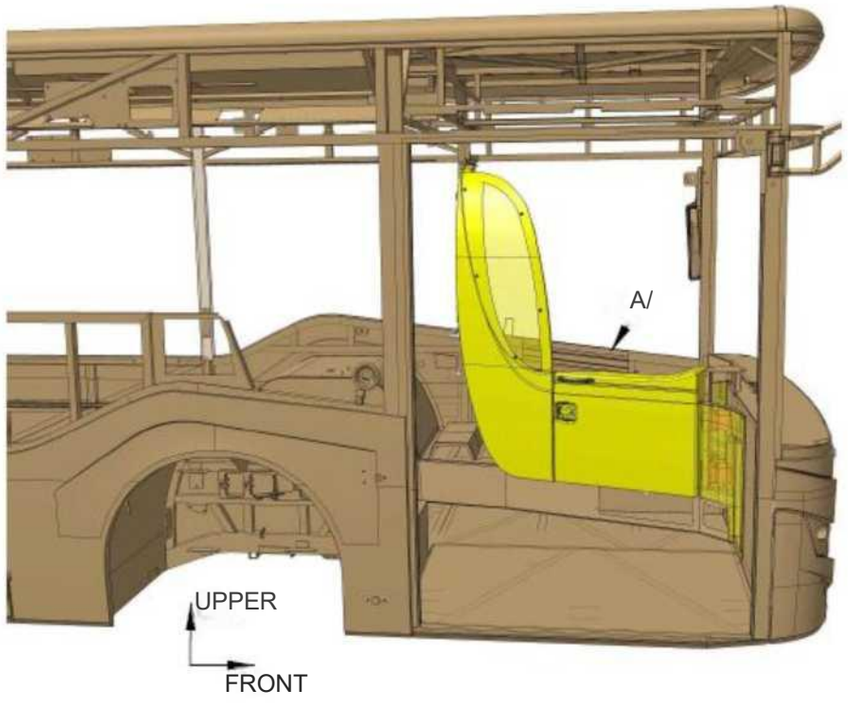


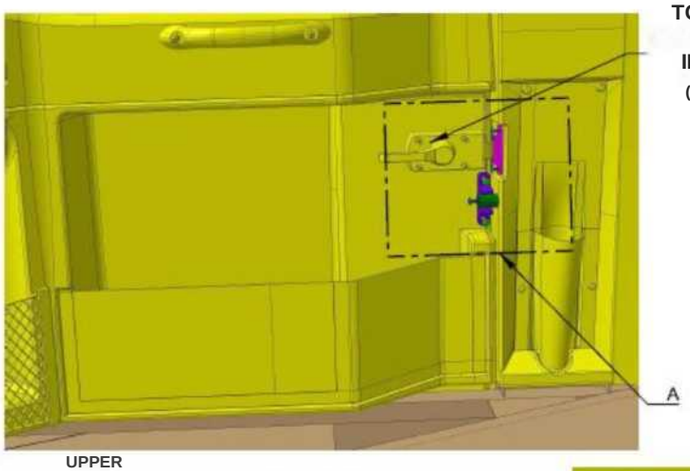


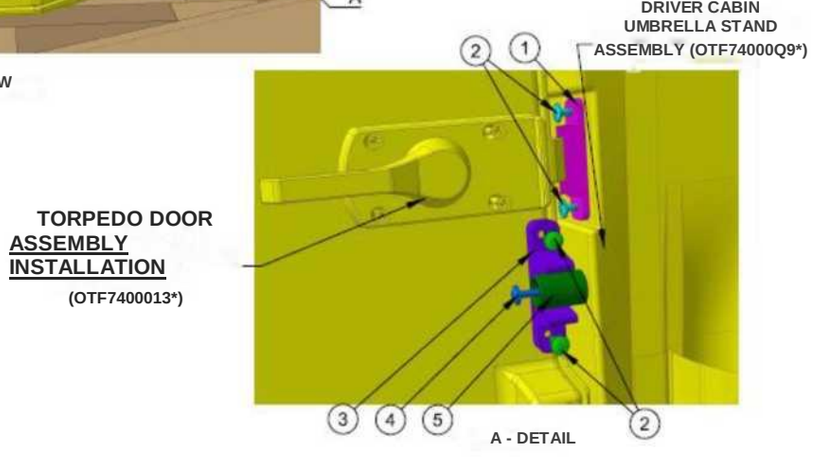
8 - VIEW

LEAFLET POSE	GROUP.'POSE	PART NO	COMPONENT'S NAME	NUMBER
1	740/007	38760174'	TORPEDO. DOOR ASSEMBLY	1
1	740,007	387656323*	TORPEDO DOOR ASSEMBLY	1
2	740/032	307050960*	SİM. CİTİPORT DRIVER DOOR, LEFT	4
3	740/047	301520830*	SCREW M8x30 DİN 7987	8
4	**740/075**	387033266*	HANDLE , MEDIUM SIZE	2
5	740/076	301500535*	SCREW M5x35 DİN 79S5	4

TORPEDO DOOR LOCK STRIKE ASSEMBLY

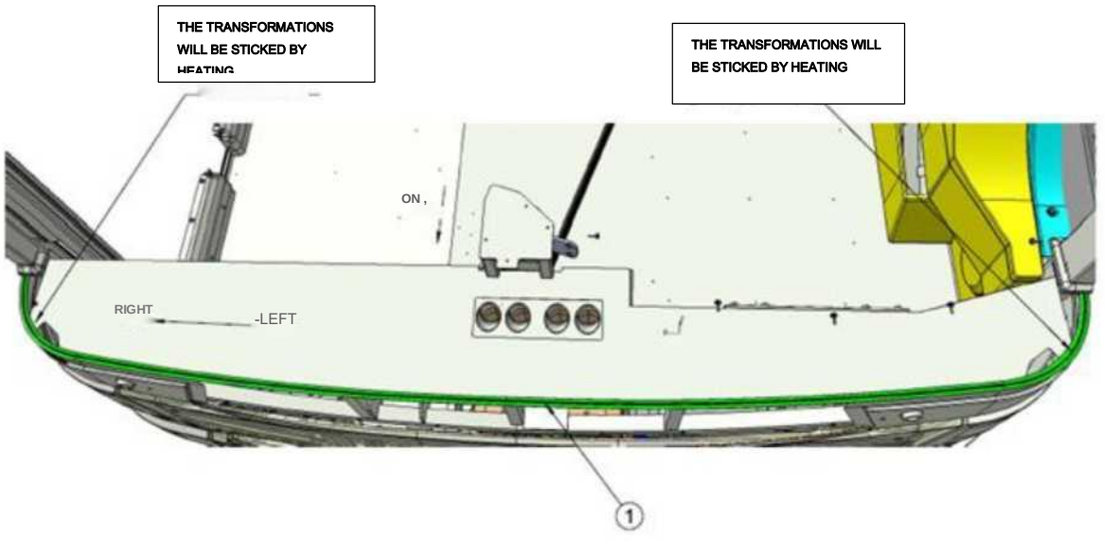






LEAF LET POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	740/059	387037953'	LOCK HOUSING CASTERMID	1
2	74D/068	301904219*	SCREW 4.2x19 DİN 7981 YELLOW	4
3	740/060	307037954*	LOCK HOUSING II. CASTERMID	1
4	740/064	301994825*	SCREW	1
5	740/061	387037955*	STOPER, CASTERMID	1

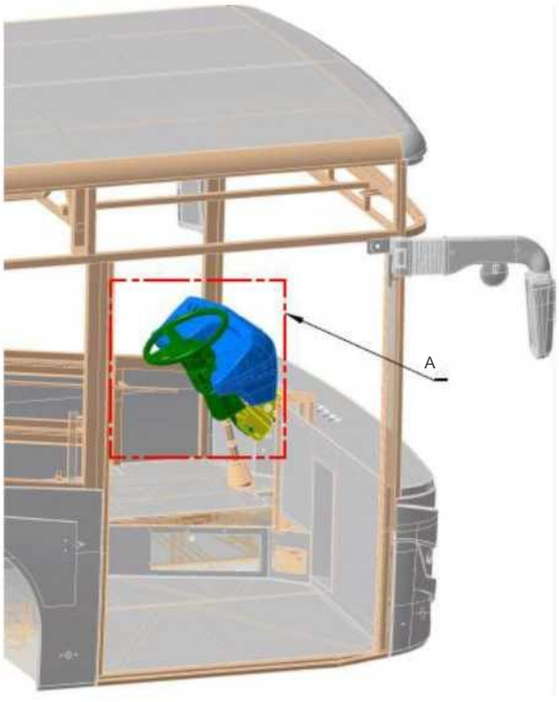
FRONT WINDOW PVC PROFILE ASSEMBLY

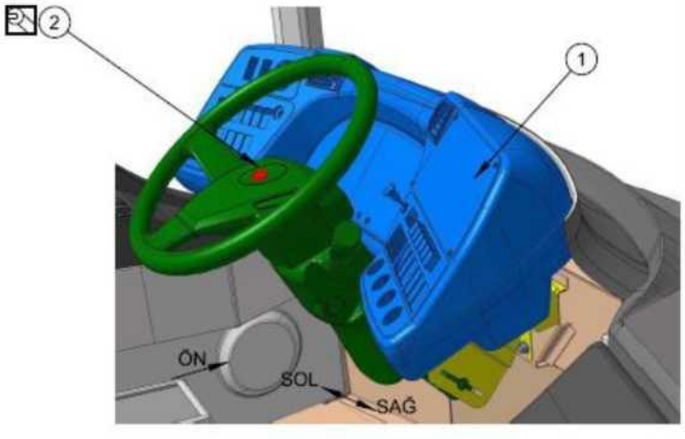


LEAFLET POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	740/062	357001022*	PVG PROFILE	1

DASHBOARD INSTALLATION

STEERING WHEEL MOUNTING





A DETAIL

LEAFLET POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	821-010	3870 32951 *	PANEL, DRIVER AC967348	1
2	821- 020	3005300226*	NUT , AKB THIN M22X1.5, THIN D. DİNİ936	1

BANDING PODIUM CABLES



PODIUM CABLES SIDE OF DRIVER CONSOLE
(BEFORE INSTALLATION)



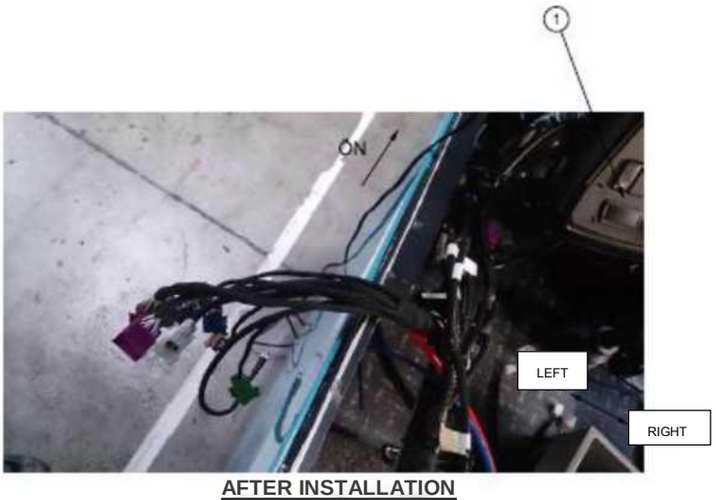
WITH CLOTH BANDING, STARTING FROM THE CABLE DIE, TAPPING TO THE SIDE OF THE CONNECTOR WITHOUT A GAP



ALL HANDLES ARE SEPARATELY BANDED



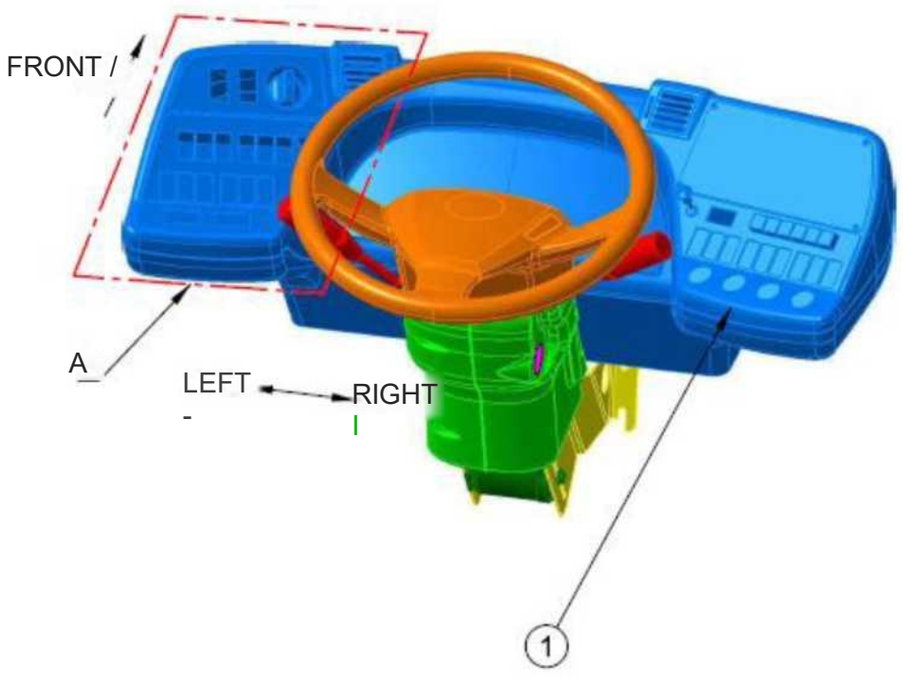
AFTER FINISHING THE BANDING PROCESS IS BANDED FROM THE JOINING POINT OF THE ARMS TWO TIMES MORE.



AFTER INSTALLATION

LEAFLET POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	821 -010	387032951*	PANEL, DRIVER	1

DASHBOARD LEFT SWITCH LAYOUT

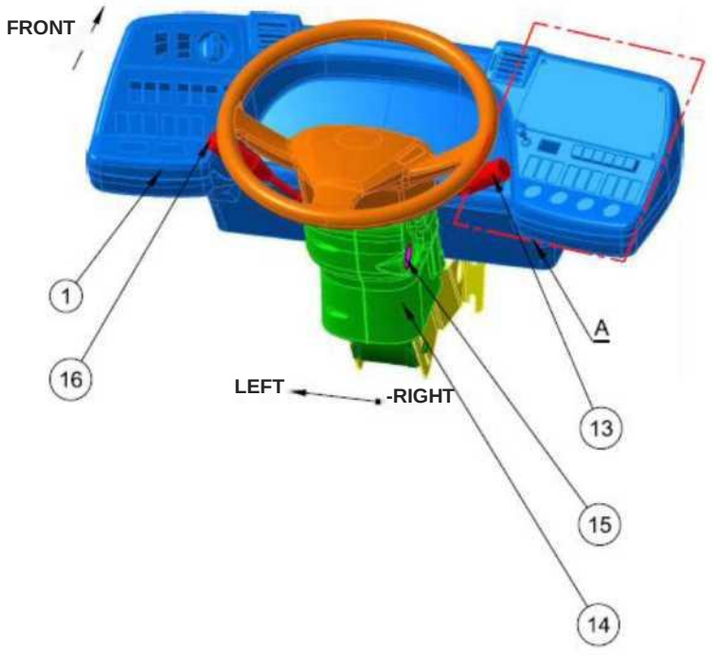




A DETAIL

LEAF LET POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	821 -010	387044757*	SWITCH, DASHBOARD	1
2	821 -050	387044732*	DUMMY COVER 1	2
3	821 -051	387044733*	SWITCH . ROLLER CURTAIN	1
4	821 -052	387044734"	SWITCH . ROOF WINDOW 1	1
5	821 -053	387044735"	SWITCH . ROOF WINDOW 2	1
6	021 -054-	387D44736'	SWITCH . TWO STAGE PASSENGER LIGHTING	1
7	821 -055	387044737*	SWITCH . DRIVER LIGHTING	1
8	821 -056	387044738*	SWITCH . ASR	1
9	821 -057	387044739"	SWITCH . SIDE MIRROR HEATING	1
10	821 -058	387044740"	SWITCH . DRIVER WINDOW HEATING	1
11	821 -059	387044751*	SWITCH , STEERING WHEEL LOCK	1
12	821 -060	387044752*	FLASHER	1
13	821 -061	387044753"	DUMMY COVER 1	4
14	821 -062	387044754"	SWITCH . HEADLIGHT	1
15	821 -063	387044755"	**COVER**	1

DASHBOARD RIGHT SWITCH LAYOUT



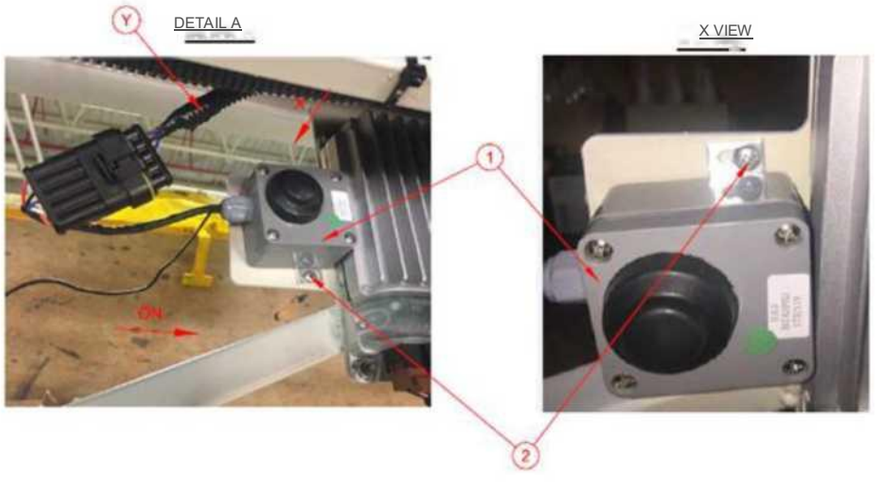


A DETAIL

LEAFLET POSE	GROUP /POSE	PART NO	COMPONENT'S NAME	NUMBER
1	821-010	307044757*	SWITCH . DASHBOARD	1
2	821 -050	387044732'	DUMMY COVER 1	4
3	821 - 079	387044771*	LGD CLOSURE	1
4	821-066	387044758'	SWITCH HEATING	1
5	821 -067	387044759“	SWITCH , FRONT DOOR OPENING DIRECTION	1
6	621 -068	3870447B0-	SWITCH , VEHICLE UPPER LOWER POSITION	1
7	821 -069	3B70447B1'	SWITCH , VEHICLE TILTING	1
8	821-070	367041762*	SWITCH , DISABLED SENSOR	I
9	821-071	3070+4763-	SWITCH , FRONT DOOR	1
10	821-072	307044764*	SWITCH . MIDDLE DOOR	1
11	821-073	3070447ar	SWITCH . REAR DOOR	1
12	821 - 074	387044766'	SWITCH , DOOR MIDDLE-REAR, GREEN	1
13	821-078	387044767'	RETARDER ARM	1
14	821 - 076	387044768“	RIGHT SIDE CLOSING	1
15	821-077	387044769“	IGNITION SWITCH	1
16	821 -078	367044770-	SELECTOR LEVER	1

REMOTE CONTROL INSTALLATION





FULLY INSERT THE MEN'S SOCKET FULLY INTO THE DENTAL SOCKET, MAKE SURE THE CONNECTION NAILS ON IT FULLY FIT.

LEAFLET POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	825-004	387032474*	REMOTE CONTROL SET, 2 DOOR	1
1	825-004	387053541*	REMOTE CONTROL SET, 2 DOOR, NEGATIVE	1
2	825 - 780	3870313350*	SELF-TAPPING SCREW, YSB SMART, M4. B X 25	2

DRIVER CONSOLE SWITCH ASSEMBLY





LEAFLET POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	825 - 026	387009888*	SWITCH , LCD TV	1
2	825 - 055	387029970*	SWITCH , AUTOMATIC WINDOW	1
3	825 - 058	387008903'	DUMMY COVER. SWITCH OFF	4
4	825 - 061	387041724*	SWITCH . STARTING A REGENERATION	1
5	825 - 770	377778953*	SWITCH , MIRROR ADJUSTMENT	1

STEEL INSTALLATION





LEAFLET POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	B26 /001	387002663*	STEEL	1

EXTERNAL MOTOR TEMPERATURE SENSOR INSTALLATION



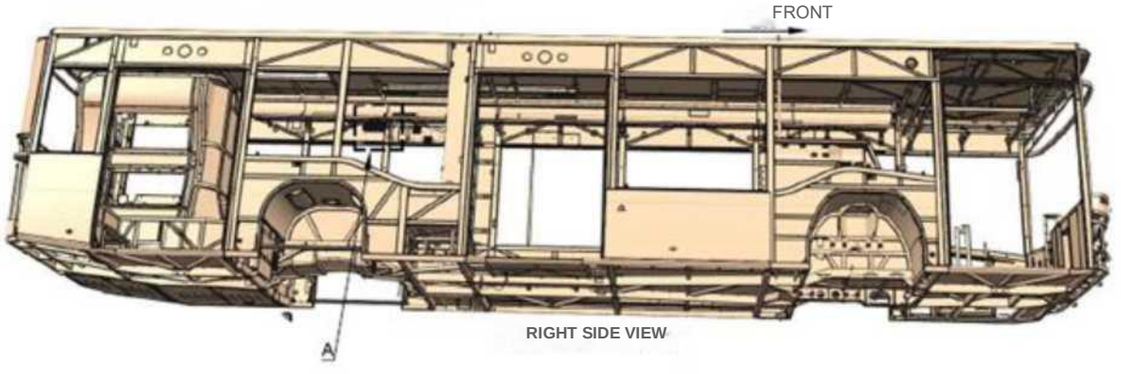
FRONT VIEW OF THE VEHICLE

DETAIL A



LEAFLET POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	826-076	3870412730'	SENSOR, AIR TEMPERATURE	1
2	826-080	3005400124*	NUT . AKB M12X1. 5. THIN D. DİN934	1

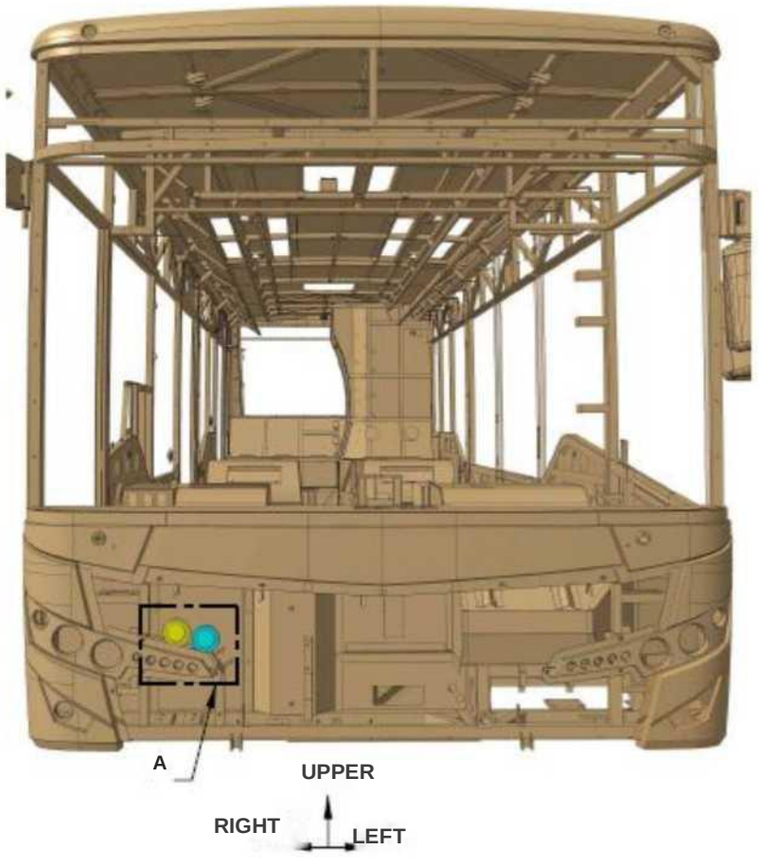
CONVERTOR INSTALLATION

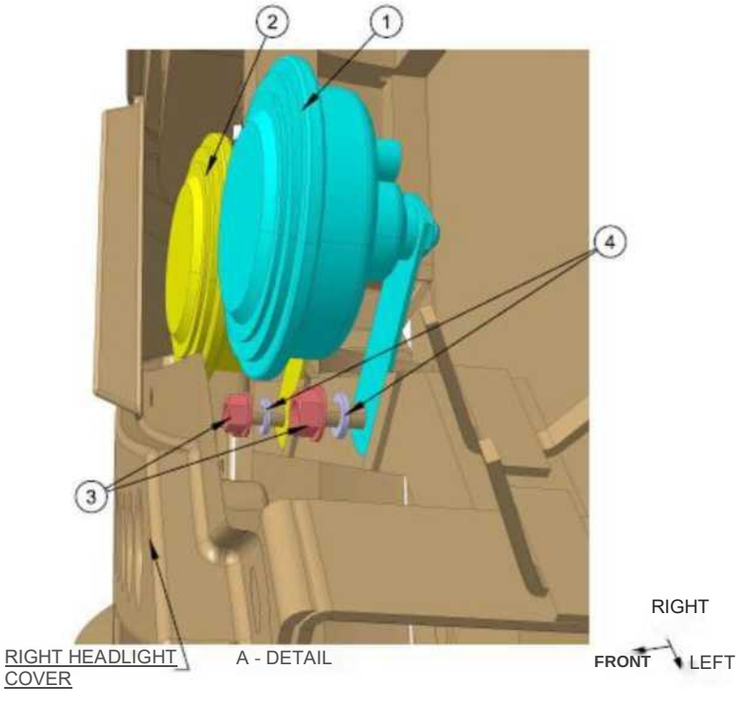




LEAFLET POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	B26 - 077	387033999*	CONVERTOR, SW MODE 24/12 30A 3A	1

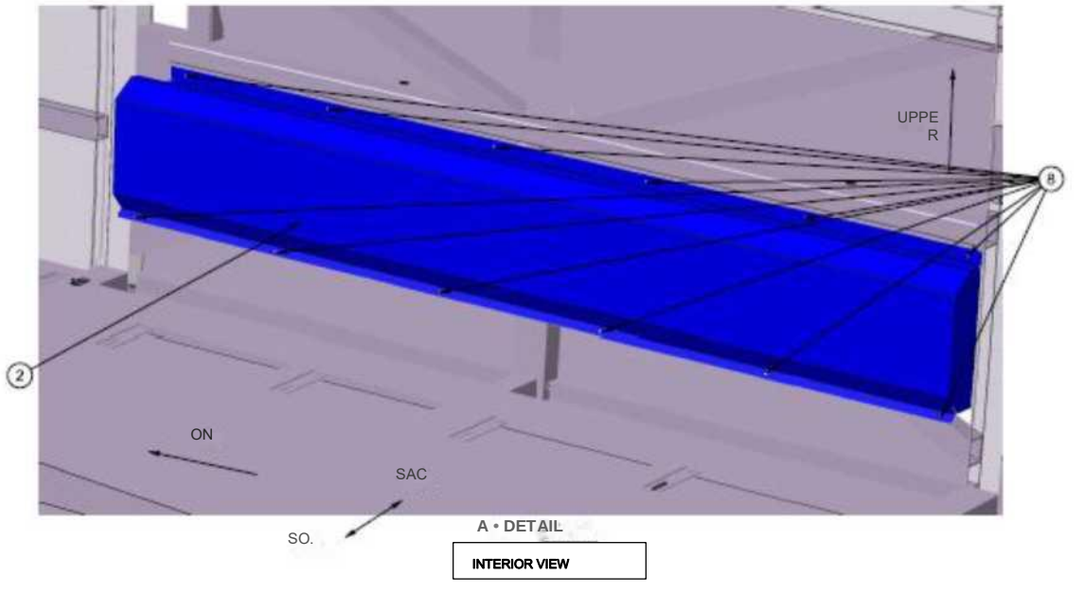
HORN INSTALLATION





LEAFLET POSE	GROUP.'POSE	PART NO	COMPONENT'S NAME	NUMBER
1	528/045	377770642'	HORN . THICK SOUND	1
2	628/044	386887550*	HORN THIN SOUND	1
3	826/057	3005800066*	NUT , FLN&TR M8X1. 25, THICK D. DİN 60.2	2
4	026/056	3010100064*	WASHER . SPRINGY D=5 DİN 127	2

HEATER SYSTEM INSTALLATION

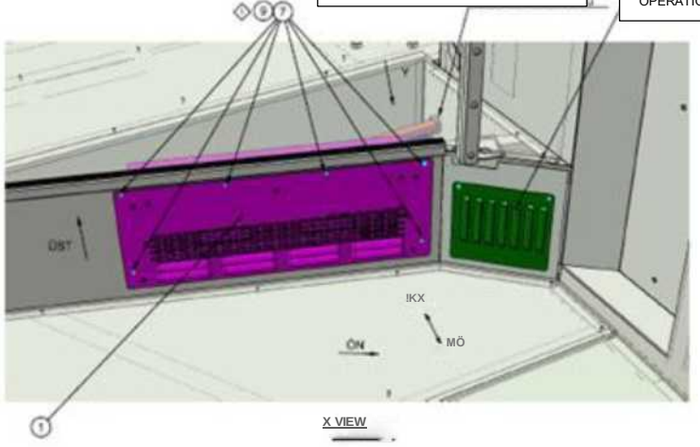


A • DETAIL

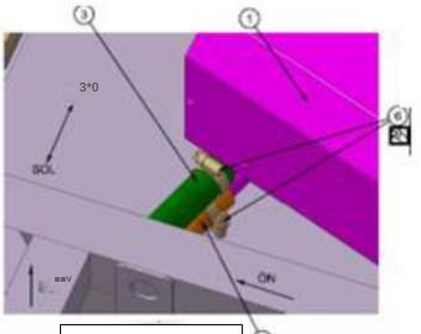
INTERIOR VIEW

SEE OTF450029 OPERATIONAL LEAF

SEE OTF5600006 OPERATIONAL LEAF

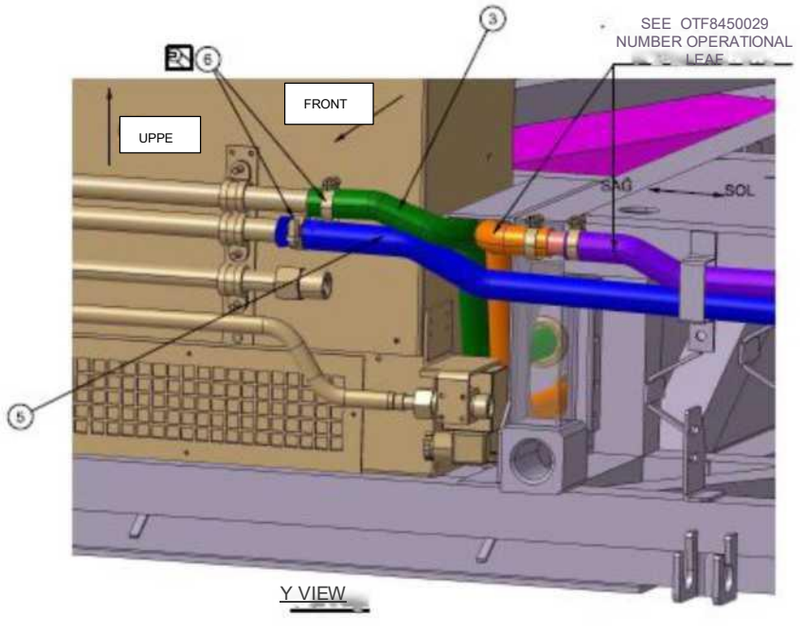


X VIEW



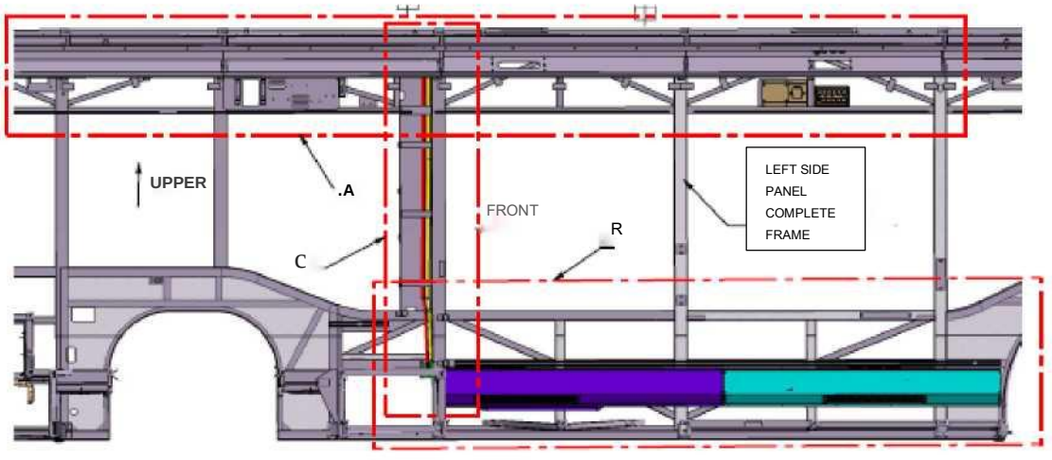
Y VIEW
HEATER CONNECTION

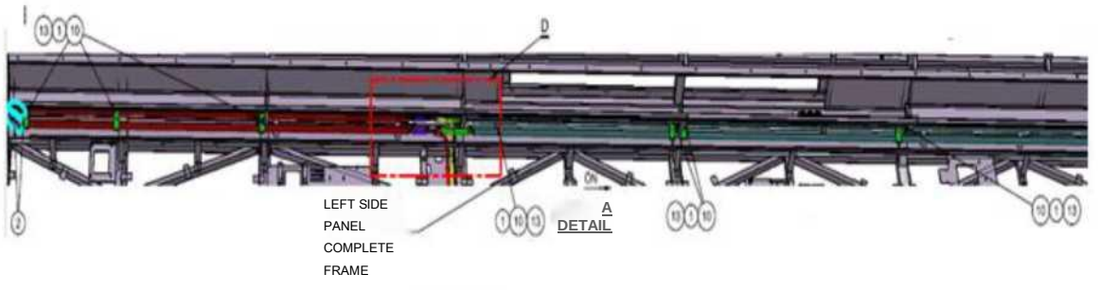
GENERAL

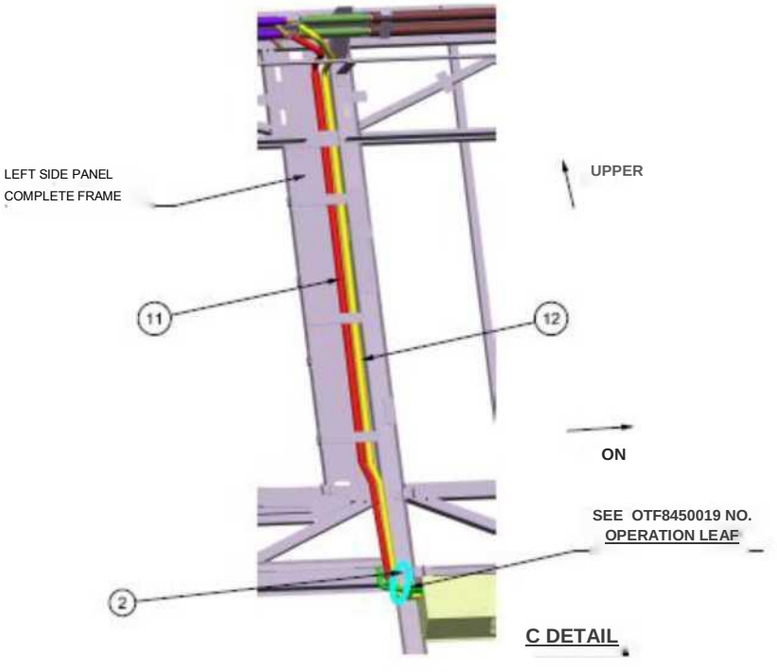


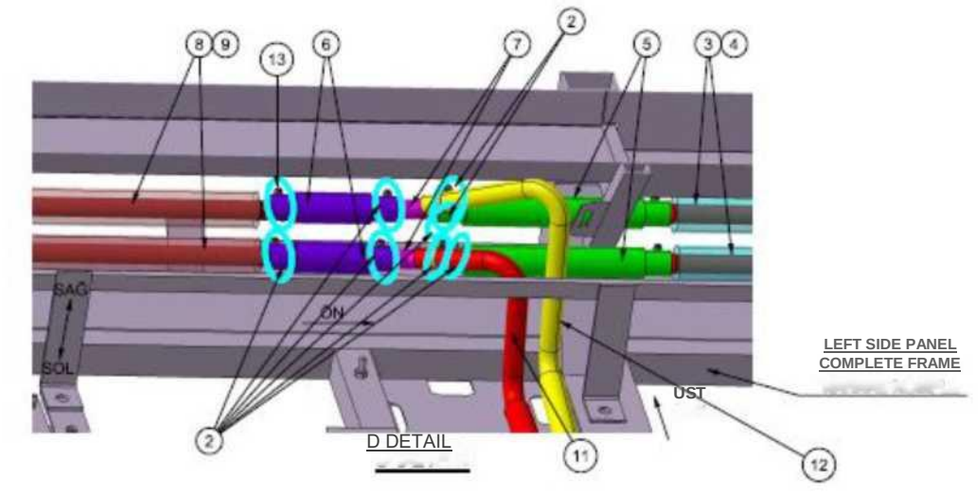
LEAF POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	845/001	387055793-	HEATER , UNDER DRIVER	1
1	845/001	387053359*	HEATER , UNDER DRIVER	1
2	845/005	387035662*	COVER HEATER	1
2	845/005	387063363*	COVER HEATER	1
3	845/006	3870389730*	HOSE , UNDER DRIVER KAL INPUT	1
4	845/007	3870388704*	HOSE UNDER DRIVER KAL OUTLET	1
5	845/008	387036696	HOSE FRONT HEATER	1
6	845/098	3854000320*	CLAMP SCREW B12 SPRINGY ø20-32 DIN3	4
7	845/133	3016006154	SCREW 6X16	6
8	845/203	3019043192*	SCREW 4,2X19 DIN 7981 YELLOW	12
9	845/209	377777338*	COVER SCREW EVO GRAU 2	8

HEATER PIPE CAR INTERIOR INSTALLATION



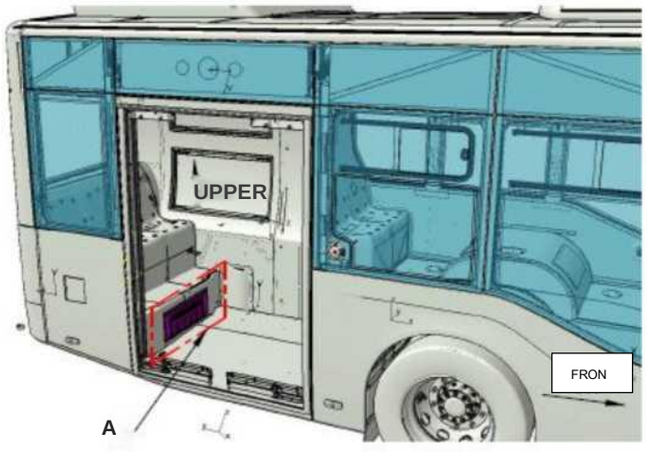


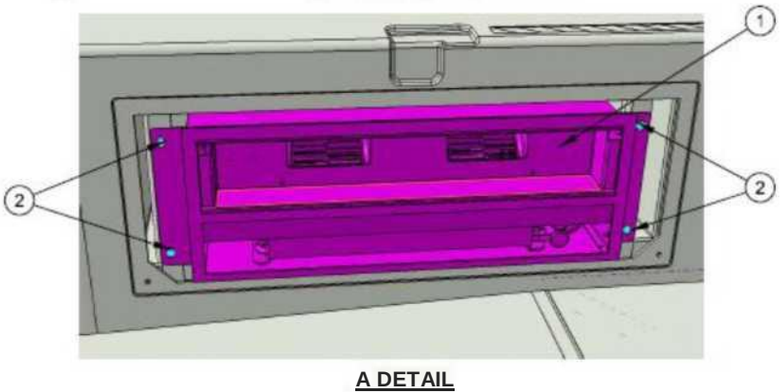




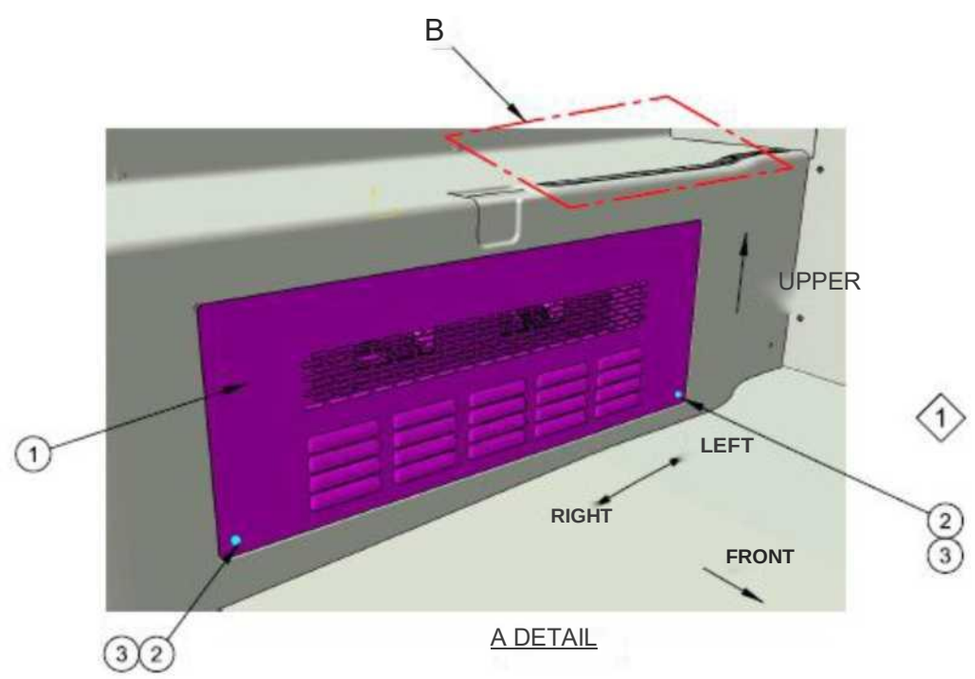
LEAF POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	645 - 073	3000106554'	BOLT . AKB M8X1X55. THICK D. DIN933	7
2	645-205	305402032*	CLAMP , SCREW B12. SPRUNG. Ø20- 32 DIN3	1 1
3	645-006	387034856	PIPE HEATER	2
4	645 - 007	387038431	ISOLATION HEATER PIPE	2
5	645- 012	387034998	HOSE , INTER CONNECTION	2
6	645 -011	337034999*	HOSE . INTER CONNECTION	2
7	645-010	397027584*	ADAPTER, Y 22/22X18	2
8	645 - 057	387034855*	PIPE HEATER	2
9	645 - 035	397036434'	ISOLATION HEATER PIPE	2
10	645-016	387030153	BRACKET. PIPE	7
11	645 -017	387036436'	HOSE MIDDLE HEATER TURN	1
12	645- 361	387045879'	HOSE . MIDDLE KALORİLER INPUT	1
13	645- 396	3006000064	NUT AK3M6XT THICK D. DİN 934	7

REAR HEATER INSTALLATION

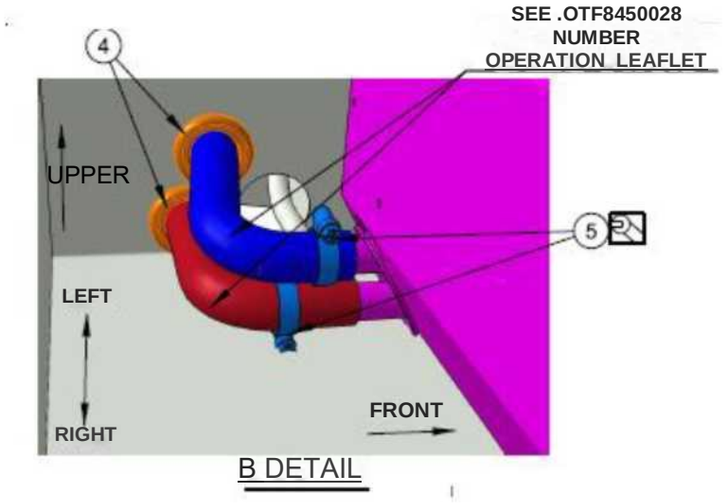




A DETAIL



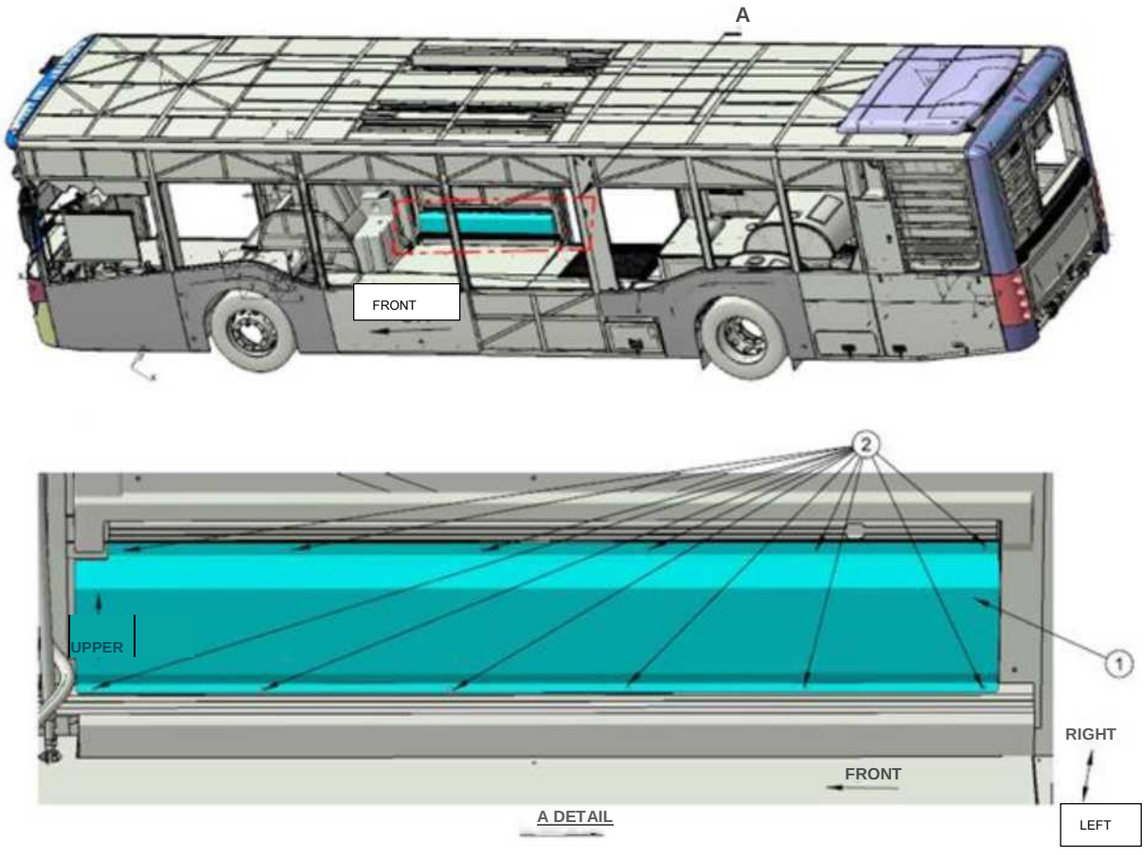
A DETAIL



B DETAIL

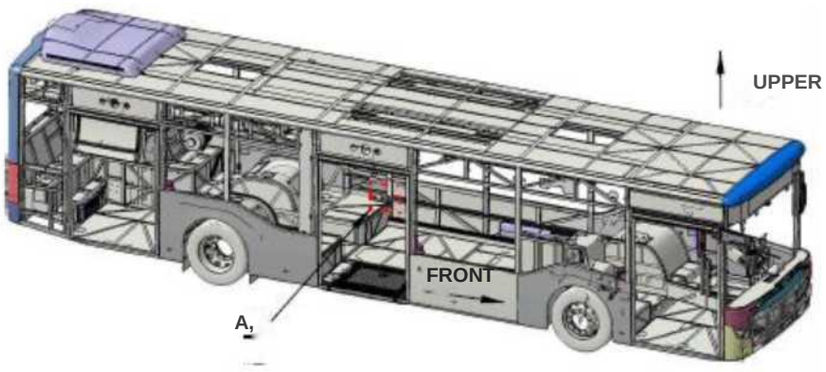
LEAF POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	845/004	387035809'	HEATER , REAR	1
2	845/133	3016006154'	SCREW 6X15	6
3	845 ı 209	377777338'	COVER, SCREW EVO GRAU 2	2
4	845/ 071	387030364-	GROMMET	2
5	845 / 098	305402032-	CLAMP . SCREW B12, SPRINGY , Ø20 32. DİN3	2

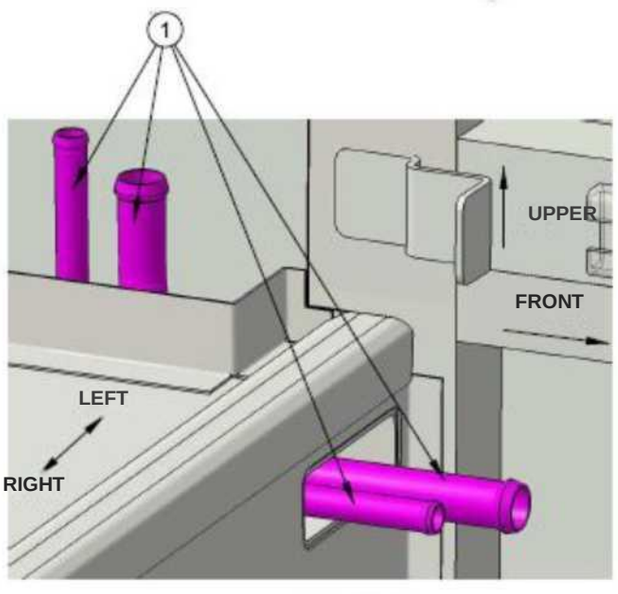
RIGHT HEATER TRAP PLATE INSTALLATION



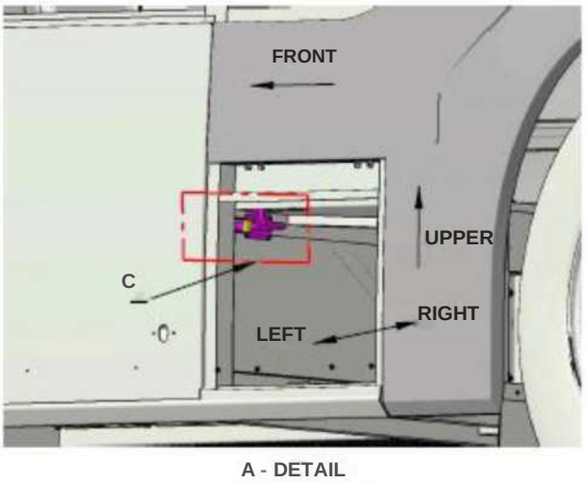
LEAFLET POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	845 005	387035062*	COVER. HEATER	1
2	845 203	3019042192*	**SCREW** 4,2x19 DIN 7981 YELLOW	12

LEFT HEATER PIPE ASSEMBLY INSTALLATION

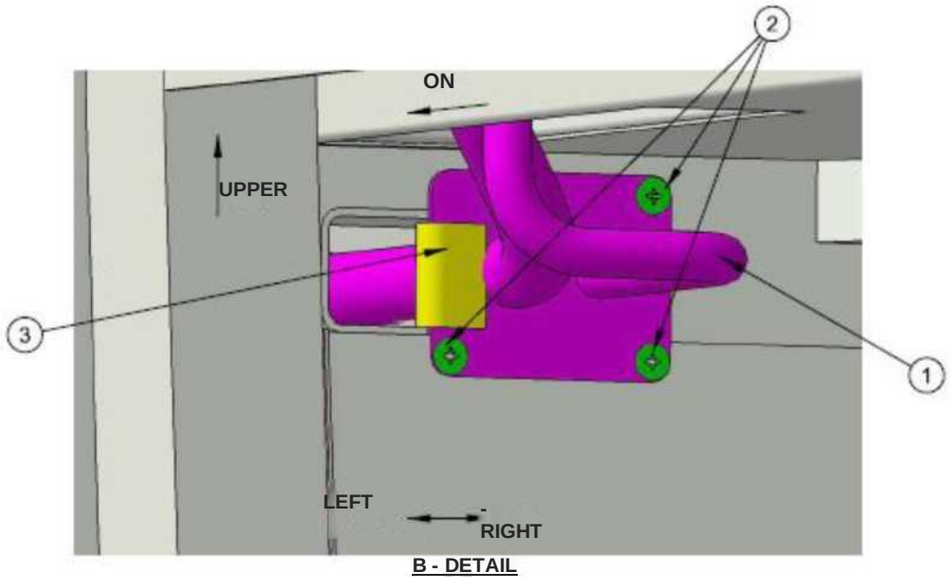




A - DETAIL
INSIDE LOOK



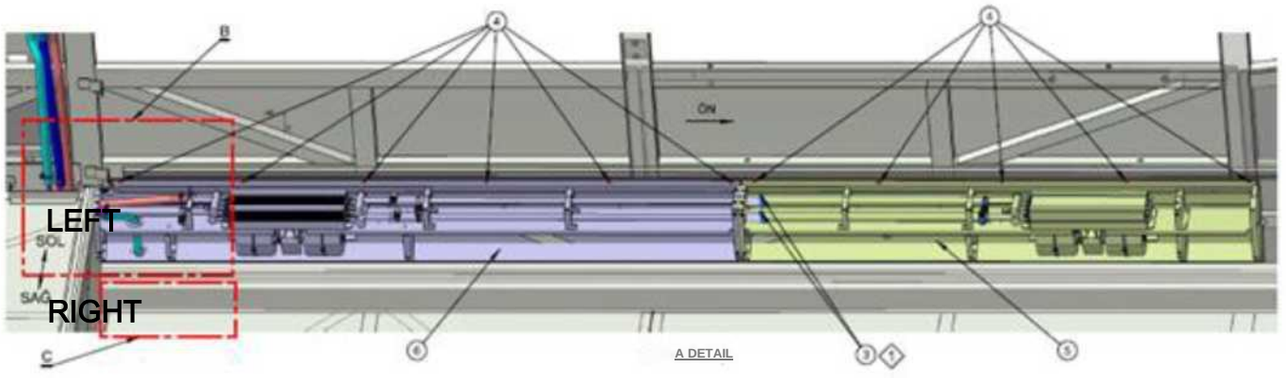
A - DETAIL
LEFT VIEW



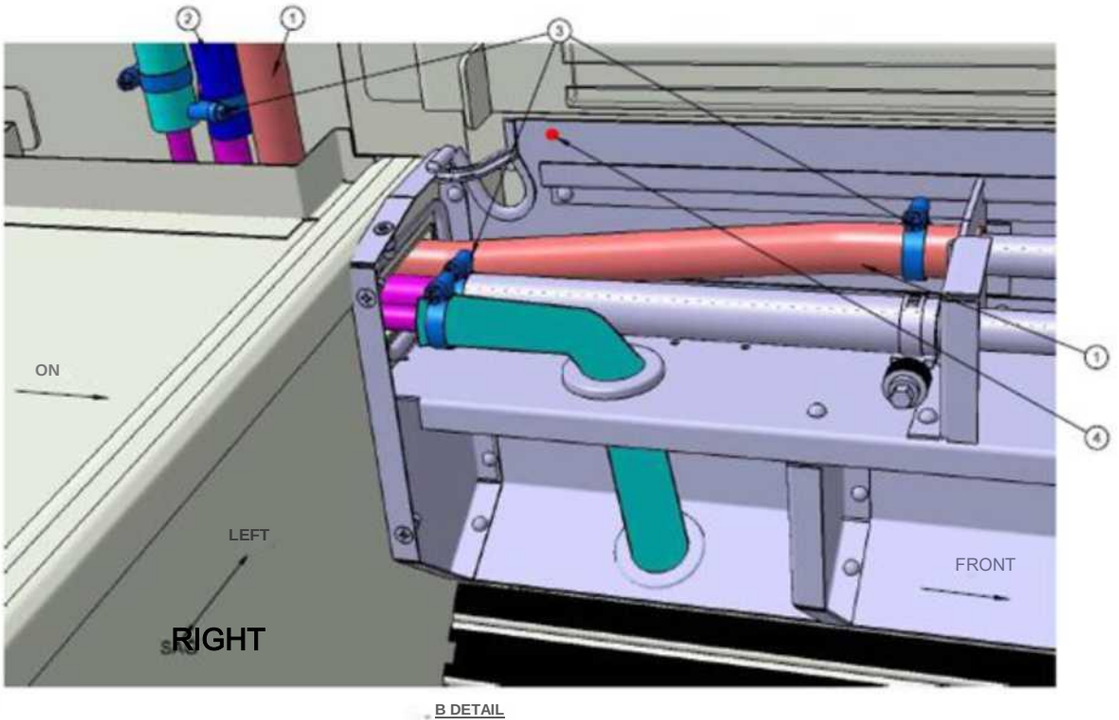
B - DETAIL

LEAF POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	845 i 055	387039313'	PIPE ASSEMBLY	1
1	846/014	307039313-	PIPE ASSEMBLY	1
2	845/100	3870337600'	SMART SELF-TAPPING SCREW DİN 7504 P 4.8X19	3
3	845/181	387052254'	SIDE WICK, HEATER INPUT	1

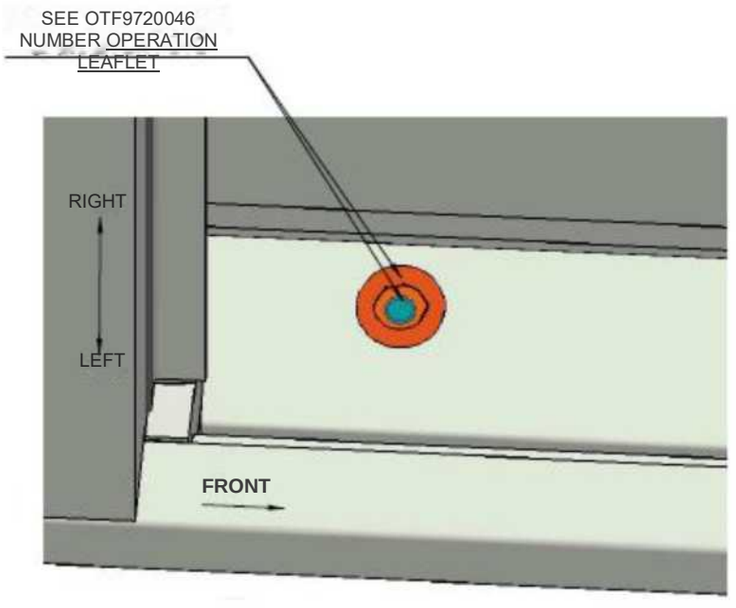
LEFT HEATER HOSES INSTALLATION



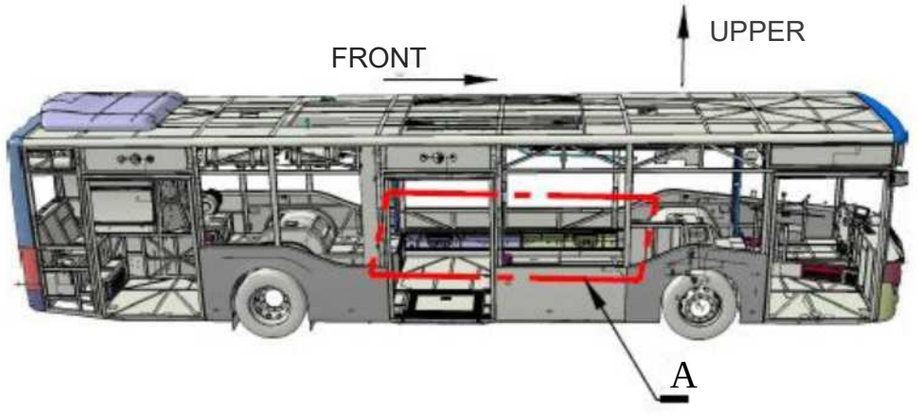
A DETAIL



B DETAIL

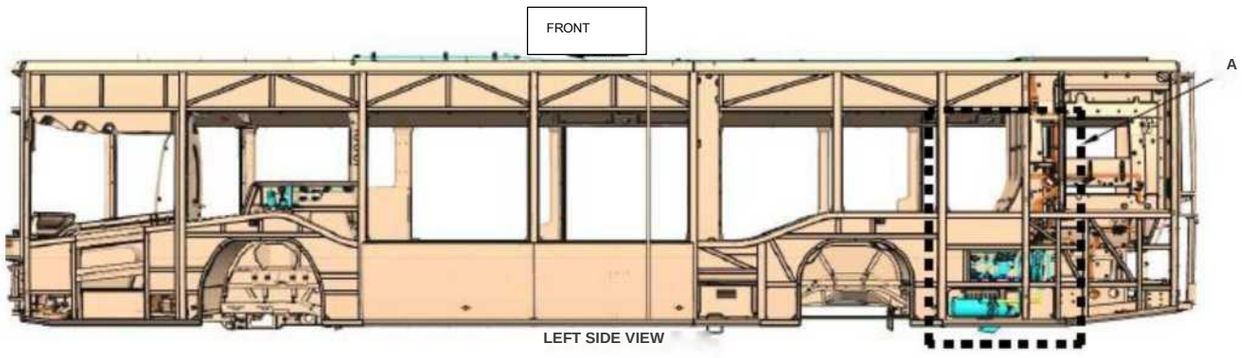


C- DETAIL
BOTTOM VIEW

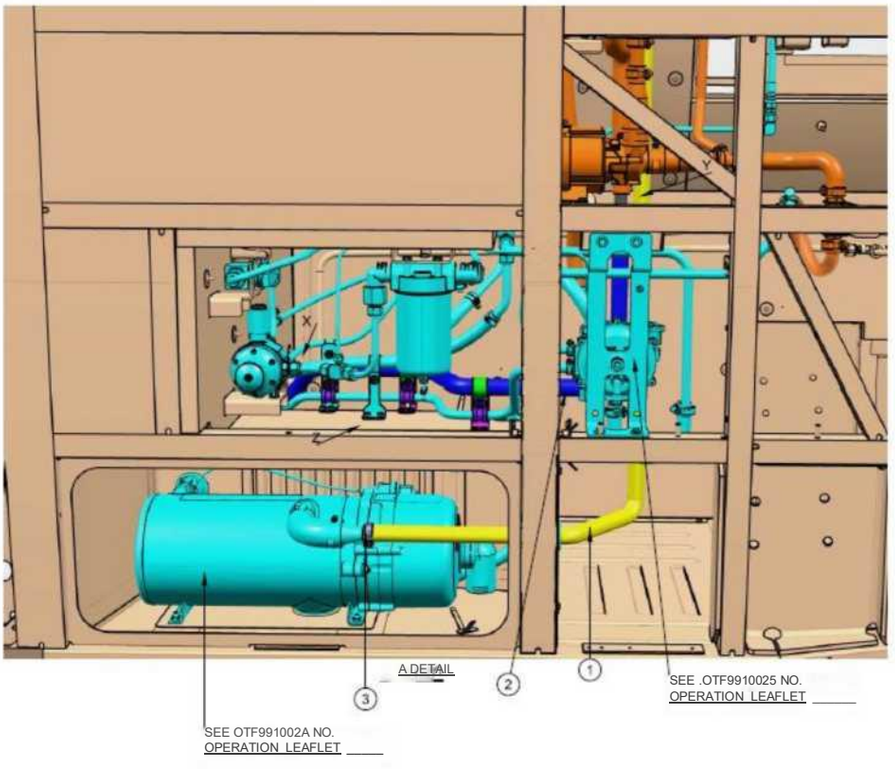


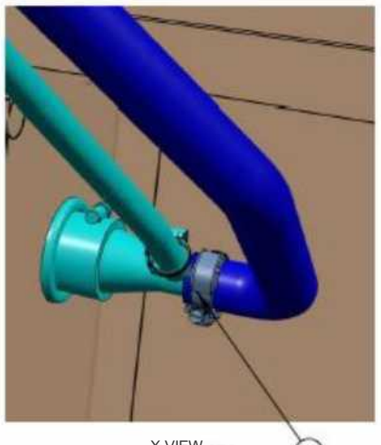
LEAF POSE	GROUP/POSE	PART N0	COMPONENT'S NAME	NUMBER
1	845/056	387038435	HOSE . MIDDLE HEATER INPUT	1
2	845/057	387038435	HOSE . MIDDLE HEATER TURN	1
3	845/098	3054020320	CLAMP SCREW B12 SPRINGY Ø20 32 DIN 3	5
4	845/203	3019043192	SCREW 4.2X1* DIN 7981 YELLOW	11
5	845/002	387037258	HEATER . MIDDLE ON	1
e	845/003	387037259*	HEATER . MIDDLE REAR	1

INSTALLATION OF HEATER HOSES TO THE PRE-HEATER

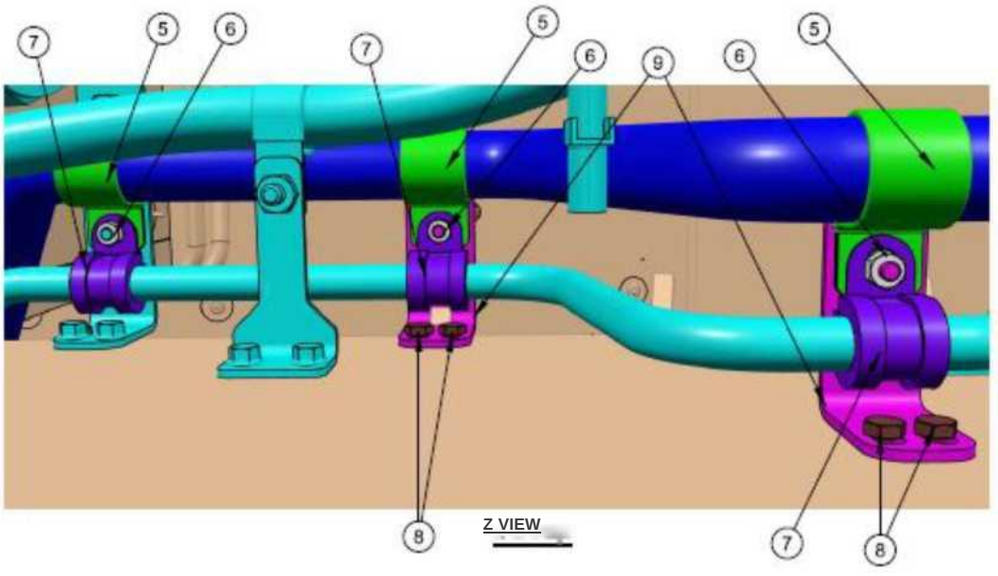


LEFT SIDE VIEW





X VIEW

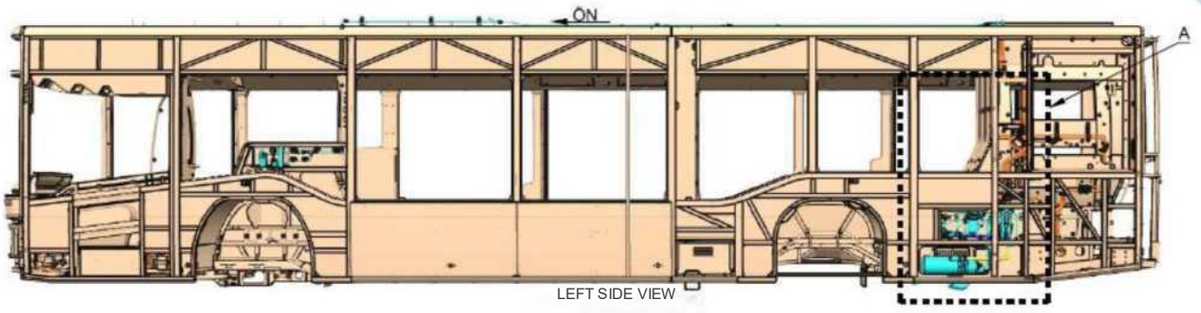


Z VIEW

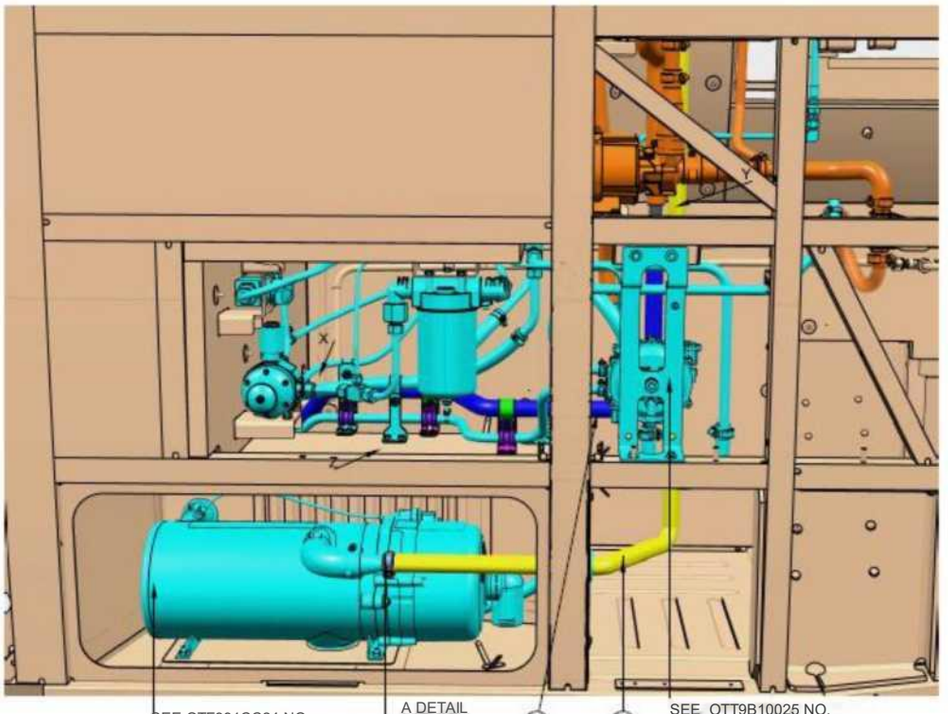


Y VIEW

LEAF POSE	GROUP/ POSE	PART NO	COMPONENT'S NAME	NUMBER
"1	845-085	387816363*	HOSE . FRONT HEATER INPUT	1
2	845-086	384311442*	HOSE . FRONT HEATER OUTLET	1
3	845-205	3054020320	CLAMP SCREW B12 SPRINGY Ø20 32 DIN3	6
4	845-084	387034423"	NIPPLE . Ø22/Ø22	2
5	845-083	1097000690"	CLIP. CHASSIS INSTALATION	3
6	845-086	3005000064	NUT AKB M6X1. THICK D. DIN934	3
7	845-220	3870402910	CLIP , Ø16 MB	3
6	845-176	3000108164	BOLT , AKB M6X1X16 THICK D DIN 933	4
9	845-092	387045002	BRACKET , PIPE CONNECTION	2



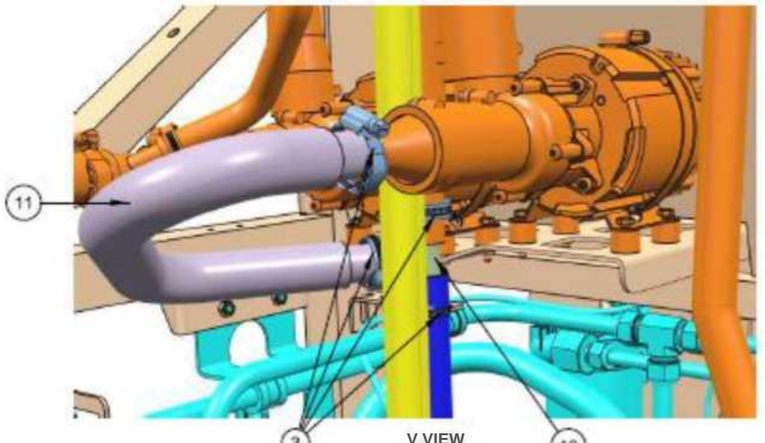
LEFT SIDE VIEW



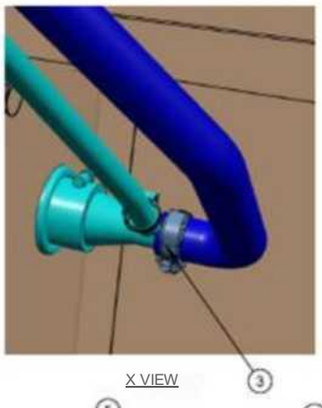
SEE.OTF991CC24 NO. OPERATION LEAFLET

A DETAIL

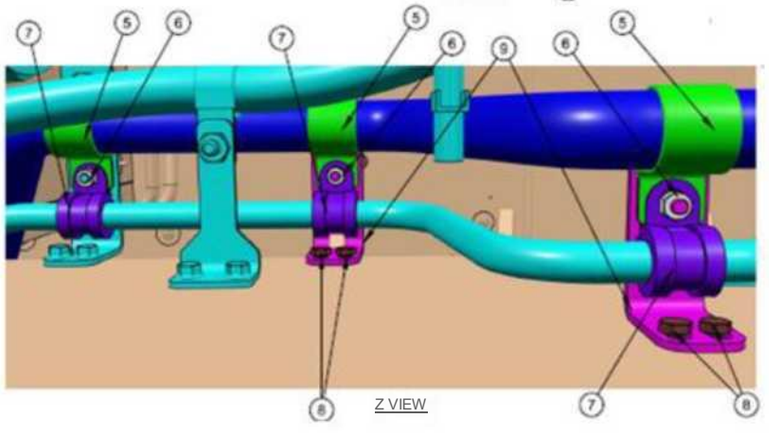
SEE OTT9B10025 NO. OPERATION LEAFLET



V VIEW
CEILING HEATED



X VIEW



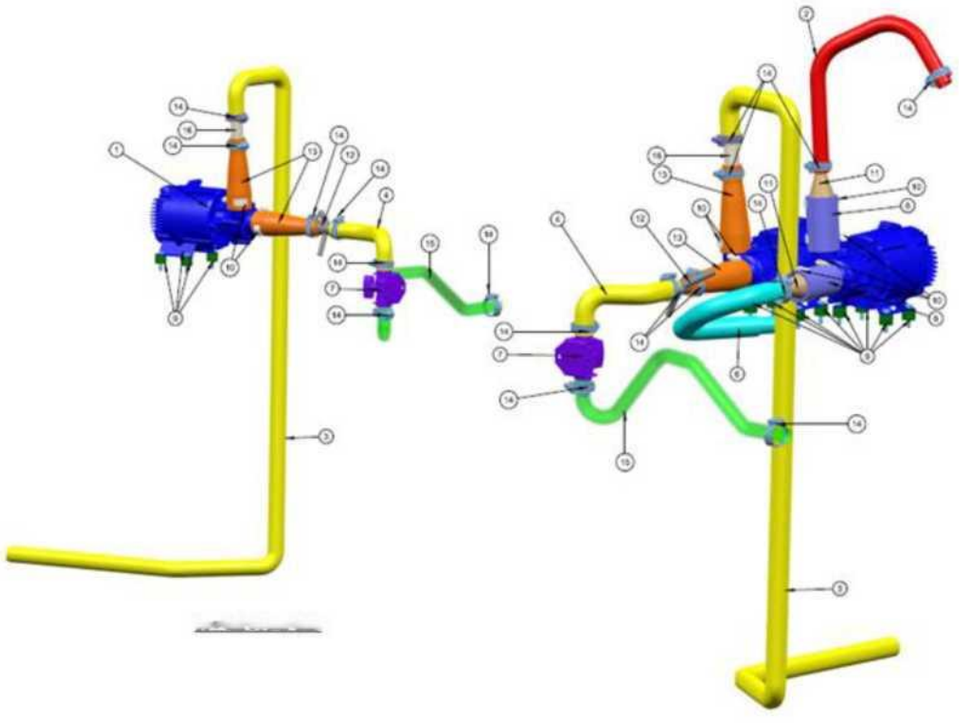
Z VIEW



Y VIEW

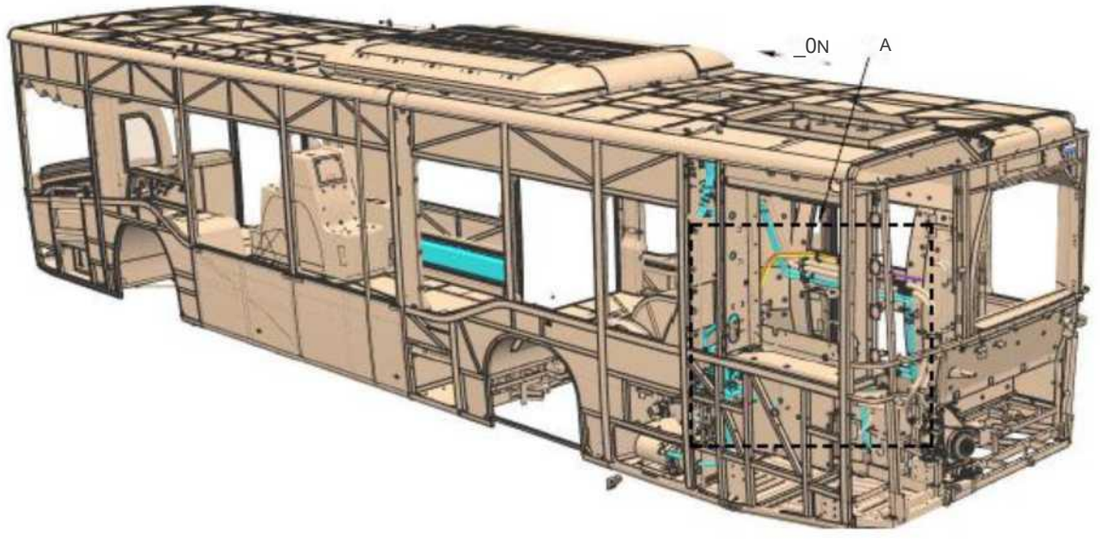
LEAF POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	845-085	387816363*	HOSE . PRE-HEATER INPUT	1
2	045- 086	384311442*	HOSE PRE-HEATER OUTLET	1
3	045-205	3054020320*	CLAMP . SCREW B12, SPRINGY , ø20 32 DIN3	7
4	845-084	387034423*	NIPPLE. ø22/ ø22	2
5	845- 083	1097009890*	CLIP , CHASSIS INSTELATION	3
6	045-096	3005000064*	NUT AKB M6X1 THICK D. DIN934	3
7	845-220	3070402910*	CLIP . ø16 M8	3
8	845- 076	3000106164*	BOLT . AKB M6X1X16. THICK D. DİN933	4
9	045-092	387045002*	BRACKET , PIPE CONNECTION	2
10	045-049	387058645*	NIPPLE. ø22-ø22-ø10-ø16	1
11	845- 121	384312100*	HOSE . HOT WATER	1

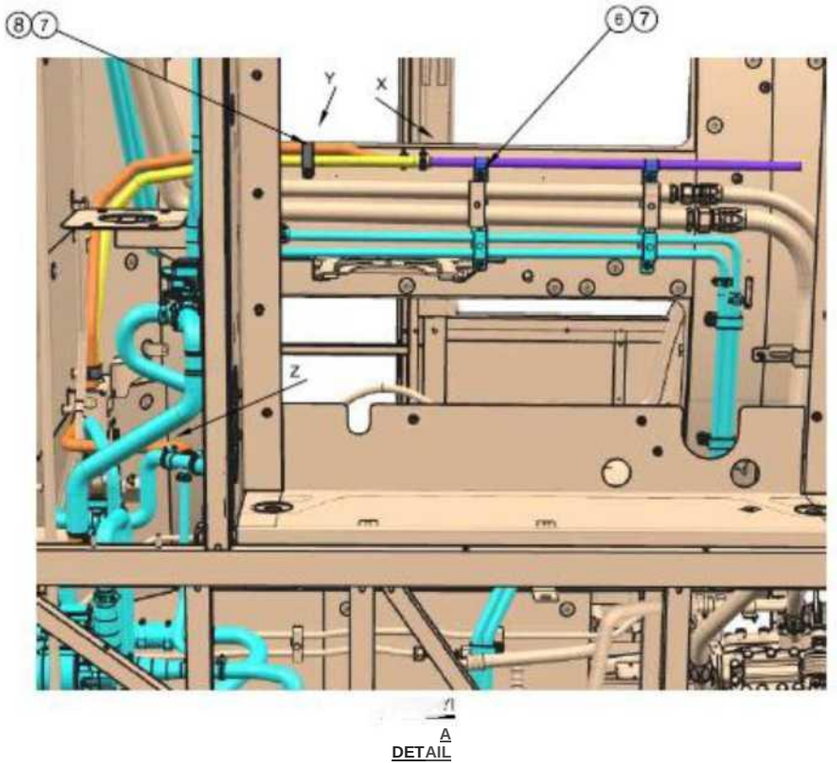
PREPARATION FOR HEATER PUMP



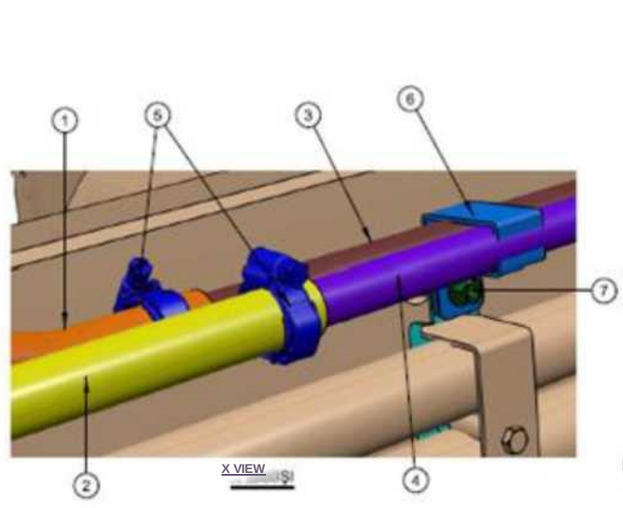
LEAFL ET PC£	GROUP / POSE	PART NO	COMPONENT'S NAME	NUMBER	ADDITIONAL INFO
1	845-105	387035027*	PUMP	1	
1	845-"100	387035027*	PUMP	2	CEILING HEATED|
2	845-118	387045373*	HOSE . HOT WATER	1	CEILING HEATED
3	845-095	387816383*	HOSE PRE-HEATER INPUT	1	CEILING HEATED
3	845-085	387816363*	HOSE . PRE-HEATER INPUT	1	
4	845-044	387816359*	HOSE . VALVE OUTLET PUMP INPUT	1	
5	845 - 043	3878163W	HOSE	1	
6	845-121	384312100	HOSE HOT WATER	1	CEILING HEATED
7	845-042	387044184*	VALVE.	I	
8	845-105	3B7036385*	HOSE . Ø38	2	CEILING HEATED
9	845-176	3000106304*	BOLT, AKB M6X1X30. THICK D. DİNB33	4	
9	845-176	3000316304*	BOLT. AKB M6X1X30, THICK D. DIN933	8	CEILING HEATED
10	845-167	3054035550*	CLAMP SCREW | B12. SPRINGY , 03555. DİN3	2	
10	845-137	3054035550*	CLAMP SCREW B12. SPRINGY , 03555. DİNİ	6	CEILING HEATED
11	845 -107	387036396*	ADAPTER	2	CEILING HEATED
12	845-090	3B431398r	ADAPTER. Ø22-Ø22-0 V-0&	1	
13	845-040	387034424*	ADAPTER HOSE	2	
14	845 - 075	305402032*	KFI FPCF SCREW 1 Ri2, SPRINGY, Ø20 32. 0|N3	10	CEILING HEATED
14	845 - $76	305402032*	CLAMP SCREW B12. SPRINGY , Ø20 32, DIN3	7	
15	845-043	387816350*	HOSE	1	
16	845-094	3870344231*	NIPPLE, Ø22/Ø22	2	

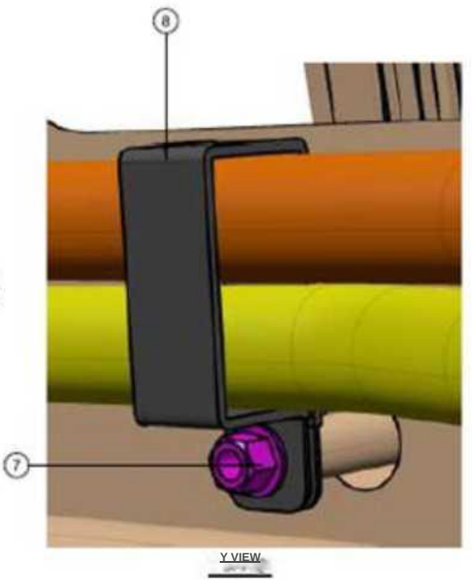
HEATER HOSE INSTALLATION

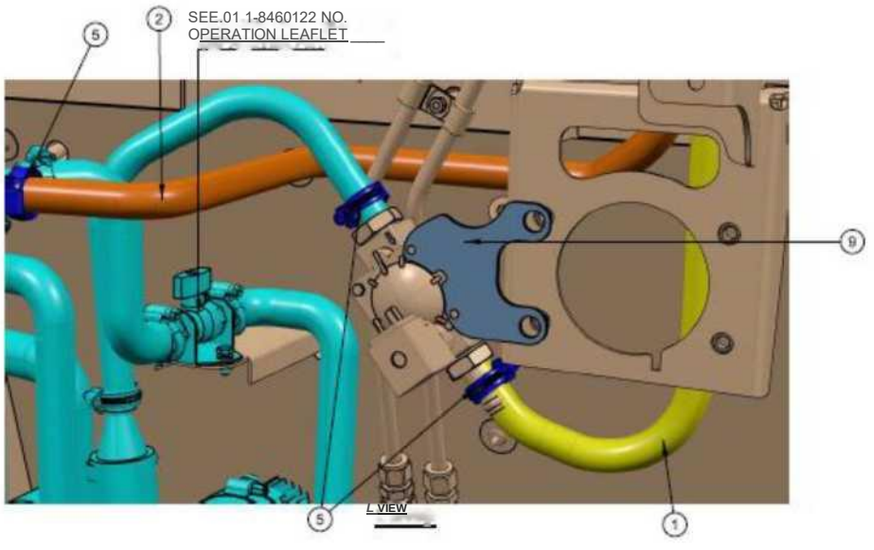




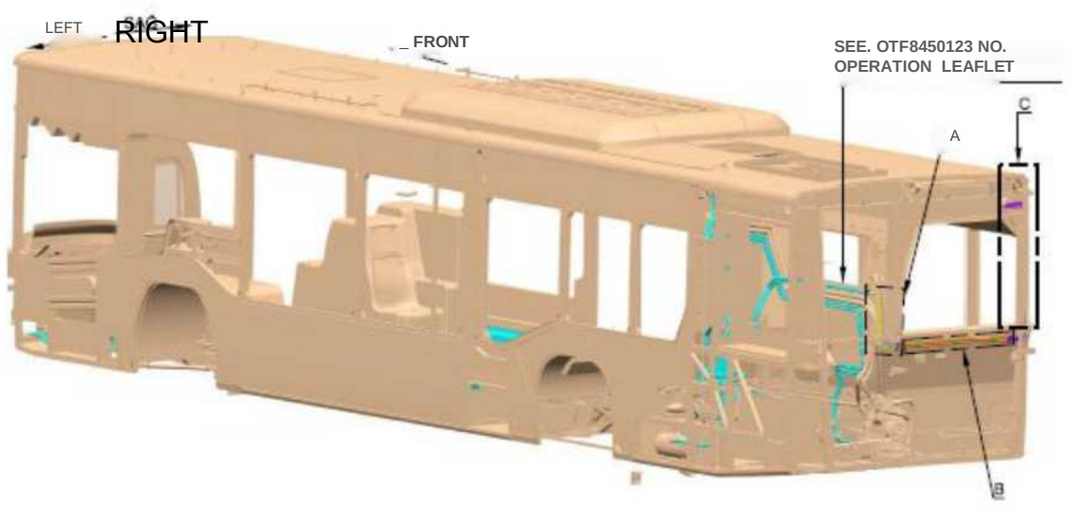
A
DETAIL

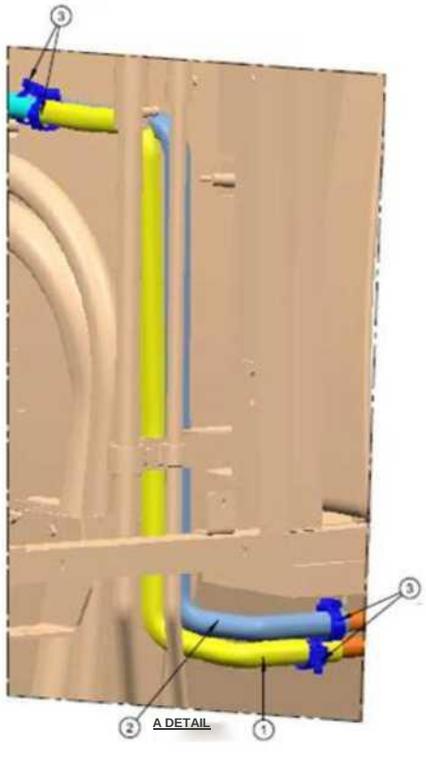




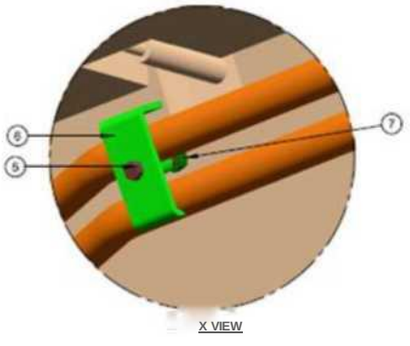


LEAF POSE	GROUP POSE	PART NO	COMPONENT'S NAME	NUMBER
1	845 -161	3B4311637*	HOSE . HOT WATER	1
2	845-119	314311634"	HOSE HOT WATER	1
3	845 - 109	387815853*	PIPE , HEATED AIR CONDITIONING	1
4	845 . 108	367816864"	PIPE , HEATED AIR CONDITIONING	1
5	845 - 204	3054016270*	CLAMP . SCREW B12, SPRINGY , ø16- 27, DİN3	6
6	845 - 132	337038432"	BRACKET	2
7	845-847	3OM0MO50'	NUT . FLN&TR M8X1. THICK D, DİN6923	4
S	845-131	337038490'	BRACKET	2
9	845-162	387045338*	BRACKET	1

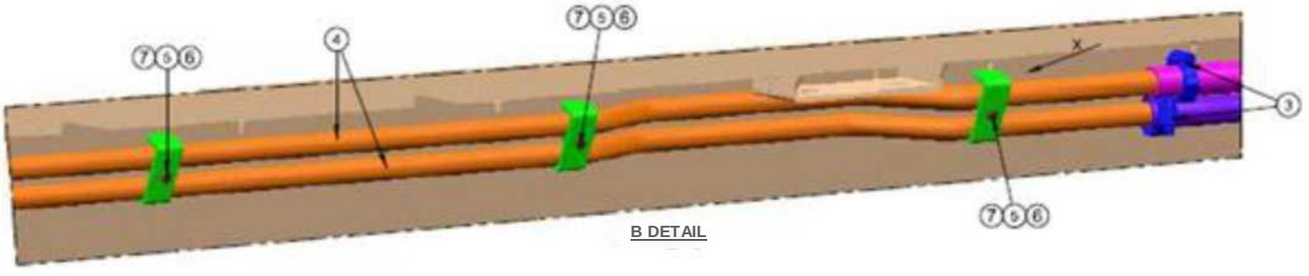




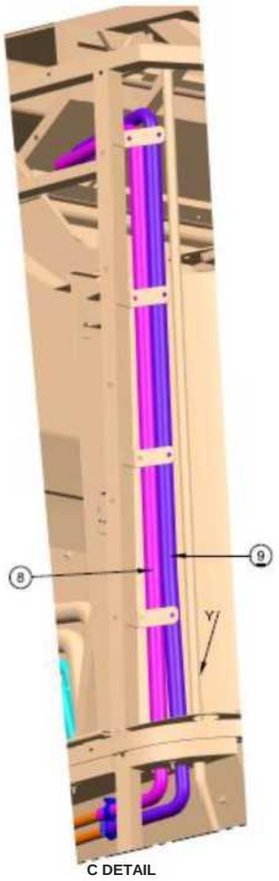
A DETAIL



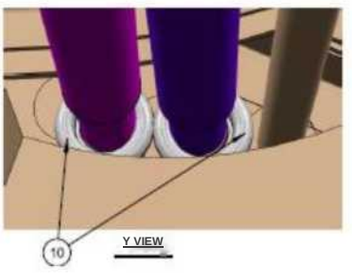
X VIEW



B DETAIL

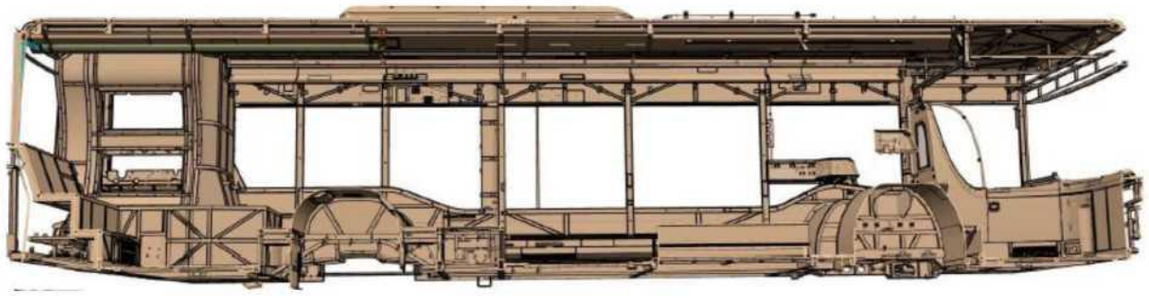


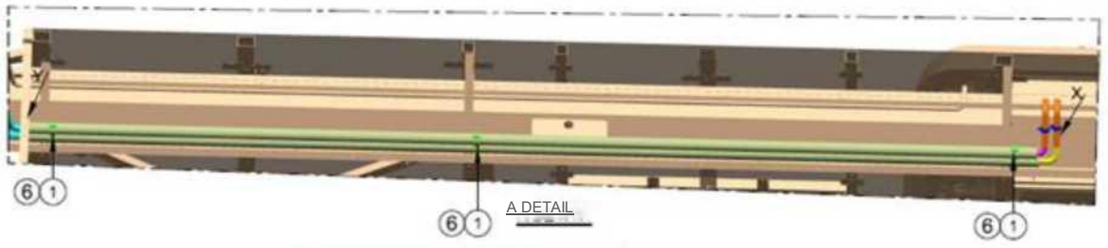
C DETAIL

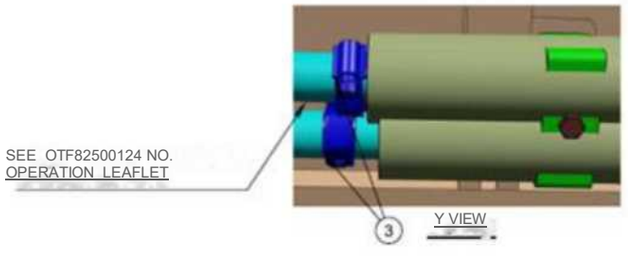


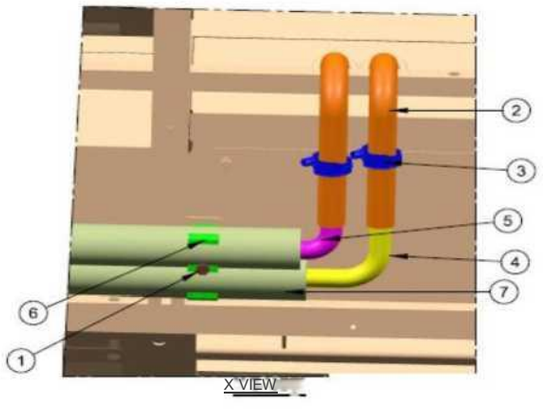
Y VIEW

LEAF POSE	GROUP POSE	PART NO	COMPONENT'S NAME	NUMBER
1	845 - 150	307036461*	HOSE HEATED AIR CONDITIONING	1
2	845-151	387036462	HOSE HEATED AIR CONDITIONING	1
3	845 -204	3054016270'	CLAMP . SCREW B12. SPRINGY ø16 27. DIN3	6
4	845-112	367033252*	PIPE . HEATED AIR CONDITIONING	2
5	845 - 648	3000105354	BOLT , AKR M5X0.8X35, THICK D. DIN933	3
6	845- 157	357033907*	BRACKET	3
7	845-096	3005000064	NUT AKR V6X1. THICK D DİN934	3
8	845 - 113	387036467*	HOSE HEATED AIR CONDITIONING	1
9	945 - 114	**387036468**	HOSE HEATED AIR CONDITIONING	I
10	845 - 082	387030364*	GROMMET	2



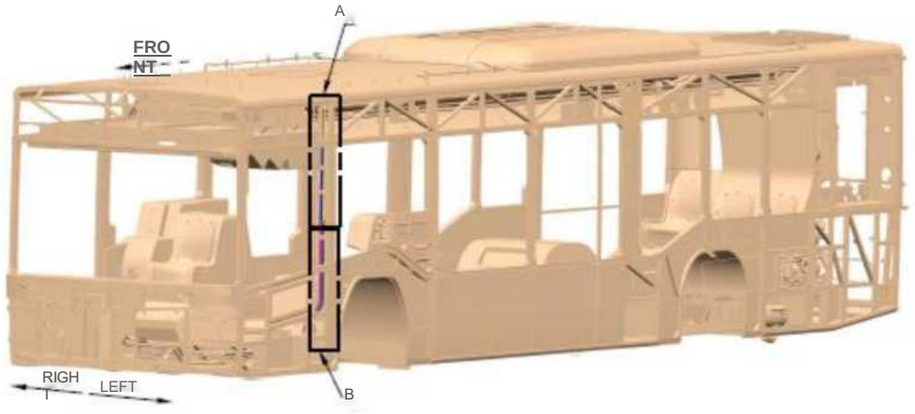


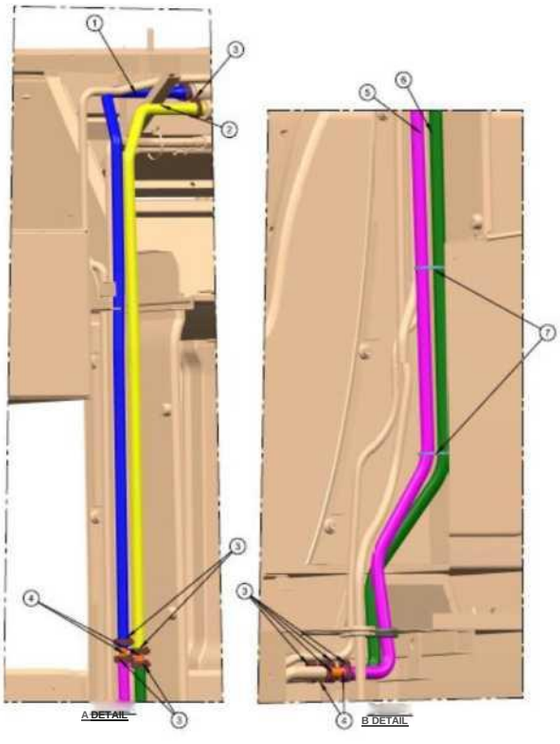




LEAFLET POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	645 - 073	3000106554*	BOLT , AKB M6X1X55. THICK D, DİN933	3
2	845-104	387036279*	HOSE , HEATED AIR CONDITIONING OUTLET	2
3	845-204	3054015270*	CLAMP, SCREW B12, SPRINGY , Ø16 27. DIN3	4
4	845 - 126	387043939*	PIPE .HEATED AIR CONDITIONING	1
5	845 - 164	387043940*	PIPE ,HEATED AIR CONDITIONING	1
6	845 - 166	387036484*	BRACKET , HEATER	1
7	845 - 124	387043941*	ISOLATION	2

INSTALLATION OF HEATER HOSES IN THE DRIVER AREA

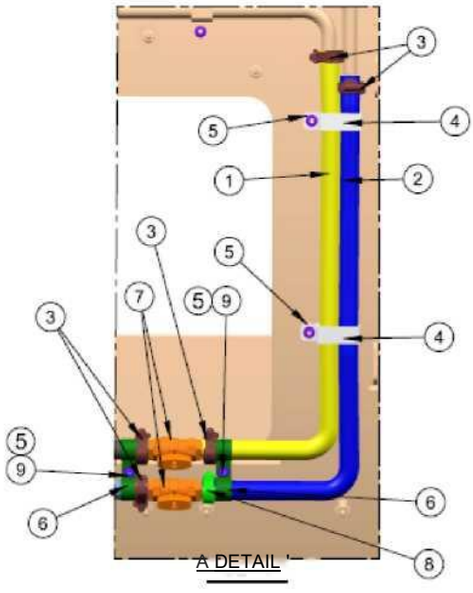




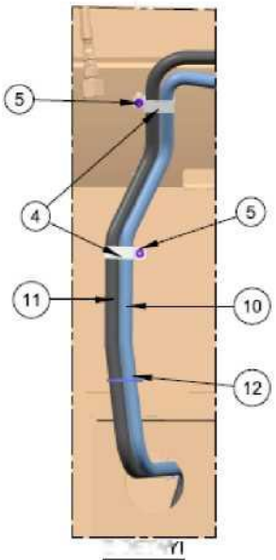
LEAFLET POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	845 - 008	3B7036571*	HOSE . HEATER B POST	1
2	845 - 009	387036570	HOSE HEATER B POST	1
3	845 -205	305402032*	CLAMP SCREW B12. SPRINGY . Ø20-32, DIN3	10
4	845 - 067	387018088*	NIPPLE	4
5	845 -015	387038430	HOSE HEATER LEFT B POST	1
6	845 - 036	337038429"	HOSE HEATER LEFT B POST	1
7	845 - 68	3777T0506'	PLASTIC CLAMP L 350 MM	2

REAR HEATER HOSES INSTALLATION



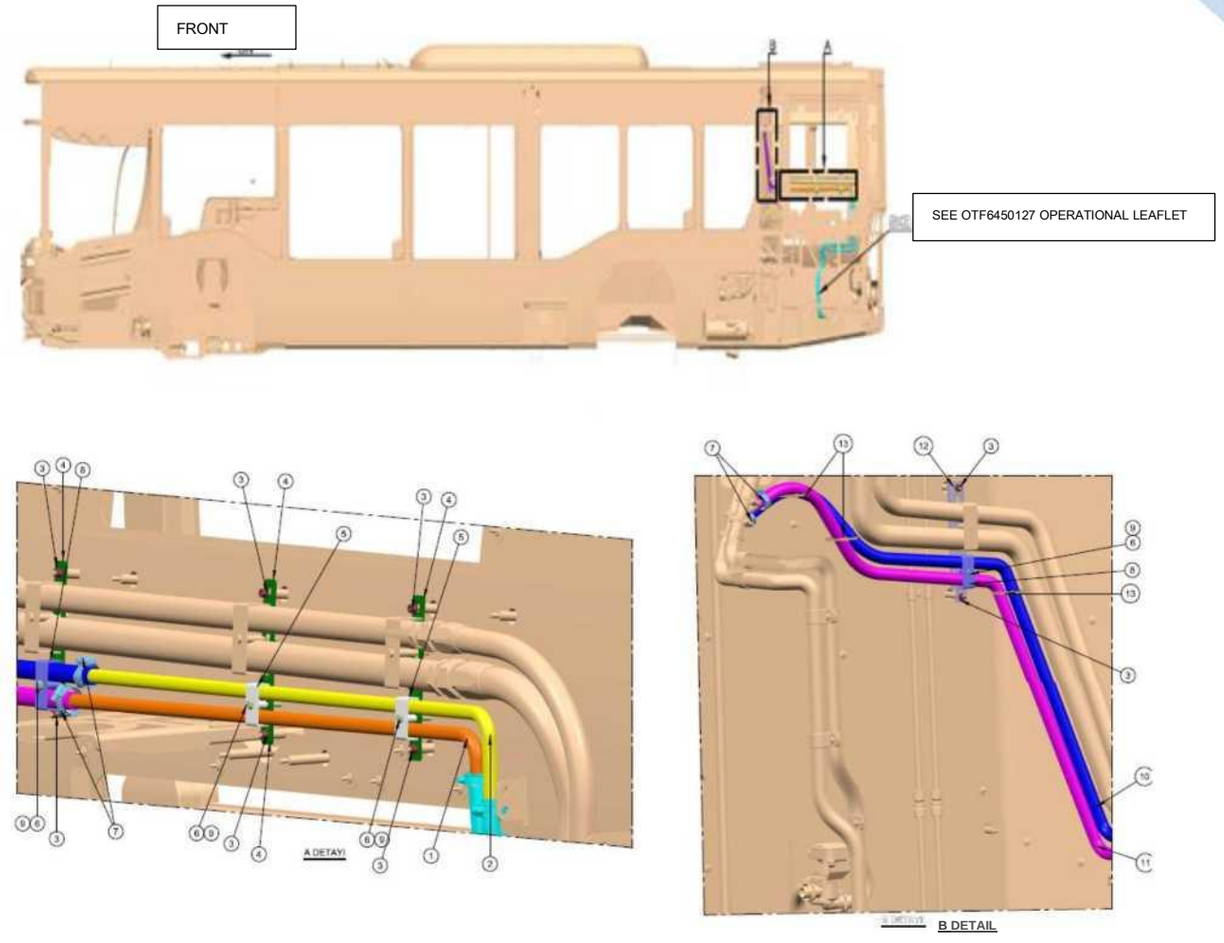


A DETAIL

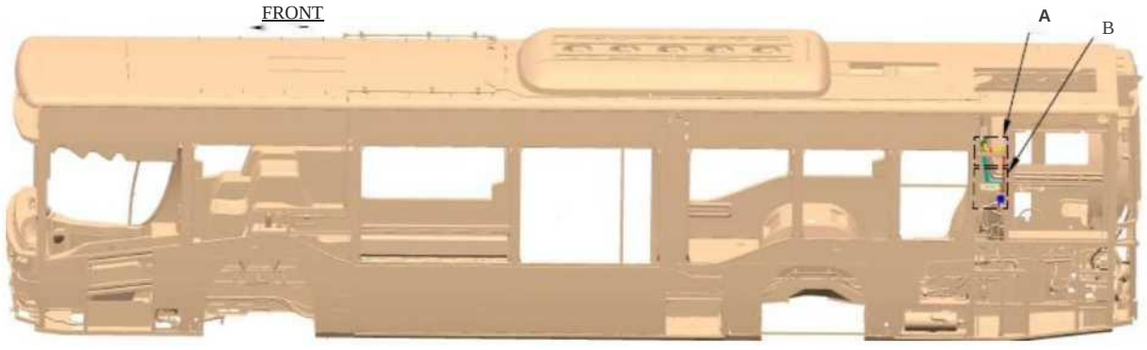


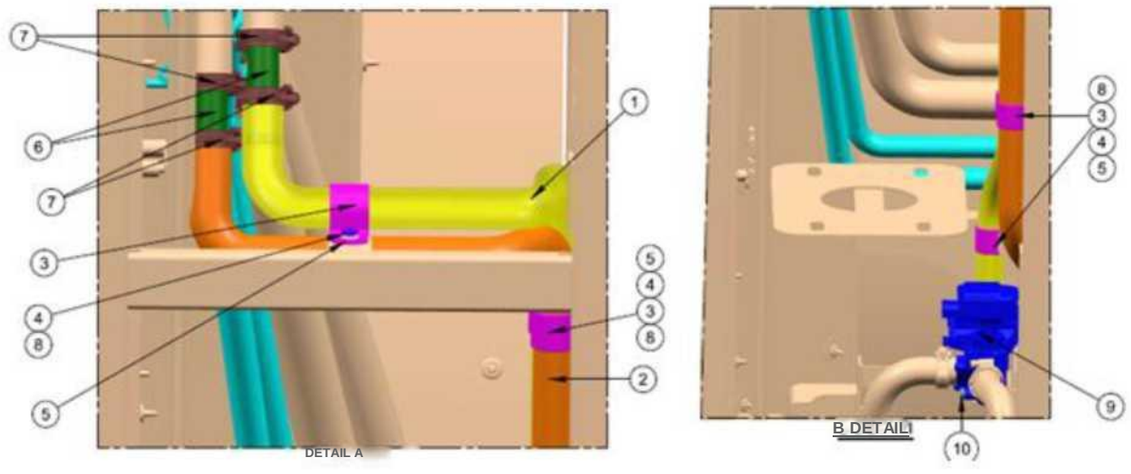
B DETAIL

LEAF POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	845 - 020	387046132*	HOSE , REAR HEATER TURN	1
2	B45-018	387046130*	HOSE , REAR HEATER OUTLET	1
3	345-205	305402032*	CLAMP , SCREW B12. SPRINGY , Ø20 32, DIN3	5
4	845 - 131	387036496*	BRACKET	4
5	845 - 845	3005800068*	NUT . FLN&TR M6X1. THICK D. DIN6923	6
6	845 - 078	387014152*	CLIP , PANEL	4
7	845-556	387041084*	VALVE MECHANİC Ø18	2
8	845-204	305401627*	CLAMP , SCREW B12, SPRINGY , Ø16 27, DIN3	1
9	845-076	3000106164*	BOLT , AKB M6X1X16. THICK D, DIN933	2
10	845 - 021	387046131*	HOSE .HEATER	1
11	845 - 022	387046133*	HOSE ,REAR HEATER	1
12	845-068	377770506*	PLASTIC CLAMP L 350 MM	1



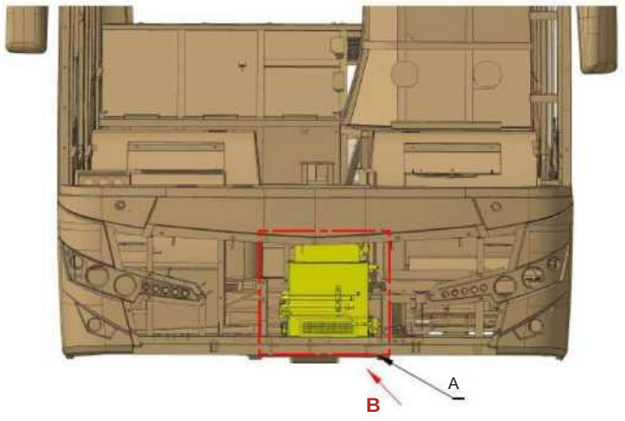
LEAF/ POSE	GROUP.POSE	PART NO	COMPONENT'S NAME	NUMBER
1	845 - D39	3B70M9D6*	PIPE REAR HEATER	1
2	845 - 037	357023905*	PIPE REAR HEATER	1
3	845-845	3005800068'	NUT FLN&TR M6X1. THICK D. DIN8923	8
4	845 - C25	357026400*	BRACKET	3
5	945 - 137	387038907	BRACKET	2
6	845 - 177	3000306464	BOLT . AKB M6X1X45. THICK D DIN 931	3
7	545 - 206	305402032*	CLAMP SCREW B12 SPRINGY , 'Ø20-32. DIN3	4
8	845 -019	357025975*	BRACKET , HEATER	2
9	B4b - W6	3005000064	NUT . AKB M6X1. THICK FDİN934	4
10	845 - D5O	387809537*	HOSE HOT WATER	1
11	949-096	387809538*	HOSE . HOT WATER	I
12	845 - 023	307033912"	BRACKET	1
13	MS-066	3777705060*	PLASTIC CLAMP L 350 VV	3



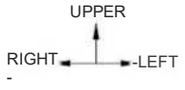


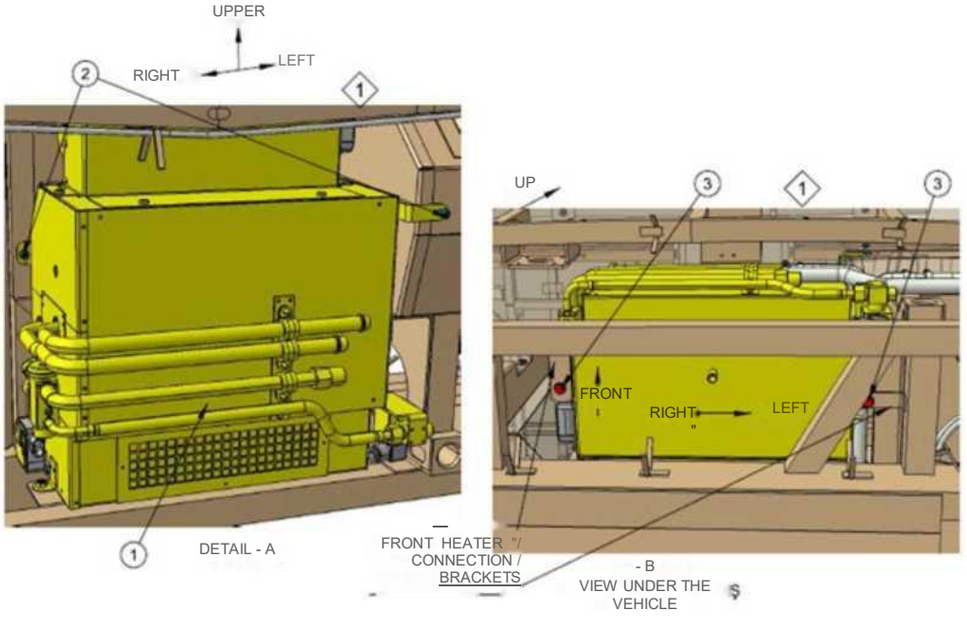
LEAFLET POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	B45 - 046	387811362'	HOSE , HOT WATER	1
2	845 - 045	387811179*	HOSE , HOT WATER	1
3	845 - 846	109700969*	CLIP , CHASSIS INSTELATION	4
4	845 - 076	3000106164'	BOLT . AKB M6X1X16, THICK D. DIN933	4
5	B45 - 075	3010000064"	WASHER . FLAT D=6 DIN125	4
6	B45 - 010	387027584-'	ADAPTER, 22/22/18	2
7	845 - 205	3054020320*	CLAMP . SCREW B12. SPRINGY , Ø20 32, DIN3	4
8	845-096	3005000064*	NUT . AKB M6X1 THICK D. DIN934	4
9	845-051	367004904*	BUSCHJOST 3 WAY MOTORIZED VALVE	1
10	845 - 073	3000106554*	BOLT . AKB M6X1X55, THICK D. DİN933	1

FRONT HEATER UNIT INSTALLATION



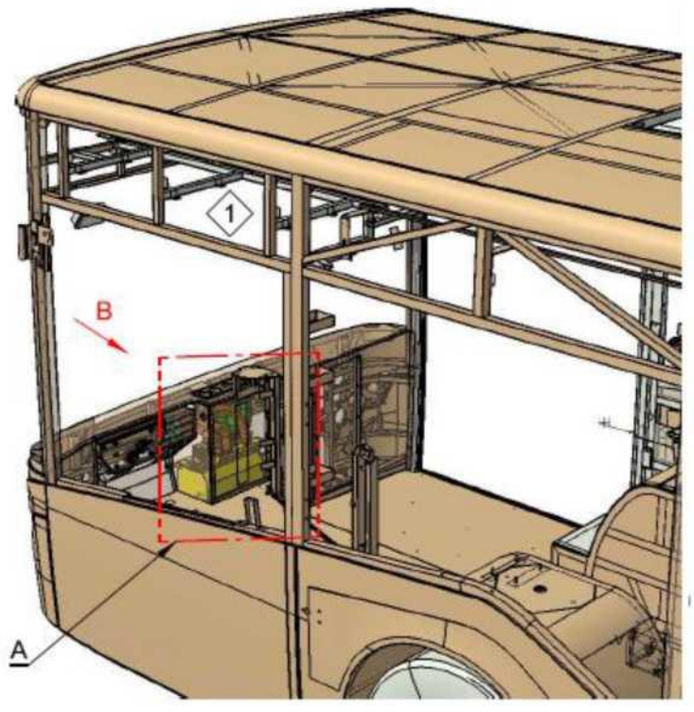
VEHICLE FRONT VIEW





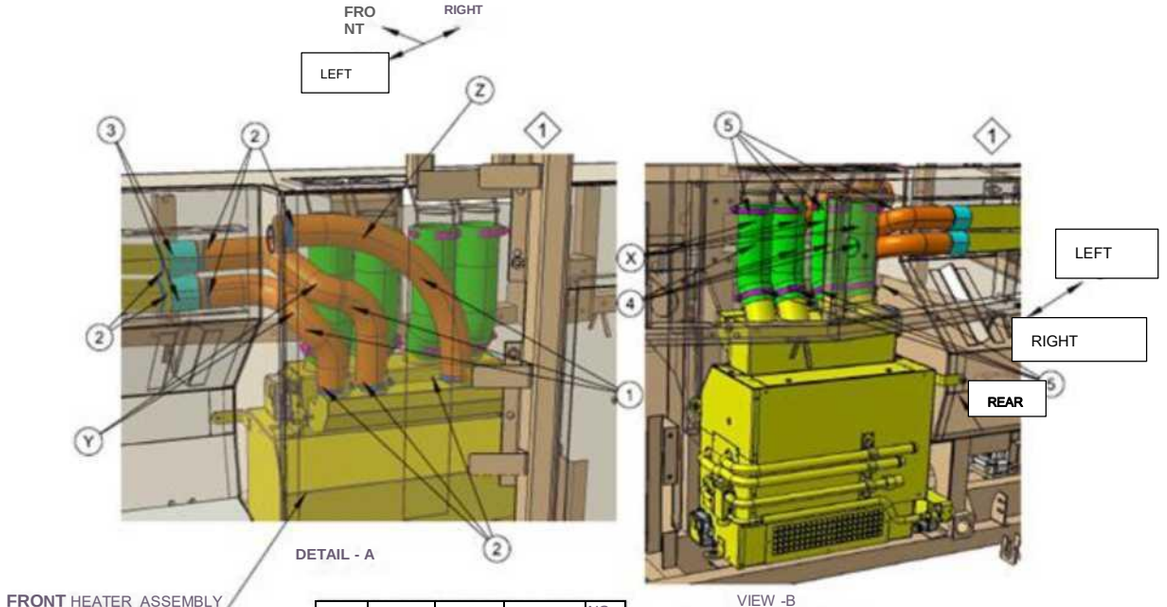
LEAFLET POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	860 - 001	387835556*	HEATER . FRONT	**1**
1	860 - 0*01	38T855641*	HEATER . FRONT, AIR CONDITION	1
1	860 - 001	387056357'	HEATER . FRONT	**1**
2	**860 - 009**	3018948183"	ROND SHEET SCREW 4.6X16	**2**
3	860 -010	3001208206'	BOLT . FLN M8X1. 25X20. THICK D. DIN692	**2**

FRONT HEATER HOSES INSTALLATION



A VEHICLE SIDE VIEW





DETAIL - A

FRONT HEATER ASSEMBLY
(OTF860C014*)

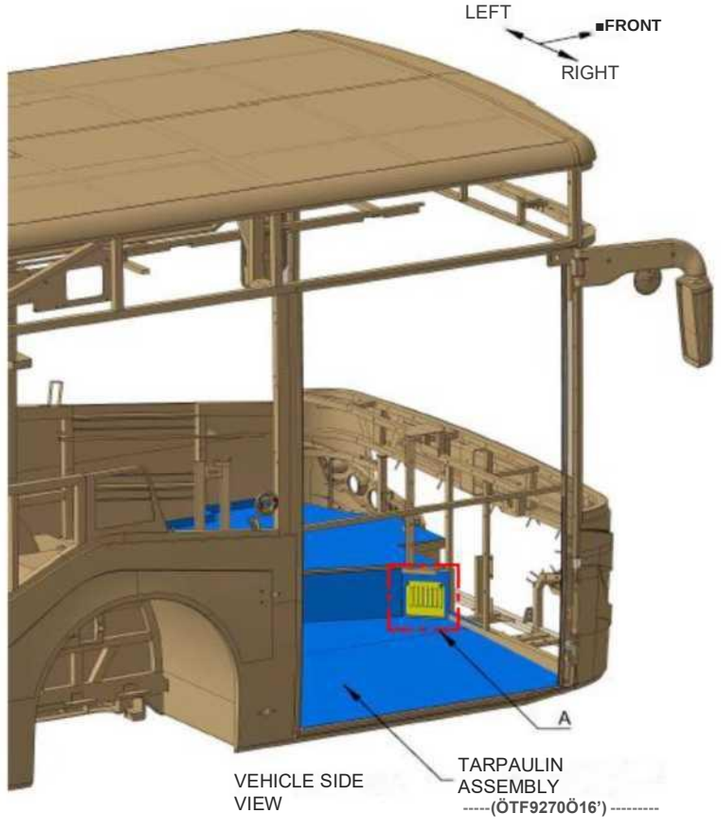
	DIAMETER	LENGTH	TOLERANCE	NO
X	60	120	T25	4
Y	40	600	t25	2
Z	40	400	T25	1

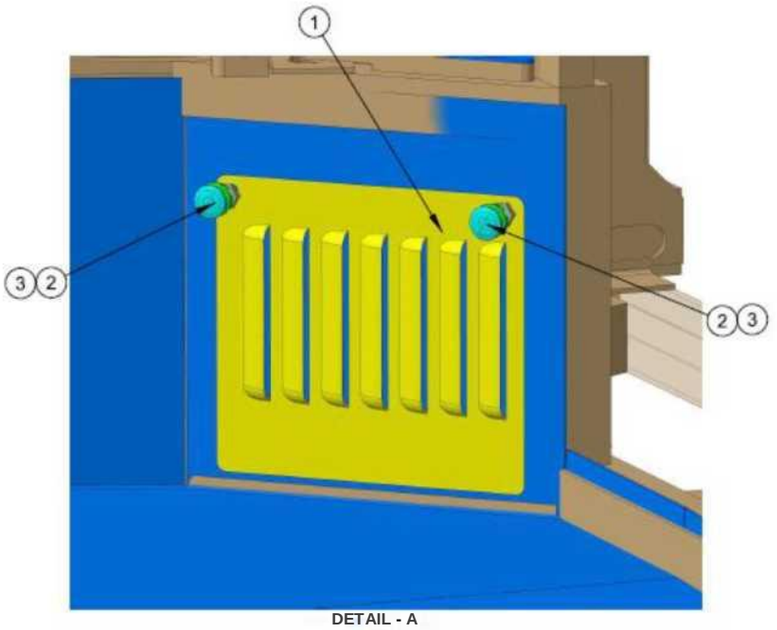
VIEW -B

VEHICLE FRONT VIEW

LEAFLET POSE	GROUP,'POSE	PART NO	COMPONENT'S NAME	NUMBER
1	B60/003	387003179'	CRAFT PIPE Ø40	3
2	B60/004	305353250*	CLAMP .SCREW B9, Ø32-50. DIN3017	a
3	860/006	387037054*	ADAPTER, FRONT HEATER	2
4	860/002	387003180*	CRAFT PIPE Ø60	4
5	860/005	305355070*	CLAMP . SCREW B9. Ø50-70, DİN3017	a

FRONT HEATER SUCTION COVER VEHICLE ASSEMBLY



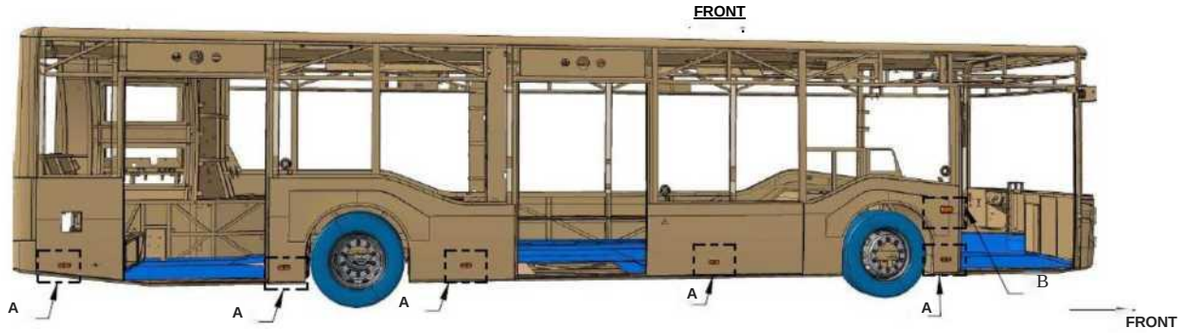


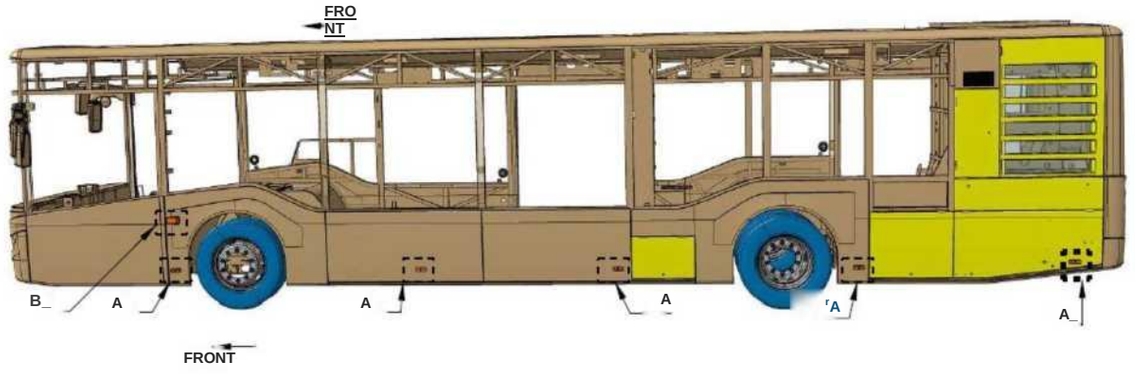
DETAIL - A

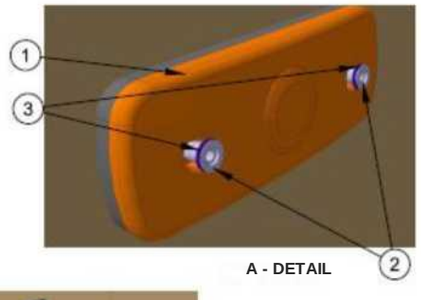
LEAFLET POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	860/D08	387036329'	COVER, FRONT HEATER SUCTION	1
1	860/'008	387053365*	COVER, FRONT HEATER SUCTION	1
2	860/043	3000906351*	BOLT , SLR M6X35 THICK D. DIN912	2
3	B60/028	387026601*	ABS SCREW COVER, DARK GREY	2

HEADLIGHT GROUP

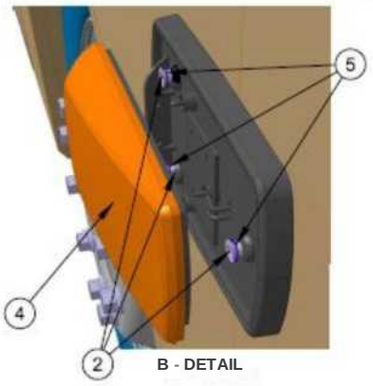
SIDE SIGNAL LAMPS INSTALLATION







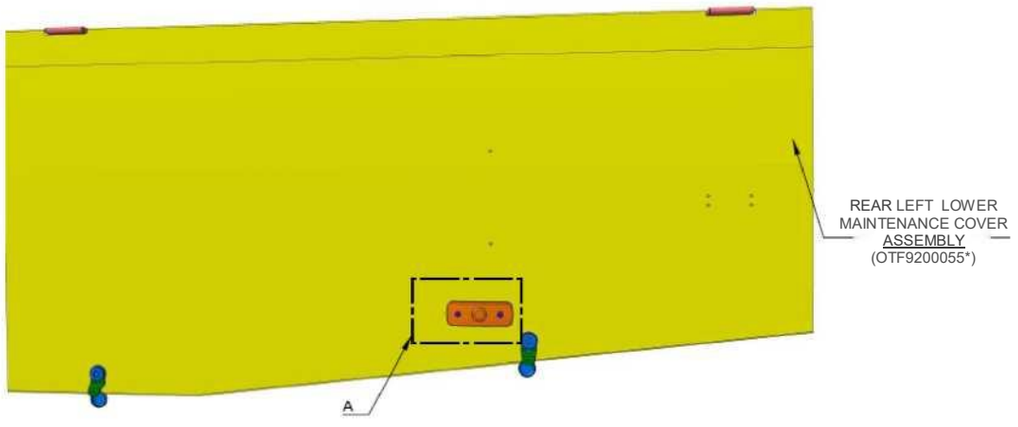
A - DETAIL

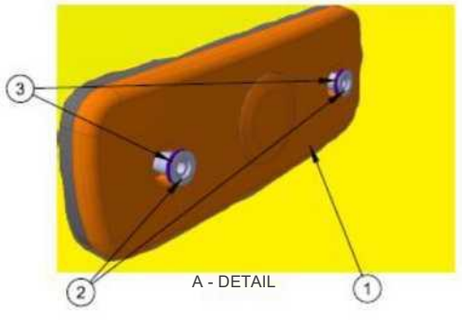


B - DETAIL

LEAFLET POSE	GROUP/LEAF	PART NO	COMPONENT'S NAME	NUMBER
1	910 - 045	387401080 *	PARK LAMP, SIDE	9
2	910 - 041	301500420*	SCREW M4X0,75X20	18
3	910-047	307004318*	SMALL ORING, SIDE MARKER	18
4	910-050	387022717*	LAMP SIDE. SIGNAL, LED	2
5	910-748	307004319*	LARGE ORING-SIGNAL	6
6	910 - 051	301500420*	SCREW M4X0,75X20	6

LEFT LOWER MAINTENANCE COVER PARKING LAMP INSTALLATION

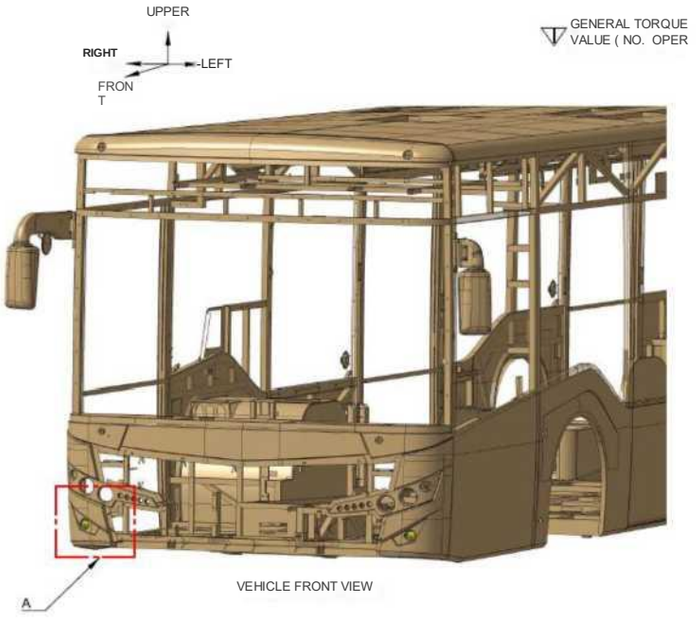


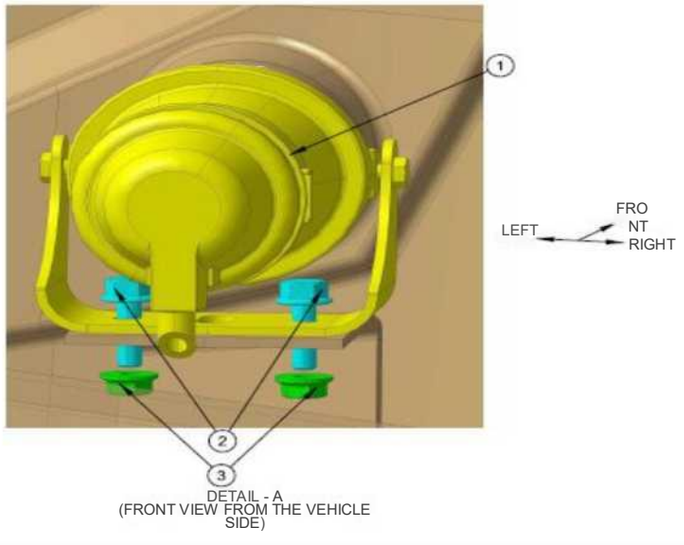


A - DETAIL

LEAFLET POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	910 - 045	387401080*	**PARK LAMP SIDE**	1
2	910 - 041	301500420*	**SCREW M4X0.75X2 0**	2
3	910 - 047	387004318*	SMALL ORING, SIDE MARKER	2

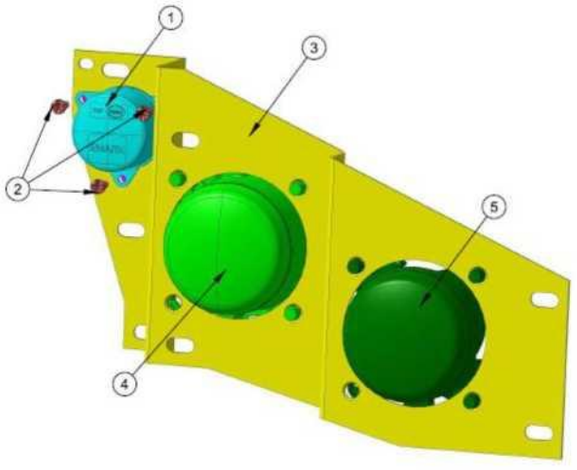
RIGHT -LEFT FRONT FOG LAMP INSTALLATION

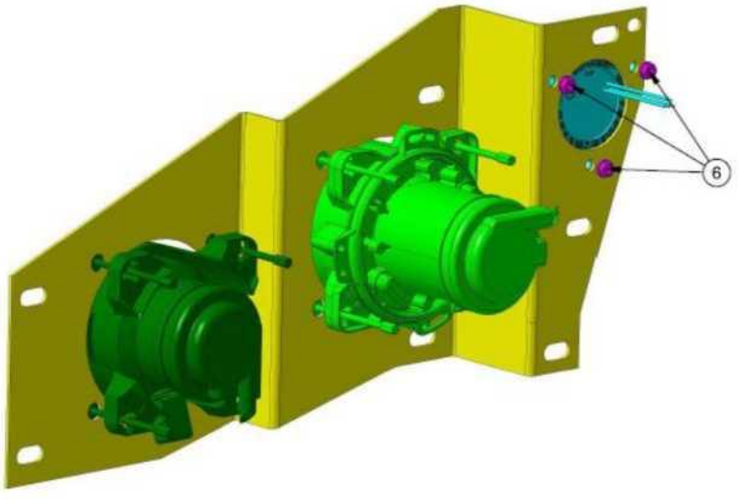




LEAFLET POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	910-003	387022710'	FOG LAMP , FRONT ASSEMBLY	2
2	910- 119	301600515*	BOLT	4
3	910-122	300580051*	NUT , FLN&TR **M5X0.8, THICK D,** DIN6923	4

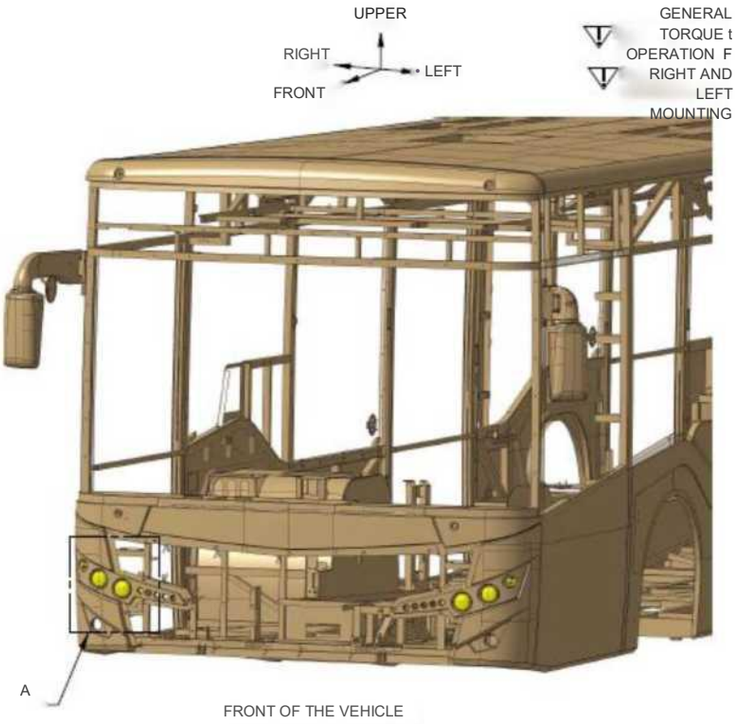
RIGHT HEADLIGHT ASSEMBLY INSTALLATION

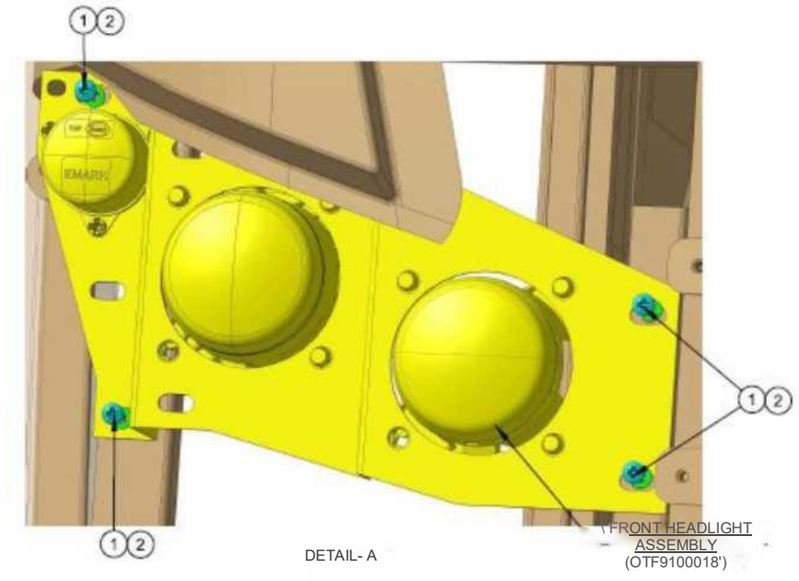




LEAFLET POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	910-024	307028006*	SIGNAL FRONT, LED	1
2	910-023	3015005158*	SCREW M5. STAINLESS STEEL	3
3	910-02B	387343969*	BRACKET , LAMP, HOLDER RIGHT	1
4	910 - 026	3B705366B*	HEADLIGHT, LOW BEAM	1
5	910 - 025	387053665'	HEADLIGHT. HIGH BEAM PARK LAM.1K0 008191-02	1
6	910-022	30058000511*	NUT , FLN&TR M5X0.8, THICK D. DIN6923	3

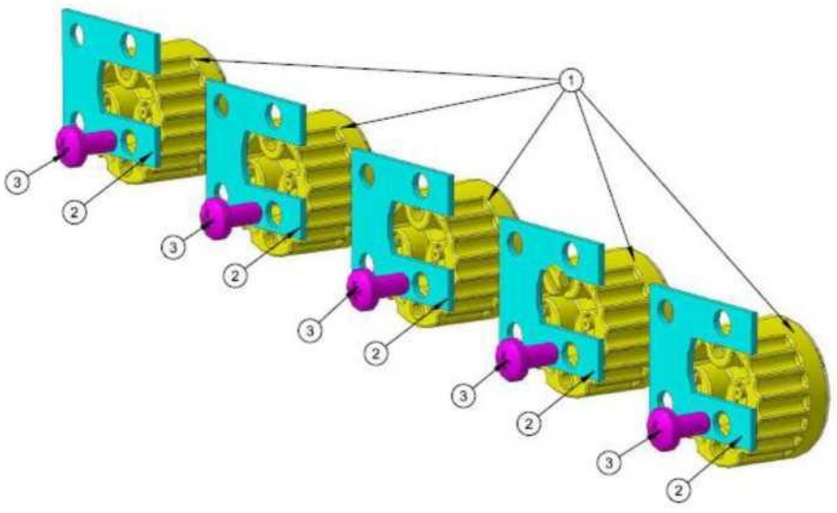
HEADLIGHT ASSEMBLY VEHICLE ASSEMBLY





LEAFLET POSE	GROUP.'POSE	PART NO	COMPONENT'S NAME	NUMBER
1	910-016	3015006253'	SCREW. M6X25	8
2	910-017	3011100063*	WASHER . FLAT D=6 DIN 9021	8

DAY DRIVING LAMP INSTALLATION



LEAF POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	910□ - 140	387028005"	LAMP. DAY DRIVING, DTRL, THE FIVE	2
2	910- 141	367032433*	BRACKET , DTRL, CONNECTION	10
3	910 - 145	301500406*	BOLT , M4X6	10



RIGHT DAY DRIVING LAMP- FRONT VIEW

DAY RIDING LAMP ASSEMBLY



RIGHT DAY DRIVING LAMP- REAR VIEW



LEFT DAY DRIVING LAMP- FRONT VIEW

DAY RIDING LAMP ASSEMBLY

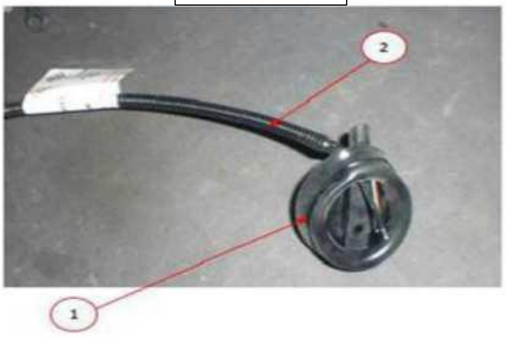


RIGHT DAY DRIVING LAMP- REAR VIEW

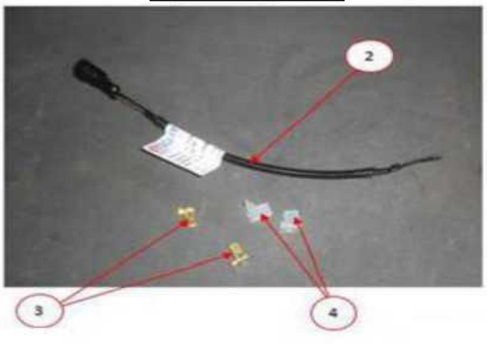
LEAFLET POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	910 - 142	30150D51DB'	SCREW M 5X10 DIN 79BG. STAINLESS STEEL	10
1	910-150	3015005153*	SCREW M 5X15 DİN 7985 (4161)	1ü

FRONT FOG LAMPS MOUNTING

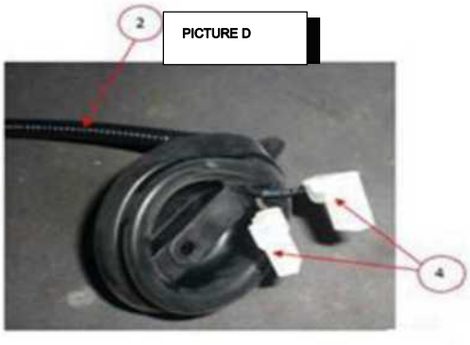
PICTURE A



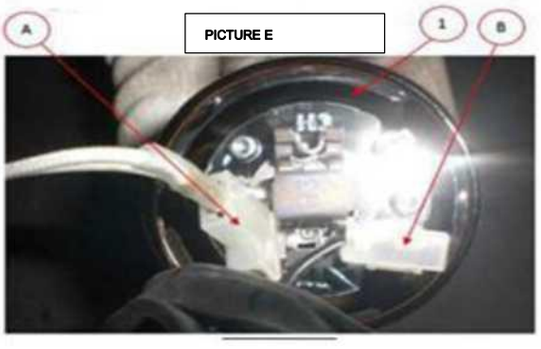
PICTURE B



PICTURE D



PICTURE E



PICTURE H



PICTURE L



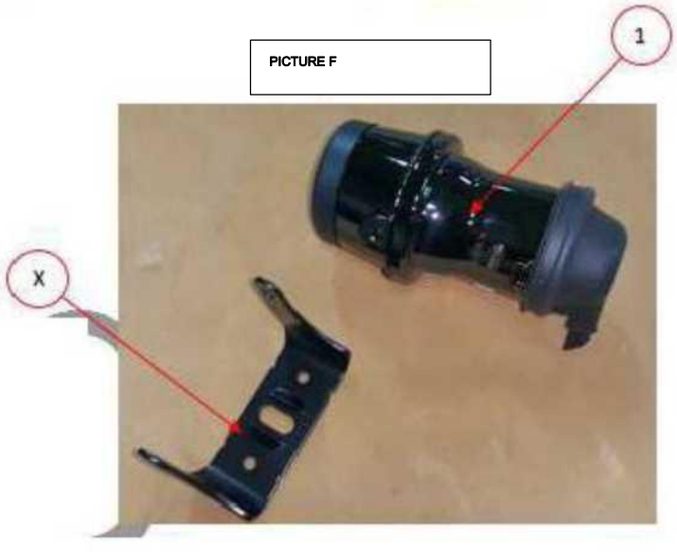
PICTURE C



PICTURE G

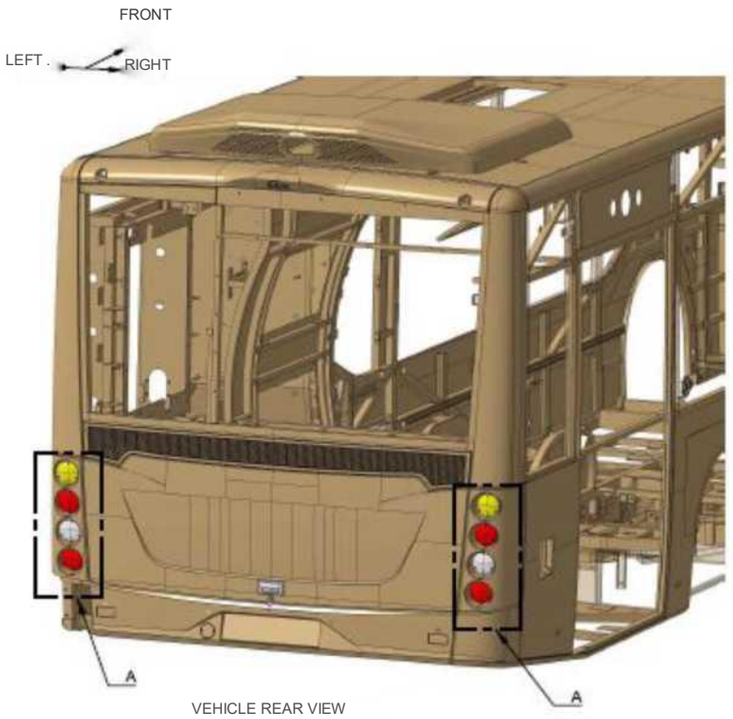


PICTURE F

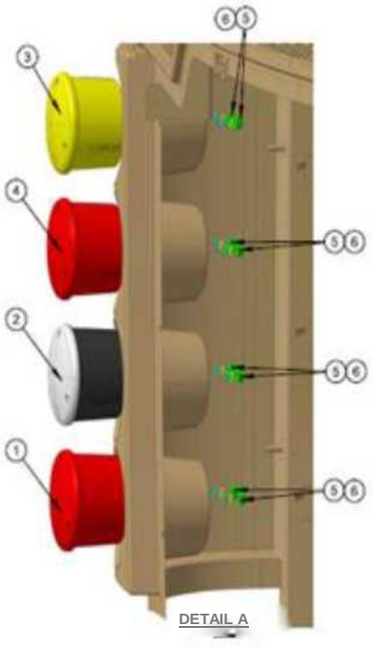


LEAF POSE	GROUP/POSE	**PART NO**	**COMPONENT'S NAME**	NUMBER
1	910-080	3870197S4*	FOG LAMP , FRONT 1NL 008 090-117	2
2	910-082	**377772165***	INSTALATION . INTER (BODY-FOG LAMP }	2
3	910-083	387023899*	FEMALE TERMINAL, CURVE	4
4	910-084	387023900*	SOCKET, CURVE FEMALE PLUG	4

VEHICLE OUTDOOR LIGHTING INSTALLATION

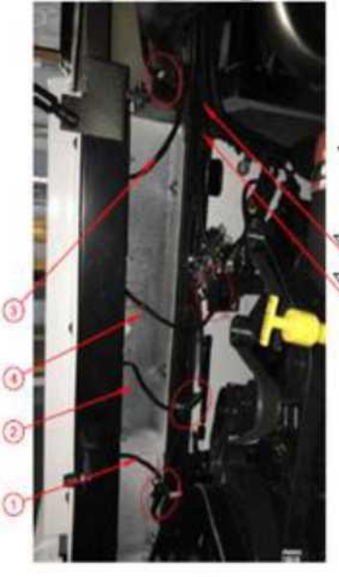


VEHICLE REAR VIEW



DETAIL A

DETAIL A (AFTER MOUNTING)



1

LOOK AT THE ORDER OF WIRES FROM THE TAIL INSTELATION, AS WHICH IS CORRESPONDING TO WHICH EXTERIOR BACK LAMP AND MAKE SURE MALE SOCKETS GET FULLY TO THE TOOTH SOCKETS

SEE NO. OTF911006500 OPERATION LEAF

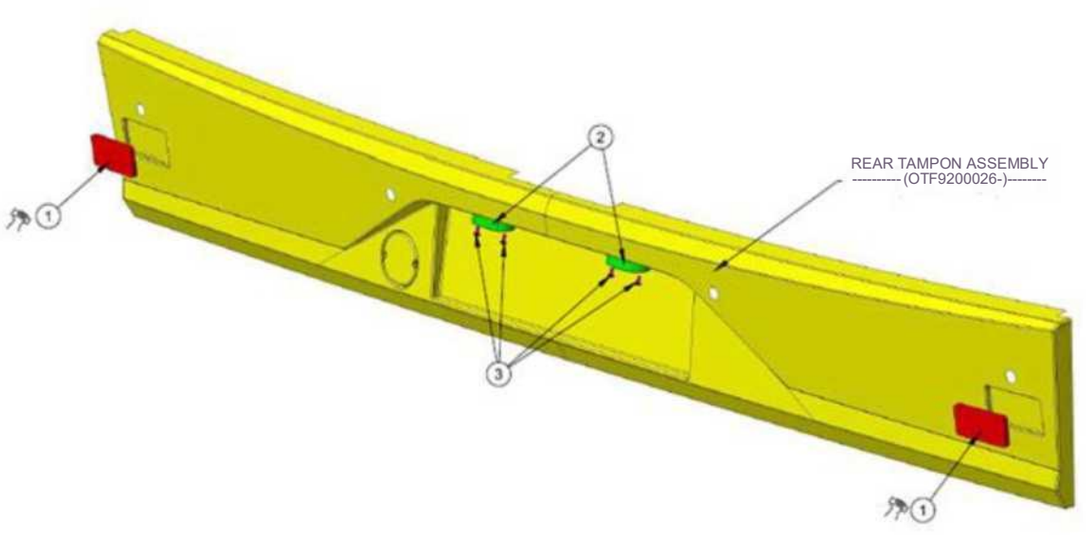
SEE OTF911002800 OPERATIONAL LEAF



LEAFLET POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	910-030	387041094*	LAMP ASSEMBLY , REAR FOG LED	2
2	910-031	387041095*	LAMP ASSEMBLY . REAR REVERSING GEAR LED	2
3	910-032	387041096*	LAMP ASSEMBLY . REAR SIGNAL LED	2
4	910-033	387041097*	LAMP ASSEMBLY , REAR PARK. STOPPING LED	2
5	910-034	3005800066*	NUT . PLN8.TR M6X1. THICK D. DİN5923	16
6	910-017	3011100063*	WASHER , FLAT D=6 D|N 9021	16
7	910-160	387041091*	BRACKET , LAMP, CONNECTOR	8

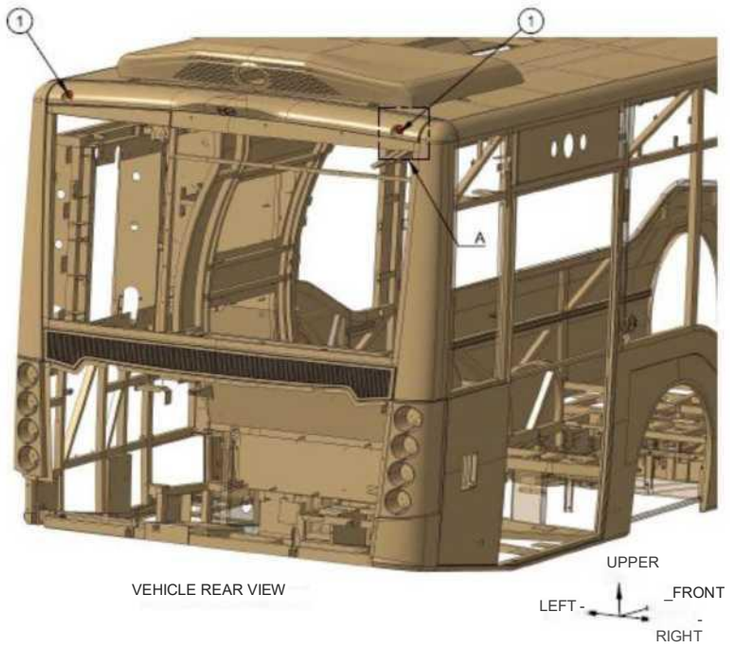
REFLECTOR AND PLATE LAMPS INSTALLATION

BEFORE MOUNTING REFLECTÖR (940/090 387053325001 (CLEANER, GLASS METAL) AFTER CLEANING WITH CLEANER, DO THE ADHESIVE FUNCTION.



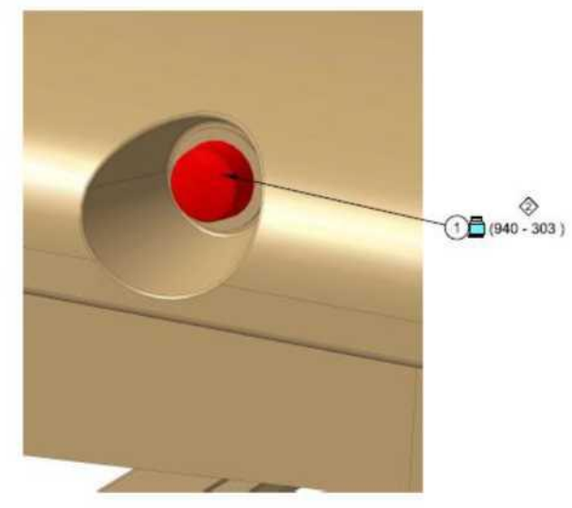
LEAFLET POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	910 - 070	388889132*	REFLECTOR, RED	2
2	910 - 040	387036183*	LAMP PLATE	2
3	910-044	301894219*	SCREW	4

REAR RIGHT AND LEFT POSITIONING LAMP INSTALLATION



VEHICLE REAR VIEW

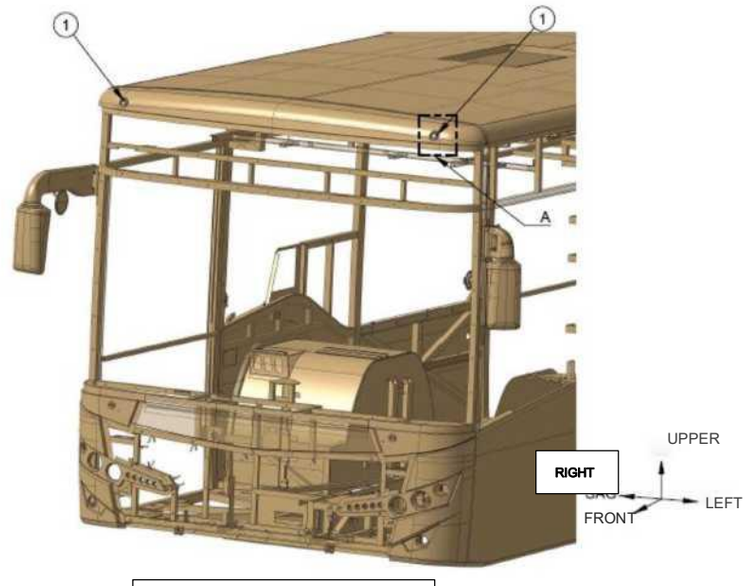
NOTE: "307050120001" SILICON IS APPLIED TO THE INTERIOR OF RIGHT AND LEFT REAR POSITIONING LAMPS.



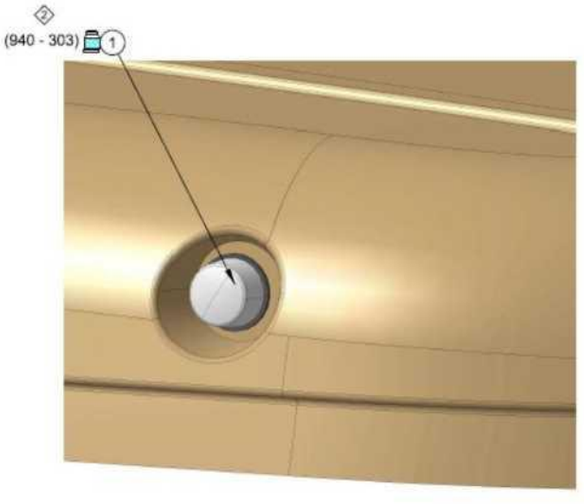
DETAIL - A

LEAFLET POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	910 - 090	38702B004'	LAMP. POSITIONING. REAR	2

RIGHT AND LEFT FRONT POSITIONING LAMPS INSTALLATION



VEHICLE FRONT VIEW

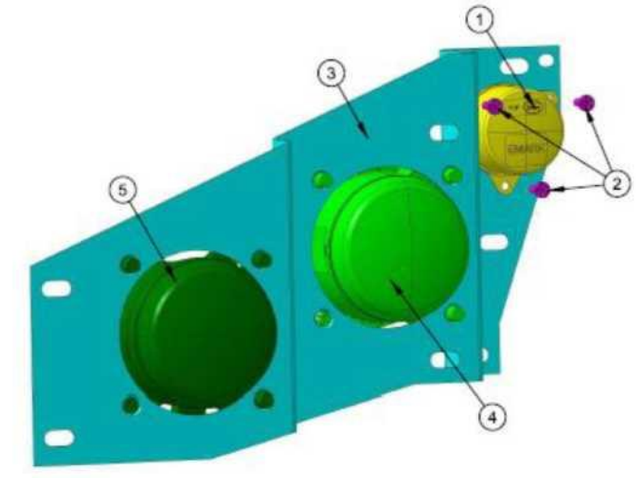


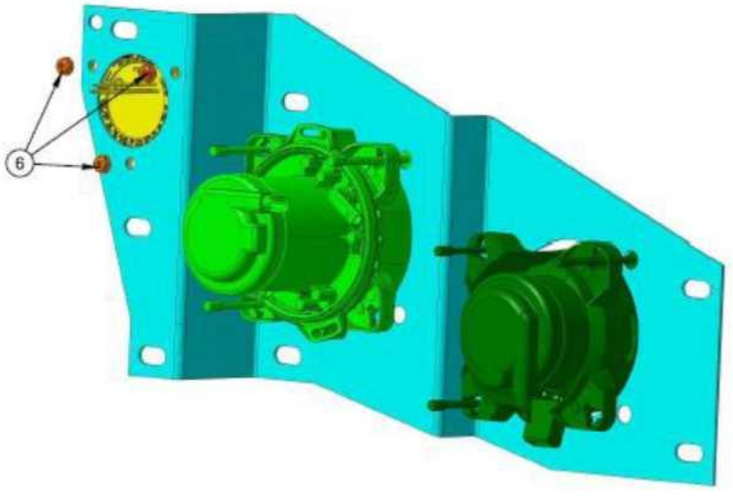
DETAIL - A

NOTE: "3870501200001" SILICONE IS APPLIED TO THE INTERIOR OF THE RIGHT AND LEFT FRONT POSITIONING LIGHTS.

LEAFLET POSE	GROUP,'POSE	PART NO	COMPONENT'S NAME	NUMBER
1	91D/080	387028003'	LAMP. POSITIONING. FRONT	2

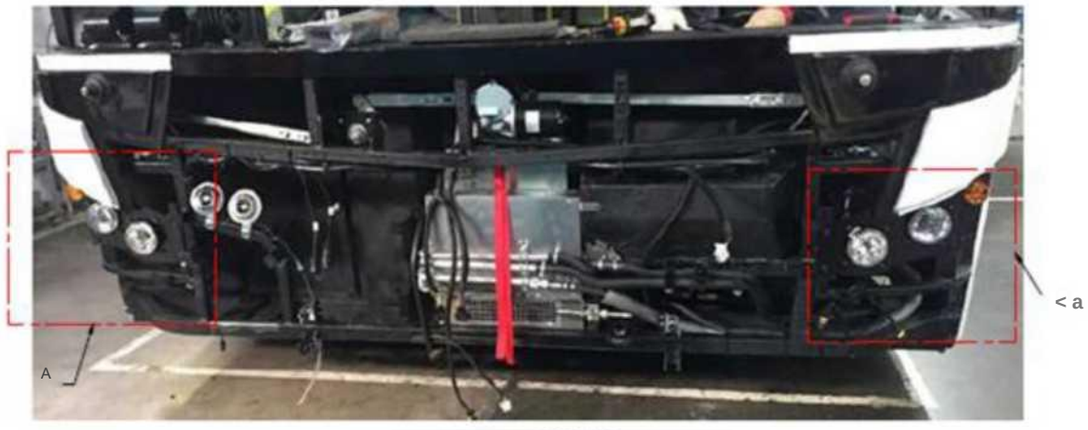
LEFT FRONT HEADLIGHT ASSEMBLY



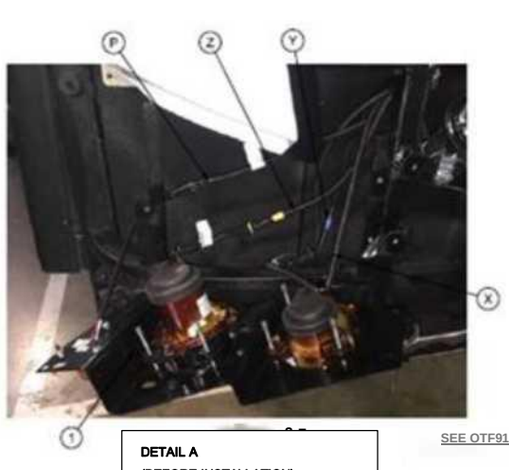


LEAFLET POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	910/024	307028006*	SIGNAL FRONT, LED	1
2	810/023	3015005158*	SCREW M5. STAINLESS STEEL	3
3	910/027	387343987*	BRACKET ,HEADLIGHT CONNECTION LEFT	1
4	910/026	387053665*	HEADLIGHT. LOW BEAM	1
5	910/025	387053665*	HEADLIGHT, HIGH BEAM PARK LAMB	1
6	910/022	3005800051*	NUT , FLN&TR M5X0.8, THICK D DIN6923	3

RIGHT AND LEFT HEADLIGHTS' INSTALLATION TO THE VEHICLE



VEHICLE FRONT VIEW



DETAIL A
(BEFORE INSTALLATION)



DETAIL A

SEE OTF9100018 NO OPERATION LEAF

-FULLY INSERT THE MALE SOCKET FULLY INTO THE FEMALE SOCKET, MAKE SURE THE CONNECTION NAILS ON IT GET FULLY FIT.

-PUT THE SOCKET FULLY INTO ITS HOLE ON THE HIGH HEADLIGHT AND MAKE SURE THAT THE CONNECTION NAILS ARE FULLY FIXED ON THE HIGH HEADLIGHT.



DETAIL B
(BEFORE INSTALLATION)



DETAIL B

SEE . 0TF910001900 NO OPERATION LEAF

LEAFLET POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	910-020	387343989*	BRACKET .HEADLIGHT CONNECTION RIGHT	1
2	910-027	387343987*	BRACKET .HEADLIGHT CONNECTION LEFT	1
3	910-016	3015006253	M 6X25 SCREW	8
4	910-017	3011100063*	WASHER . FLAT D=6 DİN 9021	8

RIGHT AND LEFT DAY LIGHTS INSTALLATION



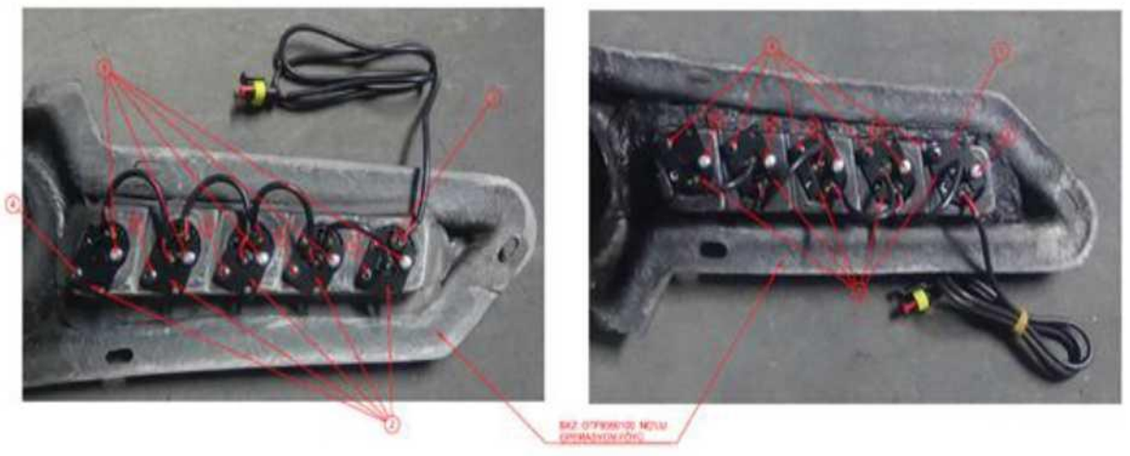


DETAIL A





DETAIL B



LEAFLET POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	910-140	337028005*	DAY DRIVING LAMPS	1
2	910- 141	337032433*	BRACKET . DTRL, CONNECTION	10
3	910-145	3015004064*	BOLT M4X6	10
4	910-150	3015005153*	SCREW M 5X15 DİN 7985 (4161)	10

DAY DRIVE UNIT INSTALLATION



VEHICLE FRONT VIEW

A DETAIL

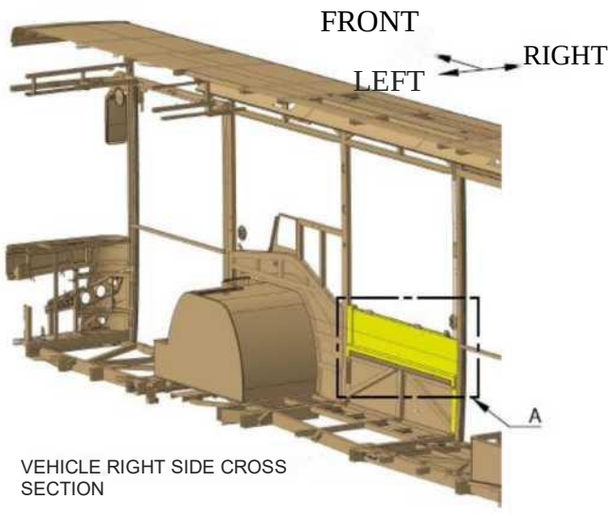




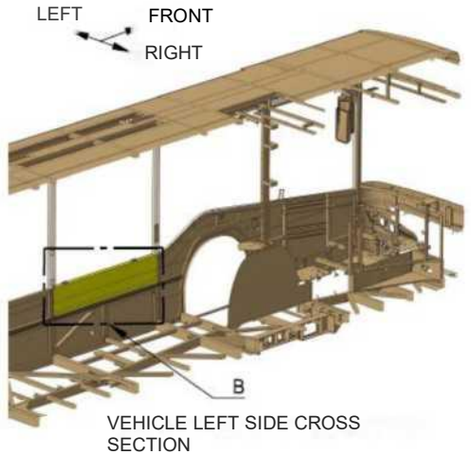
LEAF POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	910 - 140	387028005*	DAY DRIVE LAMPS	1
2	910-150	3016005153*	SCREW M 5X15 DİN 7985 (4161)	2

INSTALATION ASSEMBLY

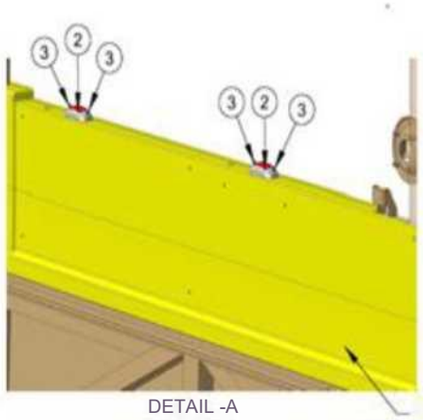
DISABLED AND PRIORITY STOP BUTTON VEHICLE INSTALLATION



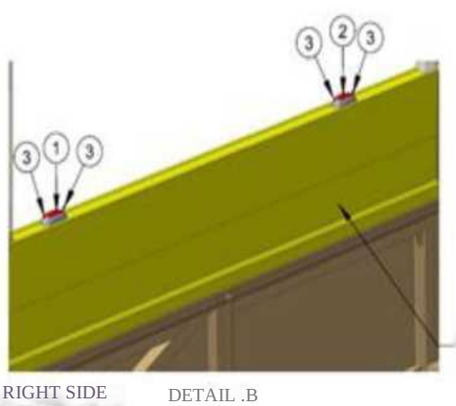
VEHICLE RIGHT SIDE CROSS SECTION



VEHICLE LEFT SIDE CROSS SECTION



DETAIL -A

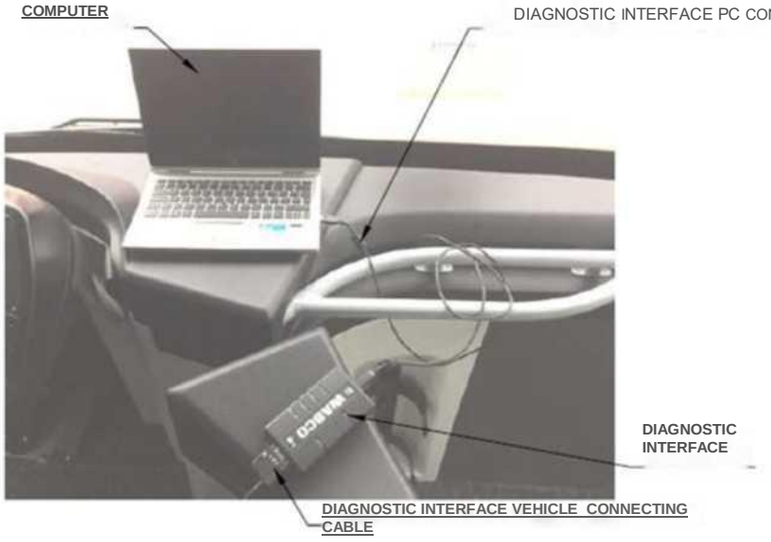


DETAIL .B

FRONT RIGHT SIDE PANEL FRP (OTF9290042*)

LEAF POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	911 - 101	387020536*	STOP BUTTON; SURFACE - DISABLED	1
2	911 - 100	387020535*	STOP BUTTON; SURFACE - FRONT STEEL	3
3	911 -206	3019042192*	SCREW 4.2x19 DİN 7981 YELLOW	8

ADJUSTING AXLE HEIGHT WITH ECAS PROGRAM





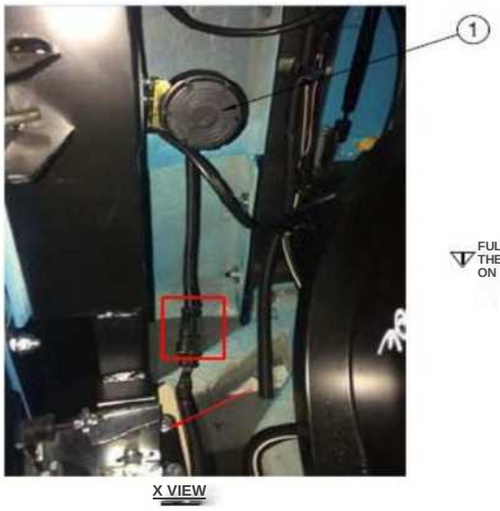
LEAF POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	911 - 010	387756428*	INSTALLATION , LEFT CEILING PWR CAN, CNG E6D, 12M	1
1	911 -010	387044320*	INSTALATION LEFT CEILING PWR CAN	1

REVERSING GEAR WARNING SIREN INSTALLATION



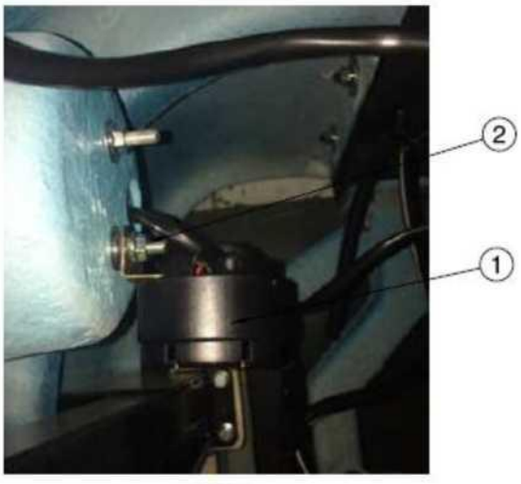


DETAIL



X VIEW

FULLY INSERT THE MALE SOCKET FULLY INTO THE FEMALE SOCKET, MAKE SURE THE NAILS ON IT FULLY FIT.



Y VIEW

LEAF POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	911 - 204	3070073801*	REVERSING GEAR WARNING SIREN	1
2	911 -025	3005800061*	NUT . FLN&TR M6X1, THICK D. DIN6923	1

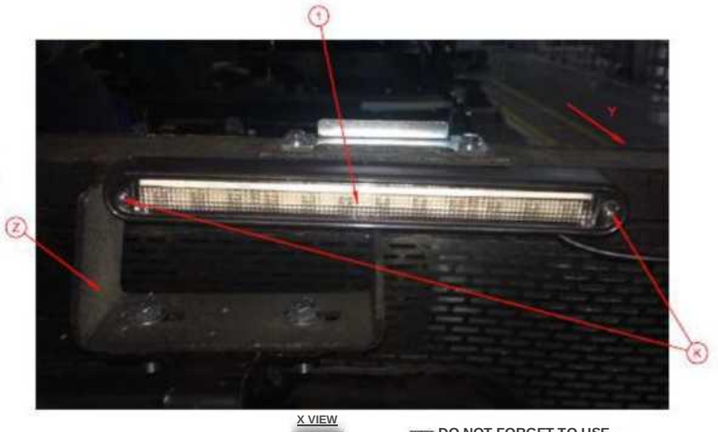
ENGINE ROOM LAMP INSTALLATION





A VIEW

MAKE SURE THE LAMP IS ZERO TO THE REAR FRAME OF THE VEHICLE AND THE BRACKET IN THE ENGINE ROOM.



X VIEW

DO NOT FORGET TO USE GLASSES



Y RAKISI

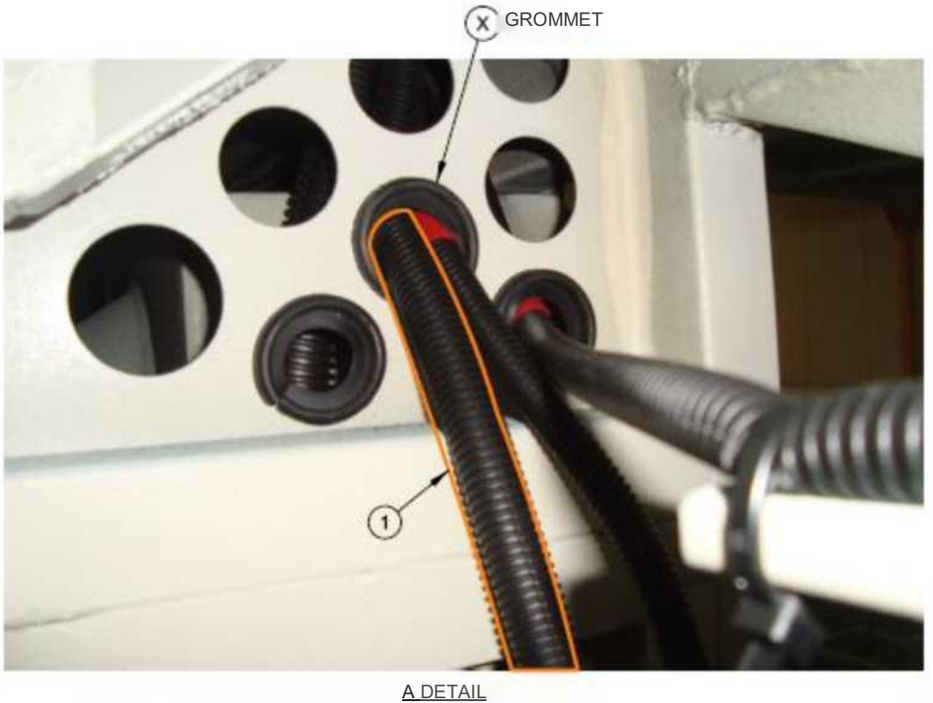
FULLY INSERT THE MALE SOCKET FULLY INTO THE FEMALE SOCKET, MAKE SURE THE NAILS ON IT FULLY GET FULLY

LEAF POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	911 - 125	387010446'	LAMP, ENGINE LIGHTING	1

TAIL INSTALATION MOUNTING IN THE VEHICLE

VEHICLE INSIDE VIEW - REAR AREA



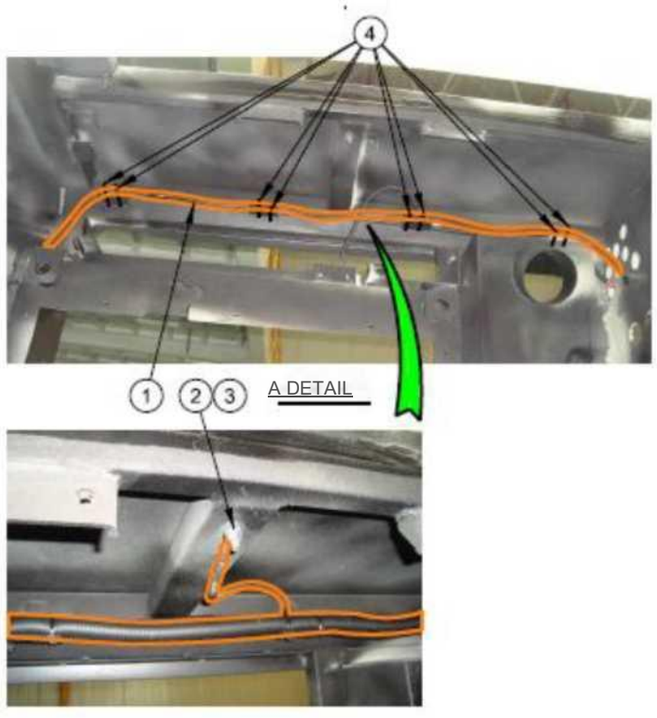


A DETAIL



B DETAIL



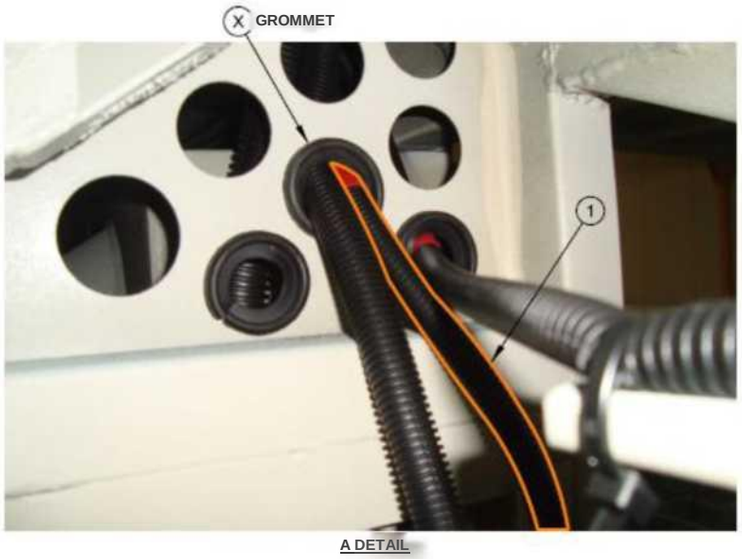


LEAF POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	911 -012	387034890*	INSTALATION , TAIL	1
2	911 -026	3005800081*	NUT . FLN&TR M8X1. 25. THICK D. DİN 692	1
3	911 -027	$010300082*	WASHER . SPRINGY GEAR D=8 D|N 6798 TIP:A	1
4	911 -925	377770500*	PLASTIC CLAMP L 350 MM	15

INSTALATION EBERSPACHER WATER PUMP WITHOUT PRE-HEATER

VEHICLE INSIDE VIEW ■ REAR AREA





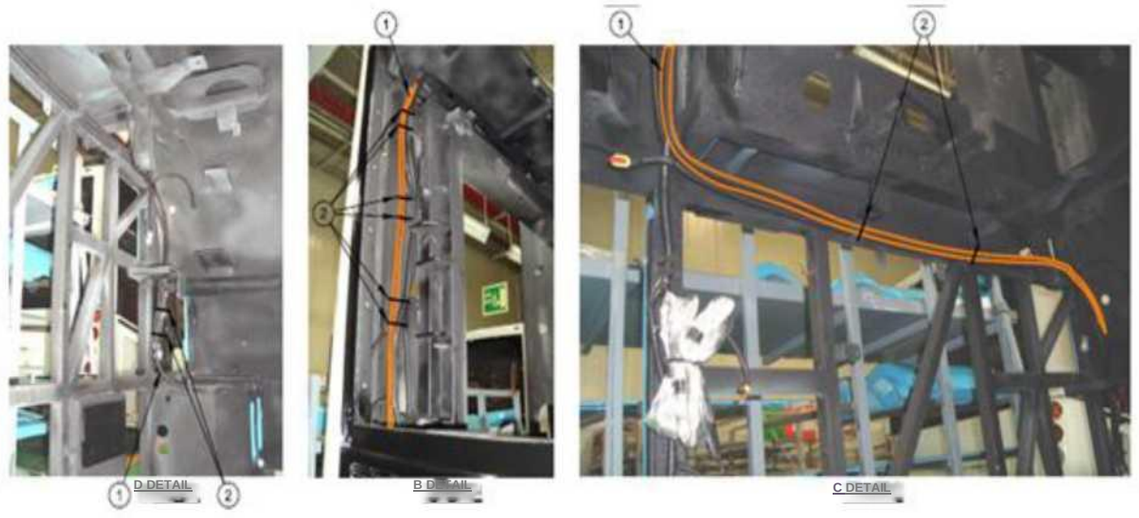
A DETAIL

OUTSIDE THE VEHICLE
VIEW - REAR AREA





A DETAIL

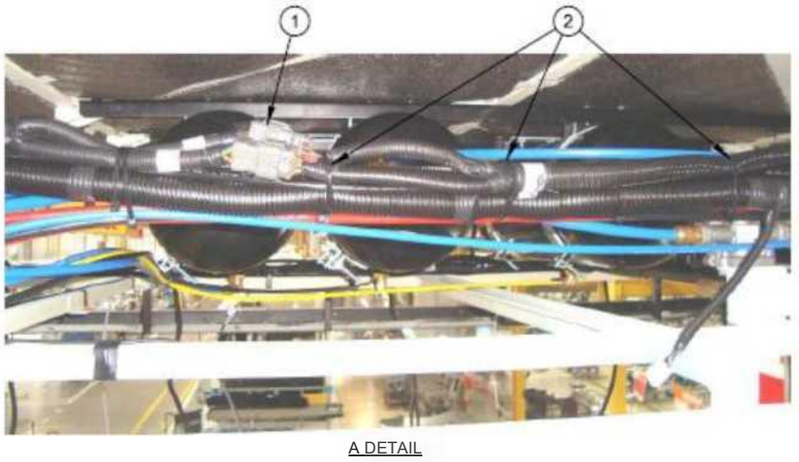


LEAF POSE	GROUP/LEAF	PART NO	COMPONENT'S NAME	NUMBER
1	911 -009	387057971*	INSTALATION . WATER PUMP	1
1	911 -013	387057971*	INSTALATION , WATER PUMP	1
2	911 -925	377770506'	PLASTIC CLAMP L 350 MM	10

RIGHT EBS INSTALATION MOUNTING

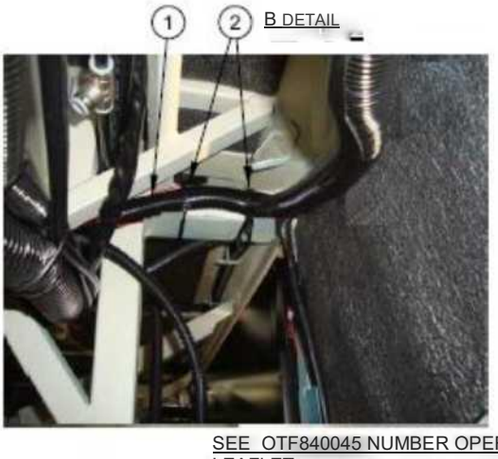
VEHICLE INSIDE VIEW - FRONT AREA



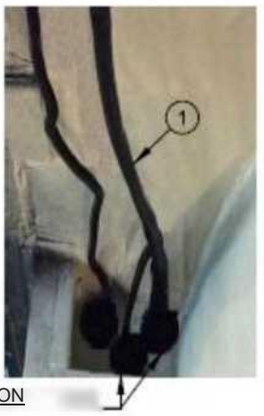


A DETAIL

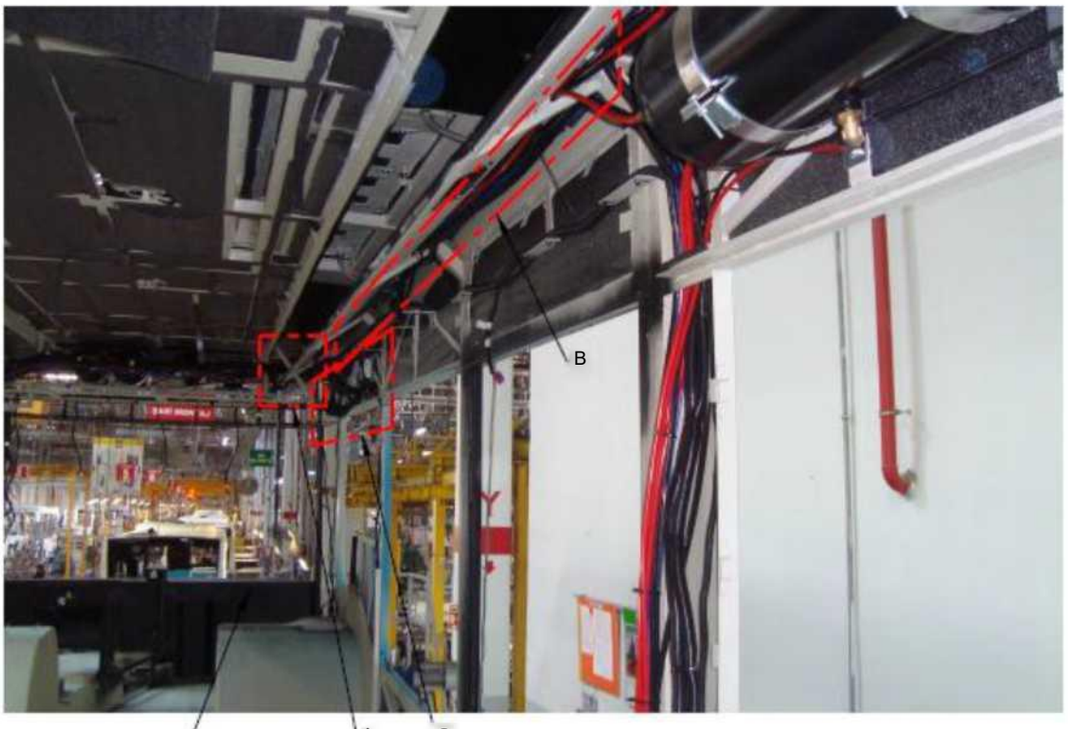
B DETAIL



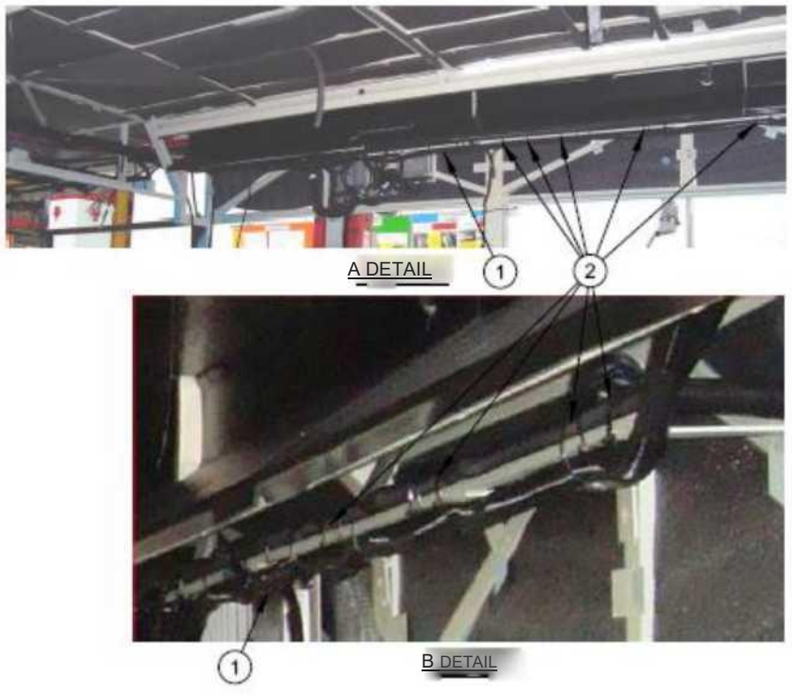
C DETAIL



SEE OTF840045 NUMBER OPERATION LEAFLET



VEHICLE INSIDE VIEW - RIGHT AREA





C DETAIL

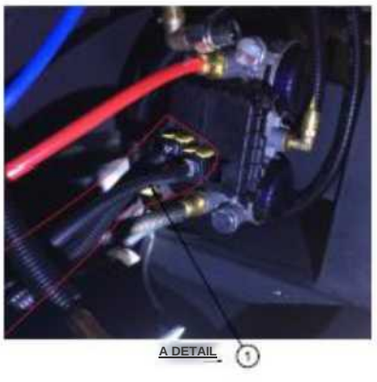
LEAF POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	911-015	387060193'	INSTALLATION , RIGHT. EBS-ECAS	1
2	911 -925	377770506'	PLASTIC CLAMP L 350 MM	15



VEHICLE OUTSIDE VIEW - BOTTOM VIEW



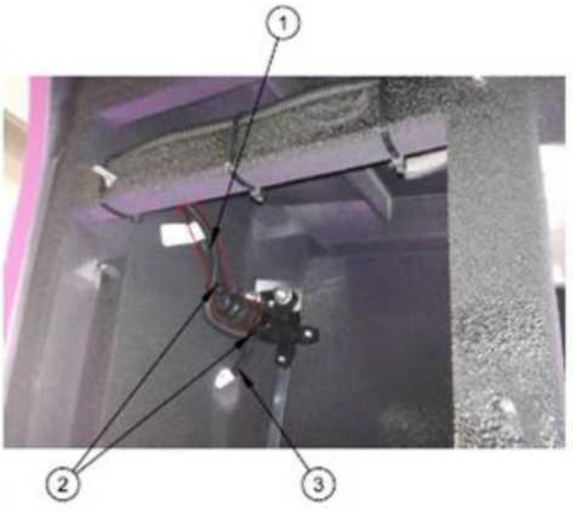




LEAF POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	911-015	387060193*	INSTALLATION , RIGHT. EBS-ECAS	1
2	911-925	377770506*	PLASTIC CLAMP L 350 MM	18

VEHICLE OUTSIDE VIEW- BOTTOM OF VEHICLE

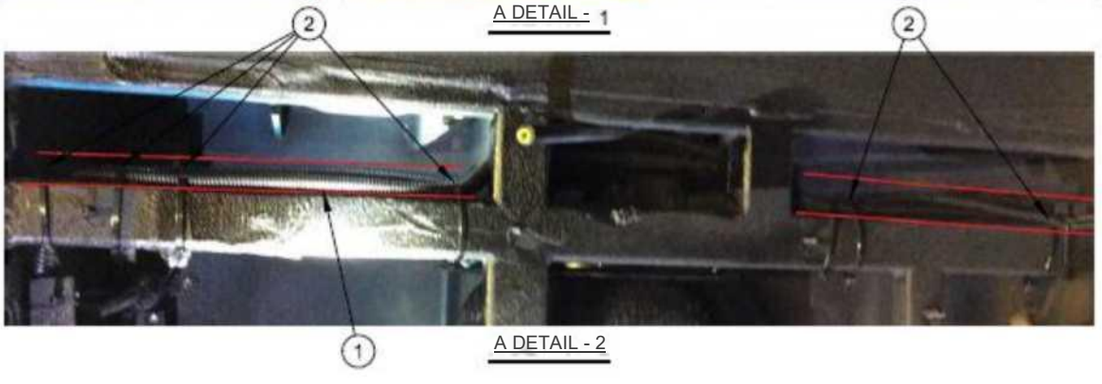




B DETAIL

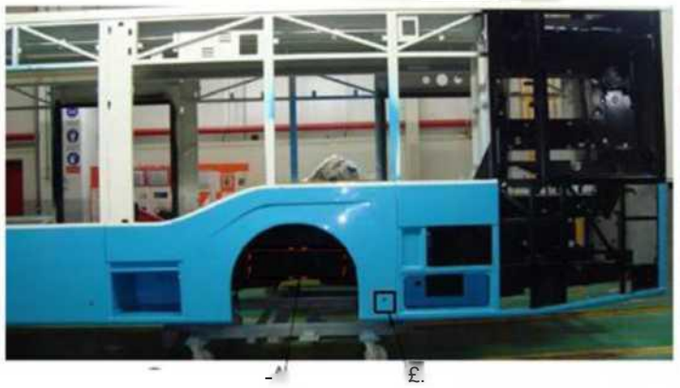


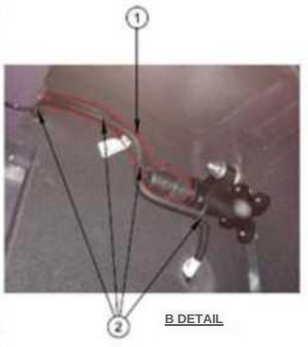
A DETAIL - 1



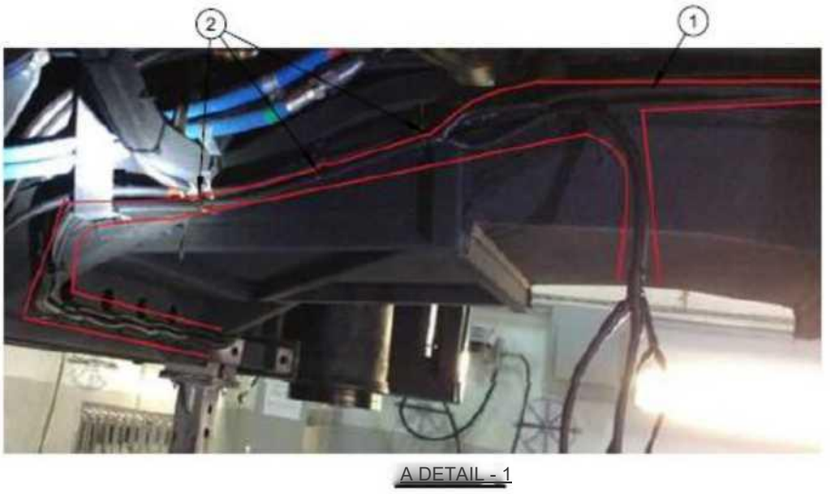
A DETAIL - 2

* VEHICLE OUTSIDE VIEW- BOTTOM OF VEHICLE





B DETAIL



A DETAIL - 1



A DETAIL - 2

LEAF POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	911-015	307060193*	INSTALLATION , RIGHT. EBS-ECAS	1
2	911 -925	377770506*	PLASTIC CLAMP L 350 MM	17
3	911 -252	387041414'	INSTALATION , REAR PARK	1

AIR CONDITIONING RELAY ASSEMBLY

VEHICLE INTERIOR VIEW

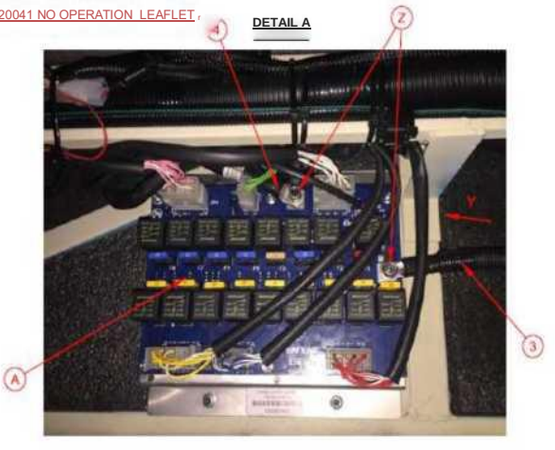


DETAIL A

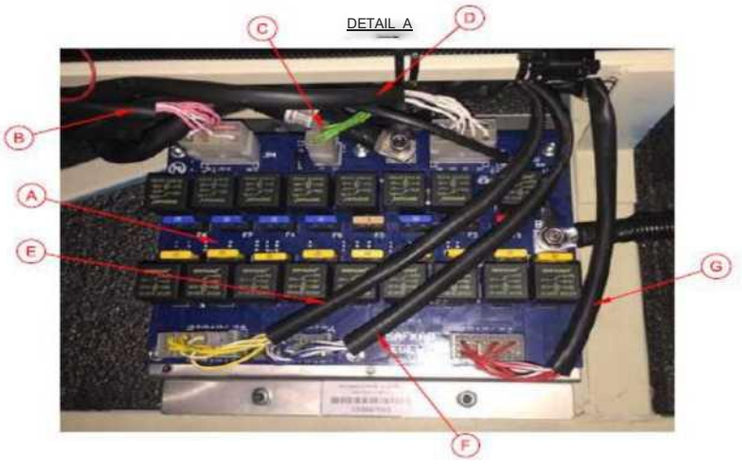
SEE . OTF9720041 NO OPERATION LEAFLET .



DETAIL A



DETAIL A

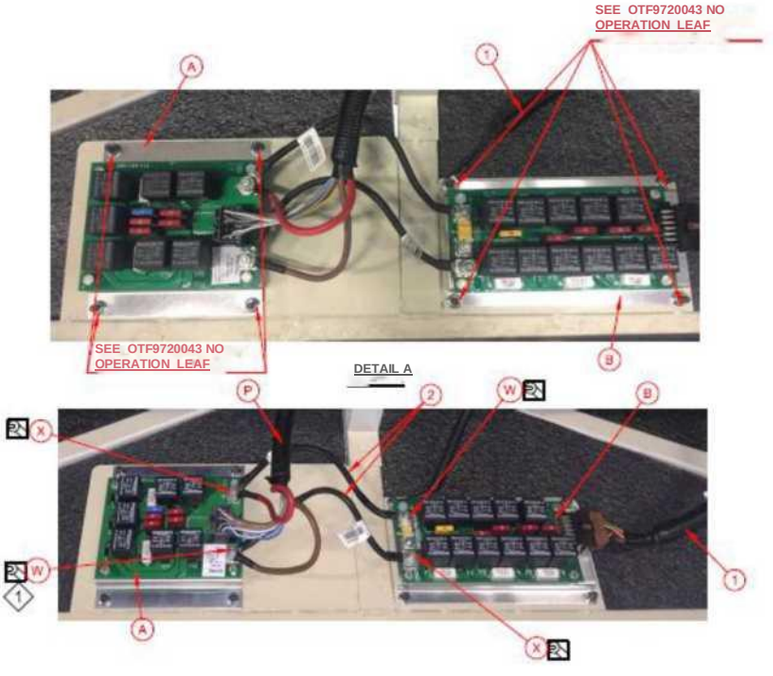




LEAFLET POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	911 -010	387044320*	INSTALATION LEFT CEILING PWR CAN	1
1	91 1 -254	387776871*	INSTALLATION, LEFT CEILING CONNECTION .CNG E6D, 12	1
2	911 -550	3005800086*	NUT , FLN&TR M8X1,25. THICK D. DIN6923	1
2	911 -550	3005800084*	NUT , FLN&TR M8X1.25 THICK D, DIN6923	1
3	911 -034	387046029*	CABLE, AIR CONDITIONING-BATTERY CONNECTION	1
3	911 -034	387039948*	CABLE, AIR CONDITIONING-BATTERY CONNECTION	1
4	911 -035	387039951*	CABLE,AIR CONDITIONING PCB FEEDING	1

AIR CONDITIONING RELAY BOARD INSTALLATION





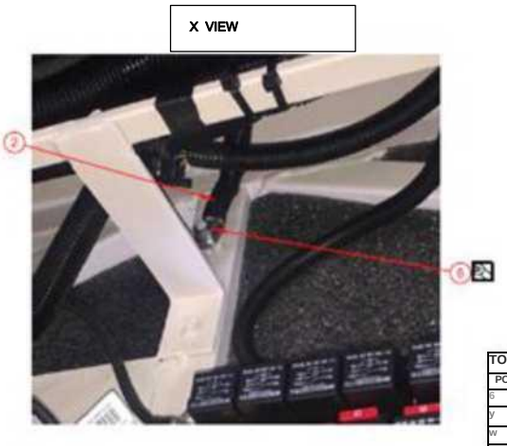
■-FULLY INSERT THE SOCKET AND MAKE SURE THE CONNECTION NAILS ON THE SOCKET GET FULLY FIT.

-MAKE SURE THE GROMMET SITS FULLY.

-MAKE MARKING AFTER TORQING PROCESS.



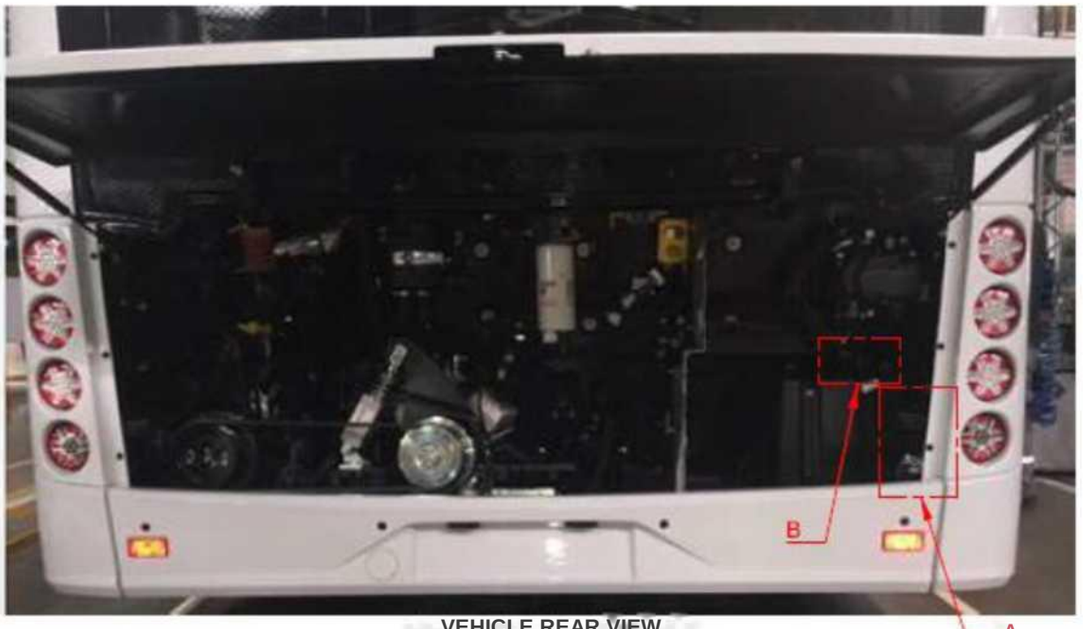




TORQUE ANTED (Nm)			
POSE	STD	MIN	MAX
	25	. 4	26
y	7	* 3	7.7
w	5,5	4 95	6.05
X	7	* 3	7.7

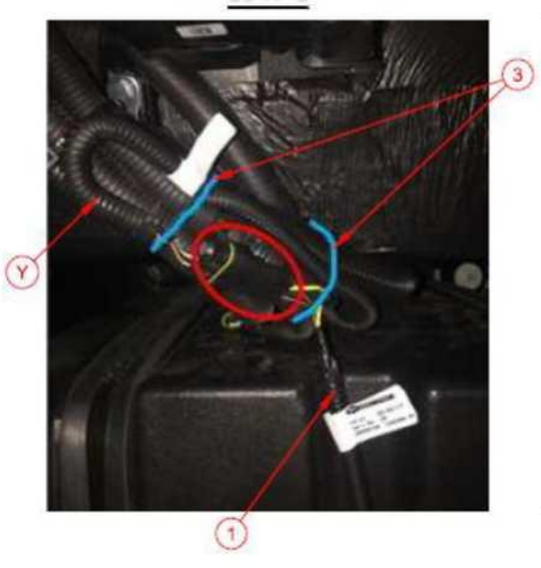
LEAFLET POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	911 -033	307042912*	INSTALATION , AIR CONDITIONING CONTROL	1
1	911 -033	387046400*	INSTALATION . AIR CONDITIONING CONTROL (KONVEKTA)	1
2	011 -035	387039951*	CABLE , AIR CONDITIONING PCB FEEDING	2
3	911 -034	387046029*	CABLE , AIR CONDITIONING-BATTERY CONNECTION	1
3	911 -034	387039948*	CABLE , AIR CONDITIONING-BATTERY CONNECTION	1
4	911 -965	388886475*	GROMMET	2
5	911 -176	388881883*	GROMMET	2
6	911 -550	3005800086*	NUT , FLN&TR M8X1.25. THICK D, DINS923	1
6	911 -550	3005800081*	NUT , FLN&TR M8X1,25, THICK D. DIN 692	1

ENGINE COVER SWITCH MOUNTING



VEHICLE REAR VIEW

DETAIL B



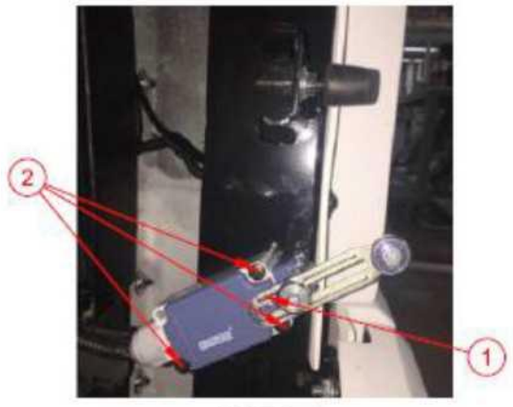
DETAIL A



-ADJUST THE DISTANCE BETWEEN THE ENGINE COVER STOPPER AND THE SWITCH NOT TO CONTACT THE MOVABLE PART STOPPER ON THE SWITCH.

- FULLY INSERT THE MALE SOCKET FULLY ON THE DENTAL SOCKET AND MAKE SURE THE CONNECTION NAILS ON IT FULLY FIT.

REMEMBER TO USE GLASSES.



X VIEW

LEAF POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	911 - 121	387022086*	SWITCH, LUGGAGE	1
2	911 - 122	3018548383*	SELF-TAPPING SCREW	3
3	911 -925	377770506*	PLASTIC CLAMP L 350 MM	2

ENGINE BUTTON VEHICLE MOUNTING



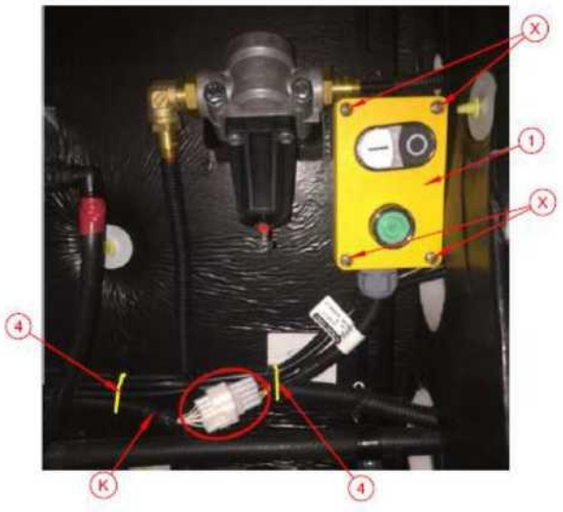
VEHICLE REAR VIEW

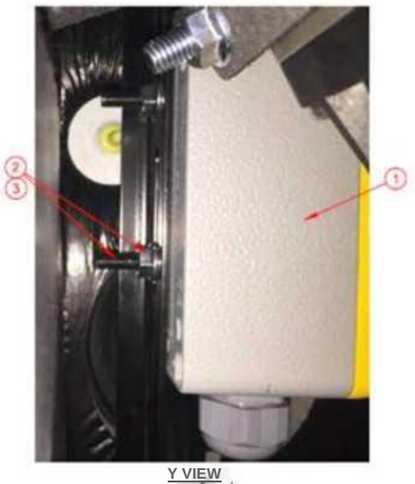






DETAIL A (AFTER MOUNTING)





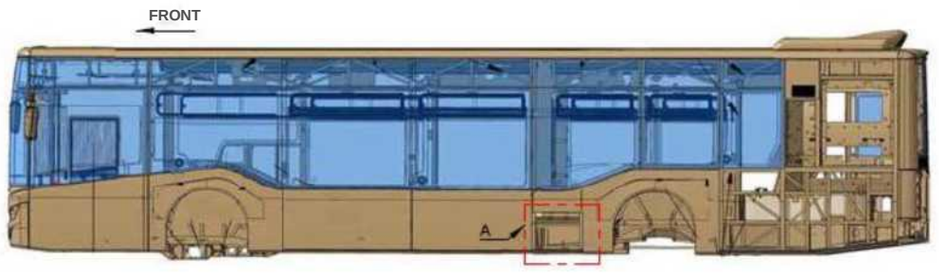
Y VIEW



DETAIL A

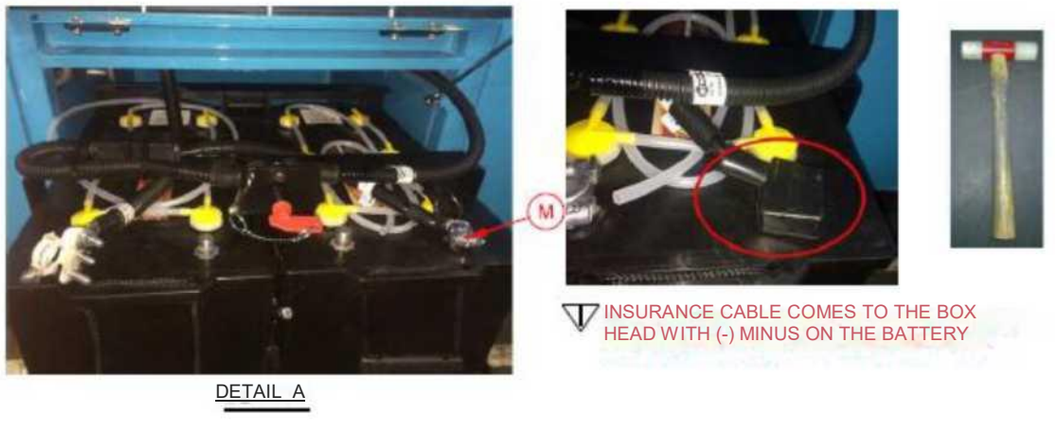
LEAFLET POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	911 - 130	387023637*	BUTTON TK, MOTOR	1
2	911 - 135	3015006253*	M6X25 SCREW	2
3	911 -025	3005800061*	NUT . FLN&TR M6X1. THICK D, DIN6923	2
4	911 -925	377770506*	PLASTIC CLAMP L 350 MM	2

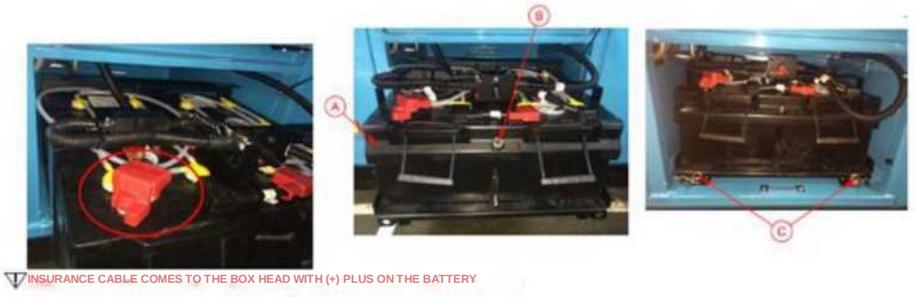
BATTERY INSTALLATION

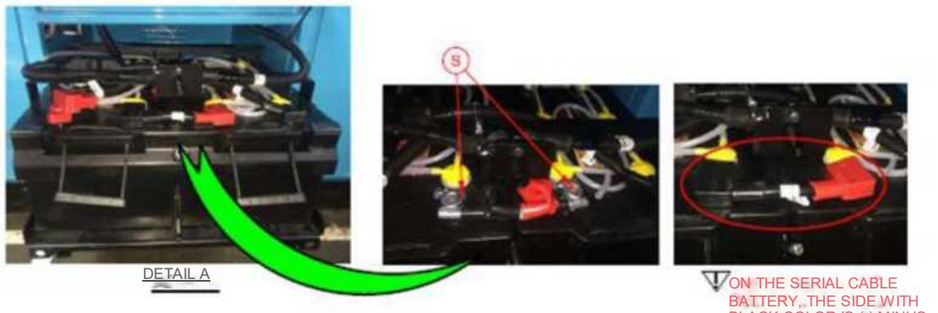


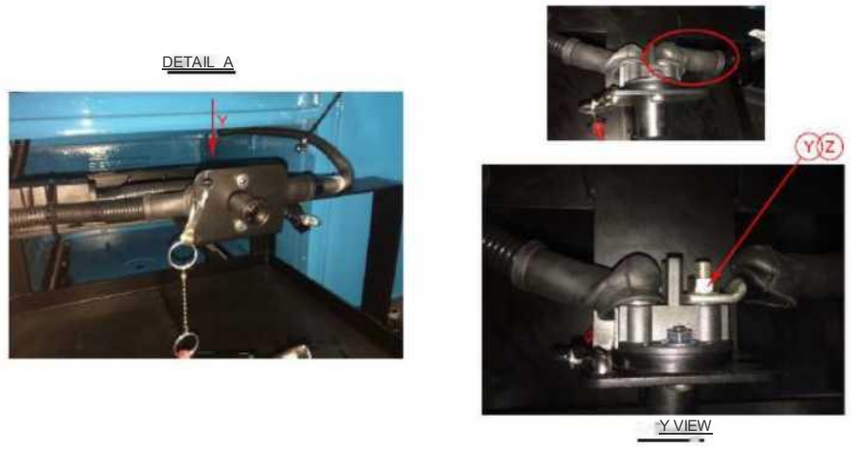








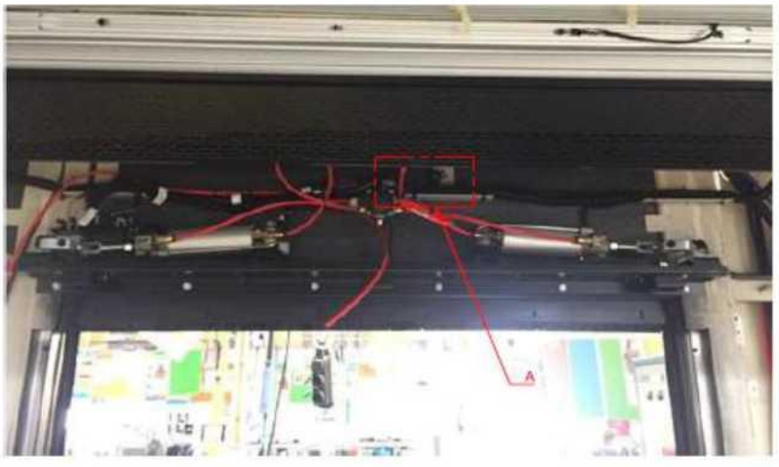




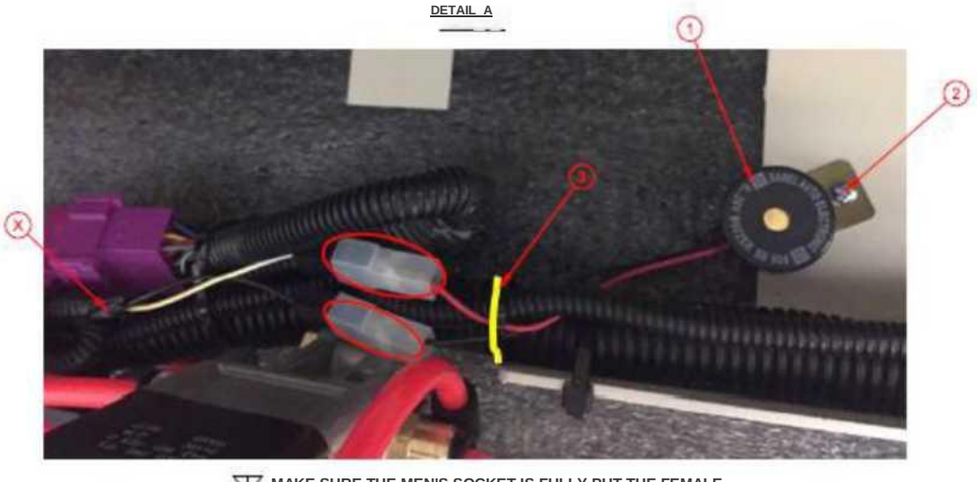
LEAFLET POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	911 -550	3005800081*	NUT , FLN&TR M3X1.25, THICK D. DİN 692	1
1	911 -550	3005800086*	NUT . FLN&TR M8X1,25. THICK D. DIN6923	1
2	911-177	377771437'	PLASTIC CLAMP . EB,03.203_3,6*15DMM	2

MIDDLE AND REAR DOOR VOICE WARNING SYSTEM

MIDDLE DOOR TOP
VEHICLE INSIDE VIEW



DETAIL A

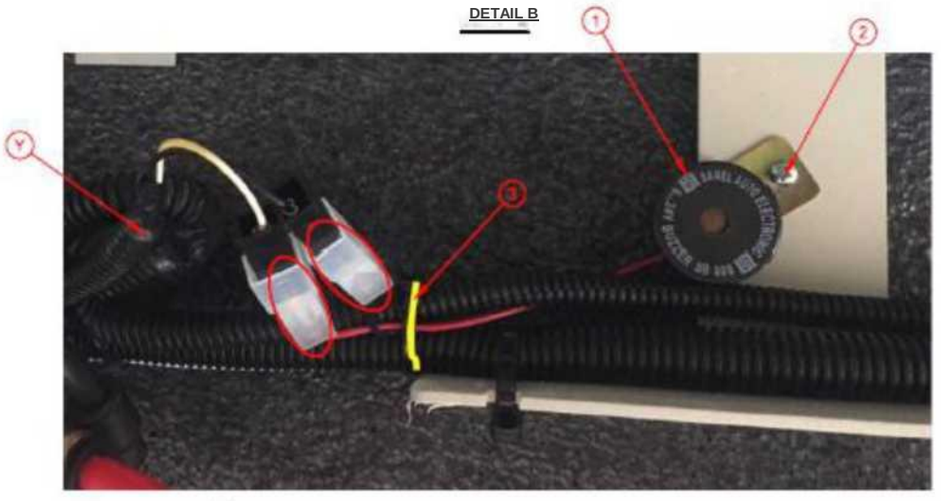


MAKE SURE THE MEN'S SOCKET IS FULLY PUT THE FEMALE SOCKET

REAR DOOR TOP **(VEHICLE INSIDE** VIEW)



DETAIL B



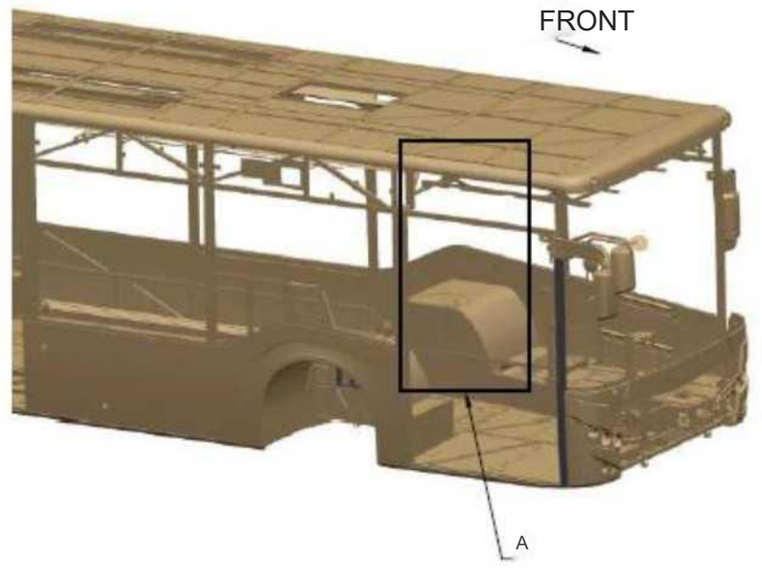
MAKE SURE THE MEN'S SOCKET IS FULLY PUT THE FEMALE SOCKET.

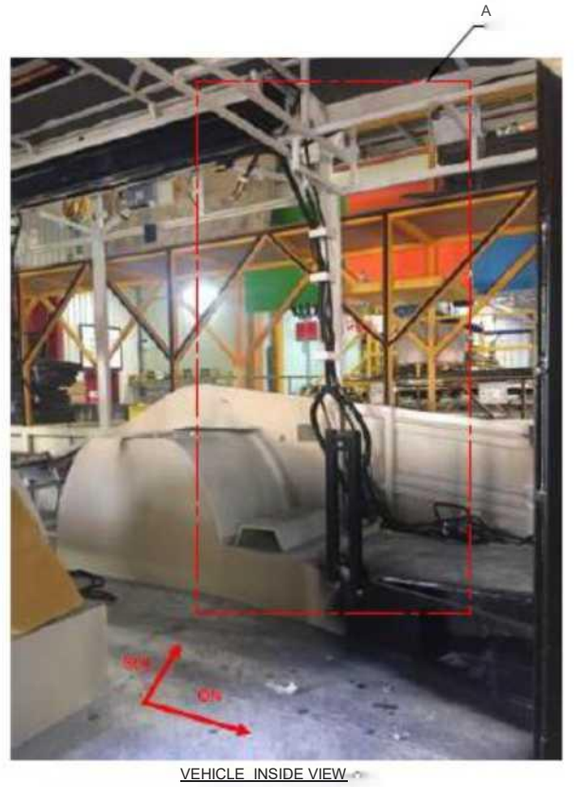
LEAFLET POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	911 -211	307001486*	SOUND WARNING 6-24	1
2	311 -230	3010139131*	SCREW	2
3	911 -220	377771438*	CLAMP . PLASTIC EB, 04, 204 3, 6*205 mm	2

VEHICLE CEILING LANDING INSTALLATION MOUNTING

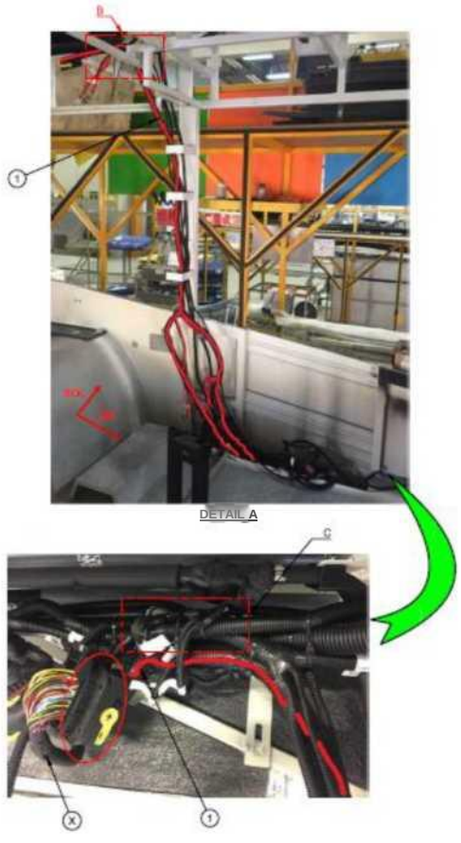
MAKE SURE THE SWITCH ON THE SOCKET ON THE CEILING LANDING INSTELATION IS FULLY CLOSED BY SOCKETING FULLY

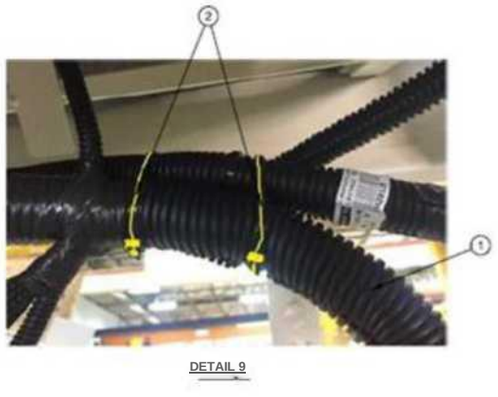
INSERT FULLY OUT OF THE MALE SOCKET, MAKE SURE THE CONNECTION NAILS ON THE SOCKET ARE FULLY FIT

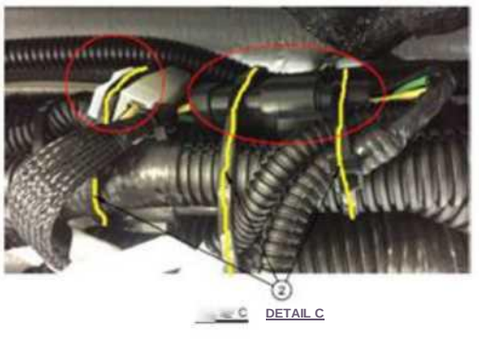




VEHICLE INSIDE VIEW

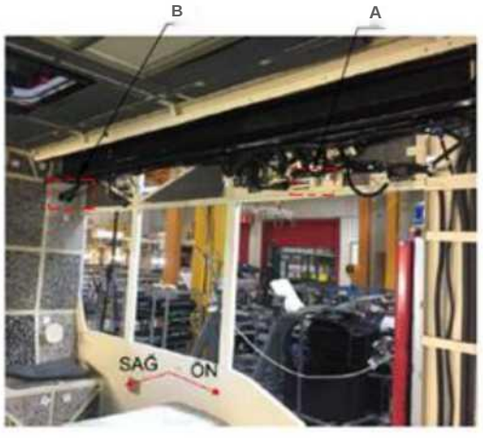






LEAF POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	911 -007	387049275*	INSTALATION , CEILING LANDING	1
1	911 -007	387756427*	INSTALLATION , CEILING LANDING. CNG E6D, 12m	1
1	911 -007	387485559*	INSTALLATION , CEILING. LANDING	1
2	911 -025	377770506*	PLASTIC CLAMP L 350 MM	5

MANIFOLD HEATER INSTALATION MOUNTING





DETAIL B

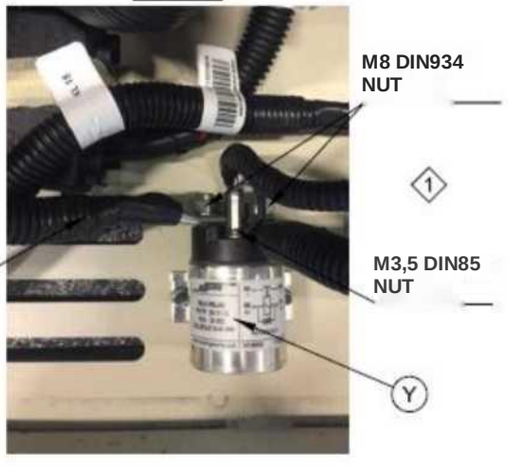
X VIEW





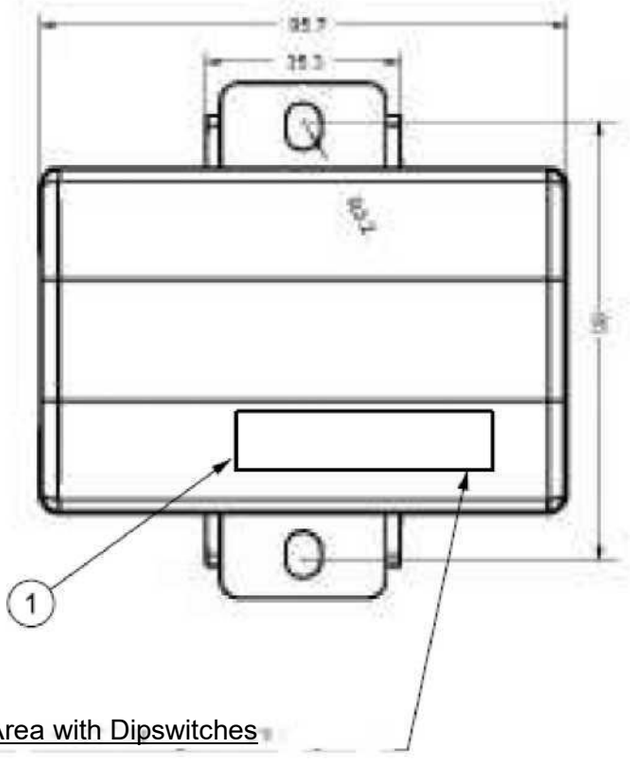
1) MAKE SURE THE GROMMET IS FULLY FITTED FROM THE SIDE SECTIONS TO THE SIDES OF THE HOLE.
2) CONNECTION IN ENGINE AREA WILL BE MADE IN ADVANCED INSTALLATION STAGES.

DETAIL A



LEAF POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	911-011	387041440*	INSTALATION , MANIFOLD HEATER	1
2	911 - 925	3777705060*	PLASTIC CLAMP L 350 MM	6
3	911 -090	3870250770*	GROMMET CAP 55	1

SPEED MODULE ADJUSTMENT

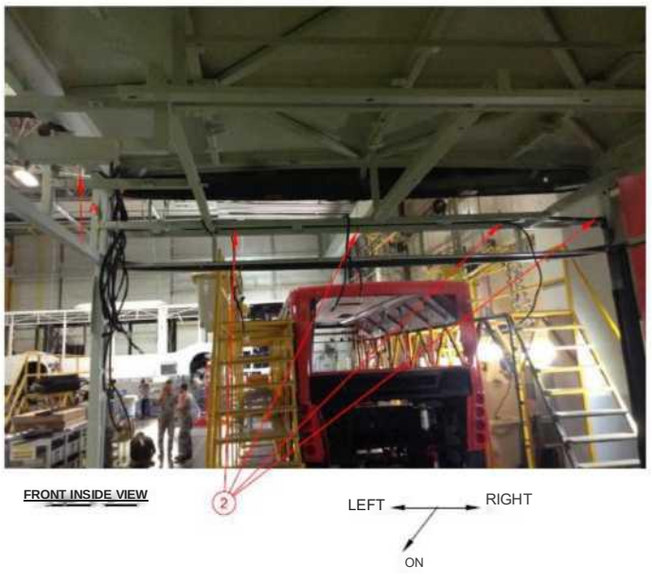


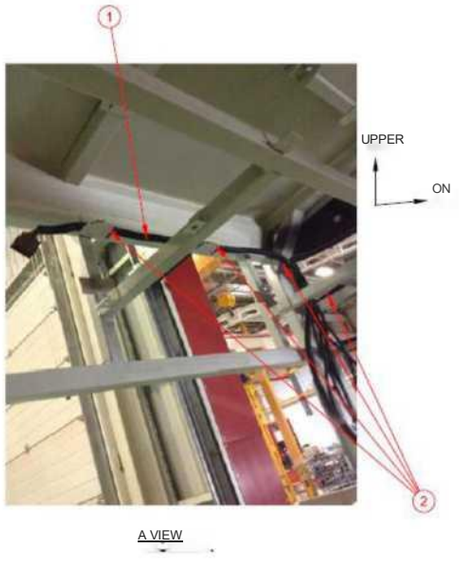
- 9 NUMBER Dipswitch is used for sensor selection. - KITAS sensor is selected in ON position (if there is a tachograph) - ISUZU sensor is selected in OFF position. (If there is no tachograph)

MODEL	K-IMPULS FIXED	SPEED MODULE ADJUSTMENT	MAXIMUM ROAD SPEED	GEAR RATIO
ECOBUS MTCO	5150	3-9-ON		
ECOBUS SENSOR GEAR	12			
CITIBUS MANUAL	5750	1-3-5-6-7-8-9-ON	108	
CITIBUS E6	12950			
CITIBUS A/T (WITHOUT TACHOGRAPH)		1-2-4-7-8-ON		
CITIBUS A/T (TACHOGRAPH)	13000	5-6-7-8-9-ON	108	
VISIGO E5 (TACHOGRAPH)	5700	1-3-5-7-8-9-ON	104	
VISIGO E5 (WITHOUT TACHOGRAPH)		1-3-4-6-7-ON		
VISIGO CUMMINS	9100		100	
VISIGO E6				4,1
CITIPORT E6	11400			
CITIPORT CNG	11750			
CITIMARK E4 - E5		2-4-6-OFF		

LEAFLET POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	911 - 110	387013091*	HIZ MODÜLÜ	1

LEFT CEILING CONNECTION MOUNTING





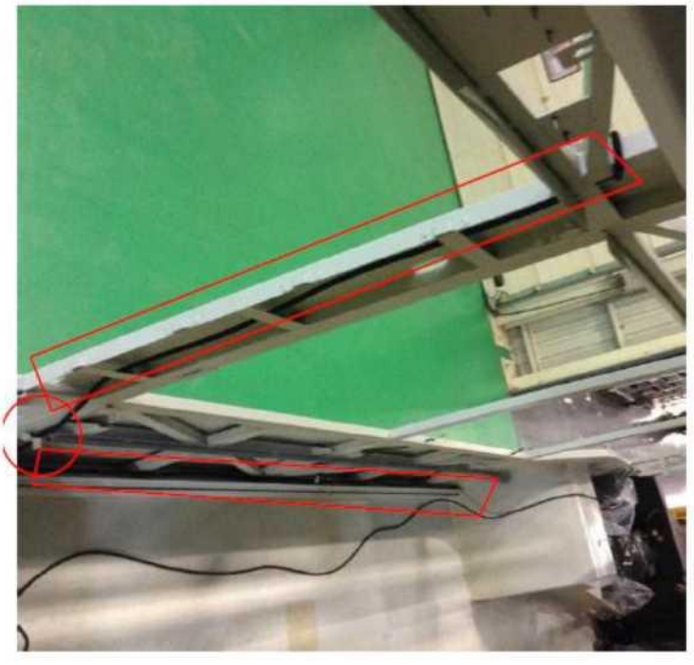
LEAFLET POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	911-254	387042D77*	INSTALATION , LEFT CEILING CONNECTION	1
1	911 - 254	38777507V	INSTALLATION , LEFT CEILING CONNECTION ,CNG E6D. 12	1
1	911 -254	387055096*	INSTALATION . LEFT CEILING ADD S	1
1	911-254	387485644*	INSTALLATION . LEFT CEILING. ADD	1
2	911 - 925	3777705060*	PLASTIC CLAMP L 350 MM	8

INSTALATION LEFT LANDING REAR



LEFT SIDE FRAME

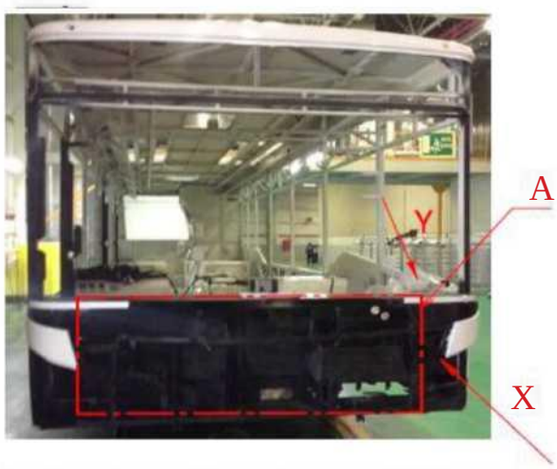




LEAF POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	911 -251	387041880*	INSTALATION , LEFT LANDING REAR	1
2	911 -251	387054675*	INSTALATION . LEFT PARK LAMPS	1

BODY INSTALATION MOUNTING

Picture-A





1 B-DETAIL





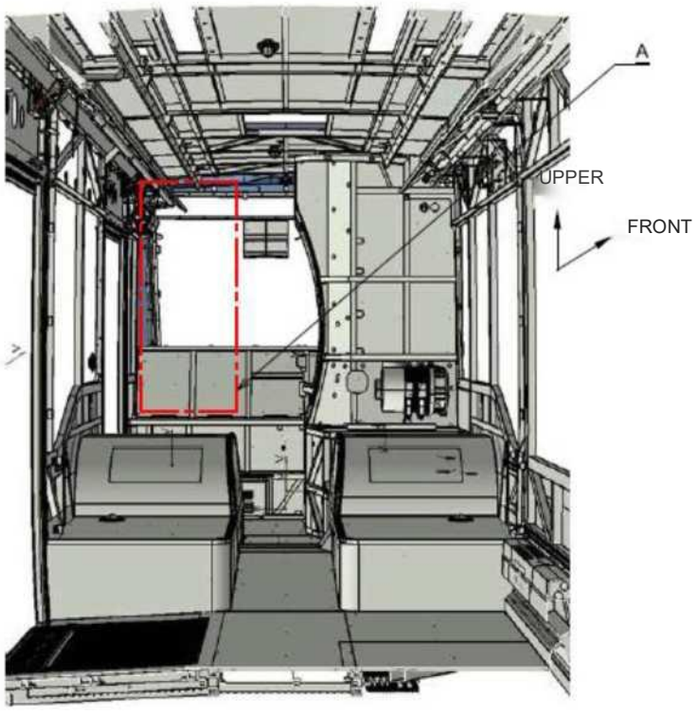
Y-VIEW

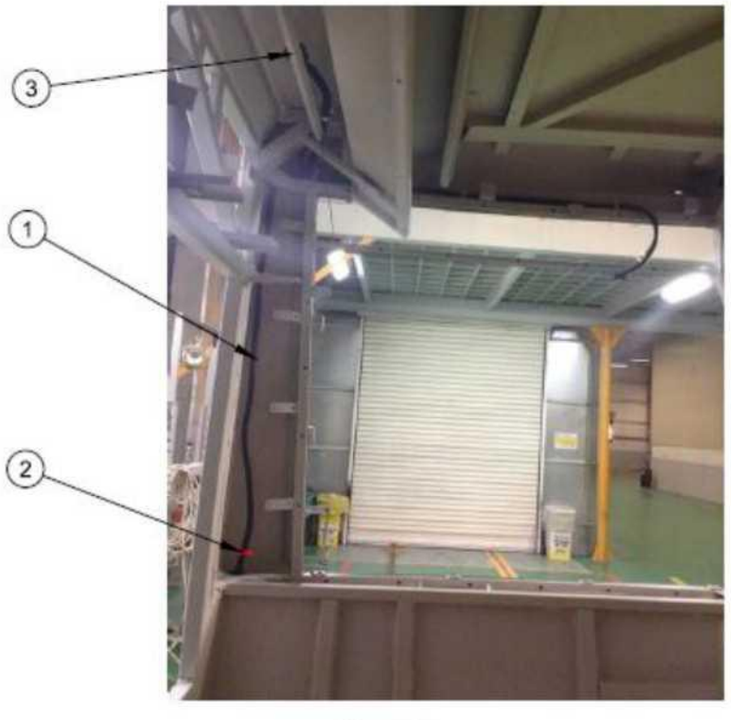


X-VIEW

LEAF POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER	ADDITIONAL INFO
1	911 -005	387054776*	INSTALATION , BODY	1	CITPORT S
1	911-005	387034792*	INSTALATION , BODY	1	CITIPORT
1	911-005	387756426*	INSTALLATION , BODY , CNG E6D, 12m	1	CITIPORT CNG

TAIL RIGHT LANDING INSTALATION





A DETAIL

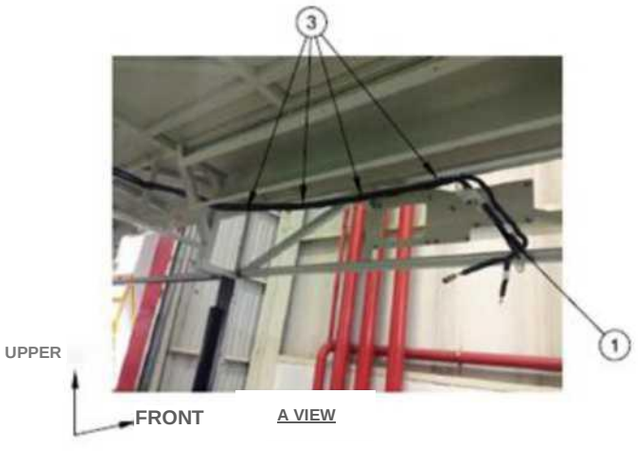


PICTURE B
REAR VIEW

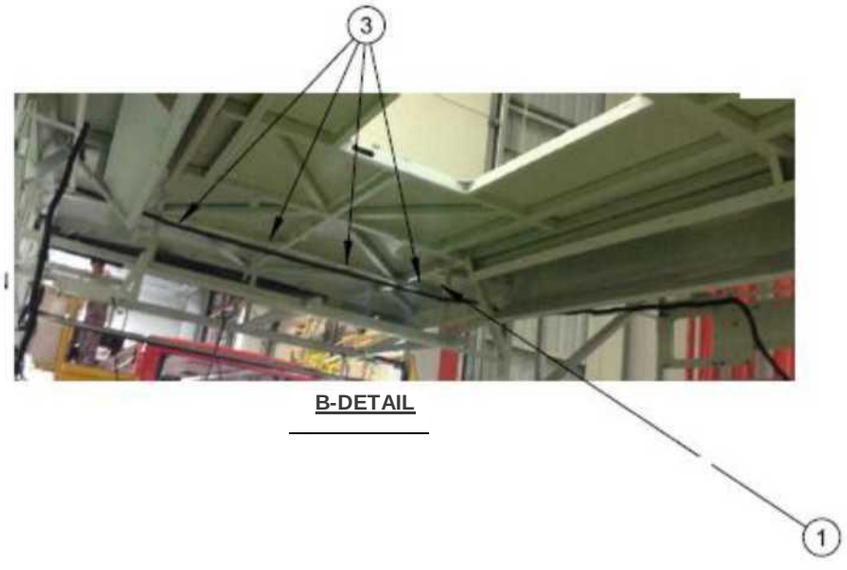
LEAFLET POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	91 1 - 250	387041519	INSTALATION , TAIL RIGHT LANDING	1
1	911 -25Û	387487975*	INSTALLATION , TAIL RIGHT LANDING	1
2	911 -925	377770506*	PLASTIC CLAMP L 350 MM	1
3	911 -955	388886475*	GROMMET	1

INSTALATION LEFT CEILING PWR CAN MOUNTING





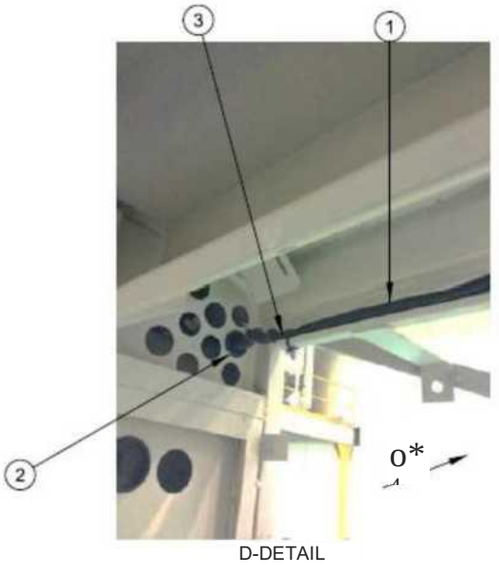
A VIEW



B-DETAIL



C-DETAIL



D-DETAIL

LEAFLET POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	911-010	357044320*	INSTALATION LEFT CEILING PWR CAN	1
1	911 -010	367485642*	INSTALLATION , LEFT CEILING PWR CAN	1
1	911 -010	367756428*	INSTALLATION , LEFT CEILING PWR CAN, CNG E6D, 12M	1
2	911 -090	357025077*	GROMMET CAP 55	1
3	911 -925	3777705060*	PLASTIC CLAMP L 350 MM	11

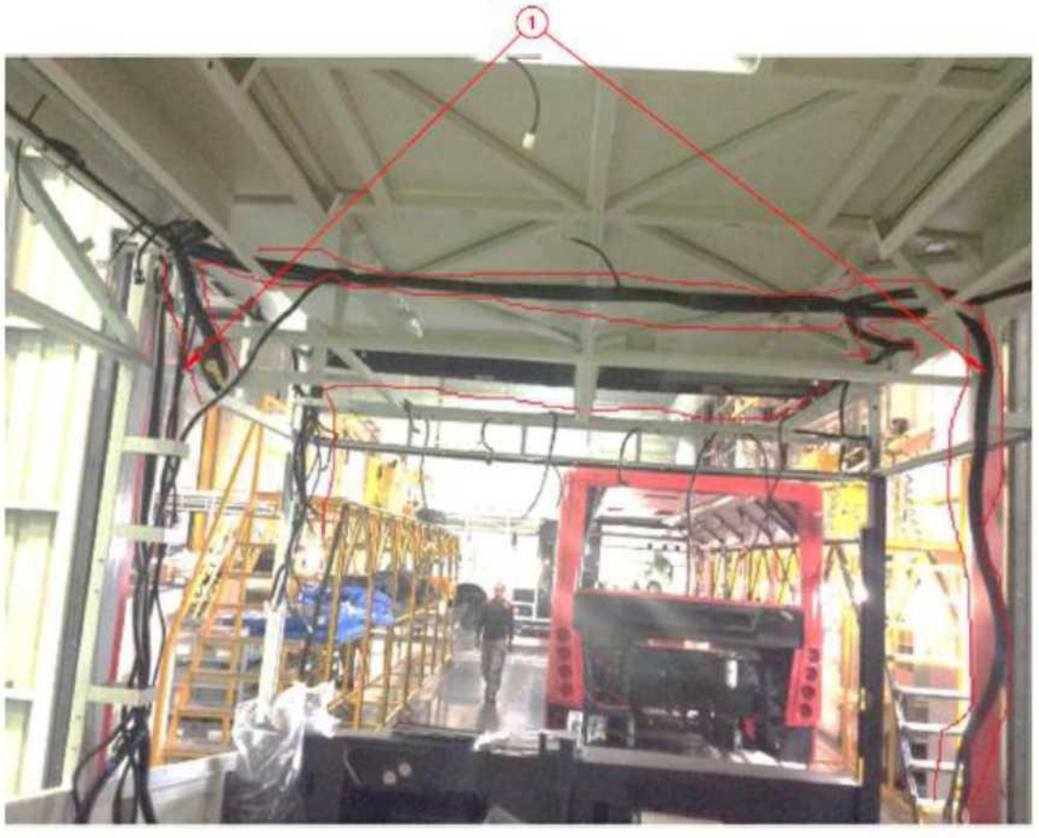
INSTALATION CEILING VENTILATION





LEAFLET POSE	■GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	911 -008	387043683*	INSTALATION , CEILING VENTILATION ADD	2

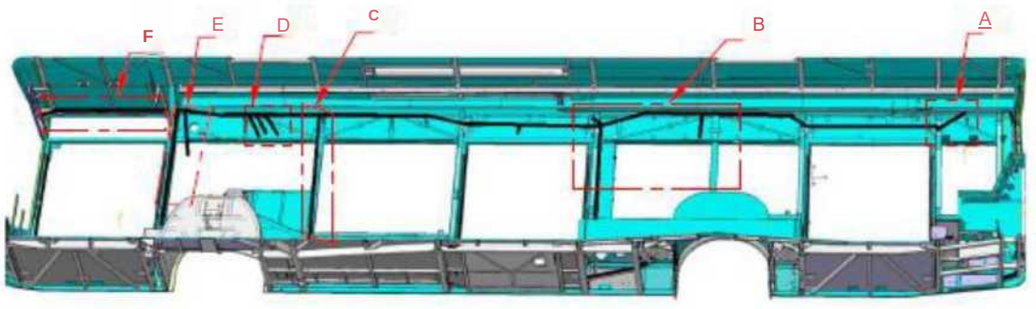
INSTALATION FRONT CEILING MOUNTING



ENS- IT IS ORGANIZED WITHOUT SAGGING AND FIXED WITH 2 NUMBER PLASTIC CLAMPS TO PROFILES WITH SPECIFIC INTERVALS.

LEAFLET POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER	ADDITIONAL INFO
1	911 -017	307038790*	INSTALATION , FRONT CEILING	1	CITIPORT
1	911-017	387783118*	INSTALLATION , FRONT CEILING , CNG EU6D 12M	1	CITIPORT CNG
1	911-017	387053920*	INSTALATION . FRONT CEILING C	1	CITI PORTS
1	911-017	357485643*	INSTALLATION , FRONT CEILING	1	ZOBAS-11530
2	911 -925	3777705060*	PLASTIC CLAMP L 350 MM	12	

RIGHT CEILING INSTALATION MOUNTING



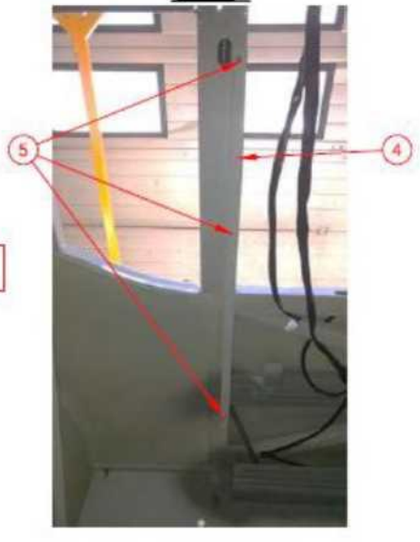


DETAIL A

ESS TAIL LAG SCREW LANDING



DETAIL C





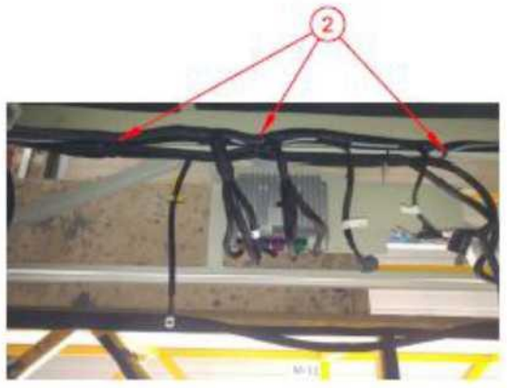


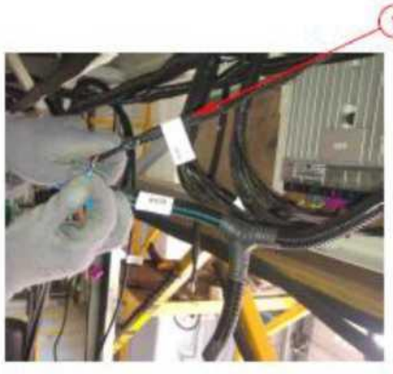
DETAIL B

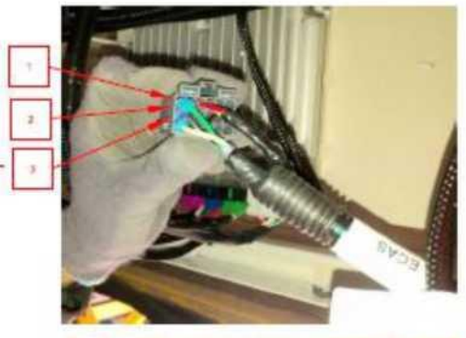


DETAIL D

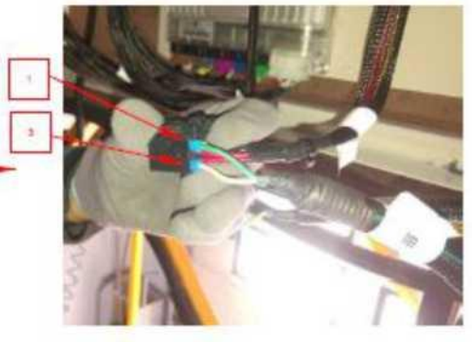












DETAIL T





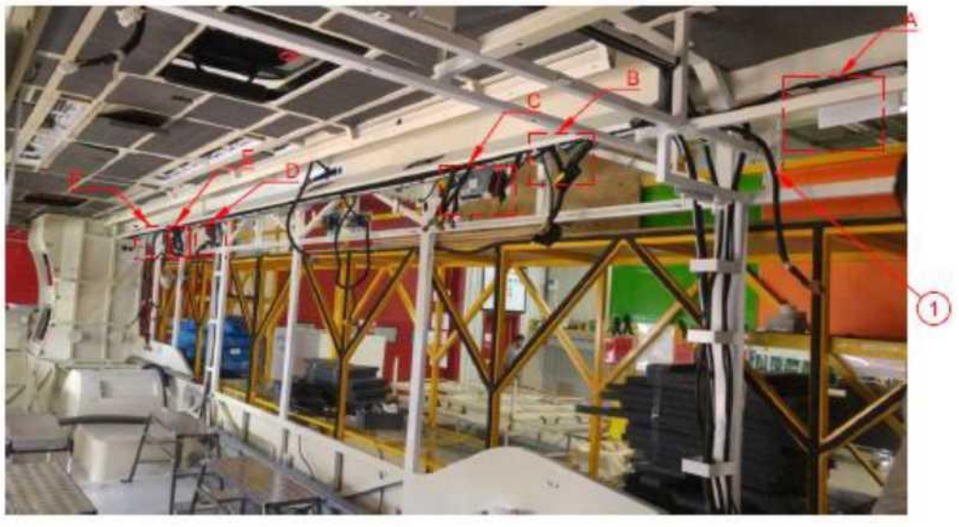
1) MAKE SURE THAT THE SOCKET CABLES ON THE EKS ARE NOT DAMAGED.
2) EKS. MAKE SURE YOUR SOCKET IS AT HORIZONTAL PROFILE FRONT SECTION
3) SHOT TORQUE DYE AFTER TORQUE PROCESS IS DONE
4) LOCK TERMINALS TO THE DOOR UNTIL THE SOUND COMES.
5) MAKE SURE THE SOCKET NAILS TOGETHER

DETAIL E



LEAF POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	911 - 002	387052000*	INSTALATION , RIGHT CEILING	1
1	911 -002	387782974*	INSTALLATION , RIGHT CEILING. CNG EU6D.12M	1
1	911 -002	387053887'	INSTALATION . RIGHT CEILING E6 S	1
1	911 -002	387485640*	INSTALLATION , CEILING, RIGHT	1
2	911 -925	3777705060*	PLASTIC CLAMP L 350 MM	35
3	911 -550	3005300081*	NUT , FLN&TR M8X1. 25, THICK **D.** DİN 6	1
4	911 -257	387041426*	CABLE , CANAL	1
5	911 - 122	3018548383'	SELF-TAPPING SCREW	3

LEFT CEILING INSTALATION MOUNTING



DETAIL E

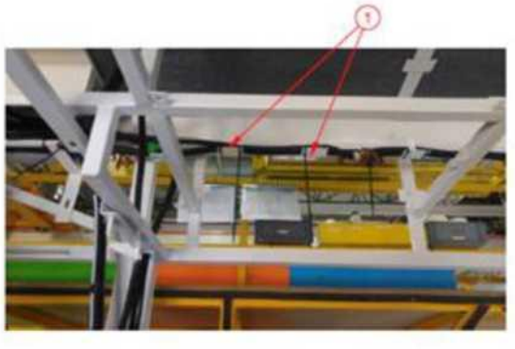


DETAIL A



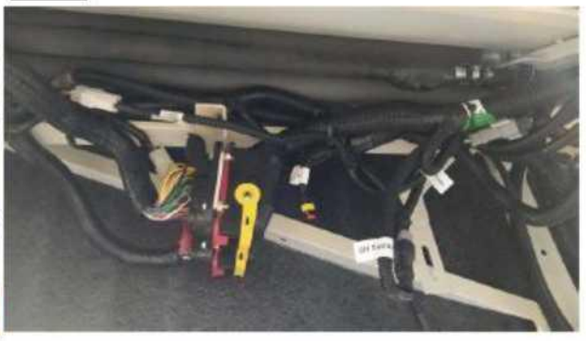
DETAIL C





DETAIL B









DETAIL F

DETAIL D





LEAF POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	911 - 001	387040300'	INSTALATION , LEFT CEILING	1
1	911 - 001	387752939'	INSTALLATION , LEFT CEILING , CNG E6D, 12m	1
1	911 - ocu	387045766'	INSTALATION , LEFT CEILING	1
1	911 - 001	387060087*	INSTALLATION , CEILING . LEFT	1
1	911 - 001	387479283'	INSTALLATION . LEFT CEILING	1
2	911 - 925	3018543383*	PLASTIC CLAMP L 350 MM	35
3	911 - 550	3005300081*	NUT , FLN&TR M8X1. 25. THICK D, DİN 692	2
4	911 - 02 5	300580006'	NUT	8

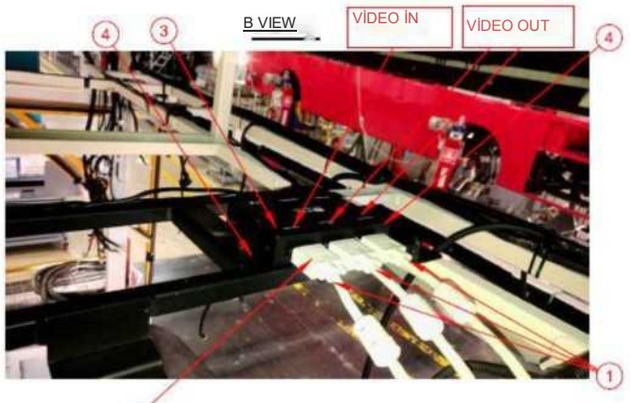
VGA CABLE INSTALLATION



A VIEW



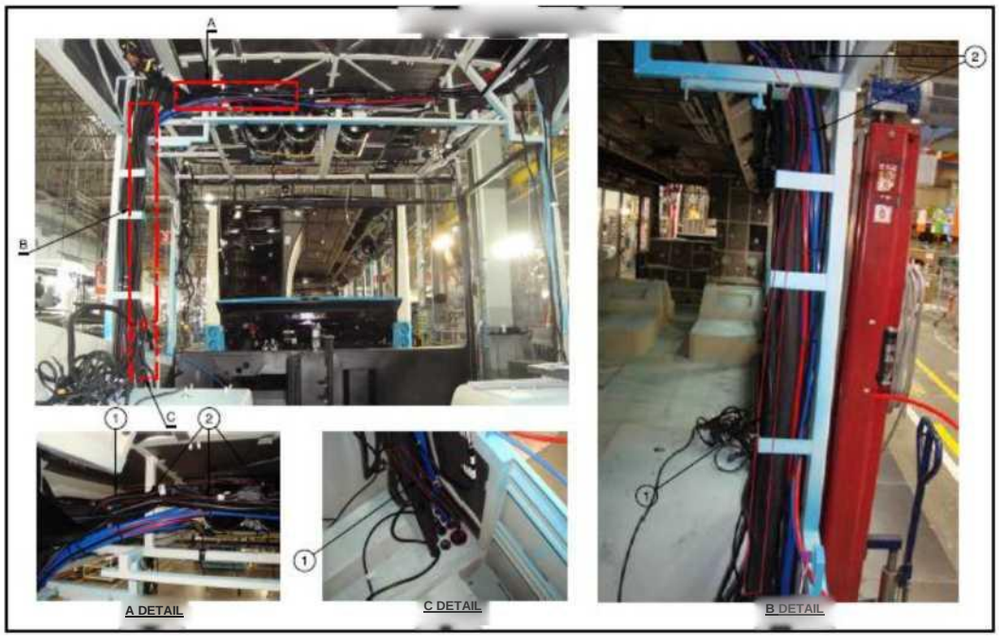


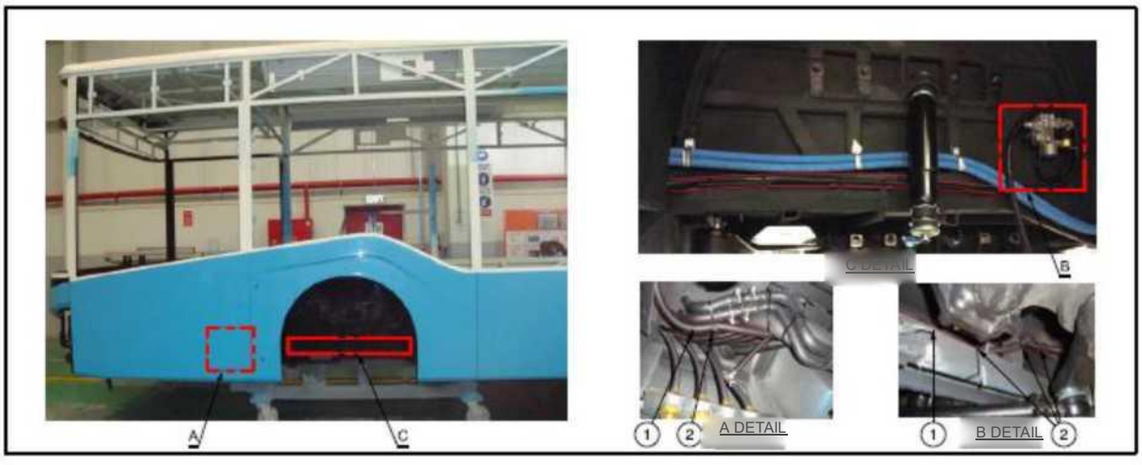


LEAFLET POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	911 - 046	387047630*	**VGA CABLE**	3
2	911 -925	3777705060-	**PLASTIC CLAMP L 350 MM**	17
3	911 - 047	387047333'	VEHICLE IN-SCREEN MULTIPLIER, 2 Pieces	**1**
4	911 - 122	3018548383*	SELF-TAPPING SCREW	2

LEFT EBS INSTALATION MOUNTING

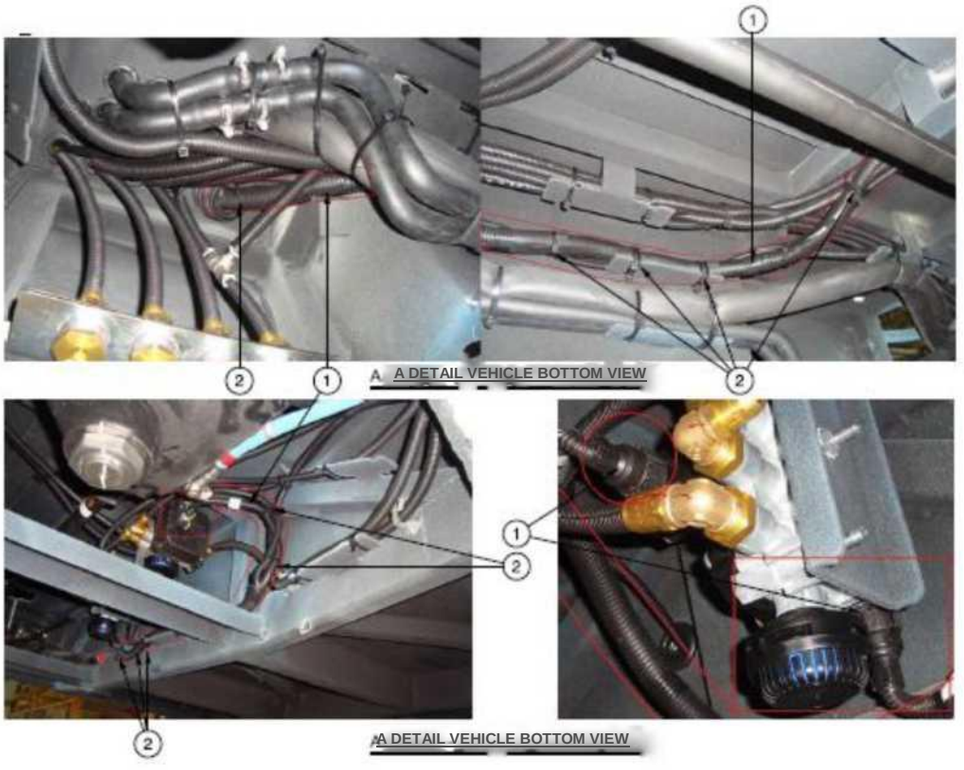
VEHICLE OUTSIDE VIEW – UNDER VEHICLE





VEHICLE OUTSIDE VIEW – UNDER VEHICLE



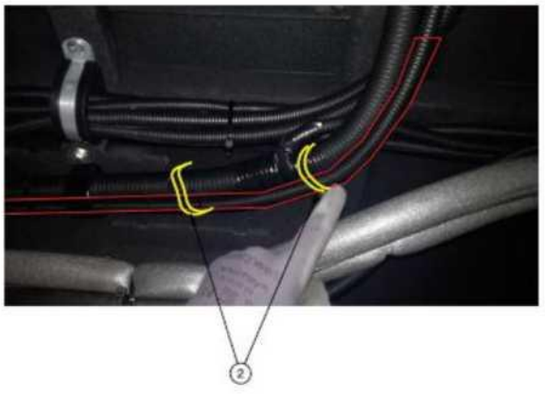


LEAF POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	911 -031	387060192'	INSTALLATION , LEFT EBS-ECAS	1
2	911 -925	377770506'	PLASTIC CLAMP L 350 MM	19

LEFT FRONT HEATER INSTALATION MOUNTING IN THE VEHICLE







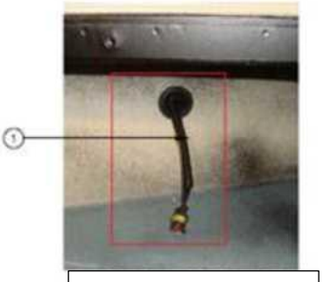
B DETAIL VEHICLE BOTTOM VIEW



DETAIL A



DETAIL B - VEHICLE **BOTTOM VIEW**



DETAIL A ZOBAS OPTION



DETAIL B

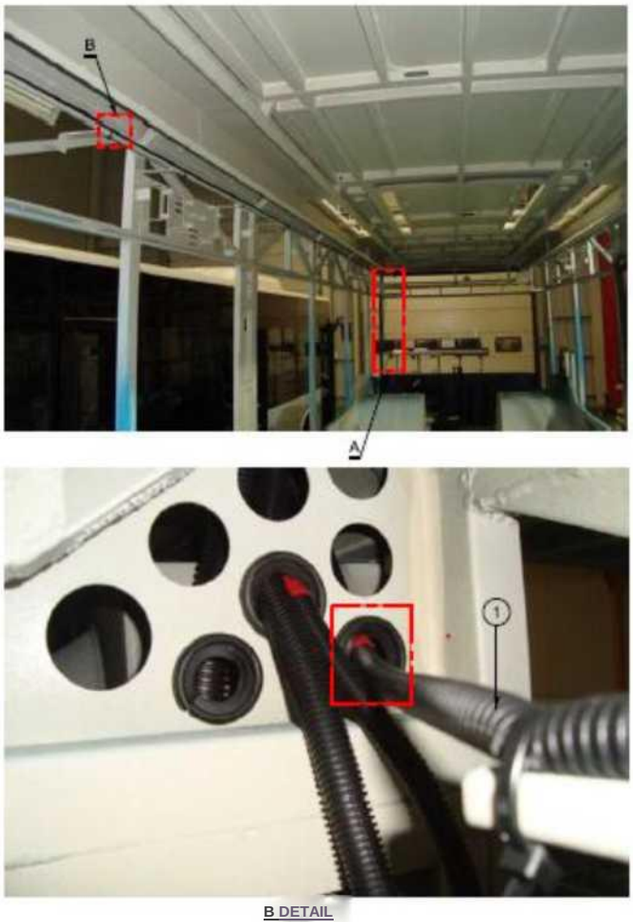




DETAIL B VEHICLE BOTTOM VIEW

LEAF POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	911 - 009	307038660'	INSTALLATION EBERSPEACHER- WATER PUMP	1
1	911 -009	387755582*	INSTALLATION , PREHEATER, CNG EBD, 12M	1
1	911 -009	387485641'	INSTALLATION EBERSPEACHER.WATER PUMP	1
2	911 -925	377770506-	PLASTIC CLAMP L 350 MM	9

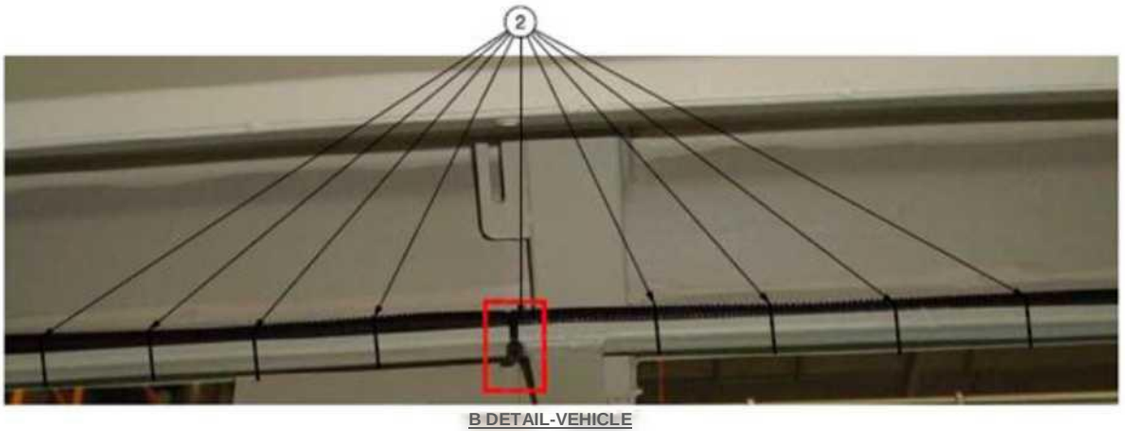
TACHOGRAPH KILOMETER INSTALATION MOUNTING



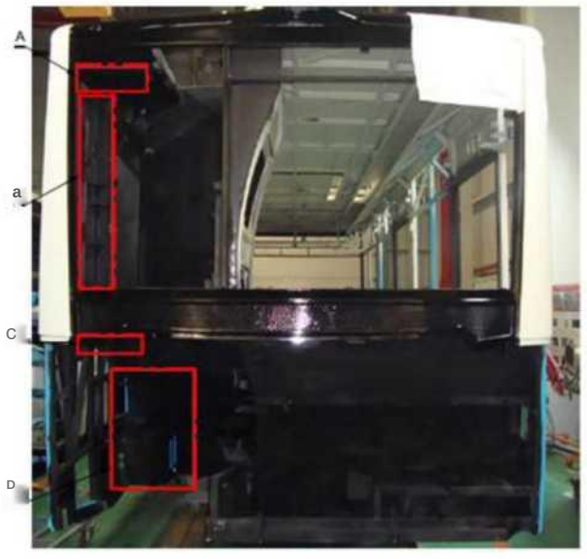
B DETAIL



A DETAIL



B DETAIL-VEHICLE INSIDE

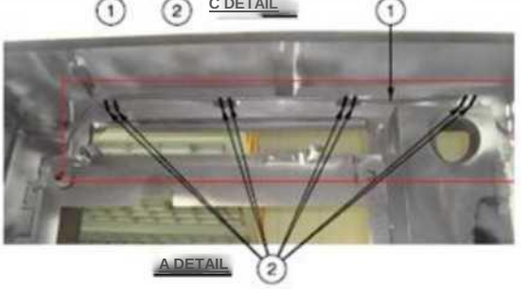




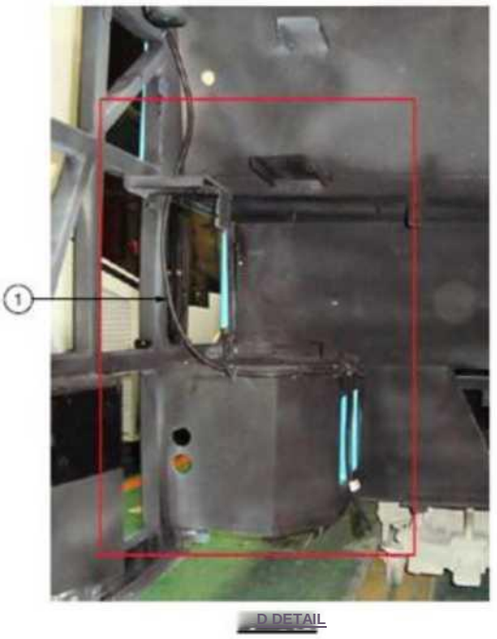
DETAIL B



C DETAIL



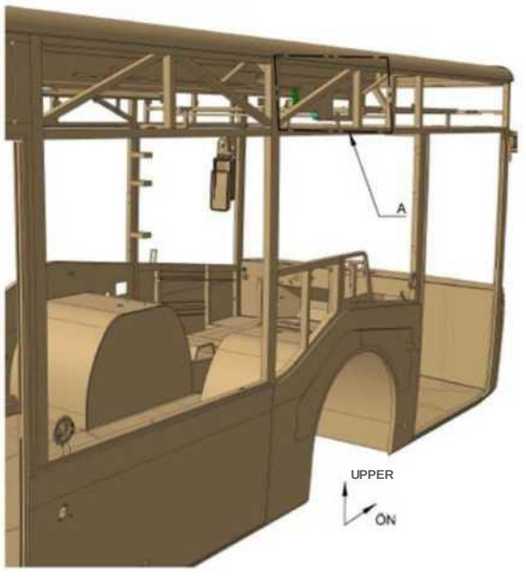
A DETAIL

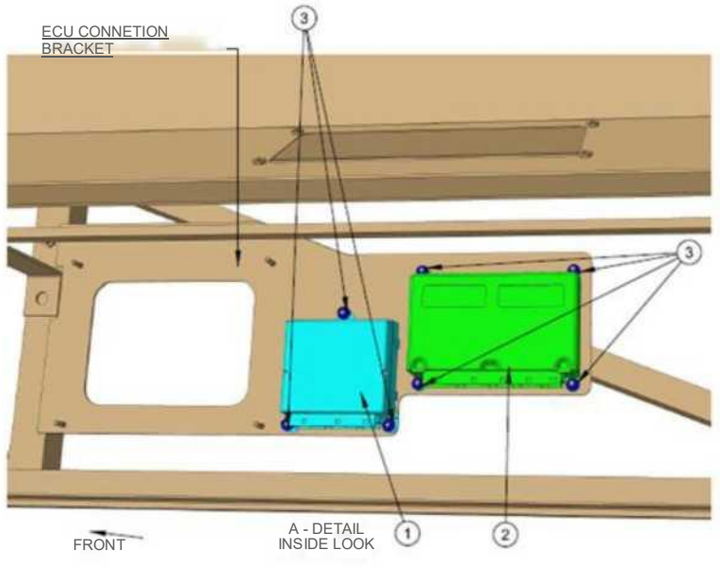


D DETAIL

LEAF POSE	GROUP/PQ7	PART NO	COMPONENT'S NAME	NUMBER
1	911 -030	387039928'	INSTALATION , KM SENSOR	1
2	911-925	377770506'	PLASTIC CLAMP L 350 MM	19

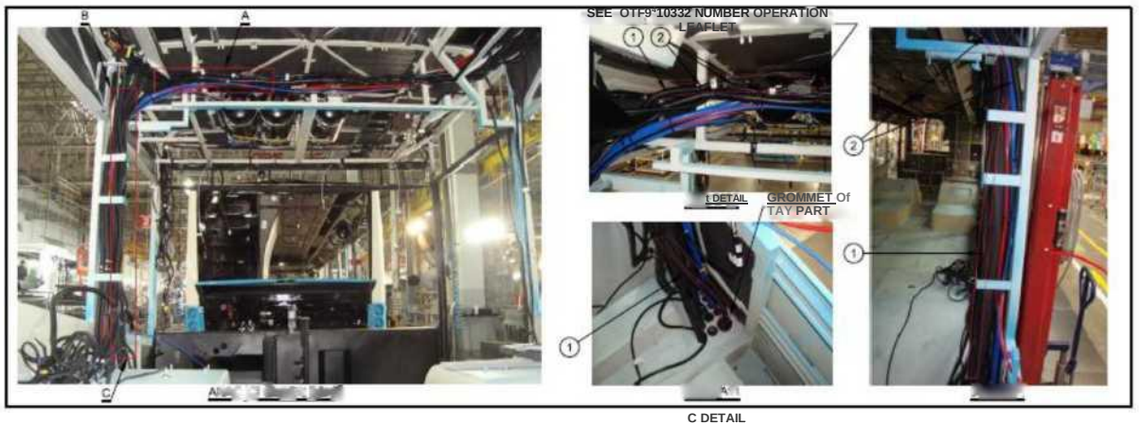
ECAS AND EBS ECU INSTALLATION





LEAFLET POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	91 1 - 040	387035401'	ECU, ECAS	1
2	911 - 600	387050424*	ECU, EBS	1
3	911-973	3006200063*	NUT , FLN M6X1, THICK D DIN6923	7
3	911-025	3005800061*	NUT . FLN M6X1. **THICK** D. DIN6923	7

LEFT EBS INSTALATION MOUNTING



VEHICLE INSIDE FRONT VIEW

C DETAIL

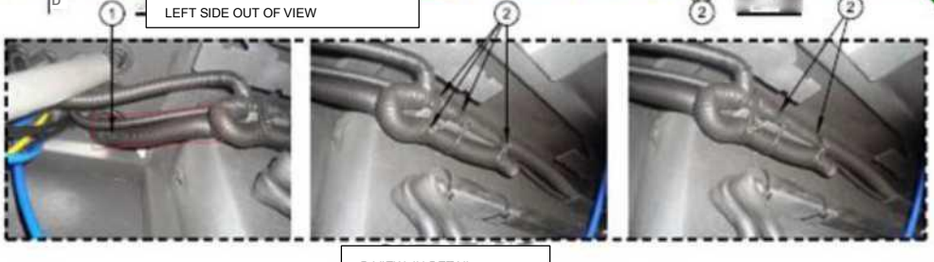
B DETAIL



LEFT SIDE OUT OF VIEW



D VIEW

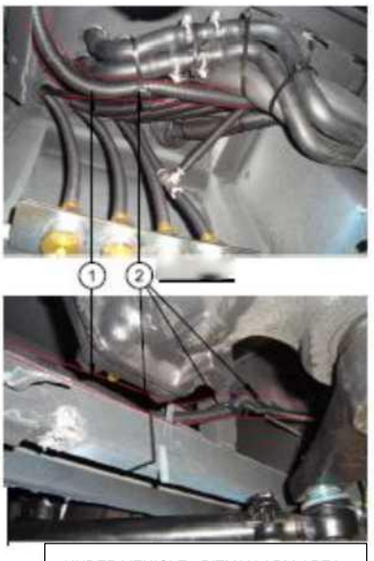


D VIEW IN DETAIL

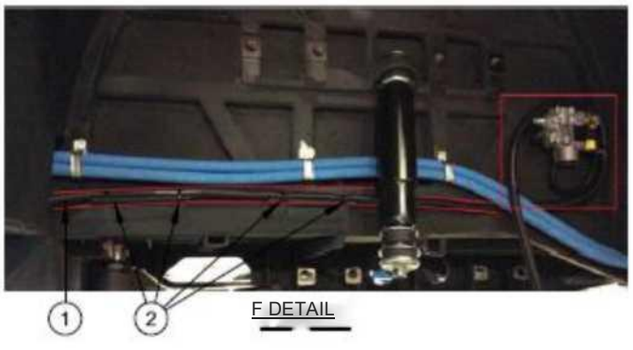




LEFT SIDE OUT OF VIEW



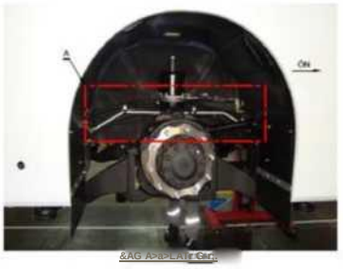
UNDER VEHICLE - PITMAN ARM AREA



F DETAIL

LEAFLET POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	911 -031	387060192*	INSTALLATION , LEFT . EBS-ECAS	1
2	911 -925	377770506*	PLASTIC CLAMP L 350 MM	25

RIGHT AND LEFT REAR-MOUNTED EBS INSTALLATION



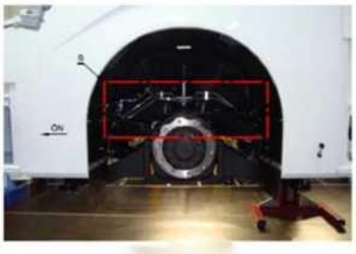
REAR LEFT WHEEL AREA



DETAIL B - BELLOW FRONT



SEE NO. OTF 9150075 OPERATIONAL LEAFLET





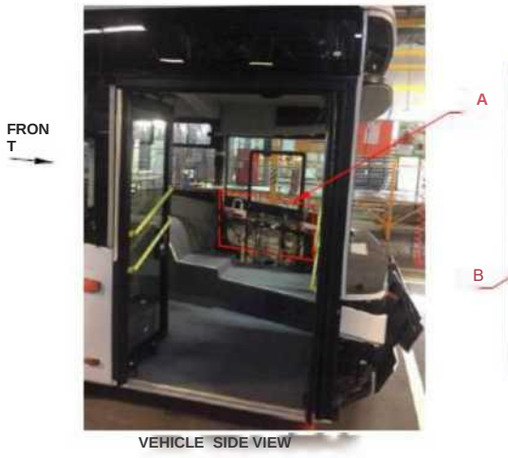
DETAIL A – BELLOW FRONT

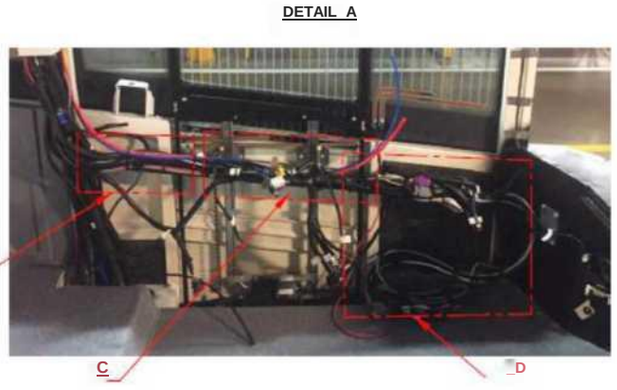


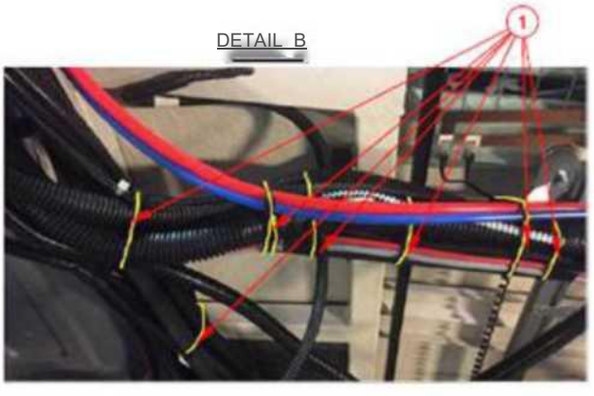
DETAIL B – BELLOW BEHIND

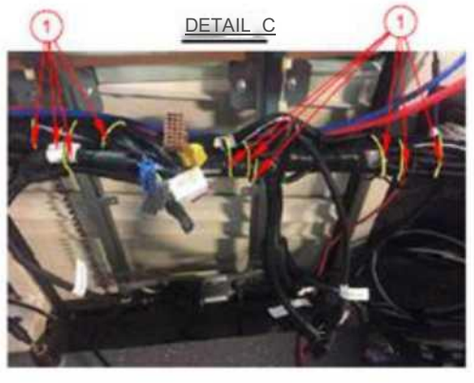
LEAFLET POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	91 1 - 925	377770506*	PLASTIC CLAMP L 350 **MM**	25

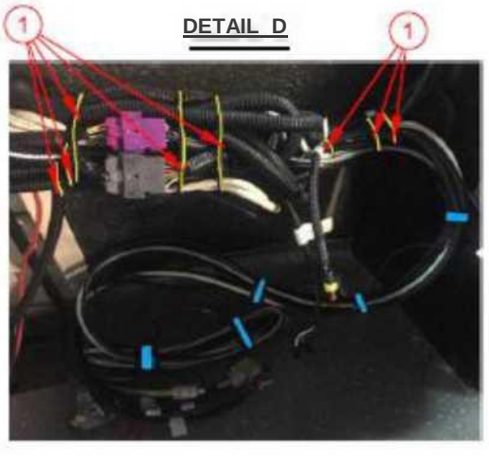
COLLECTION OF DRIVER INSIDE CONSOLE INSTELATIONS





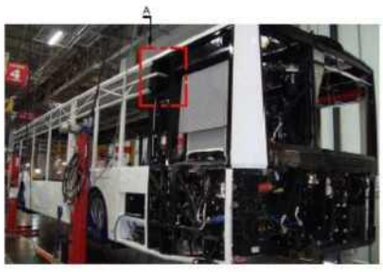


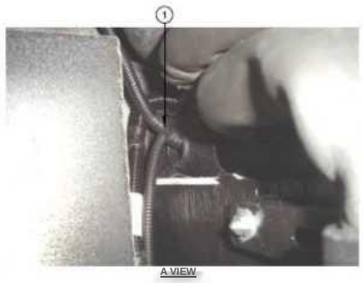




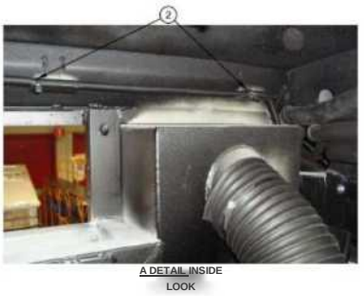
LEAFLET POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	911 - 925	377770506*	PLASTIC CLAMP L 350 MM	26

REAR HEATER INSTALATION MOUNTING





A VIEW



A DETAIL INSIDE LOOK



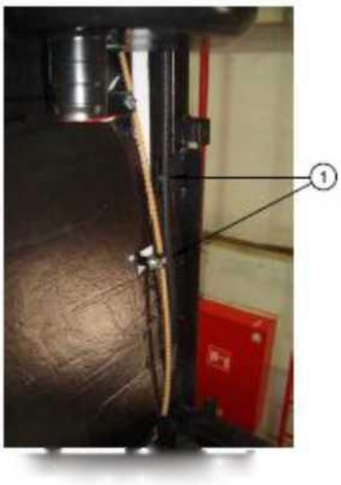
UPPER ZONE OF EXPANSION AREA



ENGINE ROOM UPPER AREA



ENGINE ROOM HYDRAULIC OIL TANK UPPER-AREA



ENGINE ROOM HYDRAULIC OIL TANK SUB-AREA



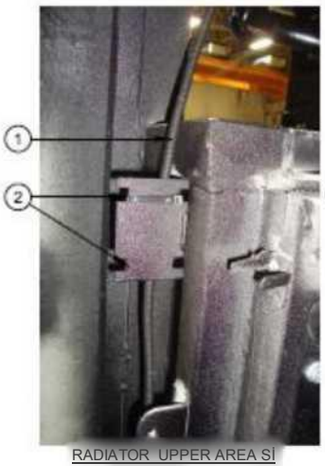
ENGINE ROOM HYDRAULIC OIL TANK SUB-AREA



RADIATOR SUB AREA



RADIATOR SUB AREA



RADIATOR UPPER AREA Sİ



RADIATOR SIDE AREA



RADIATOR SUB-AREA

LEAFLET POSE	GROUP-POSE	PART NO	COMPONENT'S NAME	NUMBER
1	911-911	387039919*	INSTALATION , HEATER REAR KONTROL	1
1	911 -032	387046032*	INSTALATION , HEATER REAR KONTROL	1
2	911 -925	377770506*	PLASTIC CLAMP L 350 MM	15

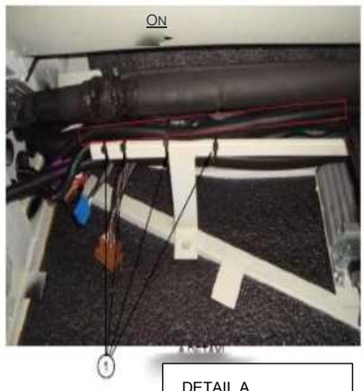
A



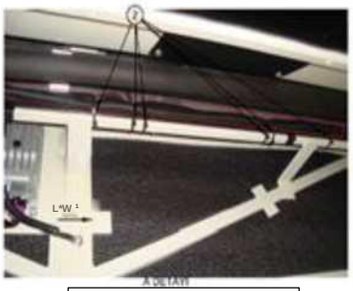
REAR ENGINE ROOM
UPPER CORNER OUTLET



A VIEW



DETAIL A
THE ROUTE
CONTINUED



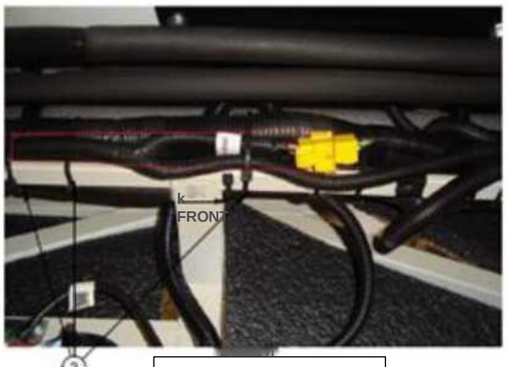
DETAIL A
THE ROUTE CONTINUED



DETAIL A
THE ROUTE CONTINUED



DETAIL A
THE ROUTE
CONTINUED



DETAIL A
THE ROUTE CONTINUED

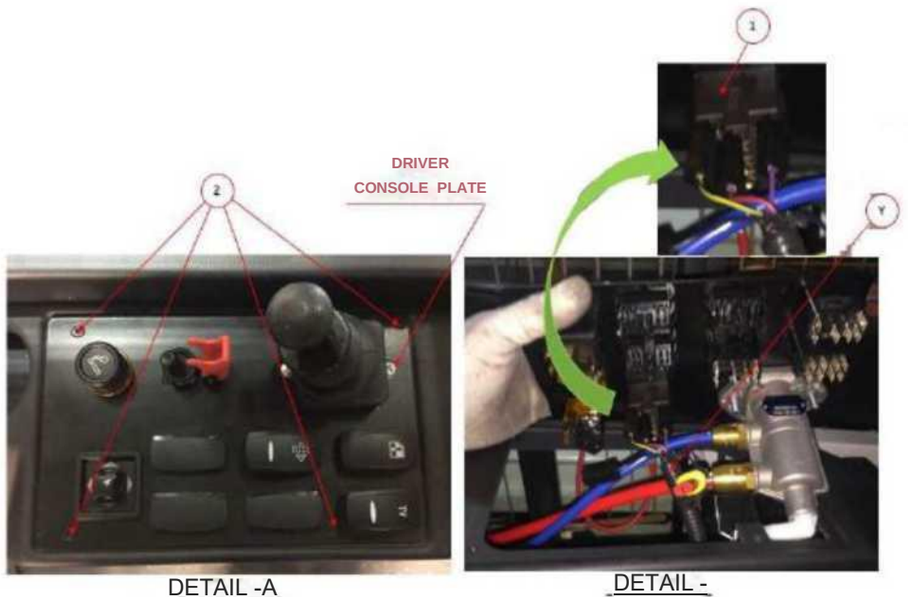


DETAIL A
THE ROUTE CONTINUED

LEAF/POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	911-911	38703991	INSTALATION . HEATER REAR CONTROL.	1
1	911 - 032	387046032*	INSTALATION . HEATER REAR. CONTROL	1
2	911- 925	377770506*	PLASTIC CLAMP L 350 XI M	15

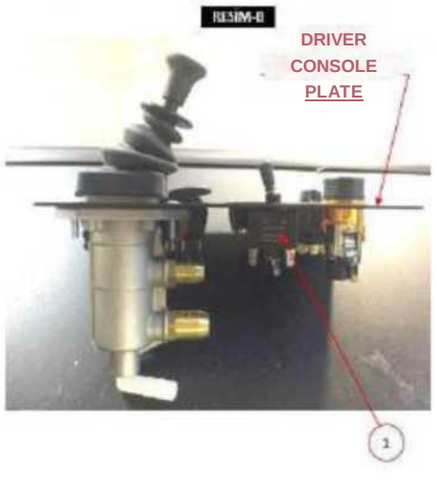
VEHICLE EMERGENCY BUTTON ASSEMBLY



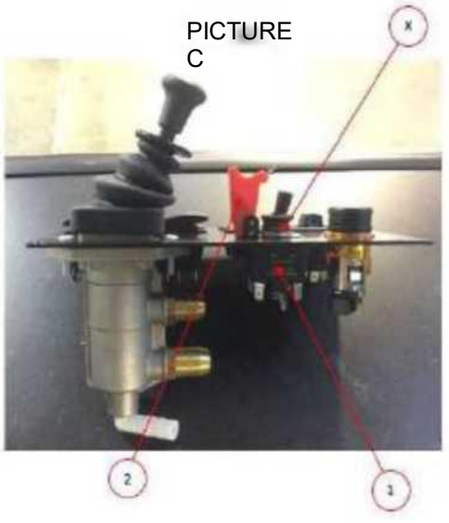


DETAIL -A
(BEFORE MOUNTING)

DETAIL -
A

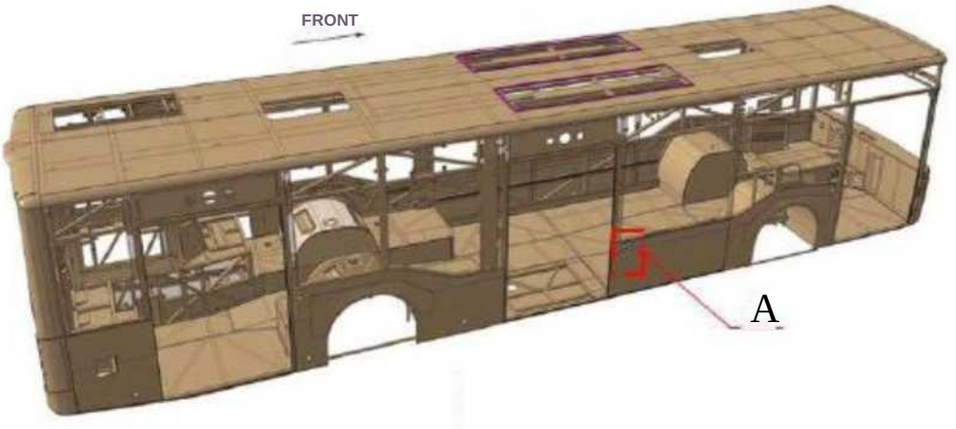


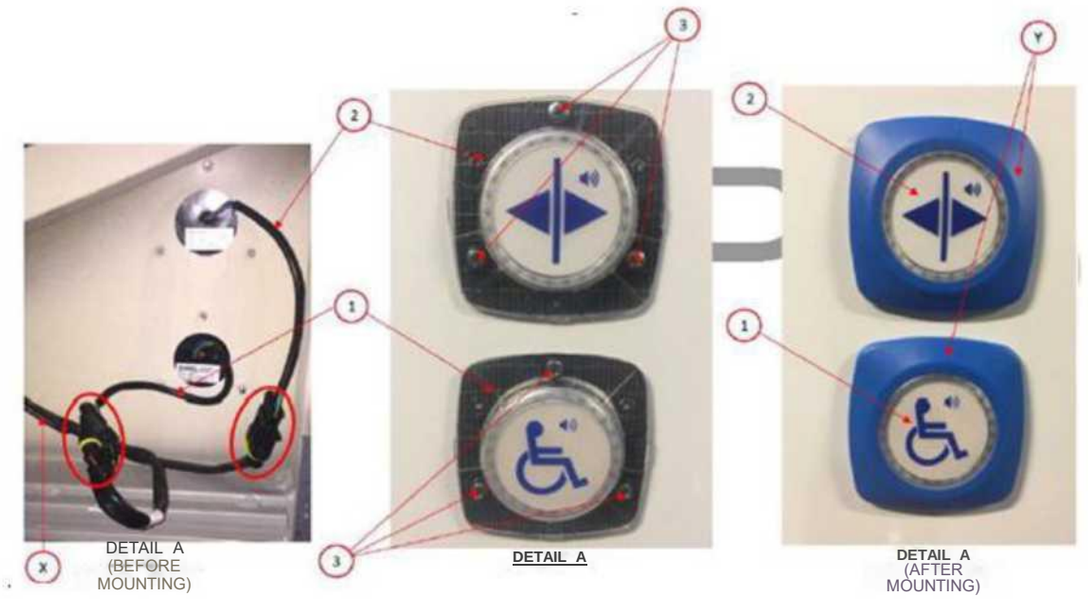
PICTURE C

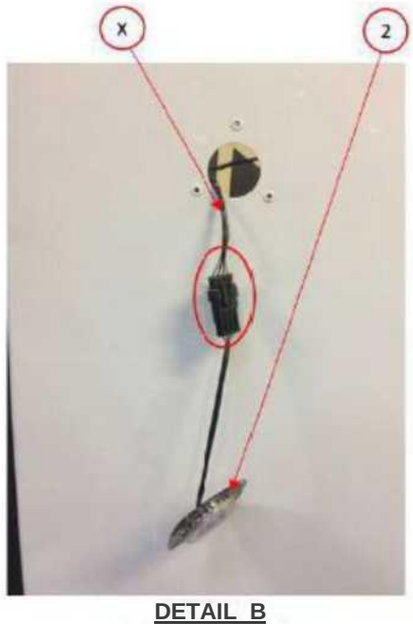


LEAFLET POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	911 -443	377773169*	SWITCH , KISLING EMERGENCY (EURO TURQUOISE)	1
1	911 -443	387040336*	SWITCH , KISSLING EMERGENCY (3 PIN)	1
2	911 - 700	377774231*	COVER, SWITCH	1

DISABLED AND DOOR OPEN BUTTONS INSTALLATION







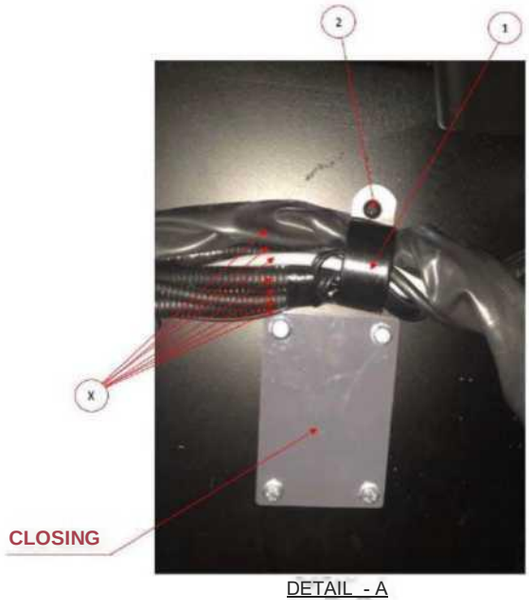
DETAIL B
(BEFORE MOUNTING)

LEAF POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	911 -080	387047258*	BUTTON, DISABLED	1
2	911-1987	387054174*	BUTTON, OPENING DOOR	1
3	911 -951	3015004208*	SCREW M4X0. 75X20	12
4	911 -952	3870043180*	SMALL O-RING, SIDE MARKER	12

FIXING PODIUM INSTALATIONS

PICTURE-A





DETAIL _ A

LEAFLET POSE	GROUP.'POSE	PART NO	COMPONENT'S NAME	NUMBER
1	911 - 953	3B7003433*	**CLIP .** TORPEDO INSTALLATION	1
2	911 - 954	301894816*	**ROND.** PLATE SCREW **4.** BX16	1

NODE LABELS MOUNTING

VEHICLE INSIDE VIEW



DETAIL A



DETAIL B





SEE OTF71Q0018 NO. OPERATIONAL LEAFLET

DETAIL B

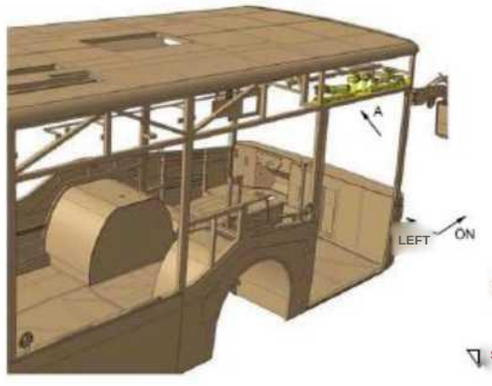


DETAIL C



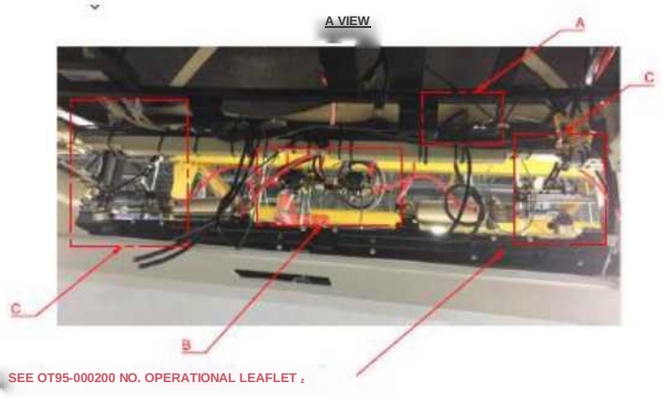
LEAFLET POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	**911 - 900**	**387038783***	**ECU. MULTIPLEX NODE 33 AC968220**	**1**
2	**911 - 901**	**387039771***	**ECU. MULTIPLEX NODE 66 (AC966221)**	**2**

FRONT DOOR TOP INSTALLATION MOUNTING



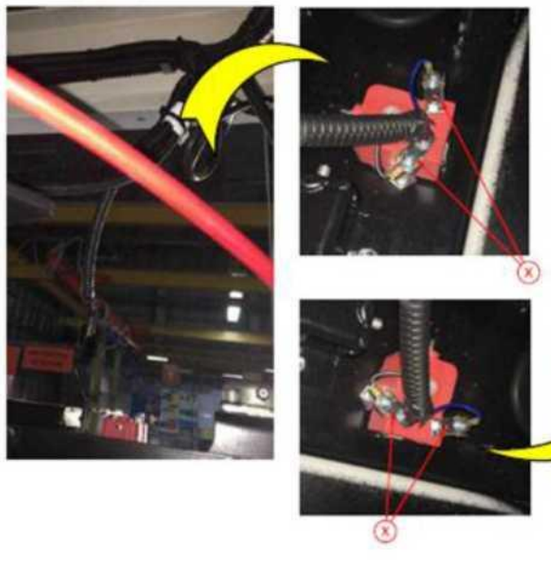
{VEHICLE SIDE VIEW)

A VIEW

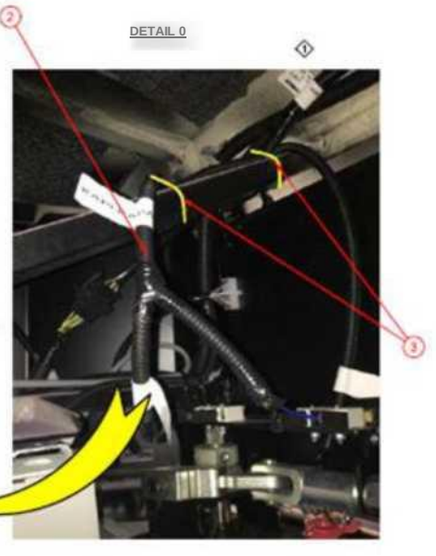


SEE OT95-000200 NO. OPERATIONAL LEAFLET ₂

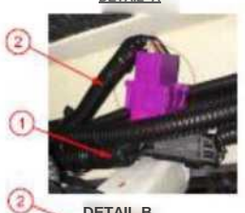
DETAIL B



DETAIL 0



DETAIL A



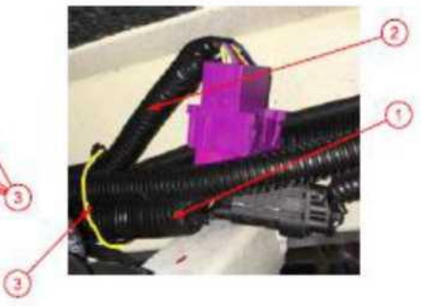
DETAIL B



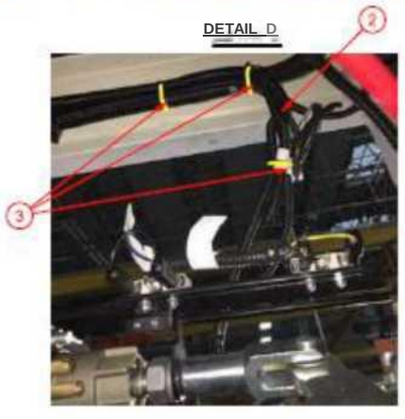
DETAIL B



DETAIL A



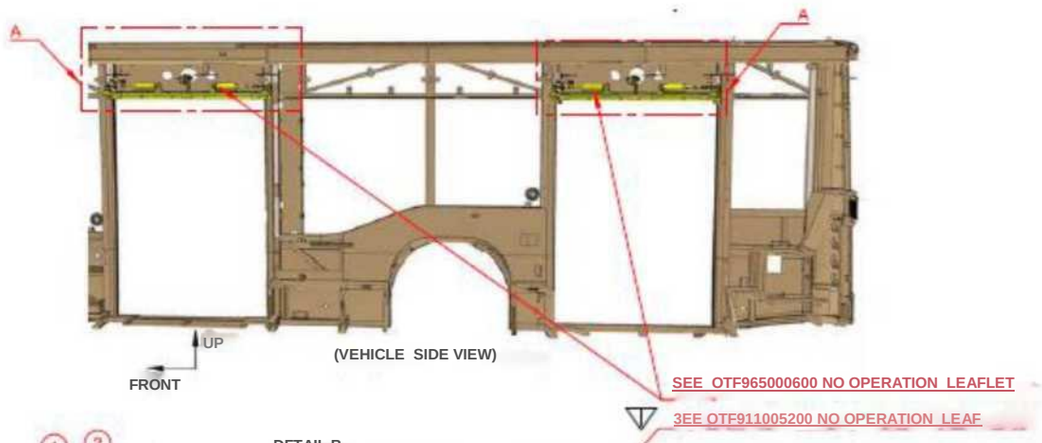
DETAIL D



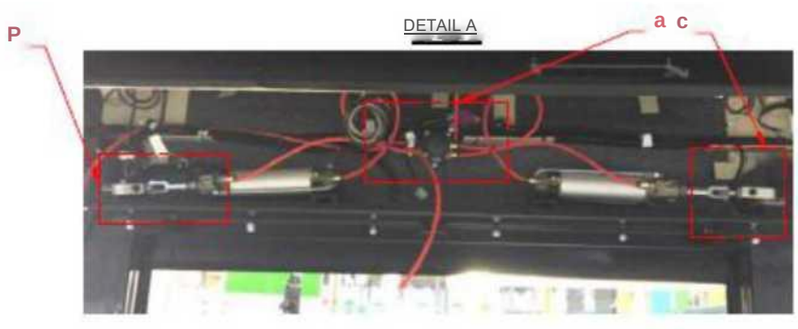
1) FULLY INSERT THE MALE SOCKET FULLY INTO THE DENTAL SOCKET AND MAKE SURE THE CONNECTION NAILS ON IT GET FULLY FIT.
2) REFER TO LEAFE OTFS51Q01200 FOR INSTALLATION OF FRONT DOOR MECHANISM.
3) MAKE SURE THERMALS FULLY PASS THE CONNECTION POINTS. THE WHITE LABEL ON THE CABLE CONTAINS DOOR JAMMED LETTER.

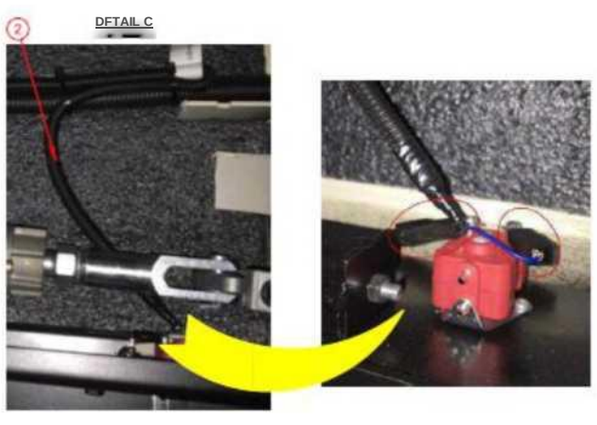
LEAF POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	911 -002	387052000	INSTALATION RIGHT CEILING	1
1	911 - 002	387732074*	INSTALLATION , RIGHT CEILING . CMG EU6D.12M	1
2	911 -018	387038865	INSTALATION FRONT DOOR	1
3	911 -220	377771433*	CLAMP . PLASTIC EB. 04. 204_3 6*205M	13

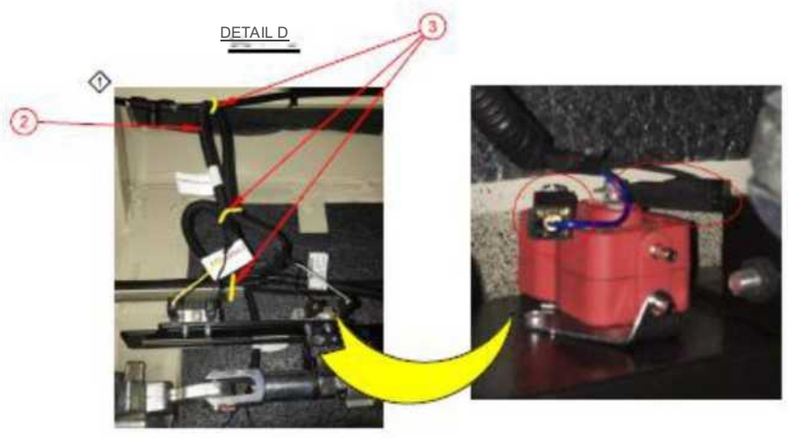
MIDDLE AND REAR DOOR INSTALATION MOUNTING

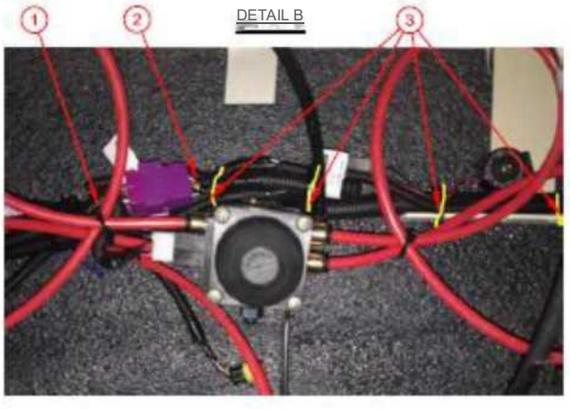


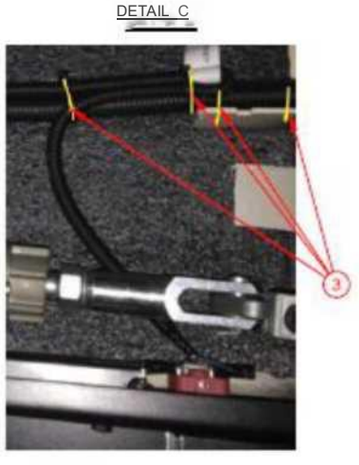








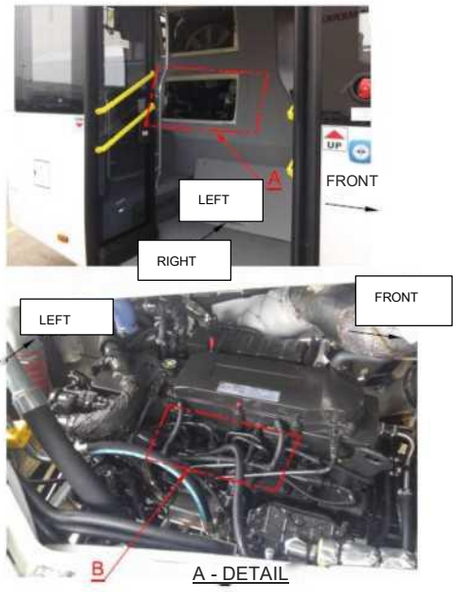




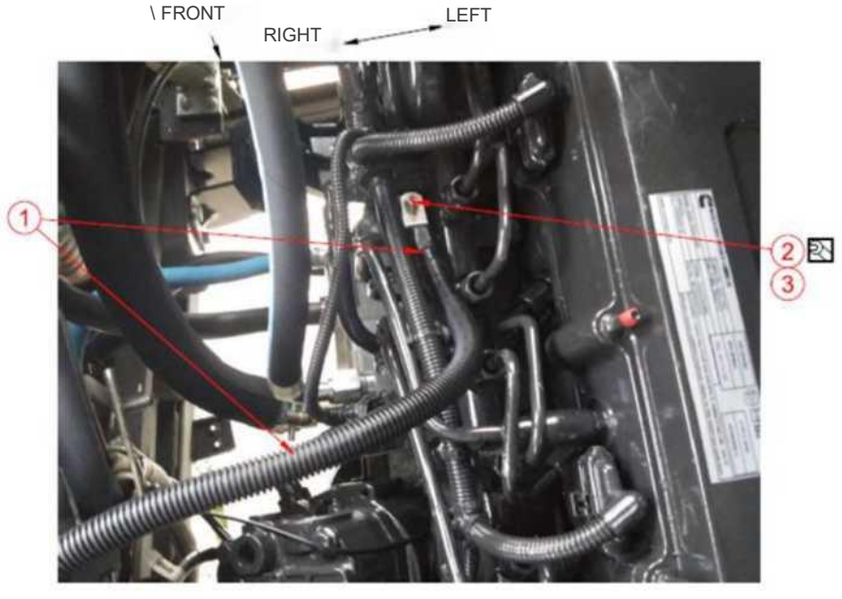
1) FULLY INSERT THE MALE SOCKET FULLY INTO THE DENTAL SOCKET AND MAKE SURE THE CONNECTION NAILS ON IT FULLY FIT.
2) THE CABLES HAVE A WHITE LABELTE DOOR COMPRESSED LETTER ON.
3) FULLY PUTS THE SOCKETS INTO THE TERMINALS BE SURE

LEAFLET POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	PIECE
1	911 -002	387052000'	INSTALATION , RIGHT CEILING	1
1	911 - 002	387732974-	INSTALLATION , RIGHT CEILING . CNG EU6D 12M	1
2	911 -019	387038888	INSTALATION . MIDDLE REAR DOOR	2
3	911 -220	377771438	CLAMP , PLASTIC EB. 04. 204_3. 6*205M	22

MANIFOLD HEATER INSTALLATION MOUNTING



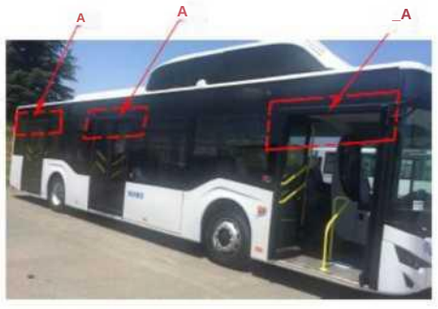
A - DETAIL



B - DETAIL

LEAFLET POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	911-011	387041440'	INSTALATION , MANIFOLD HEATER	1
2	911 -956	300060006*	NUT . PL, EMN, M6, THICK D. DİN965	1
3	911 -&54	3010100061*	WASHER . SPRINGY D=6 DİN 12	1

DOOR LOCK INSTELATION ACCESS MOUNTING



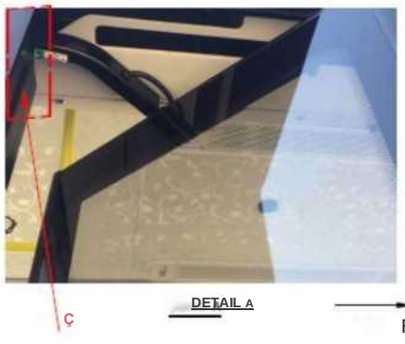


DETAIL C

FRONT



DETAIL A



DETAIL A

FRONT



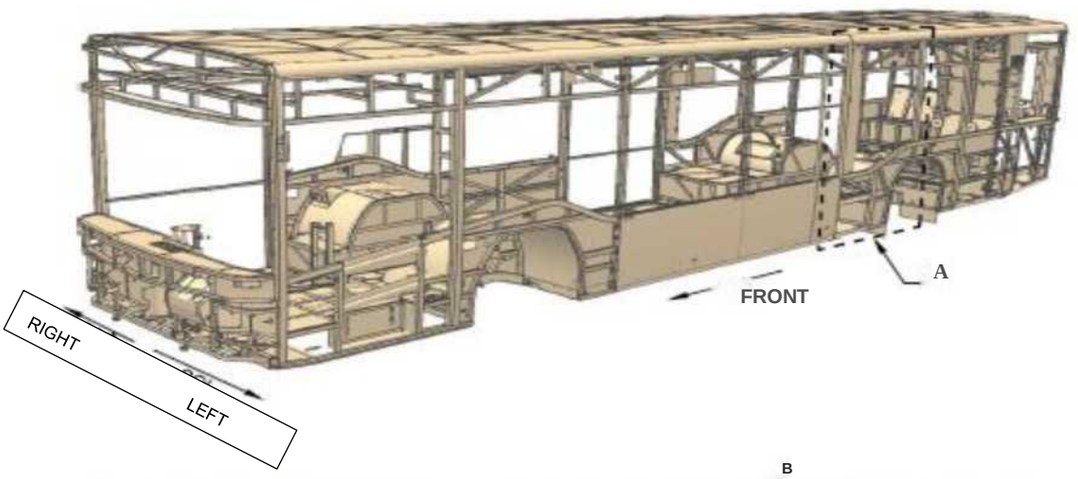


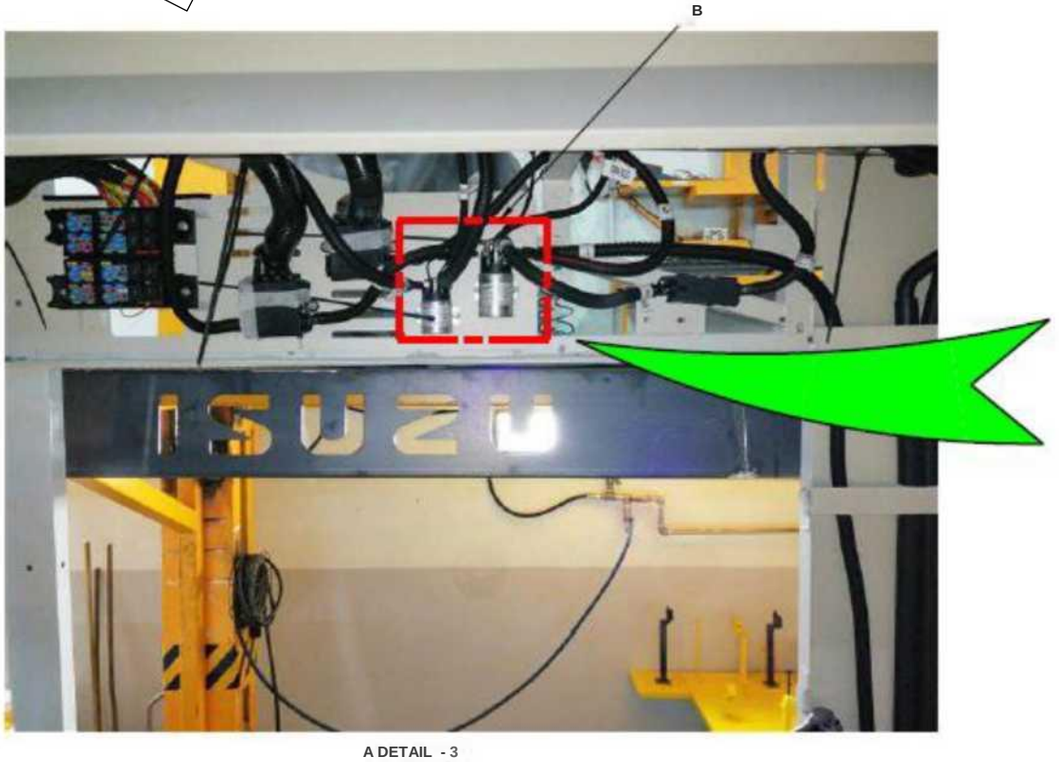
DETAIL B

IN THIS ZONE, IT SHOULD NOT BE TENSIONED WHEN THE DOOR IS OPENED AND CLOSED AND NOT TO RUB TO THE ABS.

LEAFLET POSE	GROUP.'POSE	PART NO	COMPONENT'S NAME	NUMBER
1	911-177	377771437'	PLASTIC CLAMP , ES. D3. 203_3, 6*150mm	6

LEFT CEILING ELECTRIC INSTALLATION RELAY FUSE INSTALLATION





A DETAIL - 3
INSIDE VIEW



A DETAIL •1
(İNSIDE VIEW)



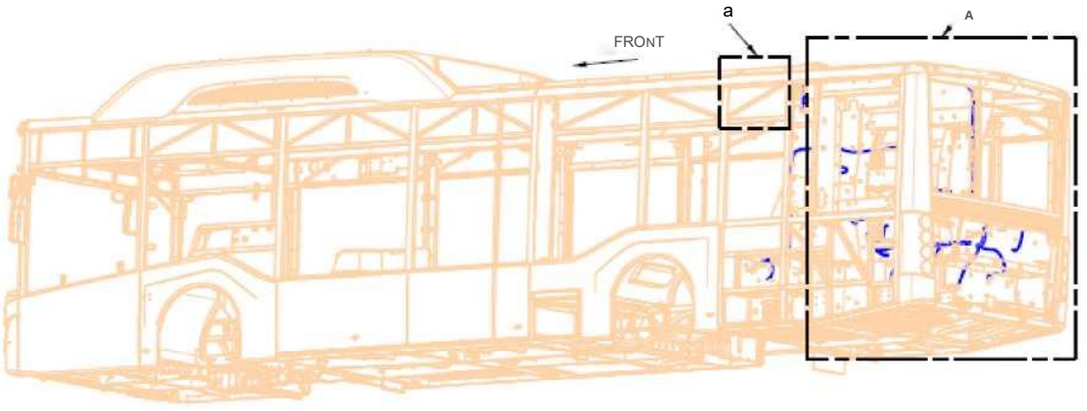
A DETAIL - 2 (İNSIDE VIEW)

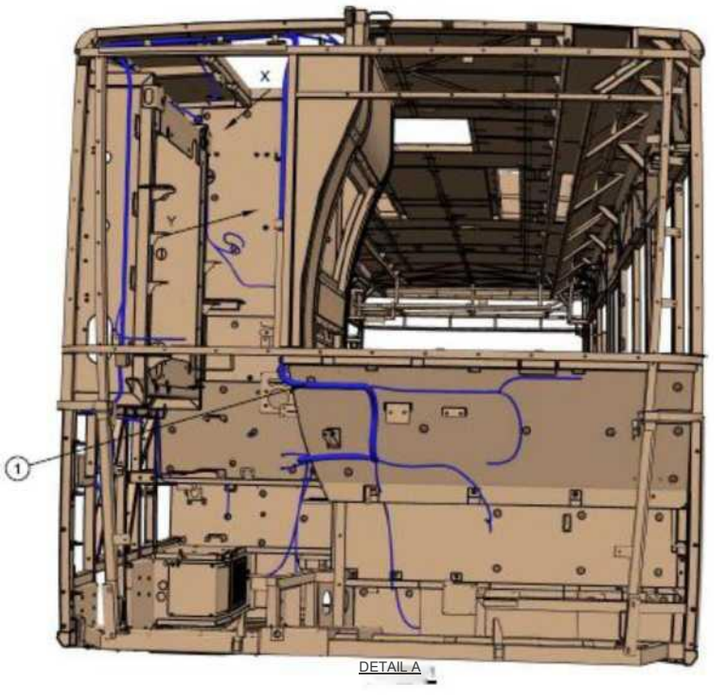


B DETAIL

LEAF POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	911 -442	387039984*	RELAY , AIR SUCTION HEATER (120A)	1
2	Sil - D14	377773168'	RELAY POWER	1

ENGINE ROOM INSTALATION U MOUNTING





DETAIL A



DETAIL B

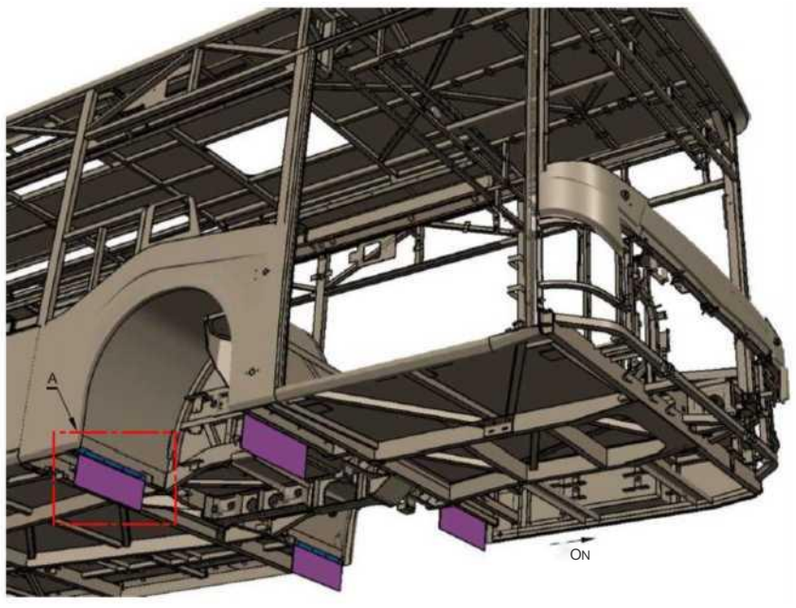


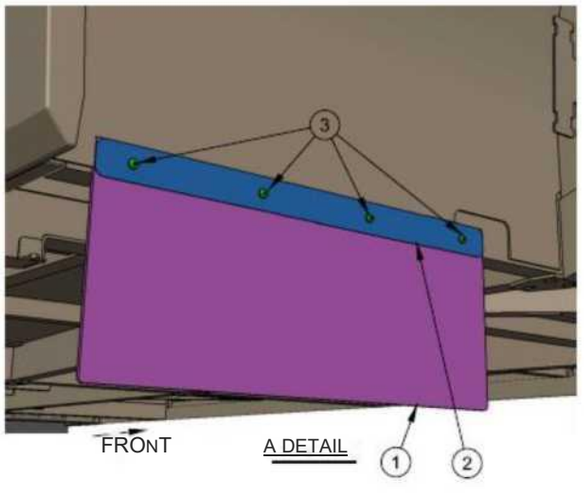
Y VIEW


X VIEW

LEAFLET POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	911 -004	387742755*	INSTALLATION , ENGINE ROOM, CNG E6D. 12M	1

FRONT MUD FLAP INSTALLATION

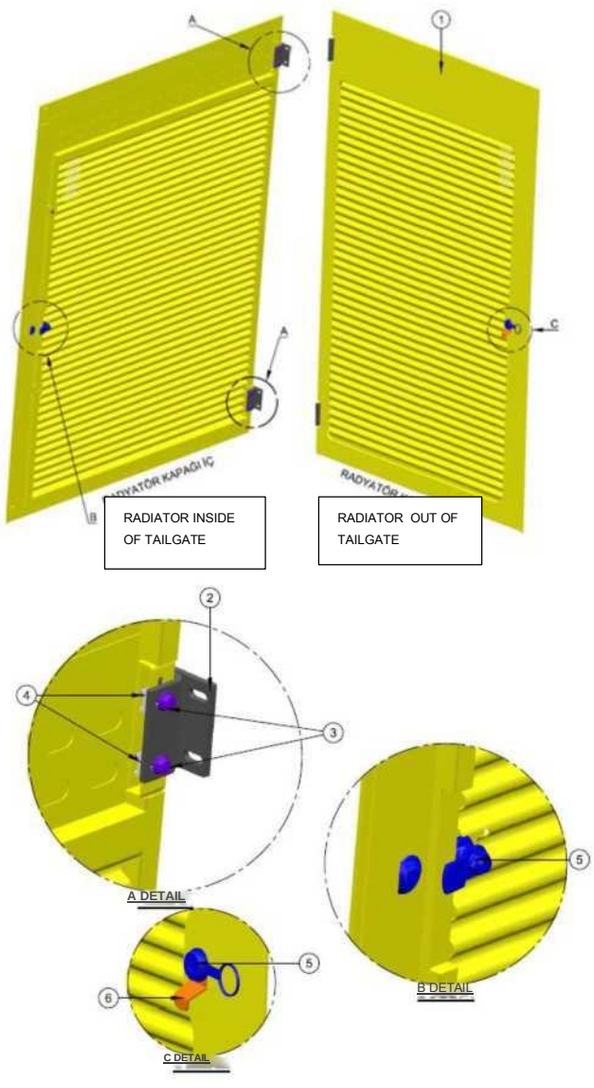




LEAFLET POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	919-004	387038087'	MUD FLAP	4
2	919-005	387053490*	PLATE MUD FLAP HOLDER	4
3	919-008	3018148163*	SCREW	16

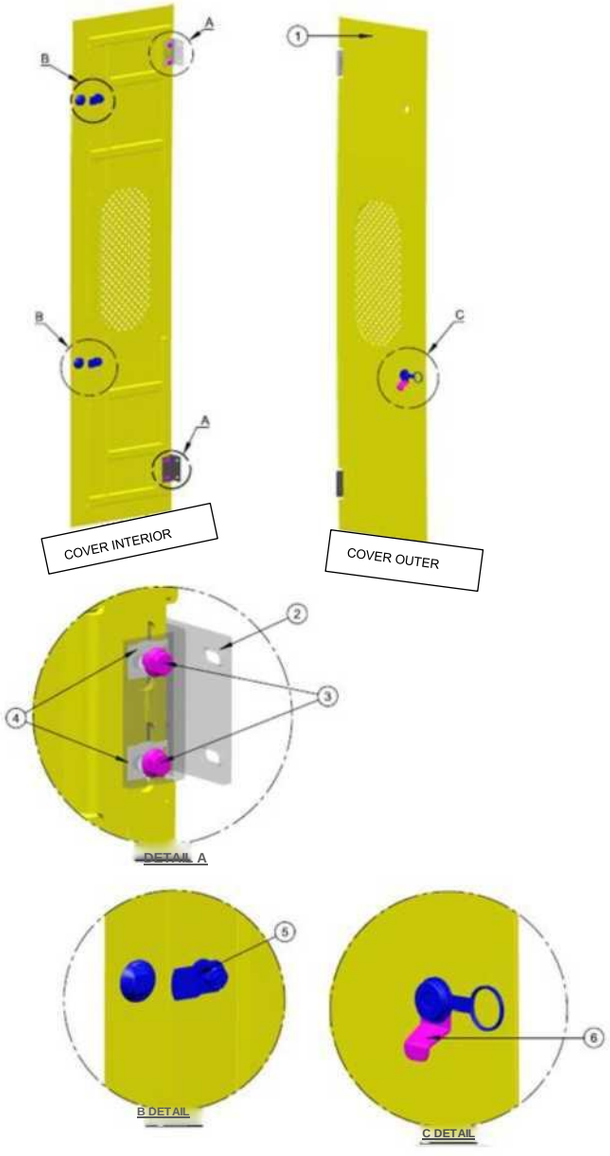
TAILGATE INSTALLATION

RADIATOR TAILGATE ASSEMBLY



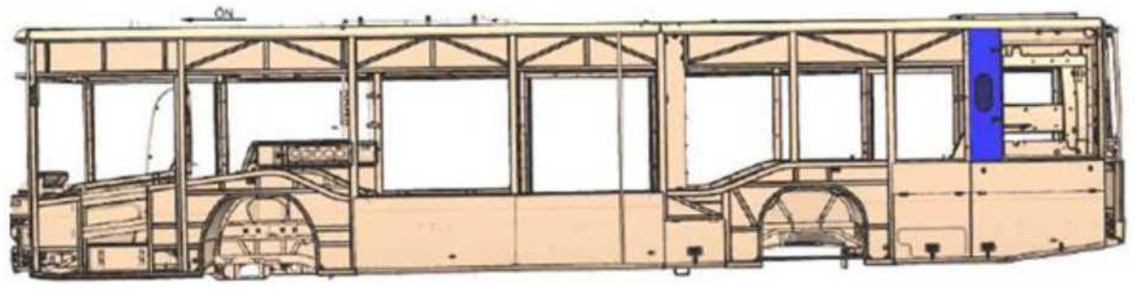
LEAFLET POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	920-01O	384313891*	RADIATOR ROOM COVER	1
2	920-028	387056139'	HINGE ASSEMBLY	2
3	920- 058	3001206206'	BOLT. FLN MSX1X20, THICK D. DIN 6921	4
4	920-047	3870387940'	METRİC SCREW CLIP , M6X1	4
5	920-054	387045909'	LOCK,, SET	I
6	920- 120	387021465*	HANDLE	1

COVER ASSEMBLY MOUNTING

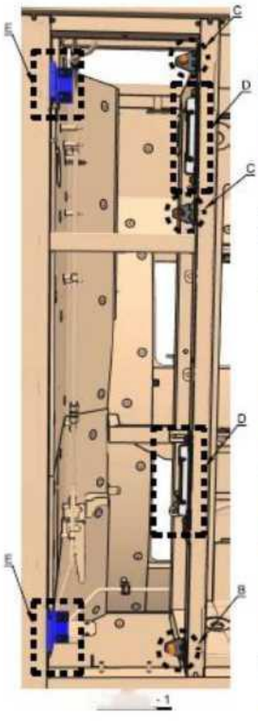


LEAF POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	920 - 01 3	384313H54-	COVER ASSEMBLY	1
2	920 - D2S	387050139'	HINGE ASSEMBLY	2
3	920 - 058	3001206206'	BOLT , FLN MSX1X2O, THICK D. DIN6S21	4
4	92 0 - 047	3B70387040'	METRİC SCREW CLIP , M6X1	4
5	920 - 054	387045909*	LOCK SET	1
6	920- 120	387021465*	HANDLE	2

COVER ASSEMBLY VEHICLE MOUNTING



SEE OTF9200187 NO.
OPERATIONAL LEAF



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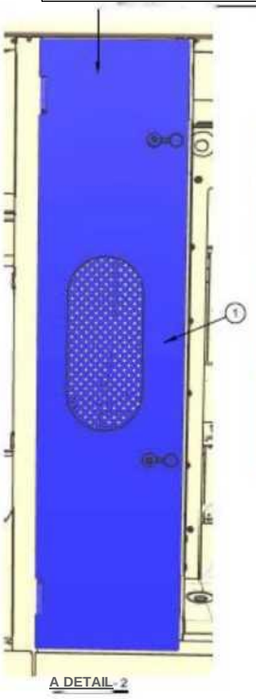
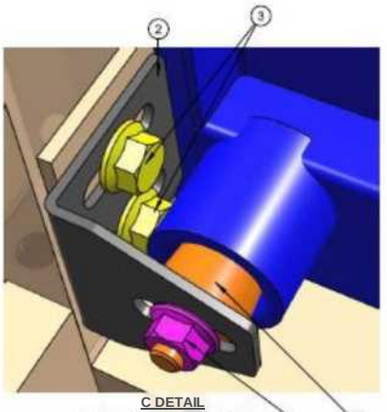
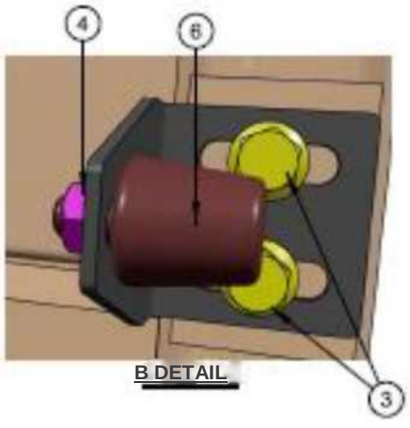


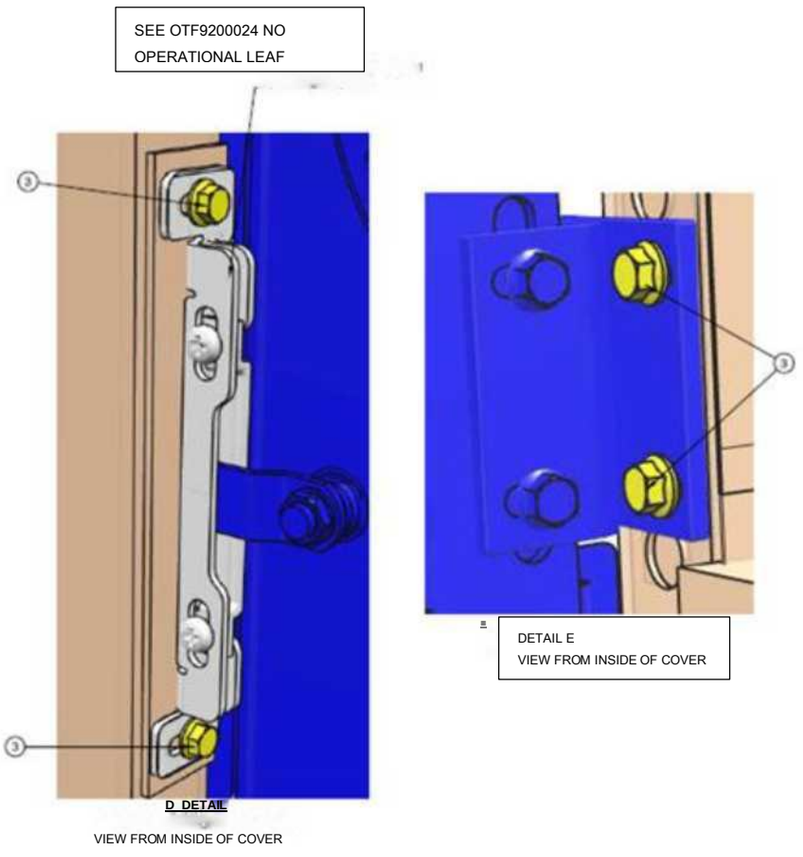
A DETAIL 2



C DETAIL
VIEW FROM INSIDE OF COVER

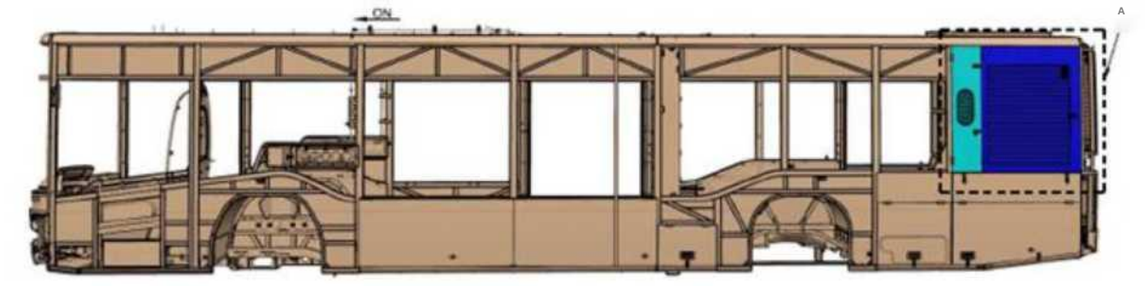


B DETAIL



LEAFLET POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	920 - 013	304313854*	COVER ASSEMBLY	1
2	920 - 031	307035491'	BRACKET	3
3	920 - 050	3001206206*	BOLT . FLN M6X1X20, THICK D. DIN6921	14
4	920 - 188	3005B00066'	NUT . FLN&TR M6X1, THICK D. DİN6923	3
5	920 - 025	307022659'	WEDGE . ARMREST. M6	2
6	920 - 154	307045910'	WEDGE M6	1

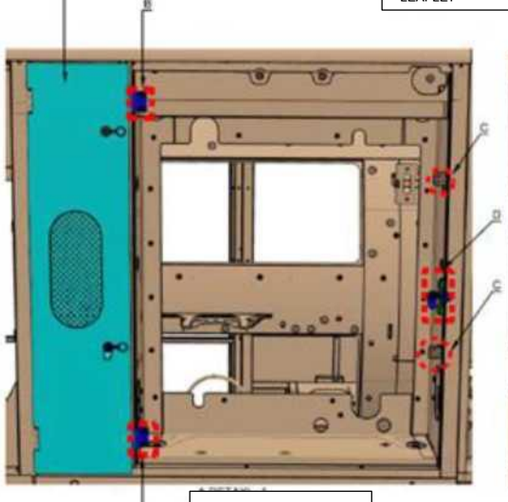
RADIATOR COVER INSTALLATION TO THE VEHICLE



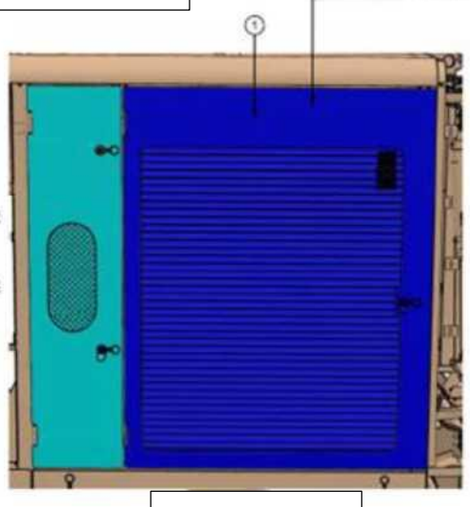
SEE NO. OTF9200188 OPERATIONAL LEAFLET

FOR GENERAL TORQUE VALUES OF BOLTSSEE NO GNF0000001 OPERATIONAL LEAFLET

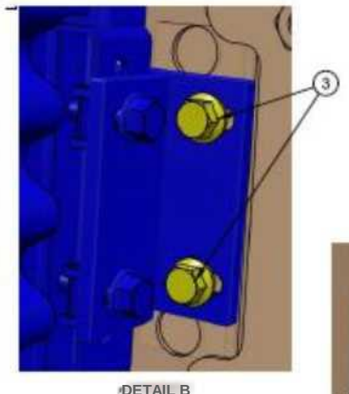
SEE NO OTF9200196 OPERATIONAL LEAFLET



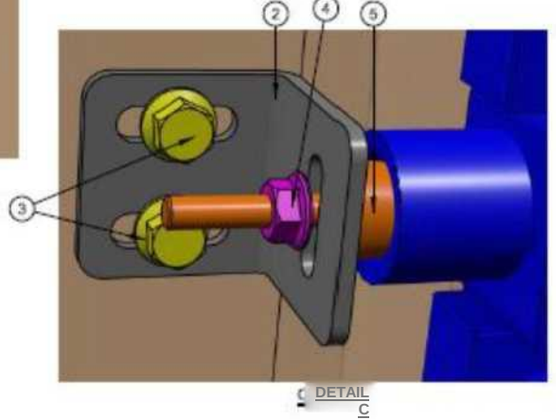
DETAIL A -1



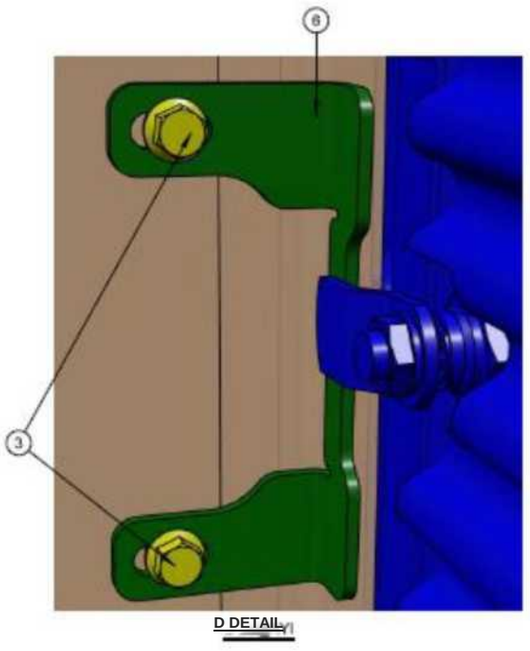
DETAIL A -2



DETAIL B

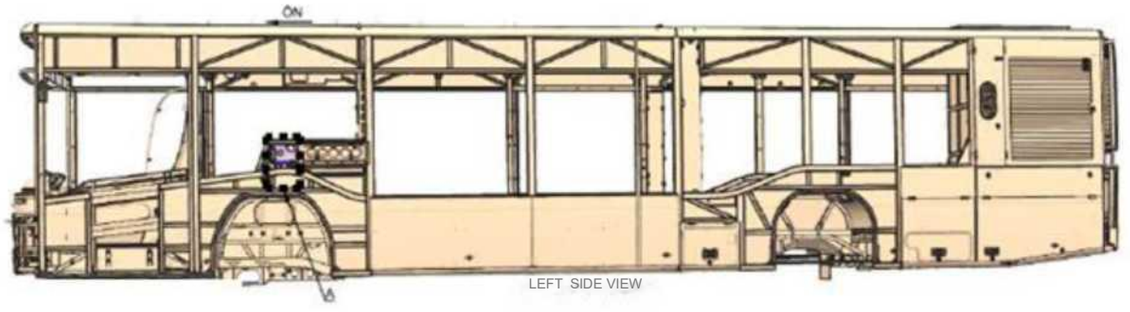


DETAIL C

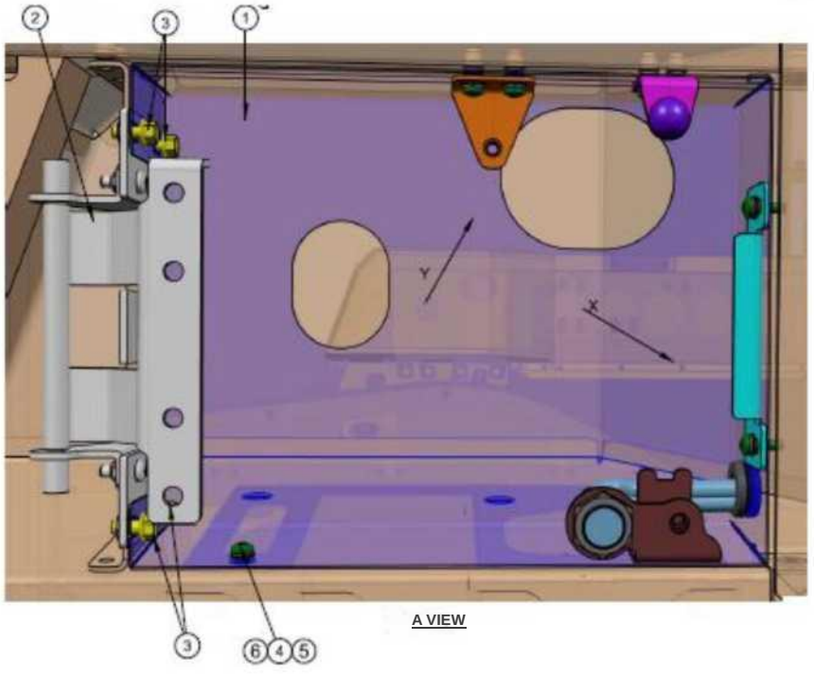


LEAFLET POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	920-009	304313891*	RADIATOR ROOM COVER	1
2	920-206	307046444'	BRACKET	2
3	920- 169	3001206164*	BOLT . FLN M6X1X16, THICK D. DIN6921	10
4	920- 183	3005800066'	NUT . FLN&TR M6X1, THICK D. DİN6923	2
5	920-025	387022659*	WEDGE . ARMREST, M6	2
6	920-032	387046399*	BRACKET	1

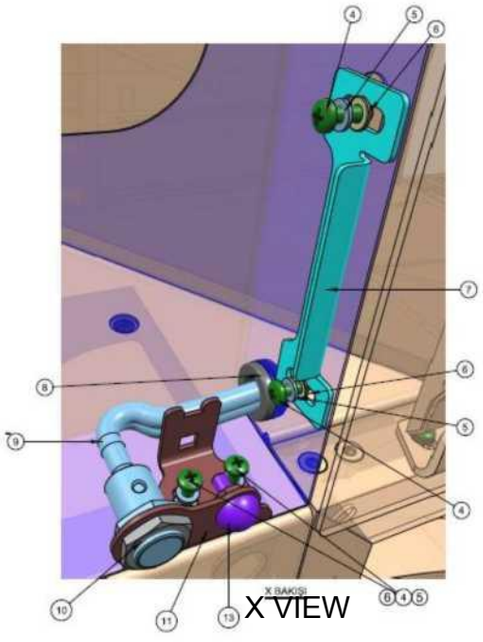
LEFT CNG FUEL FILLING CAP BRACKETS ASSEMBLY



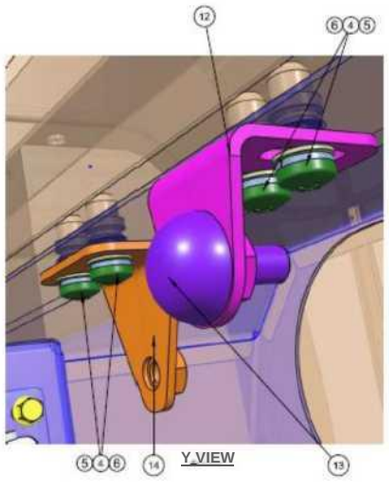
LEFT SIDE VIEW



A VIEW

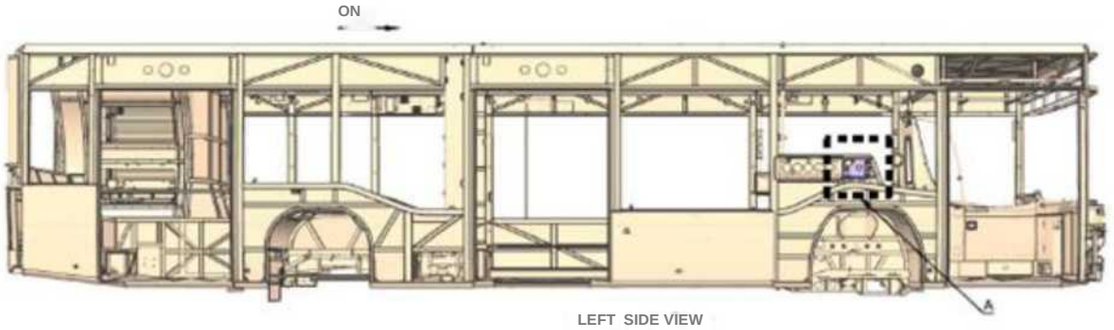


X VIEW

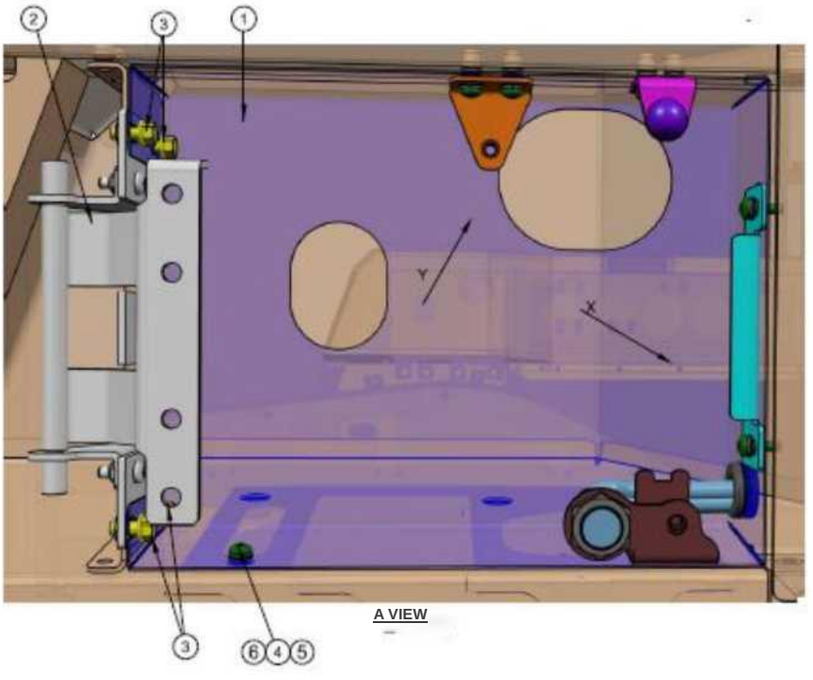


LEAFLET POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	920 - 150	307044476*	CLOSING, FUEL FILLING	1
2	920-170	307044476*	HINGE ASSEMBLY	1
3	920-098	3001205124*	BOLT . FLN M5X0.8X12, THICK D. DIN6921	4
4	920 - 167	3015005154'	SCREW. M5X15 DİN 7986	9
5	920 - 195	3010100054*	WASHER , SPRINGY D=5 DİN 127	9
6	920 - 086	3010000054*	WASHER , FLAT D = 5 DİN125	9
7	920-050	307036068*	LOCK PROVISION	1
8	920-157	3668831560*	GROMMET	1
9	920 - 156	387030714*	SENSOR ASSEMBLY	1
10	920 - 207	3070473730'	NUT . SPECIAL THIN MI 8X1	1
11	920 - 159	307045912*	BRACKET	1
12	920 - 140	387044457*	BRACKET , STOPPER	1
13	920-146	397001692*	RUBBER STOPPER ,SMALL	2
14	920-149	397044458*	BRACKET . DAMPER	1

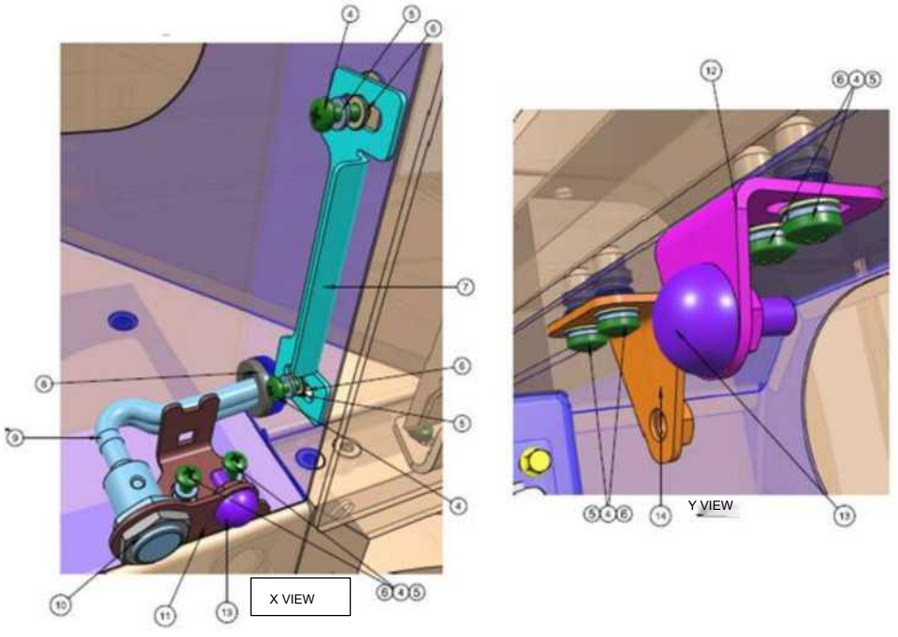
RIGHT CNG FUEL FILLING COVER BRACKETS MOUNTING



LEFT SIDE VIEW

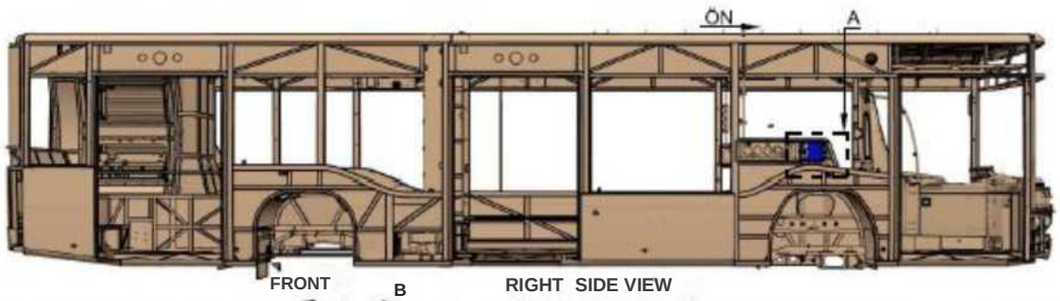


A VIEW

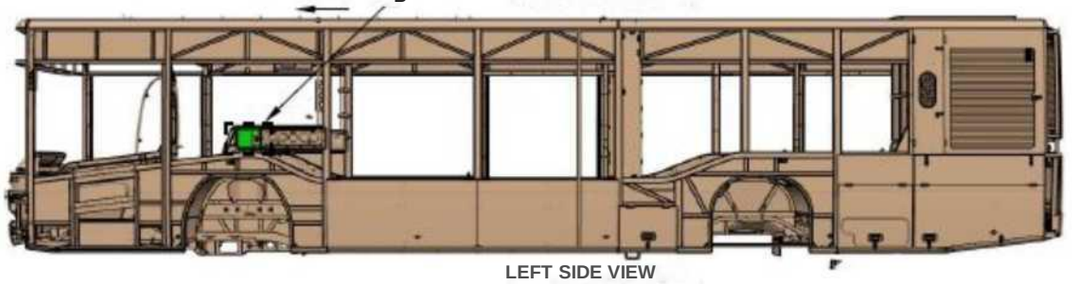


LEAF POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	920-147	387044476*	CLOSING. FUEL FILLING	1
2	920-162	387044460*	HINGE ASSEMBLY	1
3	920 - 088	3001205124'	BOLT , FLN M5X0.8X12, THICK D. DİN8921	4
4	920 - 167	3015005154'	SCREW. M5X15 DİN 7986	9
5	920-195	3010100054*	WASHER SPRINGY D=5 DIN 127	9
6	920-086	3010000054*	WASHER FLAT D=5 DİN125	9
7	920-050	307036068*	LOCK PROVISION	1
8	920-157	3888831580*	GROMMET	1
9	920-156	387038714"	SENSOR ASSEMBLY	1
10	920-207	3370473730'	NUT , SPECIAL THIN M1SX1	1
11	920-156	387045911*	BRACKET	1
12	920-143	387044457*	BRACKET . STOPPER	1
13	920-146	387001002*	RUBBER STOPPER ,SMALL	2
14	920 - 149	387044458*	BRACKET . DAMPER	1

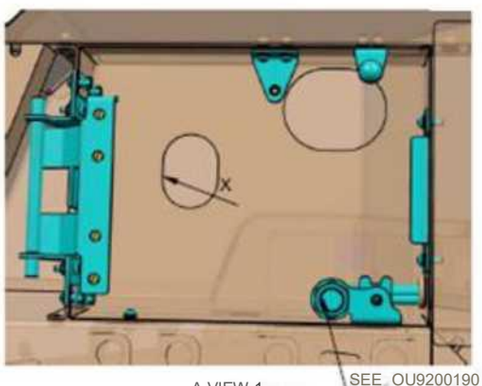
RIGHT -LEFT CNG FUEL MAINTENANCE COVERS INSTALLATION



RIGHT SIDE VIEW

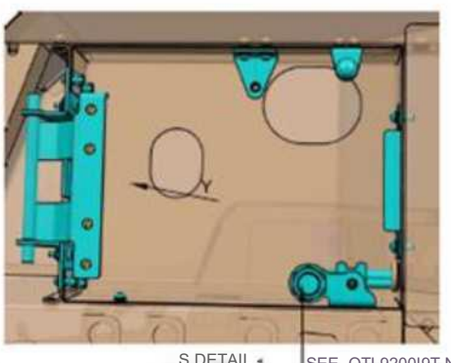


LEFT SIDE VIEW



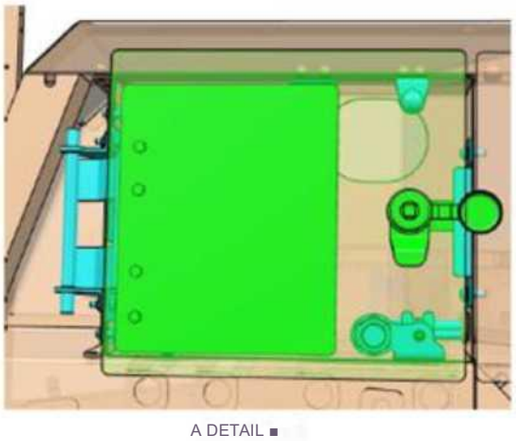
A VIEW 1

SEE OU9200190 NO. OPERATION LEAF

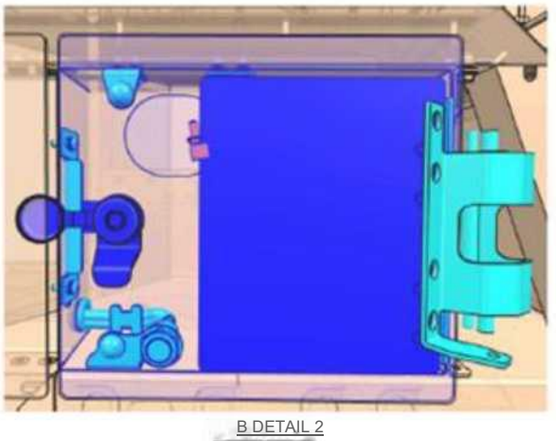


S DETAIL

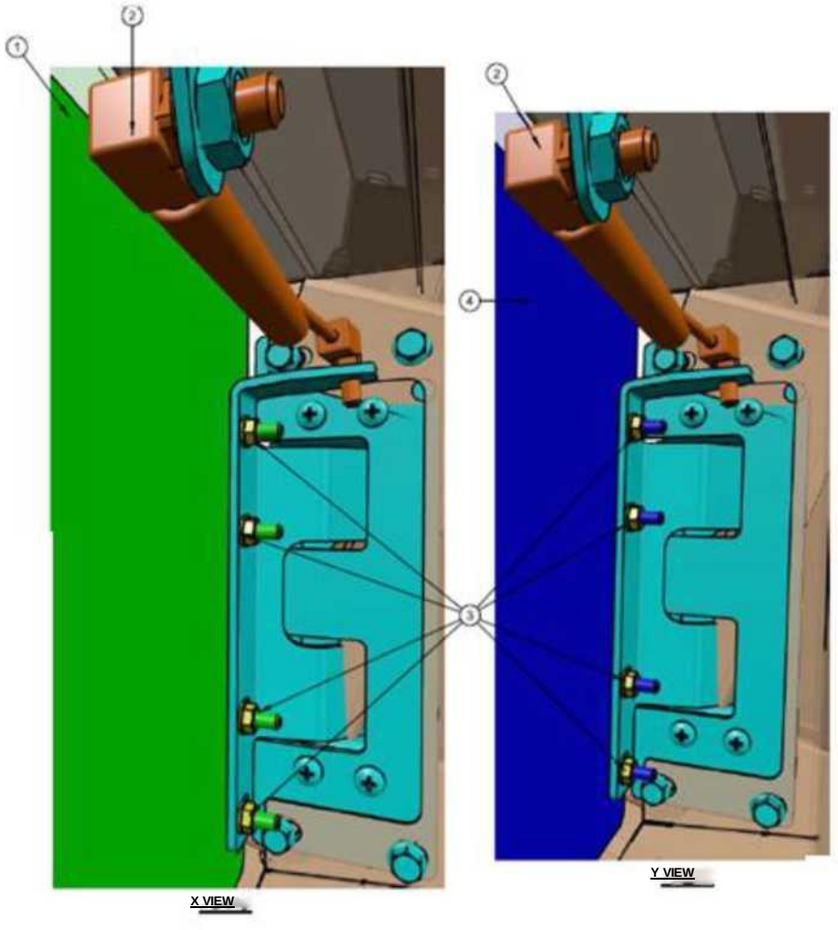
SEE OTL9200I9T NO. OPERATION LEAFLET



A DETAIL ■

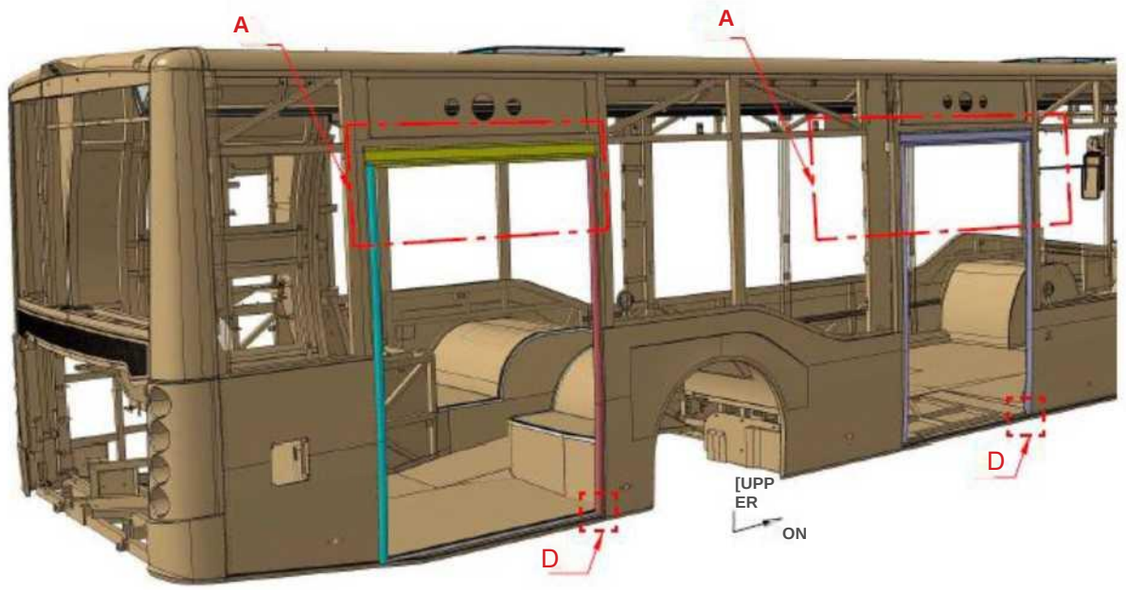


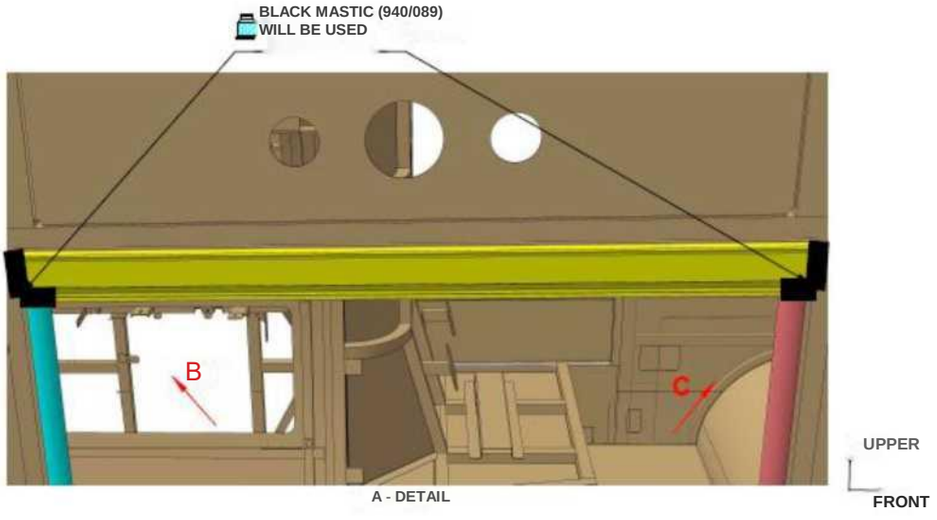
B DETAIL 2

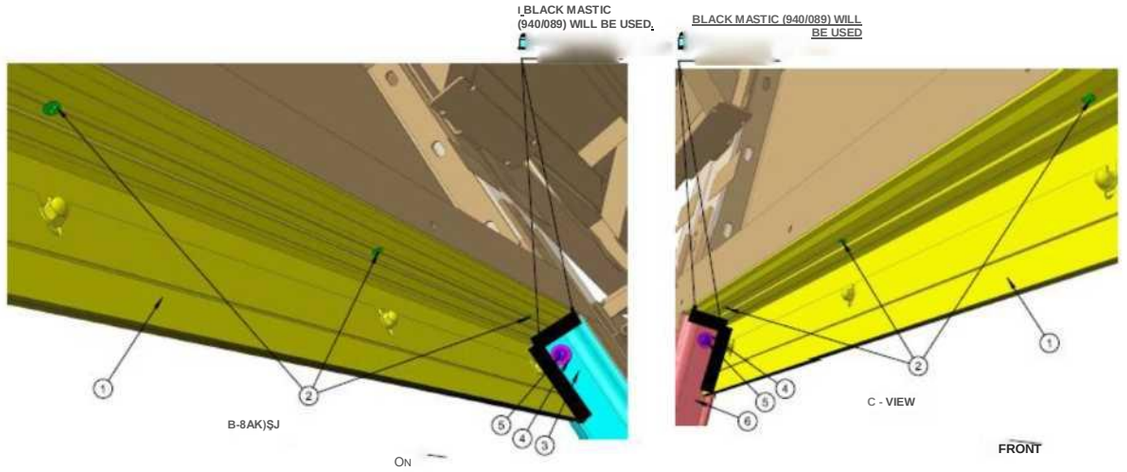


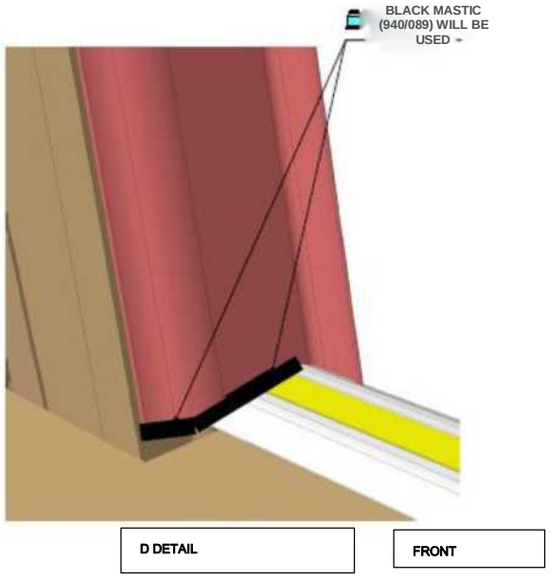
LEAFLET POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	920 - 141	307044404*	COVER FUEL FILLING	1
2	920 - 027	307031999'	DAMPER, TANK COVER	2
3	920 - 007	3005800054'	NUT . FLN&TR M5X0.3, THICK D. DIN6923	8
4	920 - 02D	387044198*	COVER. FUEL FILLING	1

REAR AND MIDDLE DOOR RAIN GUTTER PROFILE INSTALLATION



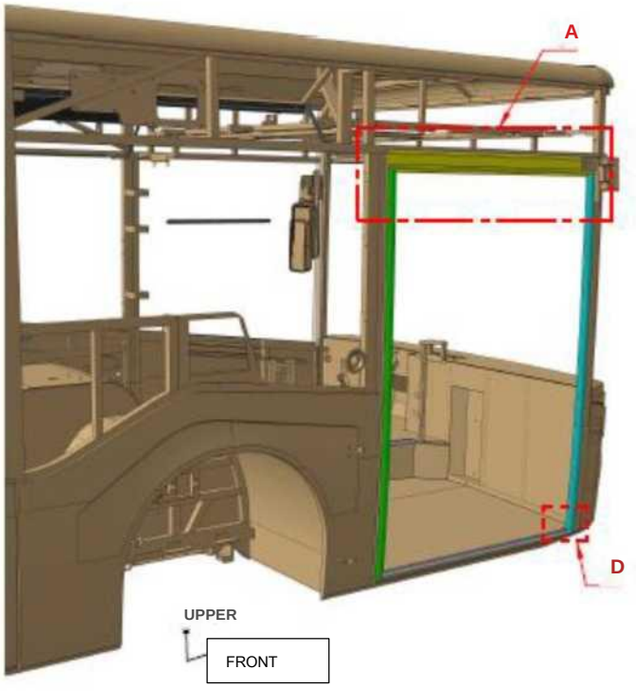


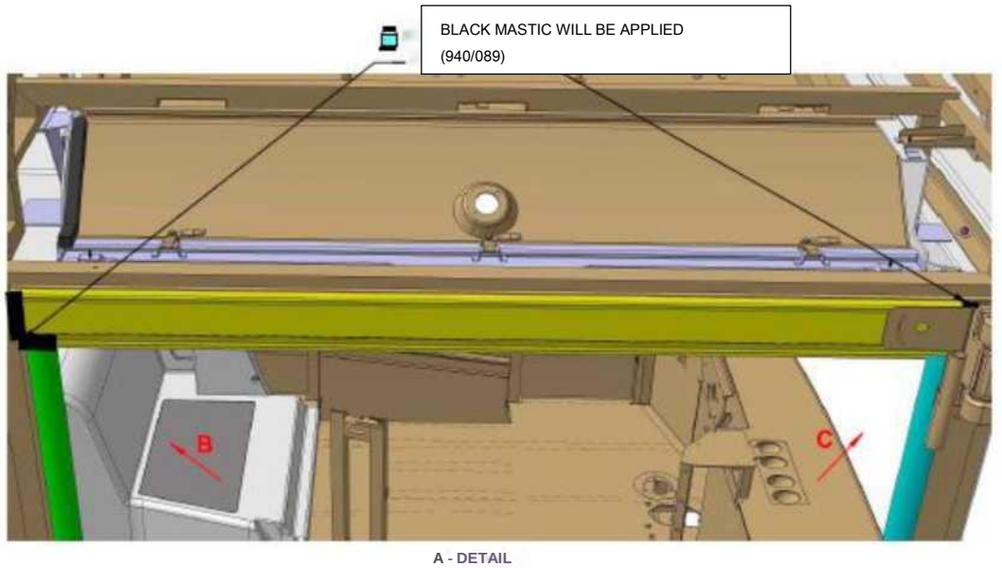




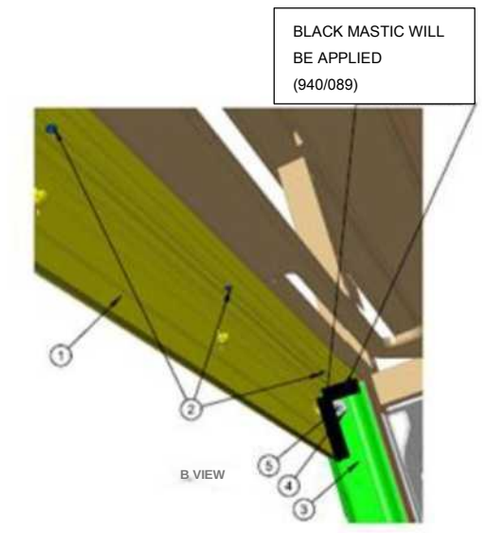
LEAFLET POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	923 - 001	307038212'	MACKINTOSH AND BRUSH ASSEMBLY	2
2	923 - 003	3018535163*	SCREW	12
3	923 - 000	307036094*	TIRE PROFILE, LEFT	2
4	923 - 024	3011100063*	WASHER , FLAT D=6 DİN 9021	4
5	923 - 022	3018948253*	SCREW	4
6	923 - 004	307036093'	TIRE PROFILE, RIGHT	2

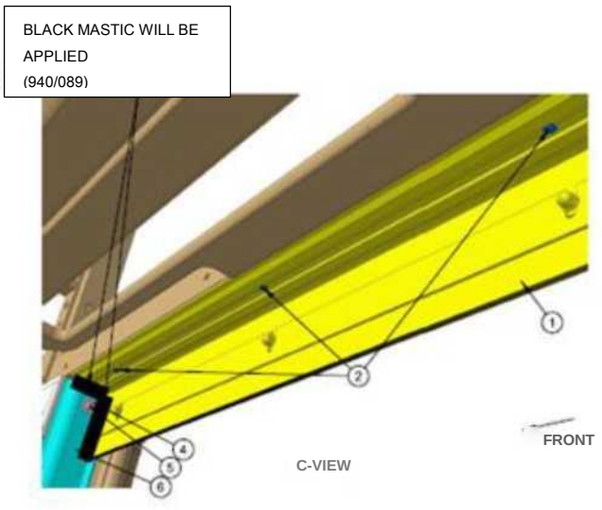
FRONT DOOR MACKINTOSH AND TIRE PROFILE MOUNTING

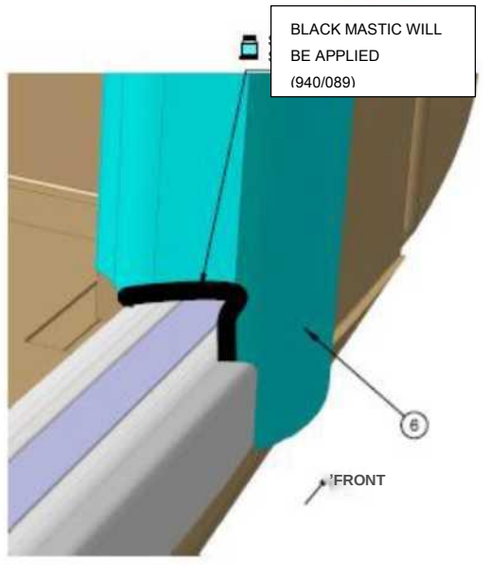




A - DETAIL

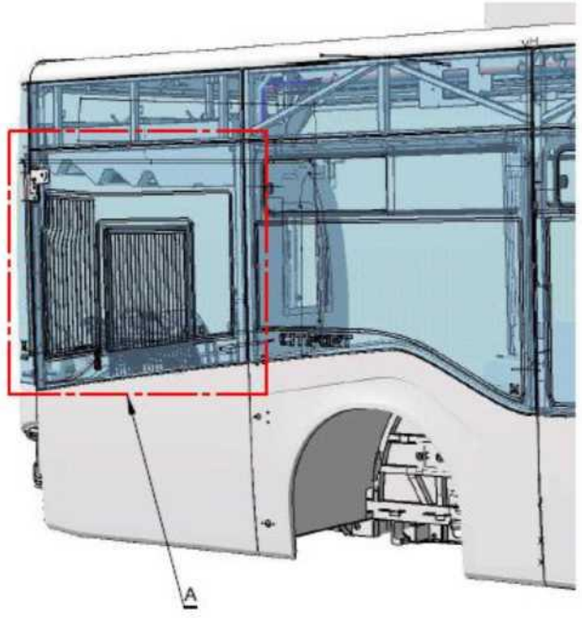


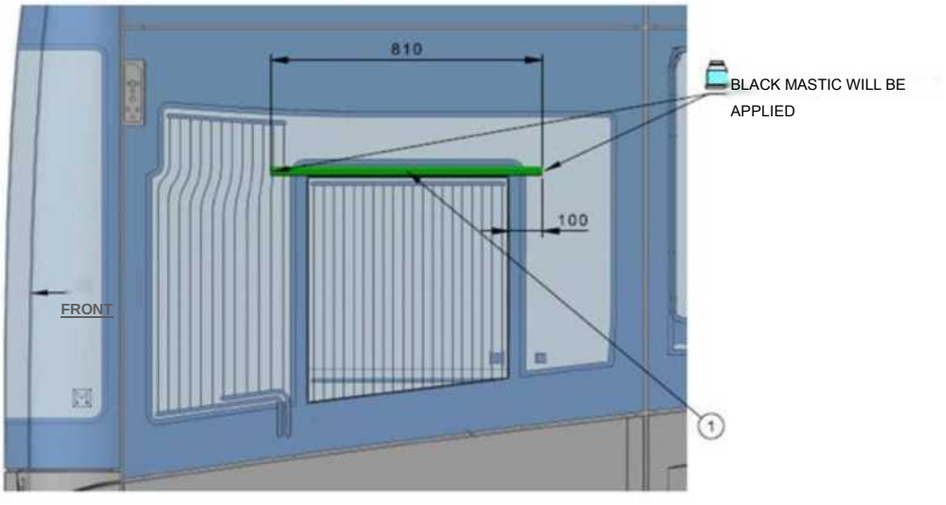




LEAFLET POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	923 - 002	387039049'	BRUSH ASSEMBLY , FRONT DOOR UP	1
2	923 - 003	3018535163*	SCREW	6
3	923 - 000	307036094'	TIRE PROFILE, LEFT	1
4	923 - 024	3011100063'"	**WASHER ,** FLAT D=6 DİN 9021	2
5	923 - 022	3018948253*	SCREW	2
6	923 - 004	307036093'	TIRE PROFILE, RIGHT	1

DRIVER GLASS RAIN TRUCK INSTALLATION

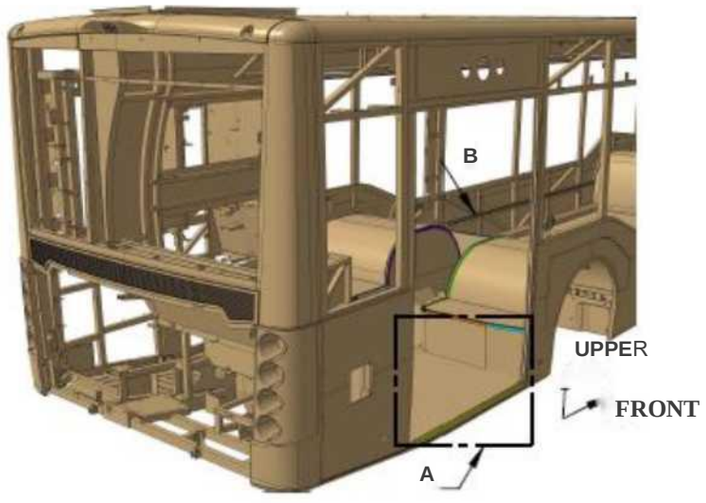


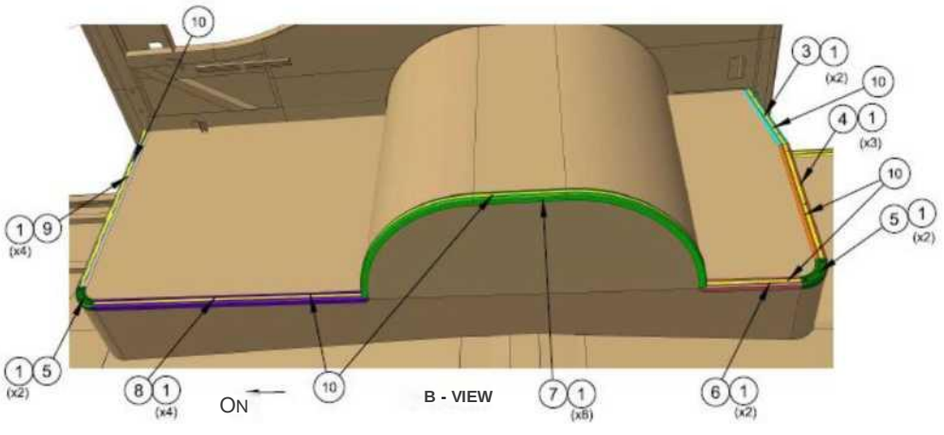


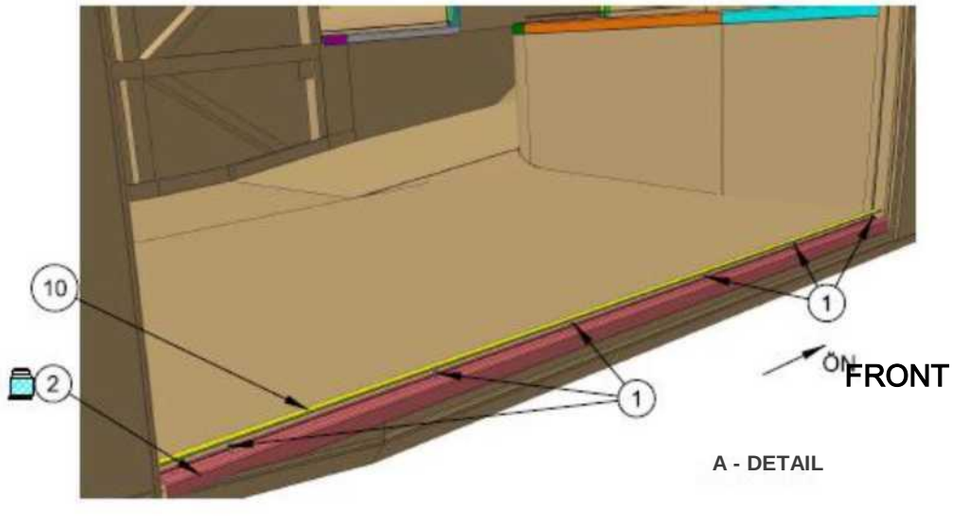
A DETAIL

LEAF POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	923 - 020	387022557*	RAIN TRUCK PROFILE, DRIVER GLASS	1

REAR DOOR AND REAR RIGHT-MOUNTED STEP MOLDING INSTALLATION

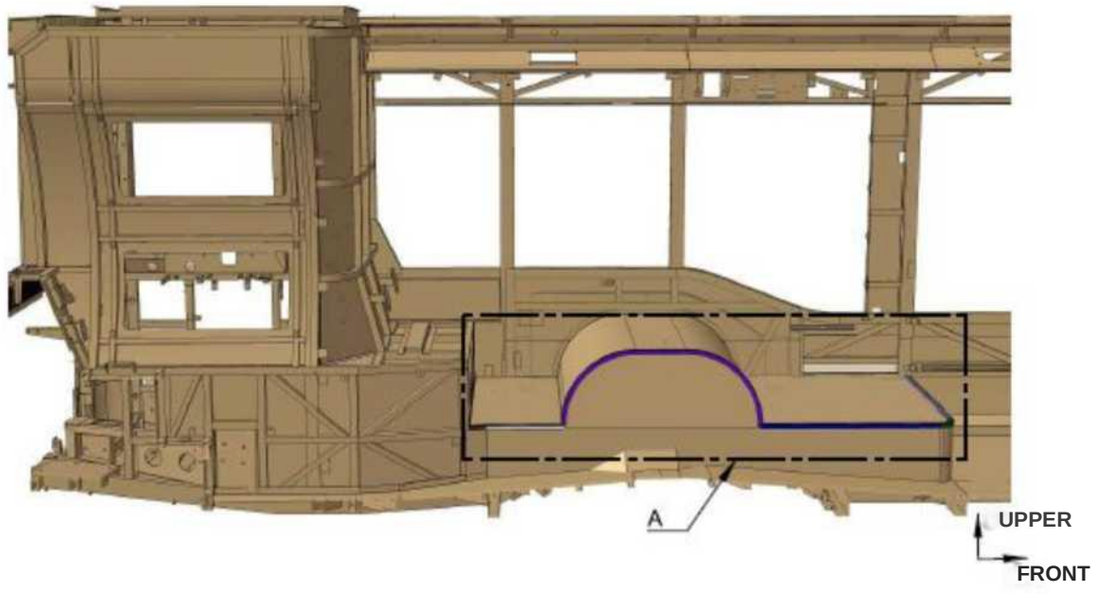


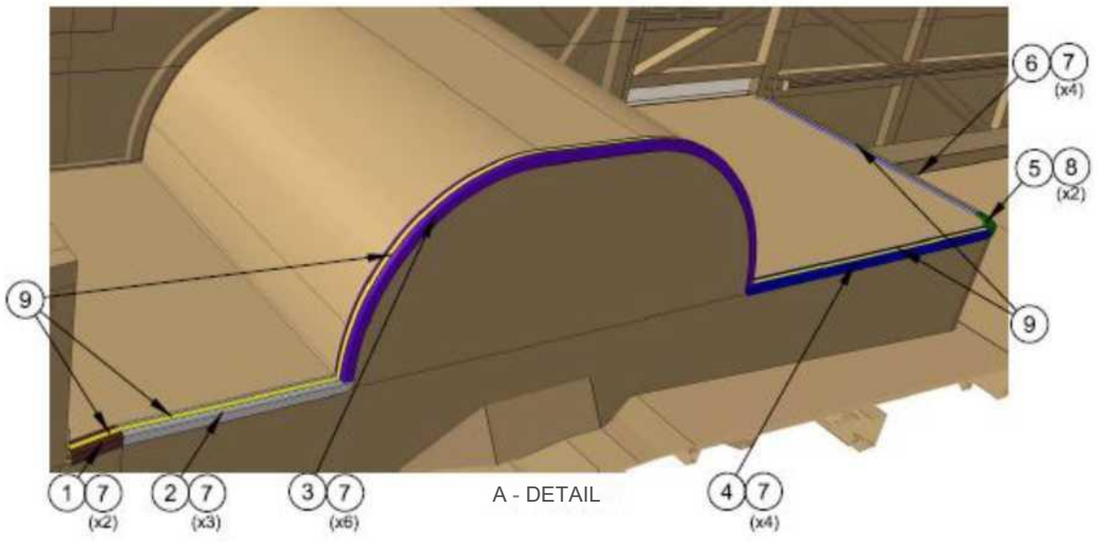




LEAFLET POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	924 - 012	3018529136'	SCREW 2,9x13 DİN 7983 WHITE	29
2	924 - 002	387038924*	STEP BAR , FRONT STEP	1
3	924-015	307038943*	STEP BAR , FRONT STEP	1
4	924 - 014	307038942*	STEP BAR , FRONT STEP	1
5	924 - 001	387036563'	PVC, CORNER CLOSING	2
6	924 - 007	387038936'	STEP BAR , FRONT STEP	1
7	924 - 010	387038940*	STEP BAR , WHEEL SIDE	1
8	924-005	307038934*	STEP BAR . FRONT STEP	1
9	924 - 004	307038929*	STEP BAR , FRONT STEP	1
10	924 - 920	3070531701*	PROFILE, PVC COVER	1

ASSEMBLY OF REAR LEFT WHEEL UPPER STEP BAR

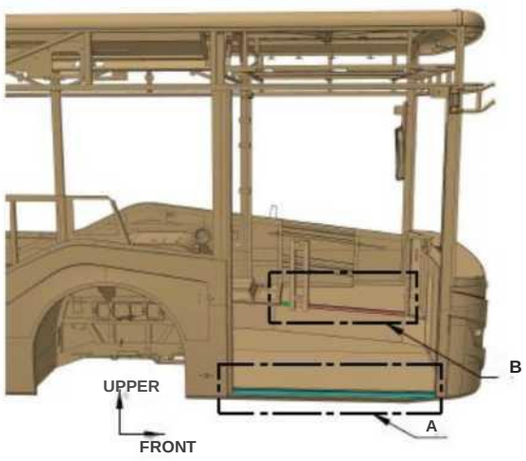


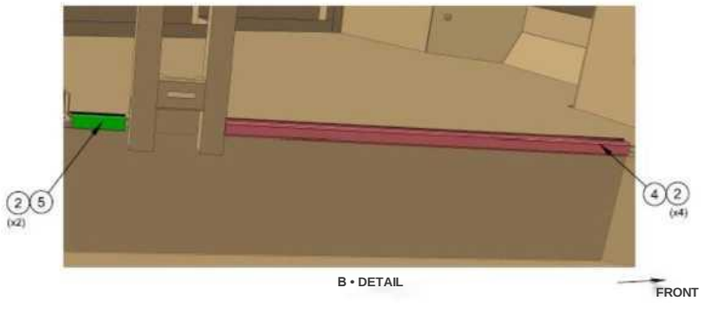


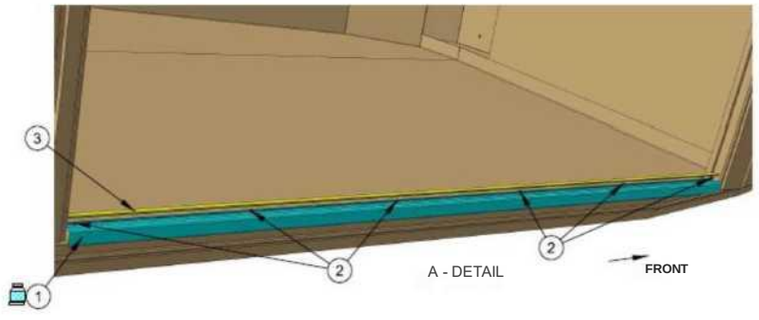
A - DETAIL

LEAFLET POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	924 -009	387038939'	STEP BAR , FRONT STEP	1
2	924-008	307039938*	STEP BAR . FRONT STEP	1
3	924-011	387039020*	STEP BAR WHEEL SIDE	1
4	924 - 006	387038935"	STEP BAR , FRONT STEP	1
5	924-001	307036563"	PVC, CORNER CLOSING	1
6	924 - 004	337038929"	STEP BAR , FRONT STEP	1
7	924-021	3010335134*	SELF-TAPPING SCREW 3,5x13	21
8	**924-012**	3018529136*	SCREW 2.9x13 DİN 7983 WHITE	**2**
9	924 - 930	387053170*	PVC COVER PROFILE	1

UNDER FRONT DOOR AND DRIVER CABIN STEP INSTALLATION

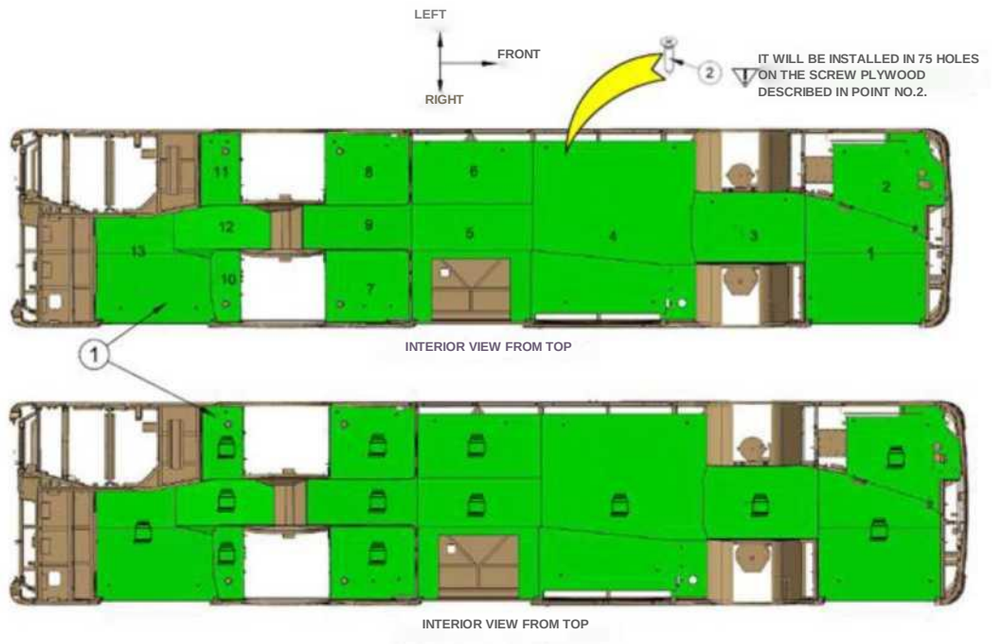






LEAF POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	924/013	387038941*	STEP BAR , FRONT DOOR DOWN	1
2	924/012	301852913*	SCREW 2,9x13 DİN 7983 WHITE	12
3	924/S30	387053170*	PVC COVER PROFILE	1
4	924/036	387051099*	FRONT LATCH STEP	1
5	924/037	387051100*	FRONT LATCH STEP	1

FLOOR PLATES AND VEHICLE INSTALLATION



CHECK ALL THE PLYWOOD AND KNEE INTO THE VEHICLE WITH RIGHT AND LEFT SHAPE.

CLEAR CHECOMASTIC OVERFLOWS IN VEHICLE. CLEAN INTERIOR BY HOLDING AIR.

195 GRAY OR ALTERNATIVE MASTIC DRIVE ON SURFACES TO BE ADHESIVE.

PLACE THE PLYWOOD ONE BY ONE.

CHECK THE SMOOTHNESS AND PARALLELNESS OF THE PLYWOOD.

2

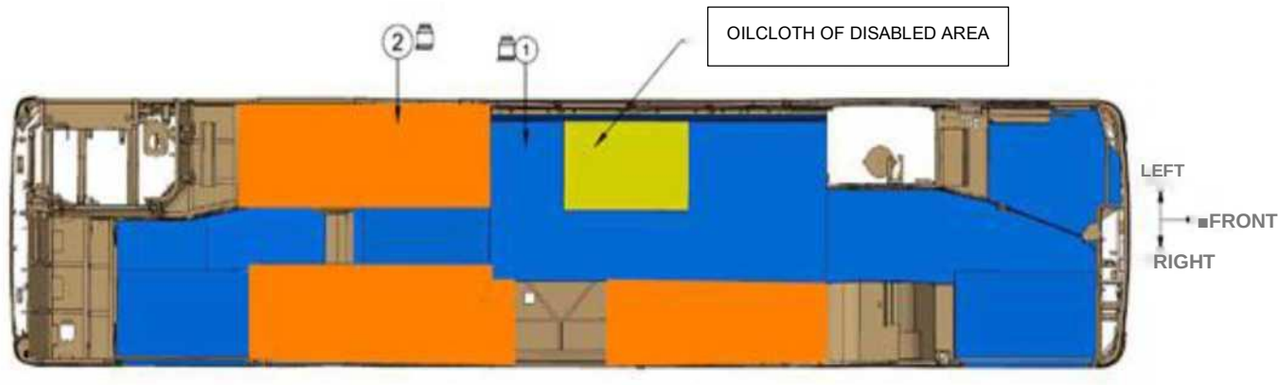
DRILLING AND SCREWING PLATES, 03 8 WITH DRILL.

MAKE THE STAGE DIFFERENCE WITH PASTE + SANDING WHERE THERE IS A DIFFERENCE.

NOTE: PLANTS 1-13 CREATE INSTALLATION IN POSITION 1.

LEAFLET POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	926-001	387035419*	PLYWOOD. BASE	1
1	926-001	387056825*	PLYWOOD BASE QNG VEHICLE	1
2	926-035	3870554550*	SCREW, 4.2X30 FINNED	230

OILCLOTH VEHICLE INSTALLATION

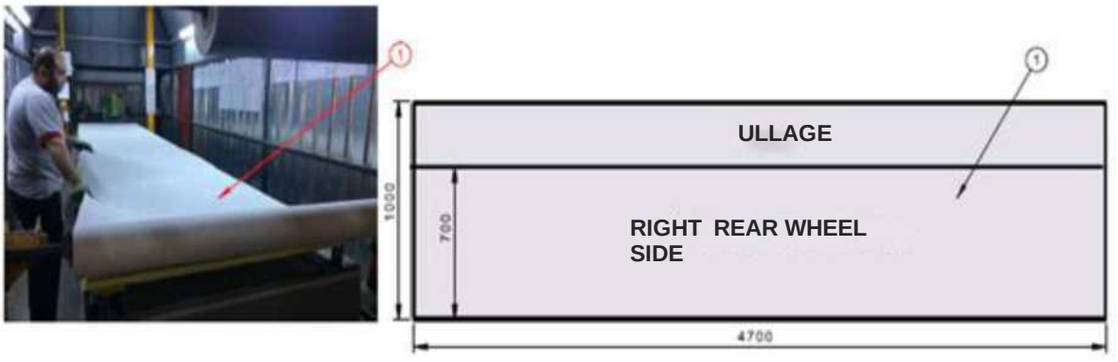


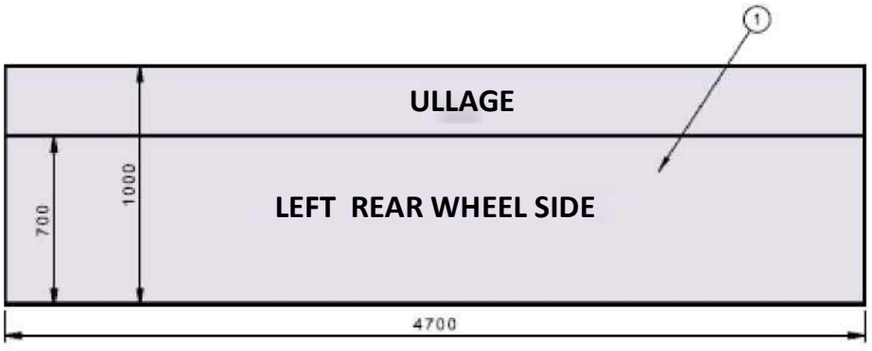
SECTIONAL VIEW ON THE VEHICLE

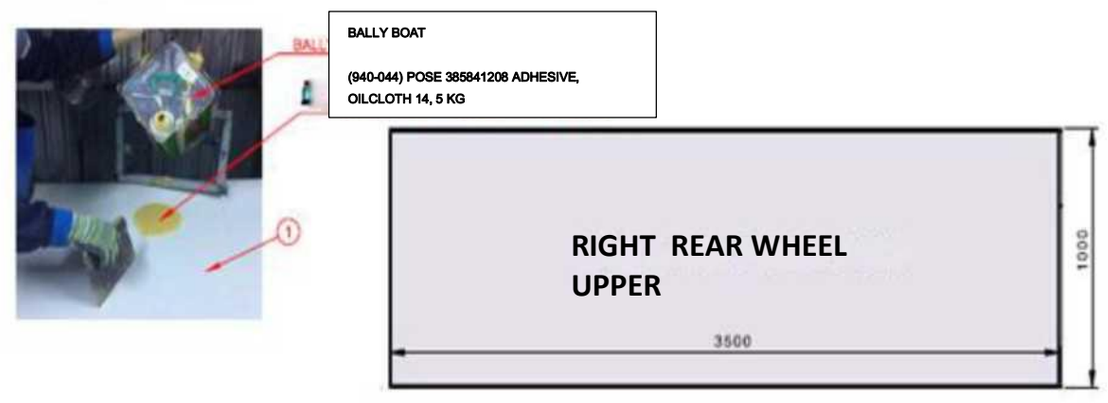
AFTER COMPLETING THE INSTALLATION OF THE PLYWOOD, APPLY BALI TO THE PLATE AND THE BOTTOM OF THE BOWL. (940/044)

LEAF POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	926-002	387042920*	OILCLOTH	1
2	926 - 003	387051084*	OILCLOTH	1

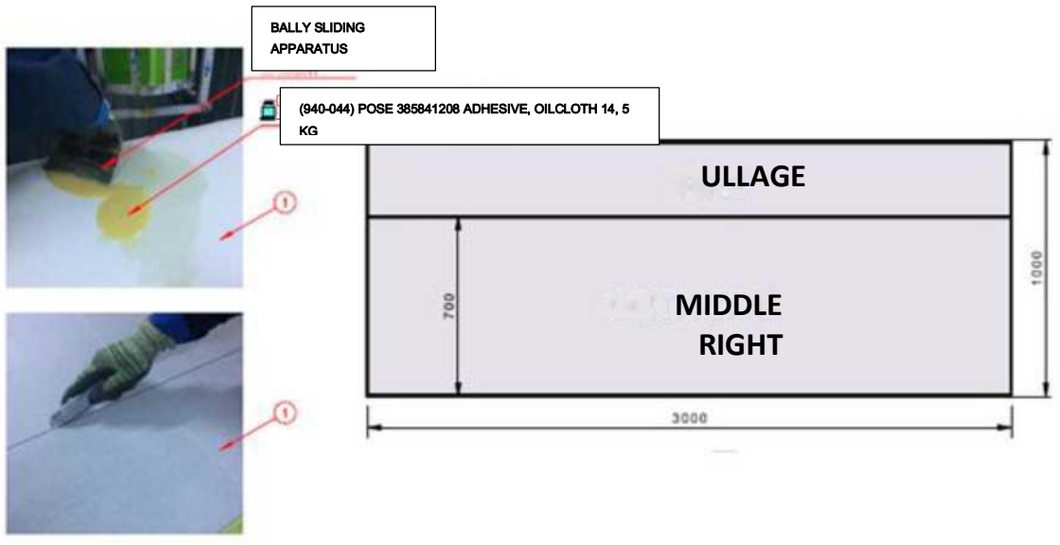
OILCLOTH PREPARATION

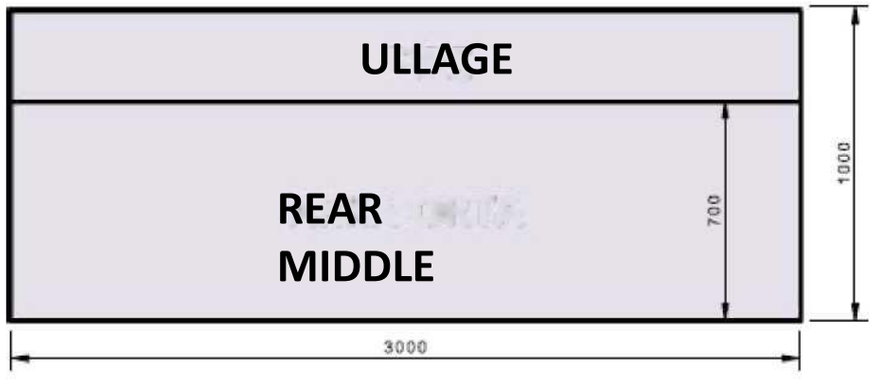



1
ULLAGE
LEFT REAR WHEEL SIDE
700
1000
4700


BALLY BOAT
(940-044) POSE 385841208 ADHESIVE, OILCLOTH 14, 5 KG
1
RIGHT REAR WHEEL UPPER
1000
3500


LEFT REAR WHEEL UPPER
1000
3500

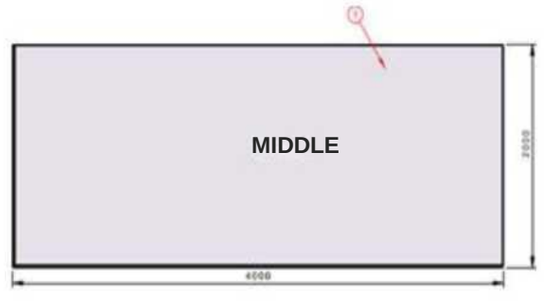




- MAKE SURE YOU MEASURE THE SIZE CORRECTLY
- OILCLOTHS COME AS A STANDARD WITH SPECIFIED 1000 MM SIZE.
- MAKE SURE YOUR BALLY IS SPREADED EVERYWHERE IN A THIN LAYER SHAPED AND MAKE SURE THAT OILCLOTH IS NOT WRINKLED.

LEAFLET POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	926-002	307042920*	OILCLOTH	1
1	926 - 002	387452237*	OILCLOTH , GERFLOR DIGITAL PRINTING 441L60	1







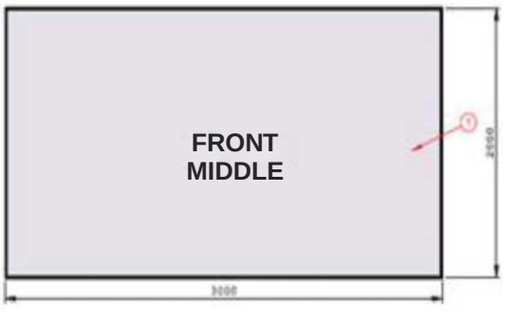
BALLY BOAT

(940-044) POSE 385841208 ADHESIVE, OILCLOTH 14, 5 KG



BALLY GLAIRING APPARATUS

(940-044) POSE 385841208 ADHESIVE, OILCLOTH 14, 5 KG

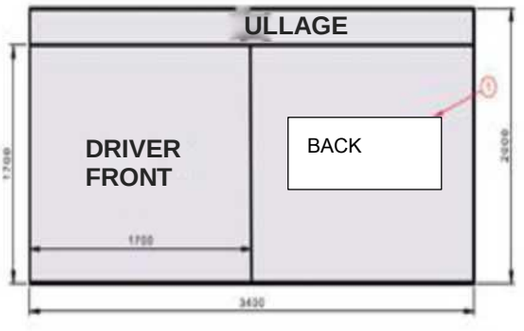




MAKE SURE YOU MEASURE THE SIZE CORRECTLY

• OILCLOTHS COME AS A STANDARD WITH SPECIFIED 1000 MM SIZE.

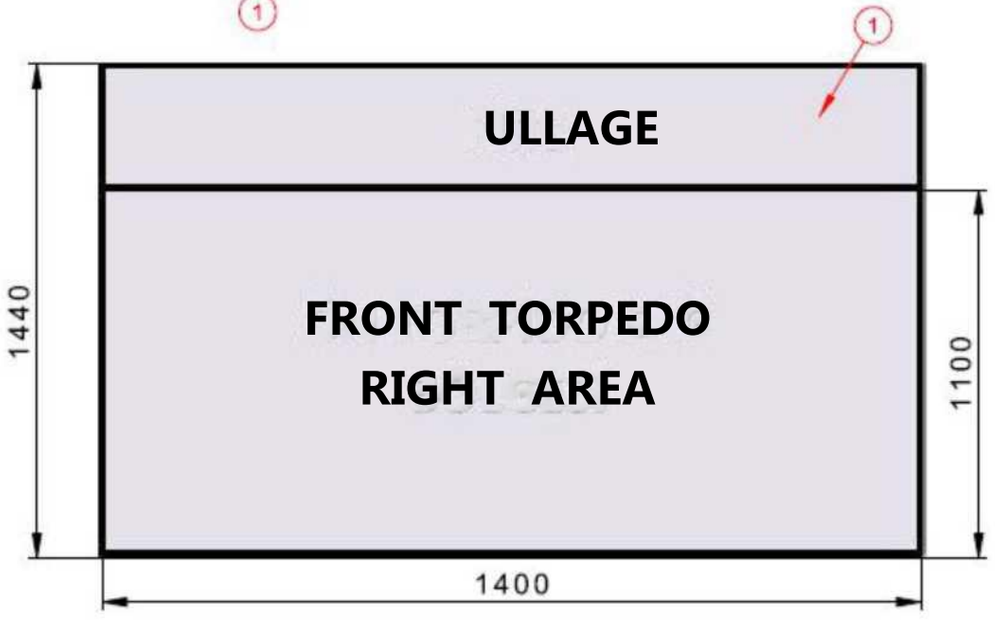
■MAKE SURE YOUR BALLY IS SPREADED EVERYWHERE IN A THIN LAYER SHAPED AND MAKE SURE THAT OILCLOTH IS NOT WRINKLED

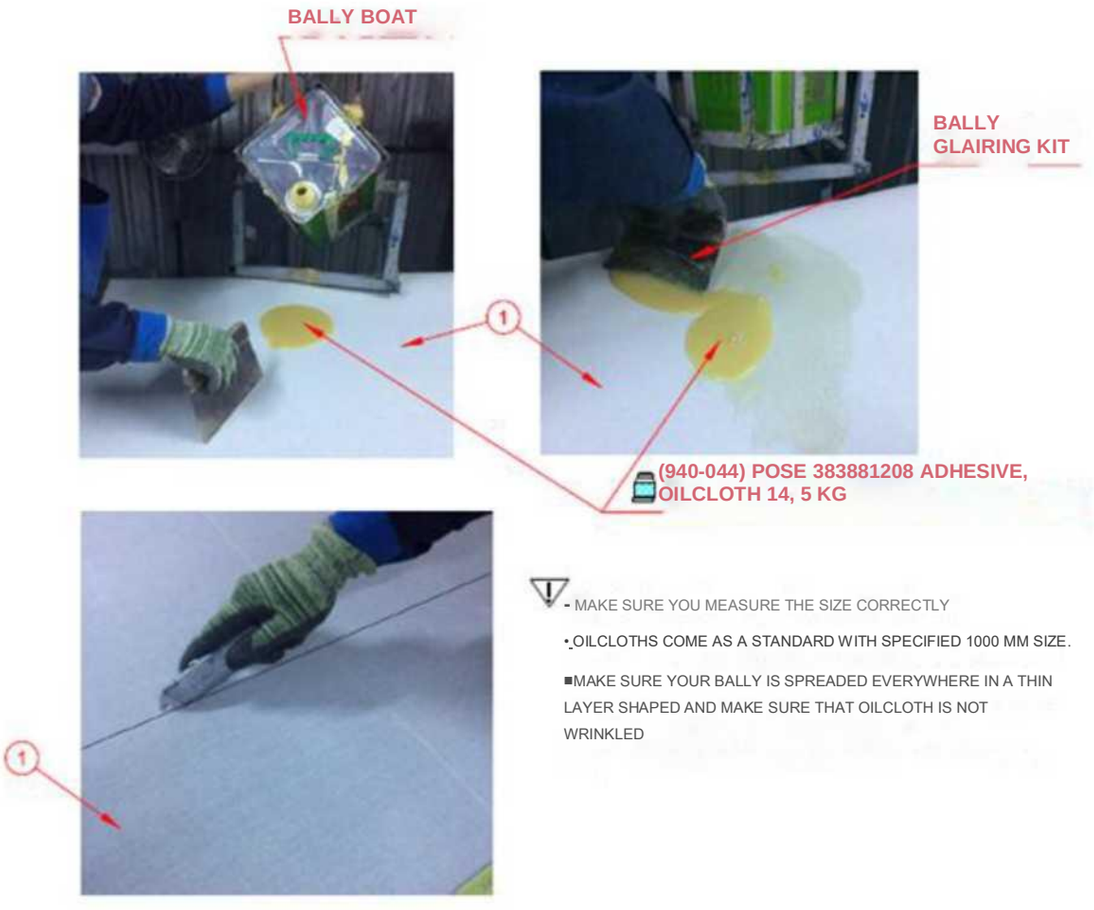


LEAF POSE	GROUP/'POSE	PART NO	COMPONENT'S NAME	NUMBER
1	926-003	387051084*	OILCLOTH	1

FRONT TORPIDO RIGHT ZONE ARTIFICIAL LEATHER PREPARATION







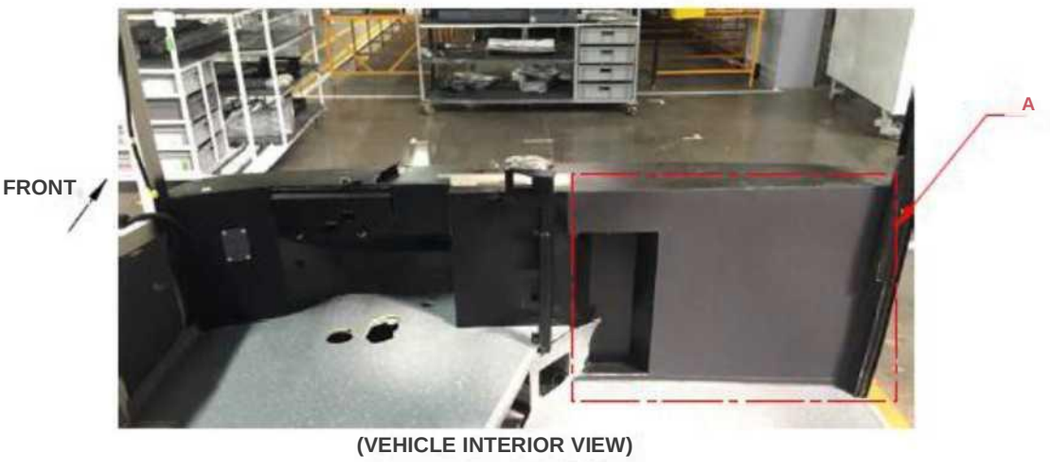
- MAKE SURE YOU MEASURE THE SIZE CORRECTLY

• OILCLOTHS COME AS A STANDARD WITH SPECIFIED 1000 MM SIZE.

■MAKE SURE YOUR BALLY IS SPREADED EVERYWHERE IN A THIN LAYER SHAPED AND MAKE SURE THAT OILCLOTH IS NOT WRINKLED

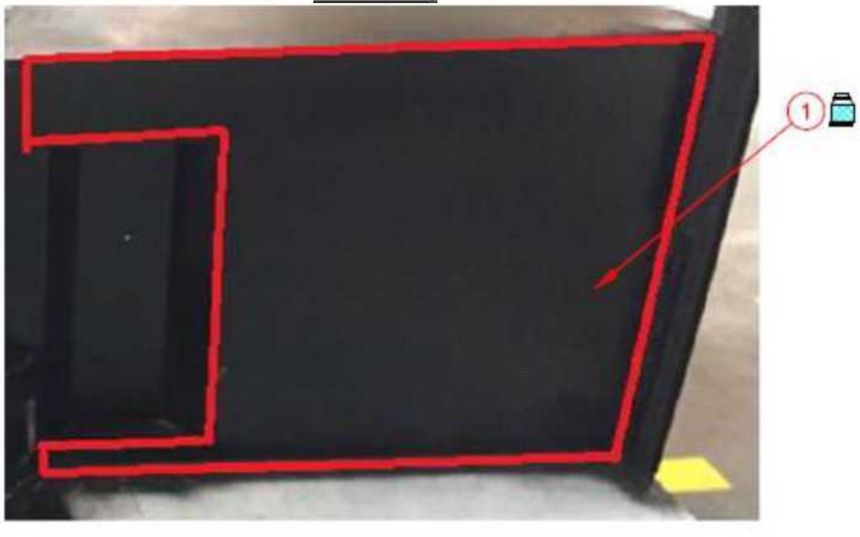
LEAF POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	926-010	388888887*	FAUX LEATHER	1.5M

ARTIFICIAL LEATHER INSTALLATION ON THE BACK OF THE VEHICLE TORPIDO



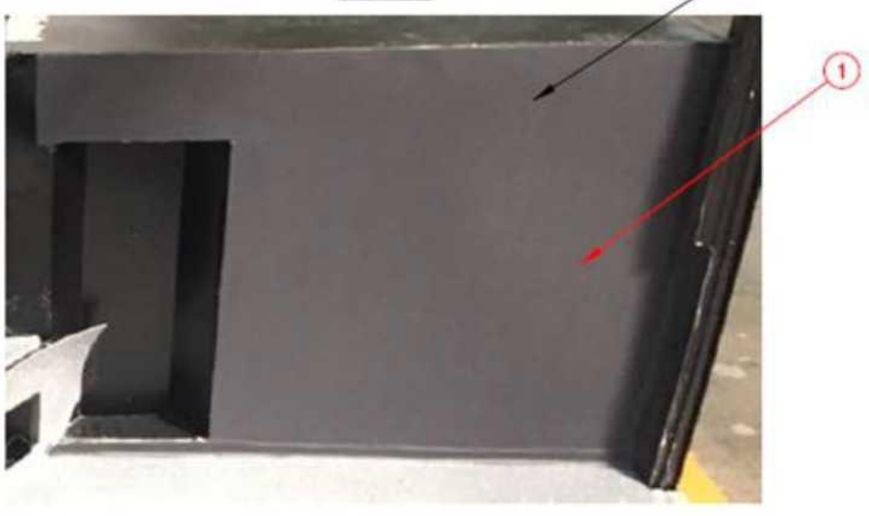
(VEHICLE INTERIOR VIEW)

DETAIL A
(BEFORE MOUNTING)



FOR ARTIFICIAL LEATHER PREPARATION PROCESS, SEE NO. OTF926001500 OPERATIONAL LEAF

DETAIL A



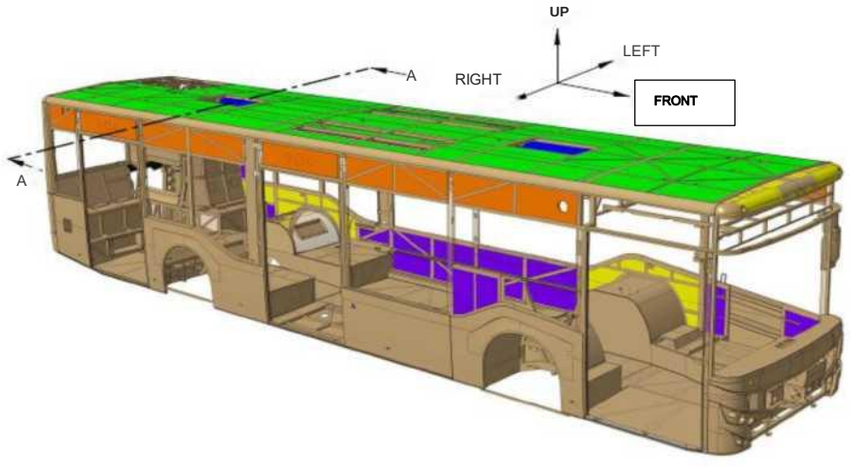
1) **MAKE SURE YOUR BALLY IS SPREADED EVERYWHERE IN THE SHAPE OF A THIN LAYER, EVEN AND STRAIGHT, AND WAIT FOR 5 MINUTES AFTER LASTING**

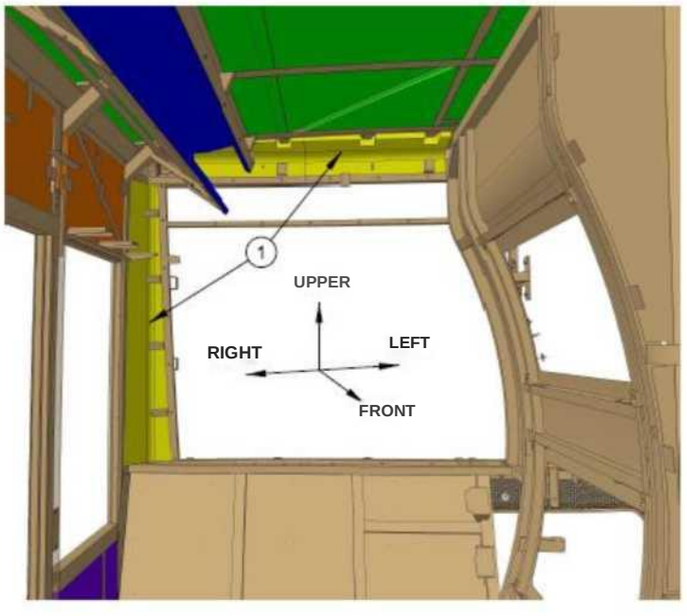
2) **MAKE SURE THAT OILCLOTH IS NOT WRINKLED.**

3) **WEAR NON-CUT GLOVES WHILE WORKING.**

LEAF POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	926-010	388888887*	FAUX LEATHER	1,5 M
1	926 - 044	3888812080*	ADHESIVE, OILCLOTH(UNITK62)14, 5KG.	0.5 KG

REAR PANEL ISOLATION INSTALLATION

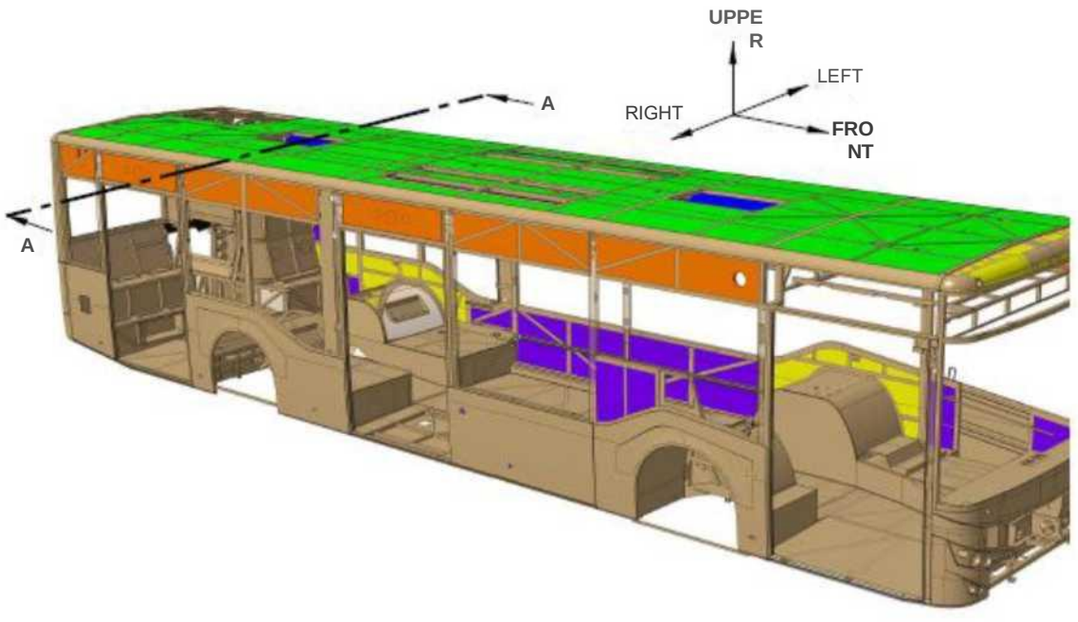


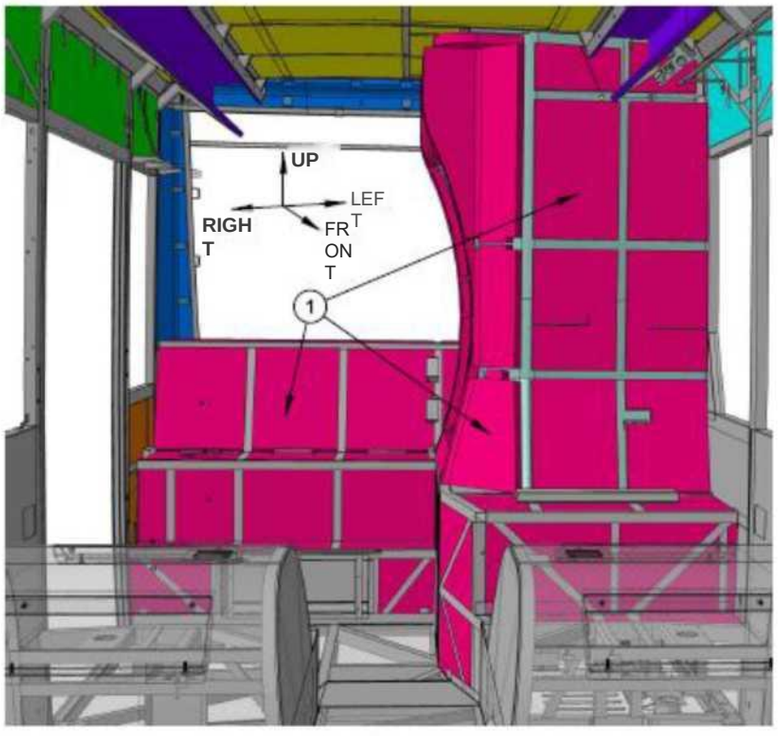


SECTION A - A

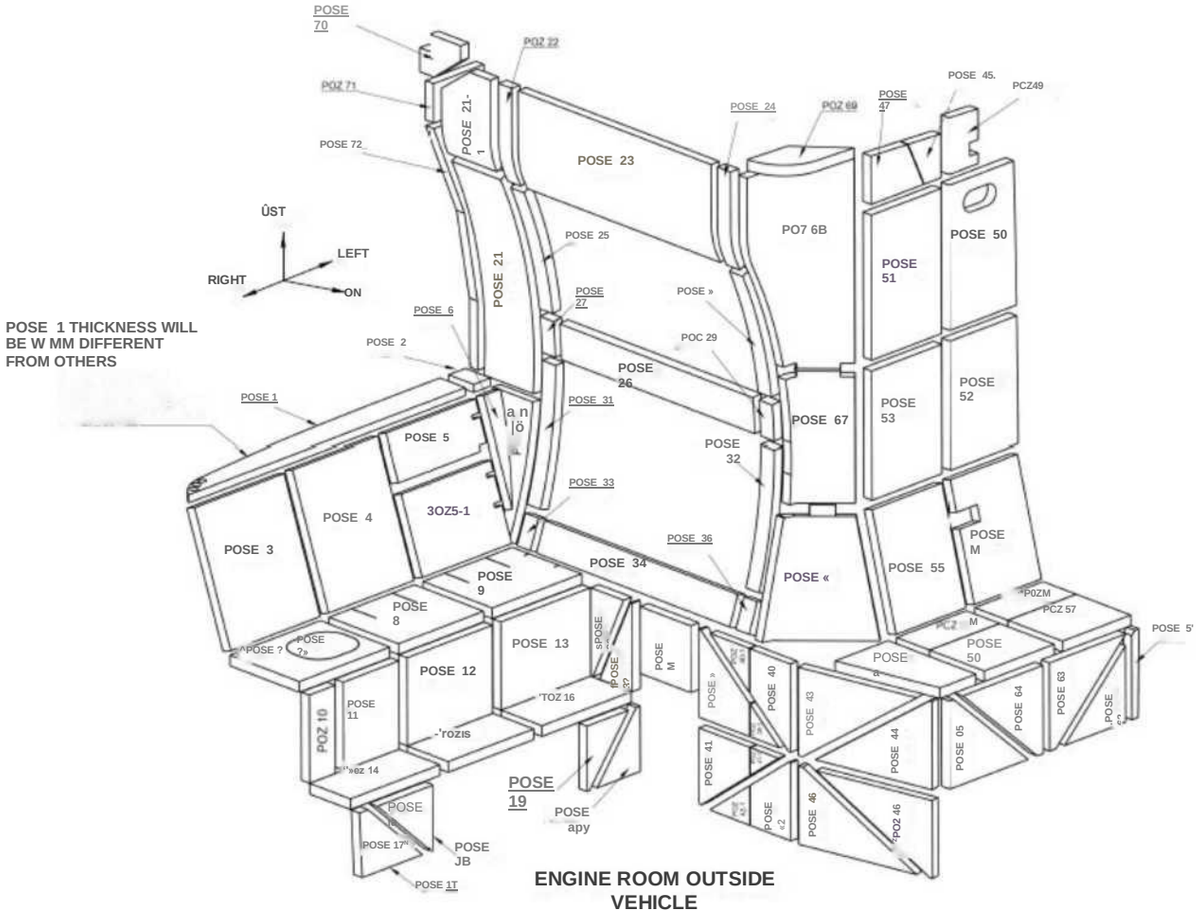
LEAF POSE	GROUP/POSE	PART NO	COMPONENT'S NAME
1	927 - 003	387038374*	ISOLATION SET, ON REAR GLASS

INSULATION INSTALLATION OUTSIDE OF ENGINE ROOM



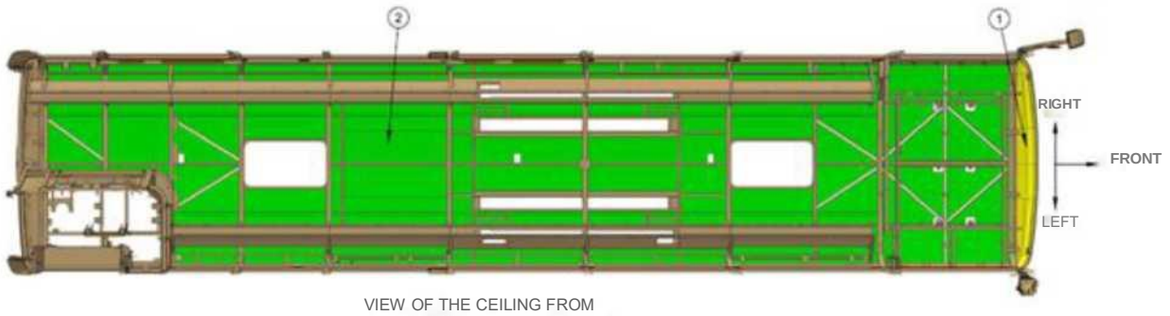


SECTION A - A



LEAF POSE	GROUP/POSE	PART NO	COMPONENT'S NAME
1	927-012	387034624*	ISOLATION SET. ENGINE ROOM OUTSIDE

CEILING ISOLATION MOUNTING



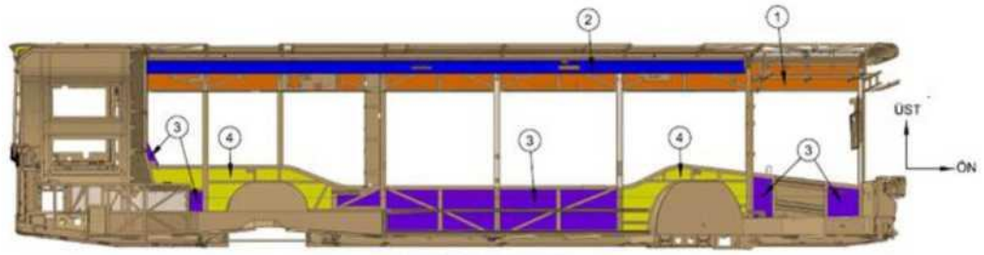
VIEW OF THE CEILING FROM THE VEHICLE

NOTE

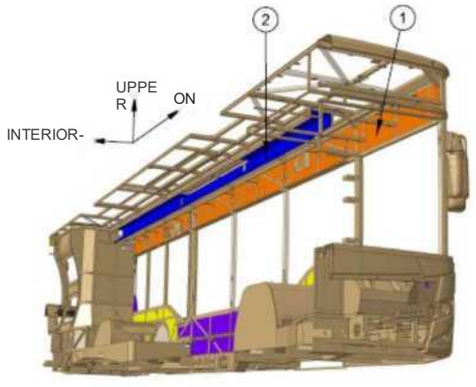
- ① FOR DETAIL LAYOUT OF 1 NUMBER ISOLATION SET ON VEHICLE, REFER TO 387038373 * NUMBER TECHNICAL PICTURE.
- ② FOR DETAIL LAYOUT OF NUMBER 2 ISOLATION SET ON VEHICLE, REFER TO NUMBER 387035356 TECHNICAL PICTURE
- ② FOR DETAIL LAYOUT OF 2 NUMBER ISOLATION SET ON VEHICLE, REFER TO 387043807 * NUMBER TECHNICAL PICTURE.

LEAF POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	927-001	387038373*	ISOLATION SET, ON FRONT WINDOW	1
2	927-002	387043967*	ISOLATION SET, CEILING	1
2	927-002	387035356*	ISOLATION SET, CEILING	1

LEFT SIDE PANEL INSULATION MOUNTING



LEFT SIDE PANEL INSIDE VIEW

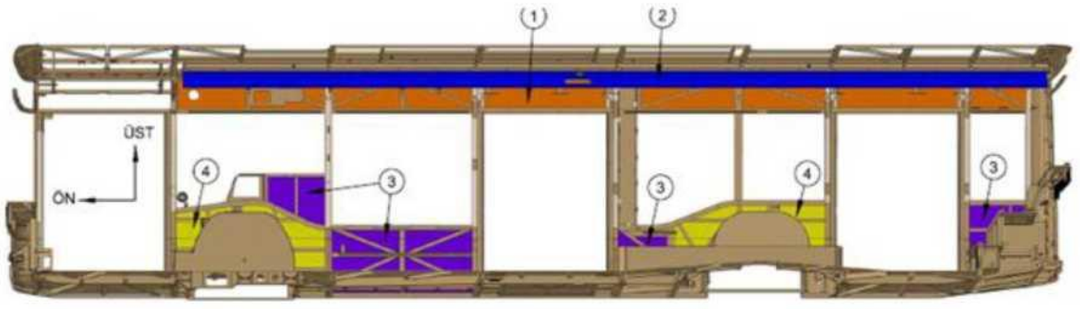


NOTE:

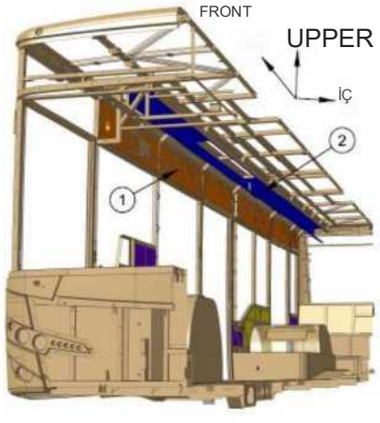
- (1) FOR DETAIL LAYOUT OF 1 NUMBER ISOLATION SET ON VEHICLE, REFER TO 387034628 * NUMBER TECHNICAL PICTURE.
- (1) FOR DETAIL LAYOUT OF 1 NUMBER ISOLATION SET ON VEHICLE, REFER TO 387045356 * NUMBER TECHNICAL PICTURE.
- (2) FOR DETAIL LAYOUT OF 2 NUMBER ISOLATION SET ON VEHICLE, REFER TO 387034929 * NUMBER TECHNICAL PICTURE.
- (2) FOR DETAIL LAYOUT OF 2 NUMBER ISOLATION SET ON VEHICLE, REFER TO 387044487 * NUMBER TECHNICAL PICTURE.
- (3) FOR DETAIL LAYOUT OF 3 NUMBER ISOLATION SET ON VEHICLE, REFER TO 387034626 * NUMBER TECHNICAL PICTURE.
- (4) FOR DETAIL LAYOUT OF 4 NUMBER ISOLATION SET ON VEHICLE, REFER TO 387047362 * NUMBER TECHNICAL PICTURE.

LEAF POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	927-005	387034628*	ISOLATION SET, LEFT SIDE PANEL UPPER	1
1	927-005	387045356*	ISOLATION SET, LEFT SIDE PANEL UPPER	1
2	927-008	387034629*	ISOLATION SET, INSIDE THE AIR CHANNEL	1
2	927-006	387044487*	PANEL, ISOLATION	1
3	927 - 007	387034626'	ISOLATION SET. LEFT SIDE PANEL DOWN	1
4	927-009	387047362*	ISOLATION SET, WHEEL UPPER SIDE PANELS	1

RIGHT SIDE PANEL INSULATION INSTALLATION



RIGHT SIDE PANE LINSIDE LOOK

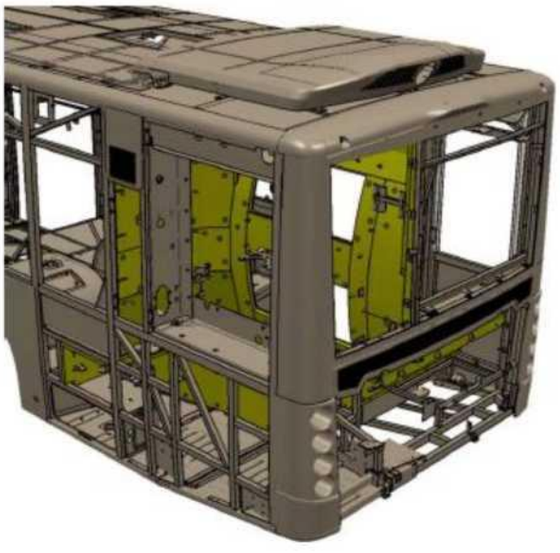


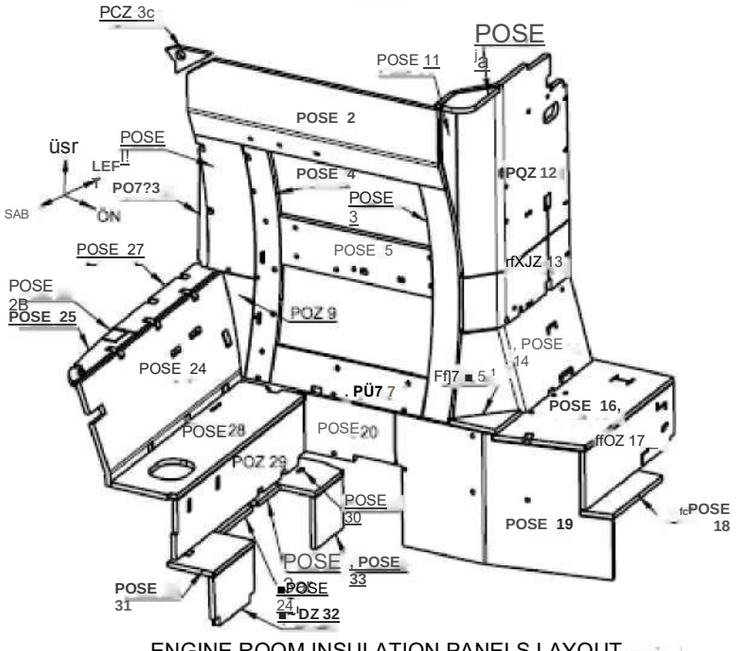
NOT:

- (1) FOR DETAIL LAYOUT OF 1 NUMBER ISOLATION SET ON VEHICLE, REFER TO 387034627 * NUMBER TECHNICAL PICTURE
- (1) FOR DETAIL LAYOUT OF 1 NUMBER ISOLATION SET ON VEHICLE, REFER TO 387044567 * NUMBER TECHNICAL PICTURE.
- (2) FOR DETAIL LAYOUT OF 2 NUMBER ISOLATION SET ON VEHICLE, REFER TO 387044487 * NUMBER TECHNICAL PICTURE
- (2) FOR DETAIL LAYOUT OF 2 NUMBER ISOLATION SET ON VEHICLE, REFER TO 387034629 * NUMBER TECHNICAL PICTURE
- (3) FOR DETAIL LAYOUT OF 3 NUMBER ISOLATION SET ON VEHICLE, REFER TO 387034625 * NUMBER TECHNICAL PICTURE
- (4) FOR DETAIL LAYOUT OF 4 NUMBER ISOLATION SET ON VEHICLE, REFER TO 387047362 * NUMBER TECHNICAL PICTURE.

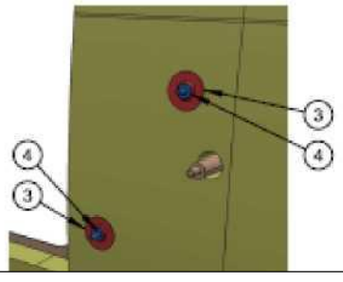
LEAF POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	927 - 004	387034627*	ISOLATION SET, RIGHT SIDE PANEL UPPER	1
1	927 - 004	387044567*	PANEL, ISOLATION	1
2	927 - 008	387044487*	PANEL, ISOLATION	1
2	927 - 008	387034629*	ISOLATION SET. INSIDE THE AIR CHANNEL	1
3	927 - 006	387034625*	ISOLATION SET. RIGHT SIDE PANEL DOWN	1
4	927 - 009	387047362*	ISOLATION SET, WHEEL UPPER SIDE PANELS	1

INSULATION INSTALLATION IN THE ENGINE ROOM

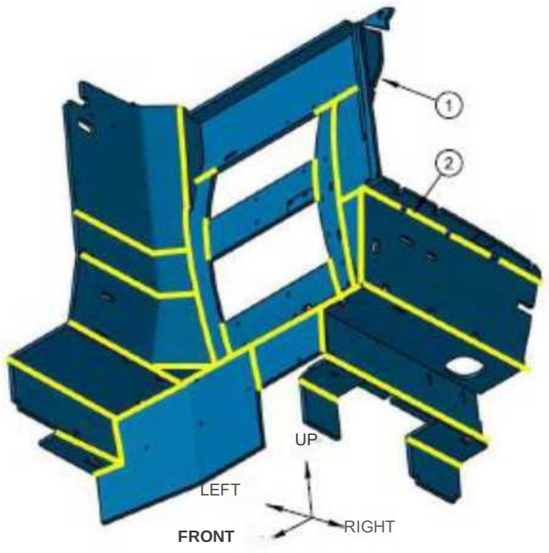




ENGINE ROOM INSULATION PANELS LAYOUT



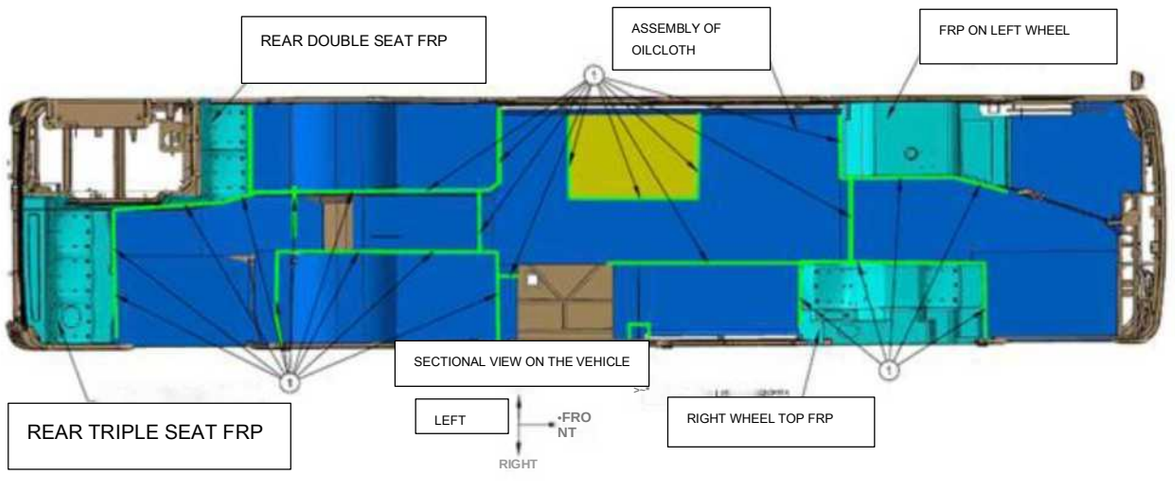
NOTE: IF THE INTERIOR INSULATION OF THE ENGINE ROOM 1 HAS SAGGED, FIX IT WITH THE WASHER PVE SMART SCREW NO 3.



2 POSITIONED BANDS WILL BE DRAWN TO THE INNER SIDE OF THE INSULATION WITH 1 POSITION AS SEEN IN FIGURE.

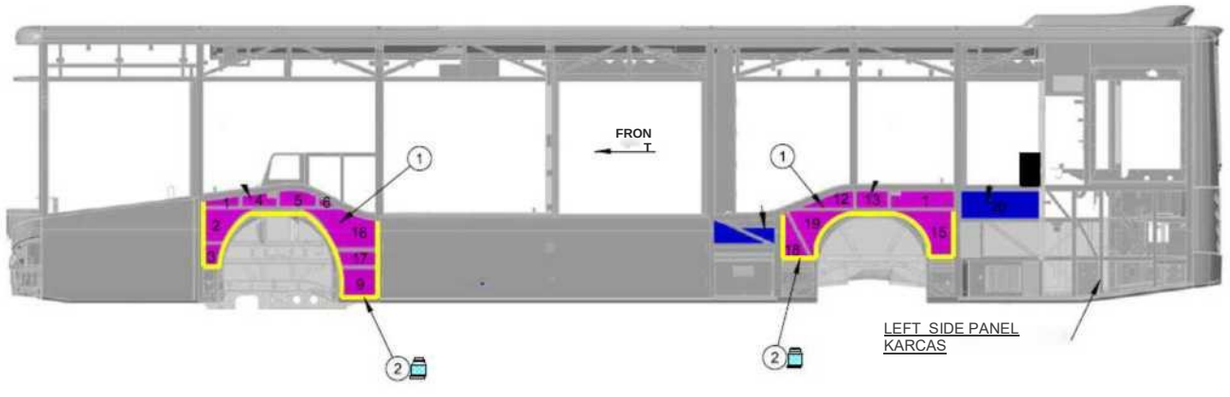
LEAF POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	927-011	387045266*	ISOLATION SET. ENGINE ROOM INSIDE	1
2	927-016	387040832*	ISOLATION GAP RANGE, ENGINE ROOM	1
3	927-013	387038376*	WASHER 2,4 MM. ISOLATION NAIL	165
4	927-014	387038375*	STOPPER 2 MM. ISOLATION NAIL	165

WICKING ON FLOORS OF OILCLOTH



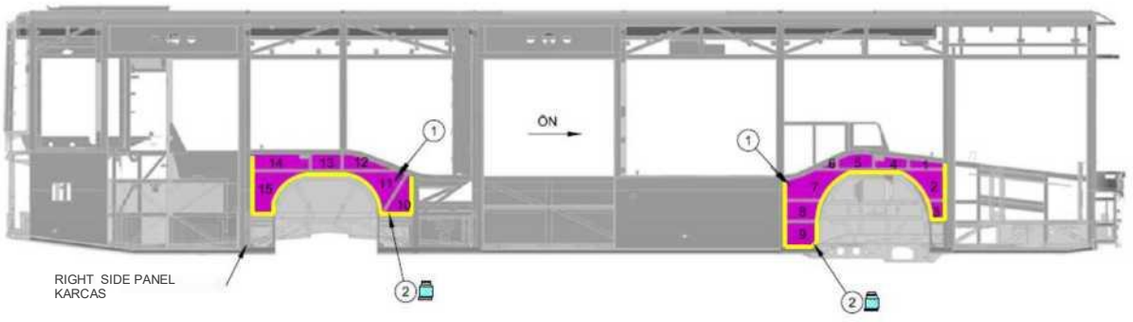
LEAFLET POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	927 - 025	3B7023323'	WICK MELTING TYPE CAP 5	15 M

ISOLATION SET LEFT WHEEL UPPER



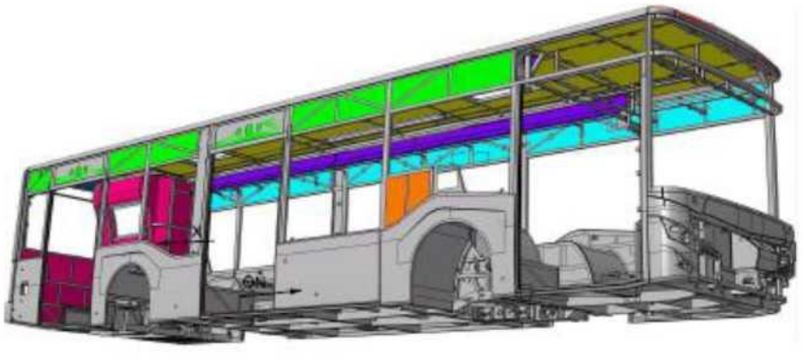
LEAF POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	**927 - 009**	**387047362***	**ISOLATION SET, WHEEL UPPER SIDE PANELS**	**1**
2	**940 158**	**387050123***	**MASTIC,TEROSAN MS 939 SOSİS**	**570 ML**

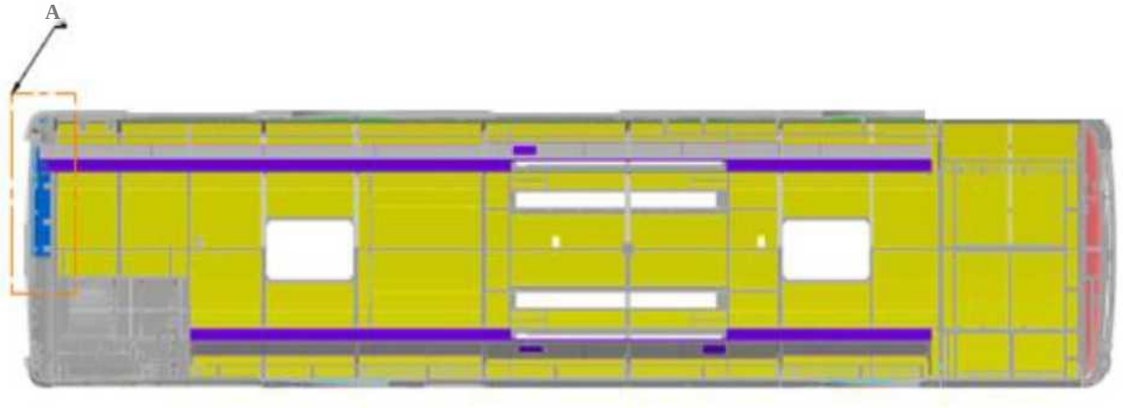
ISOLATION SET RIGHT WHEEL UPPER

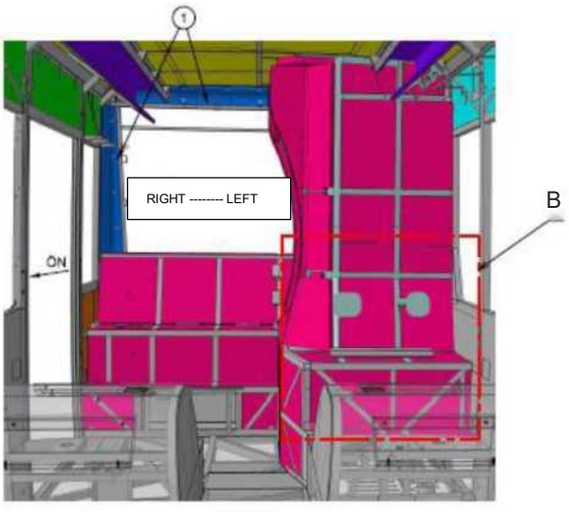


LEAF POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	927 - 009	387047362*	ISOLATION SET, WHEEL USTU SIDE PANELS	1
2	940 - 158	387050123*	MASTIK.TEROSAN MS 939 SOSİS	570 ML

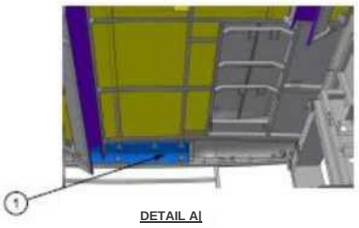
ISOLATION SPONGES INSTALLATION



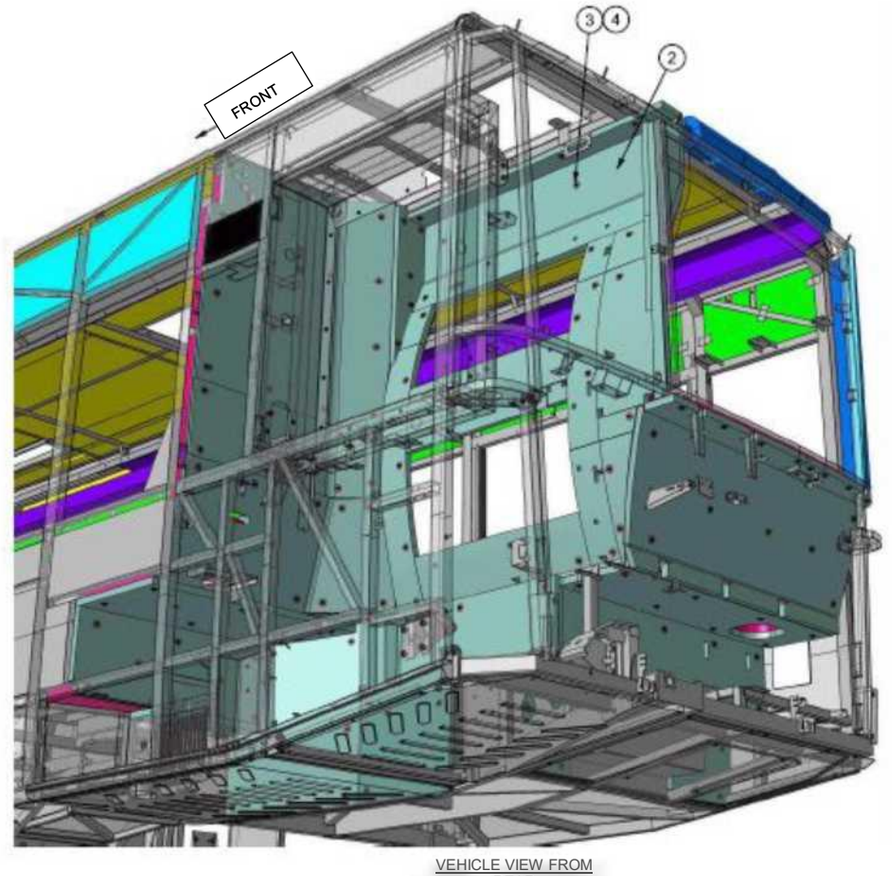




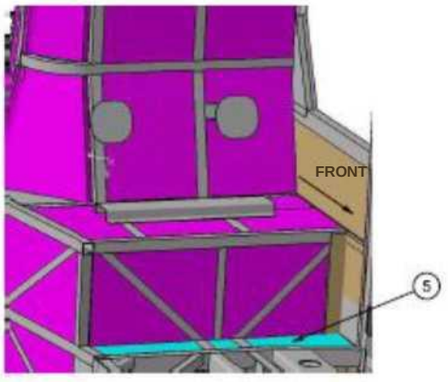
X VIEW



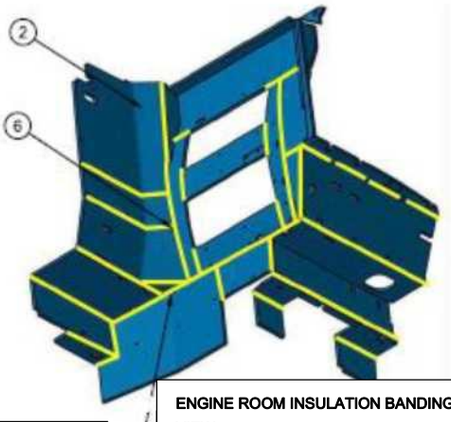
DETAIL AI



VEHICLE VIEW FROM REAR



DETAIL B

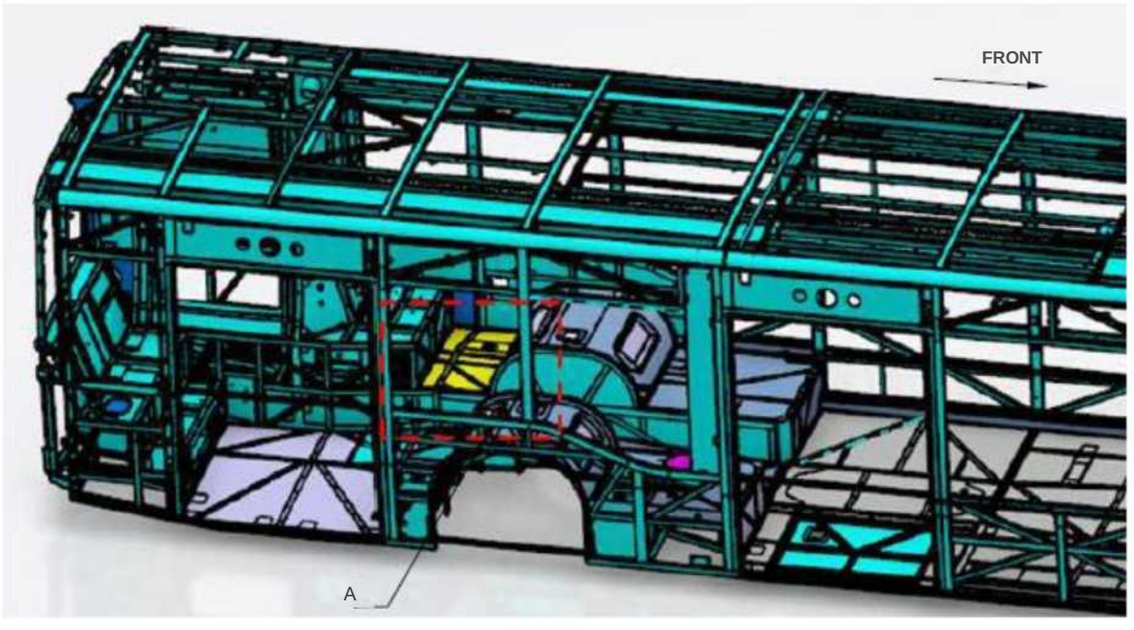


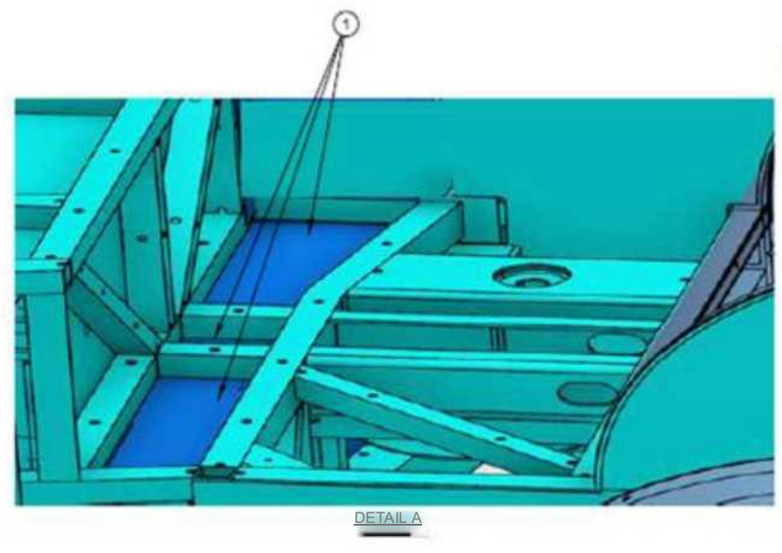
ENGINE ROOM INSULATION BANDING VIEW

6 POSITION BANDS WILL BE DRAWN TO THE INNER SIDE OF THE INSULATION WITH 2 POSITIONS AS SEEN IN FIGURE.

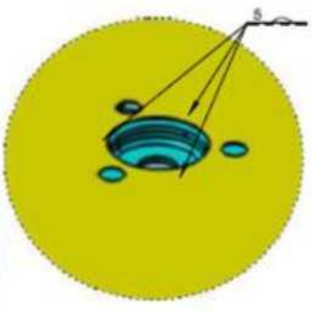
LEAF POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	927 - 003	387038374*	ISOLATION SET, ON REAR GLASS	1
2	927-011	387035336*	ISOLATION SET, ENGINE ROOM INSIDE	1
2	927-011	387045286*	ISOLATION SET, ENGINE ROOM	**1**
3	927-013	387038376*	WASHER 2.4 MM. ISOLATION NAILS	166
4	927-014	387038375*	STOPPER 2 MM, ISOLATION NAILS	165
5	927-015	387040831*	ISOLATION SET . DOUBLE SOFA LEGS AREA	1
6	927-016	387040832*	ISOLATION RANGE BAND . ENGINE ROOM	1

REAR WHEEL TOP RIGHT AND LEFT BASE COVER PLATE INSTALLATION

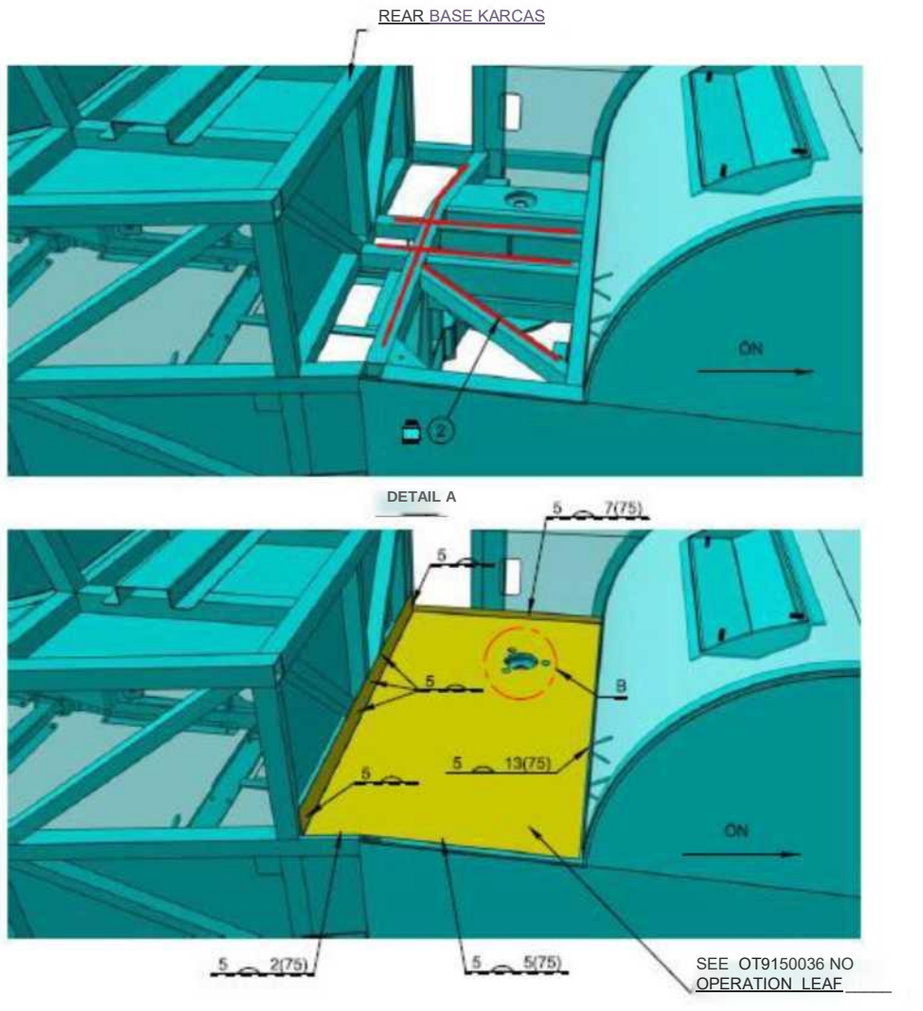




DETAIL A



DETAIL B



SHEET FRAME SHOULD BE AVERAGE FROM BOTH SIDES.

FREQUENCY OF TORTURE / TOOLS WHERE NECESSARY TO MAKE FULL CONTACT OF THE SHEET TO THE FRAME.

DURING THE REMOVING OF THE RUGS ON THE SHEET SURFACES WITH SANDING AND STONE, THE APPLICATION SHOULD BE DONE AS POSSIBLY POINTED.

COATING MUST BE MINIMUM ABRASED

TOLERANCES				IH
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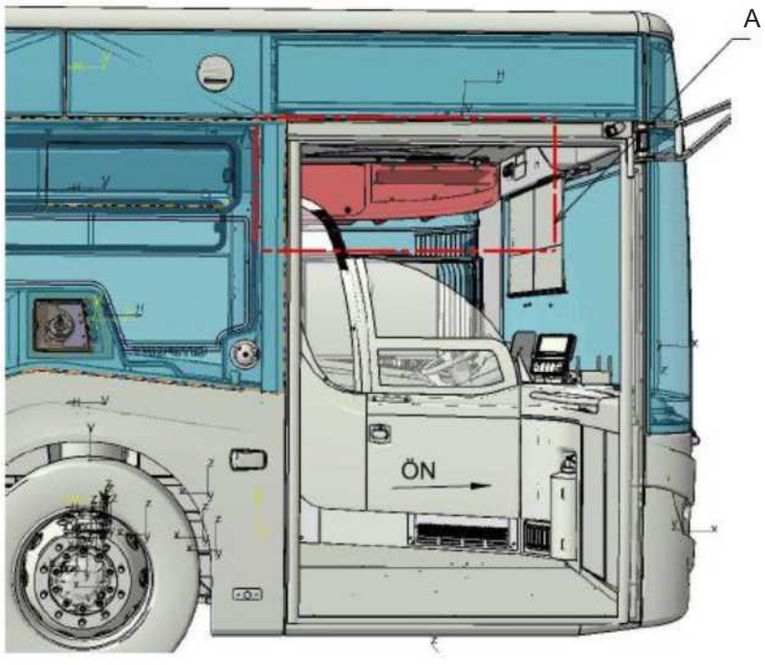
WELDING IN THE VERTICAL POSITION ARE MADE IN THE "PG" POSITION. NO POSITION CRITICAL FOR OTHER LOCATIONS

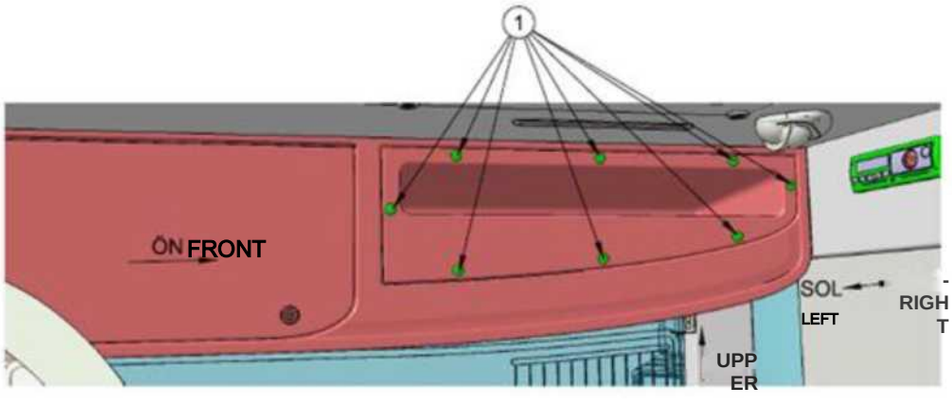
WELDING CURRENT VALUE OF THIS OPERATION 145 AMPER (min.130.5-max.159.59)

LEAF POSE	GROUP-POSE	PART NO	COMPONENT'S NAME	NUMBER
1	927-015	387040831*	ISOLATION SET, DOUBLE	1
2	940-158	387050123*	MASTIC, TEROS AN MS 939 SOSİS {570 **ML)**	1

INSTALLATION OF CEILING AND SIDE COVERINGS

DRIVER TOP CABINET PLATES INSTALLATION

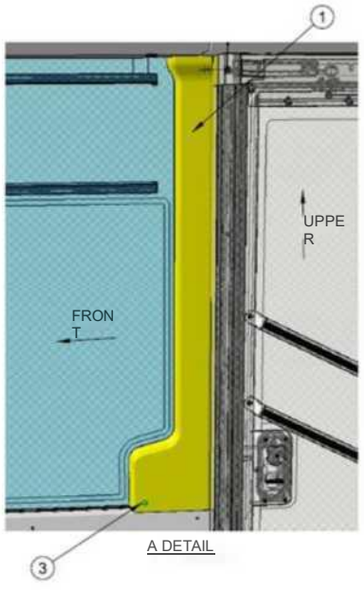




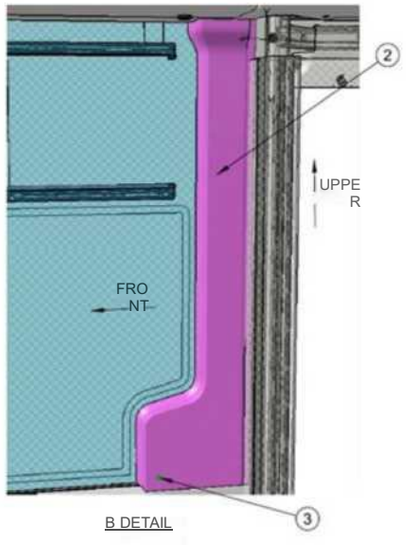
A DETAIL

LEAF POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	929 - 020	387001882*	STOPPER	8

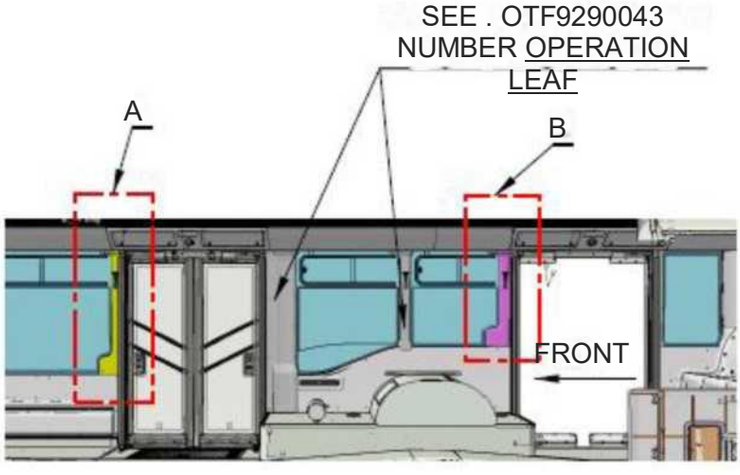
ASSEMBLY OF RIGHT ABS PILLAR PLATING



A DETAIL

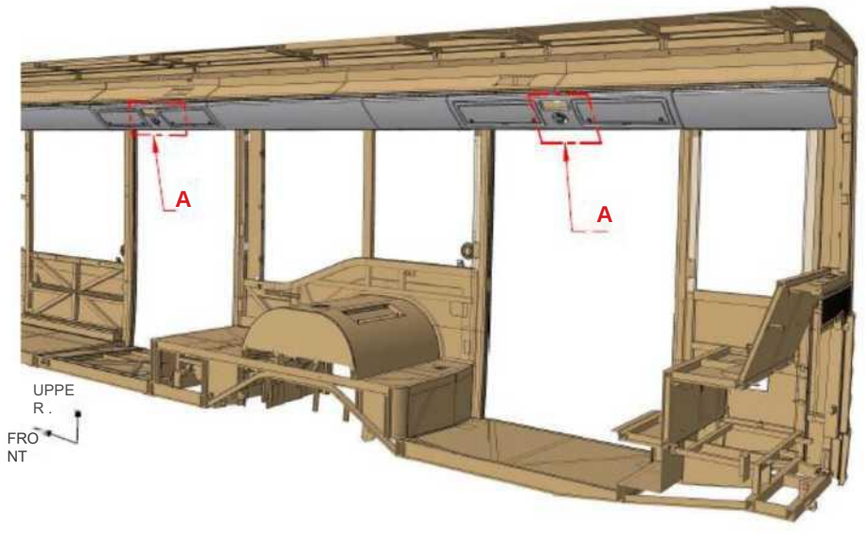


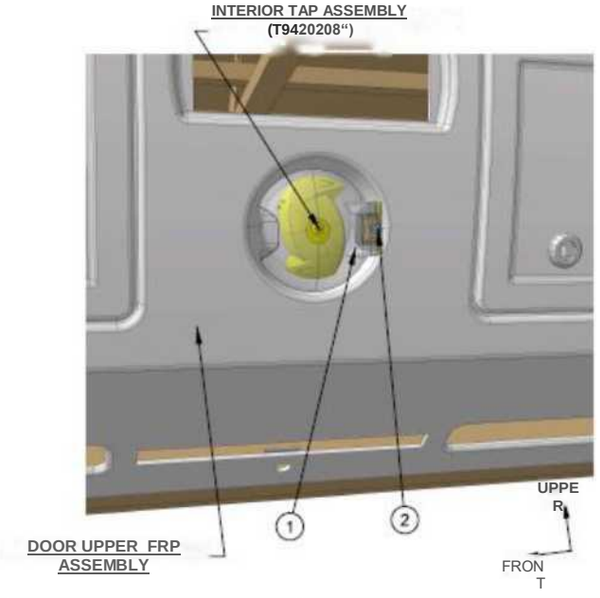
B DETAIL



LEAF POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	929 - 073	387034493*	ABS PLATING, PILLAR RIGHT 2	1
2	929 - 078	387034499*	ABS PLATING , PILLAR RIGHT 5	1
3	929 - 203	387022025*	CLIP , PANEL HOLDER , NATURAL	2

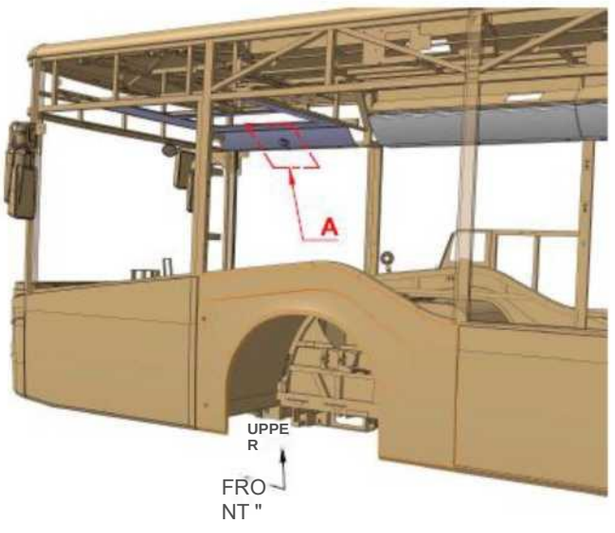
INTERIOR AIR TAP PROTECTION COVER MIDDLE AND REAR DOOR INSTALLATION

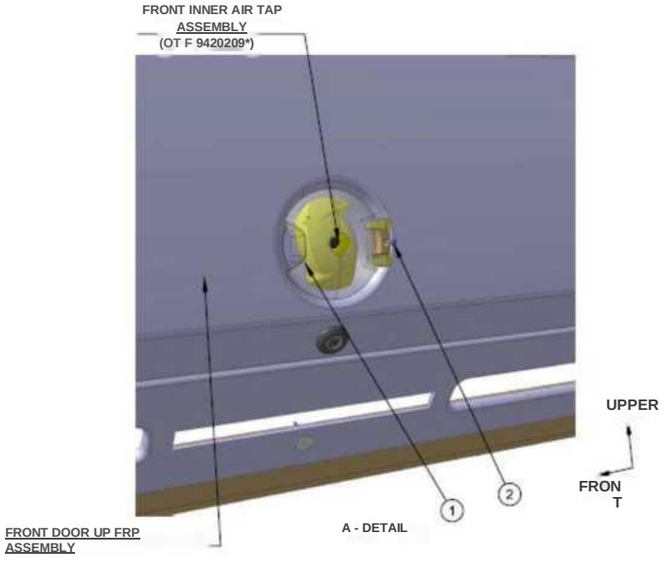




LEAF POSE	GROUP/POSE	PART NO	COMPONENT’S NAME	NUMBER
1	929-014	387036625*	TAP PROTECTION COVER	2
2	929-210	3018535193*	SELF-TAPPING SCREW	2

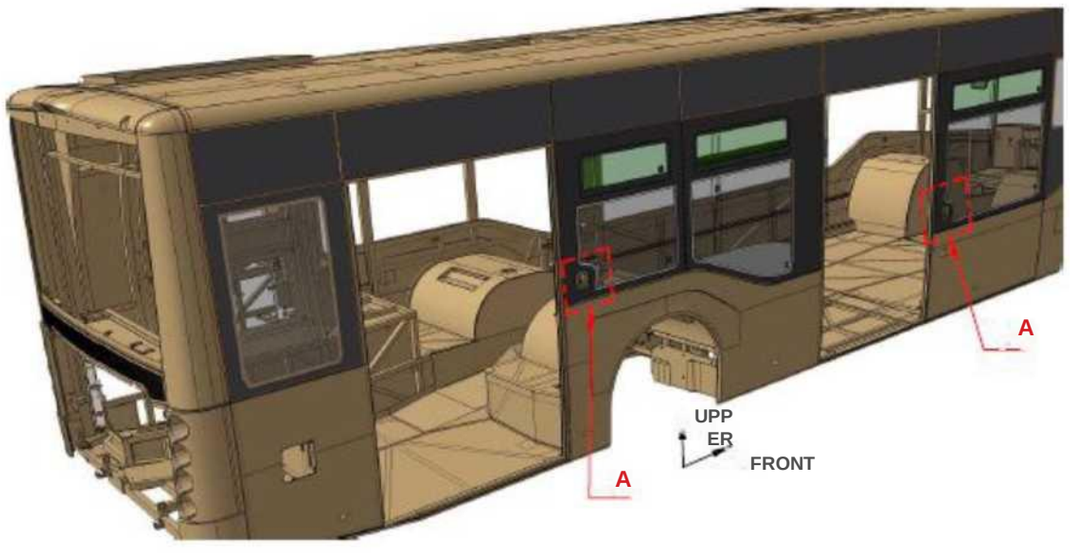
INTERIOR AIR TAP PROTECTION COVER FRONT DOOR ASSEMBLY

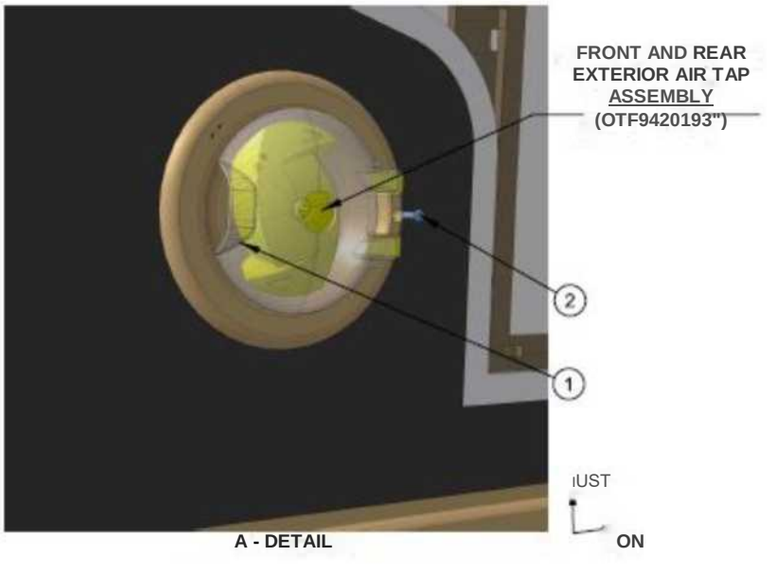




LEAF POSE	GROUP/POSE	PART NO		NUMBER
1	929-014	387036625*	TAP PROTECTION COVER	1
2	929-210	3018535193*	SELF-TAPPING SCREW	1

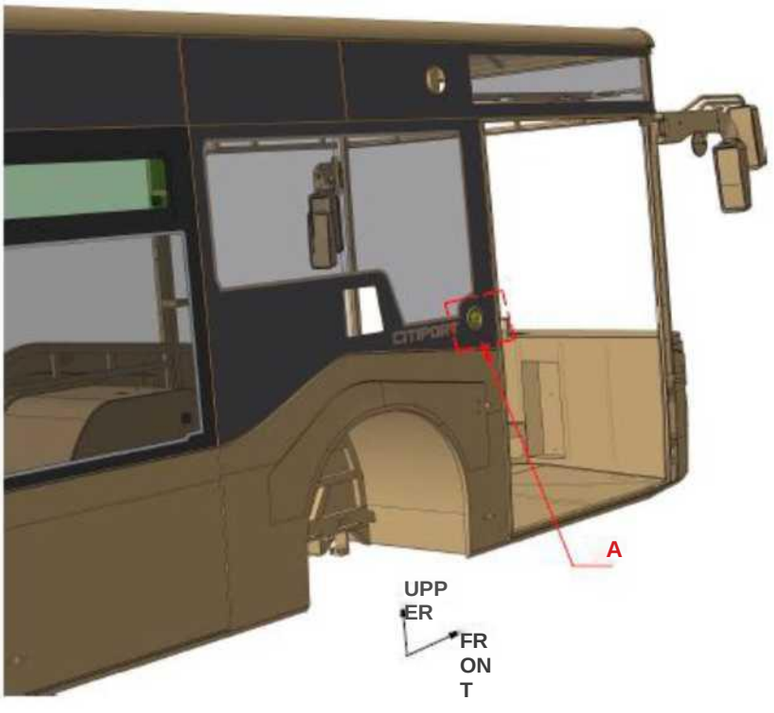
REAR AND MIDDLE DOOR EXTERIOR AIR TAP PROTECTION COVER INSTALLATION

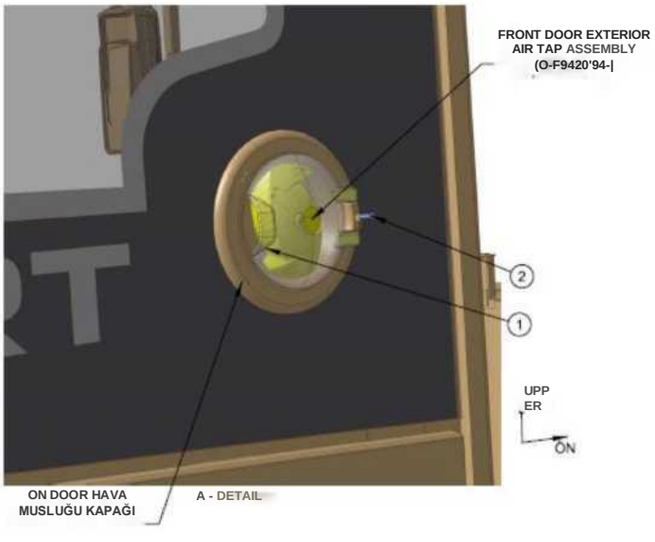




LEAF POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	929 - 014	387036625*	TAP PROTECTION COVER	2
2	929-210	3018535193*	SELF-TAPPING SCREW	2

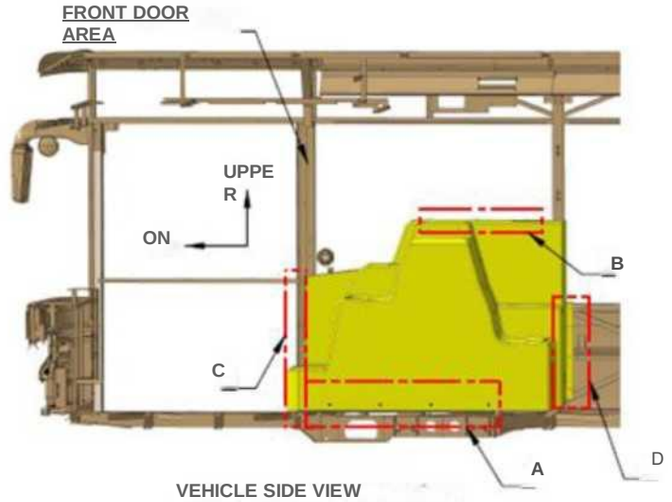
FRONT DOOR EXTERIOR AIR FAUCET PROTECTION COVER ASSEMBLY



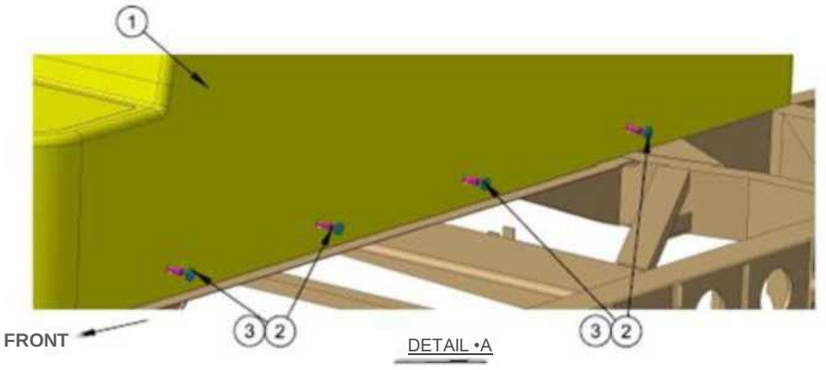


LEAF POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	929-014	387036625*	TAP PROTECTION COVER	1
2	929-210	3018535193*	SELF-TAPPING SCREW	1

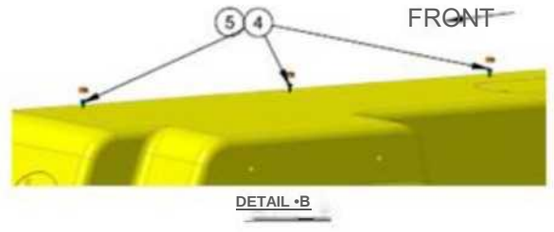
RIGHT WHEEL TOP FRP COATING VEHICLE INSTALLATION



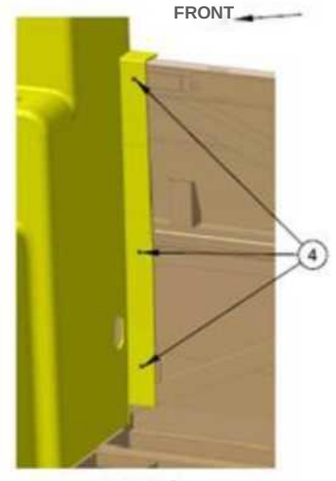
VEHICLE SIDE VIEW



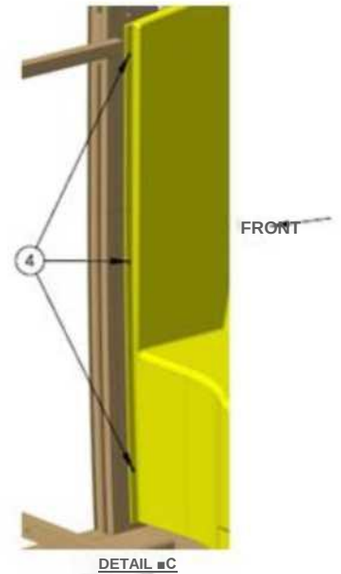
DETAIL •A



DETAIL •B



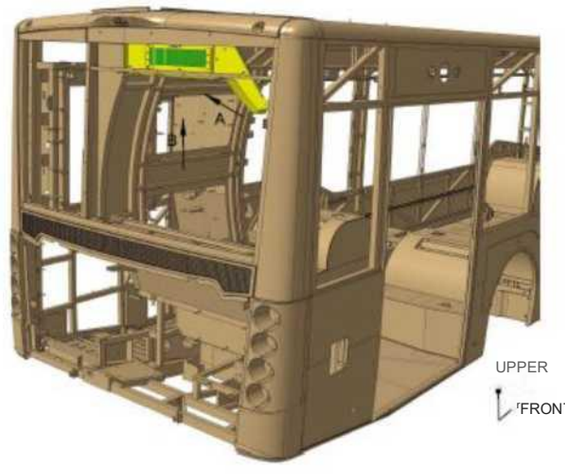
DETAIL • D

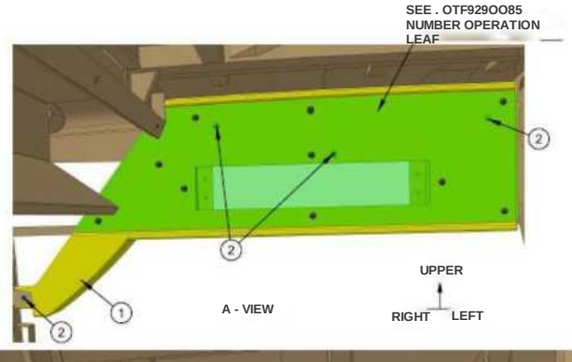


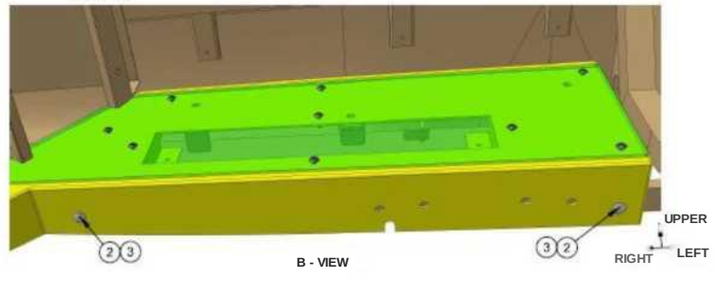
DETAIL ■C

LEAF POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	929- 152	387033009*	FRP, RIGHT WHEEL UPPER	1
1	929- 152	387046185*	FRP, RIGHT WHEEL UPPER	1
1	929- 152	387053129*	FRP, RIGHT WHEEL UPPER	1
1	929- 152	387604611*	FRP, RIGHT WHEEL UPPER	1
2	929-214	3000906201*	BOLT , SLB M6X20, THICK D. DIN912	4
3	929-223	387041212*	CLOSING, HEADLIGHT PLASTIC	4
4	929-212	3018142254*	SCREW, YSB 4.2x25, DİN 7981	9
5	929-211	387026601*	ABS SCREW COVER, DARK GREY	3
5	929-221	387026601*	ABS SCREW COVER , DARK GREY	3

UPPER CORNER REAR FRP COVER ASSEMBLY

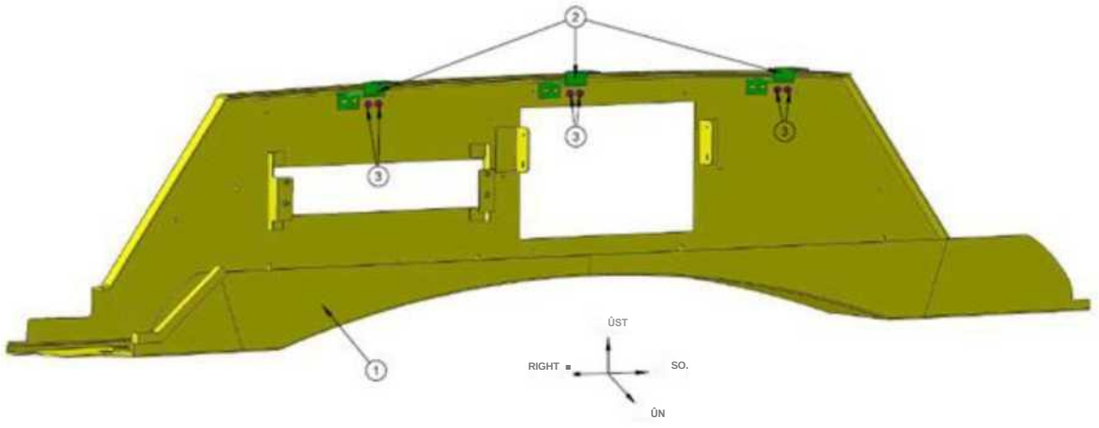






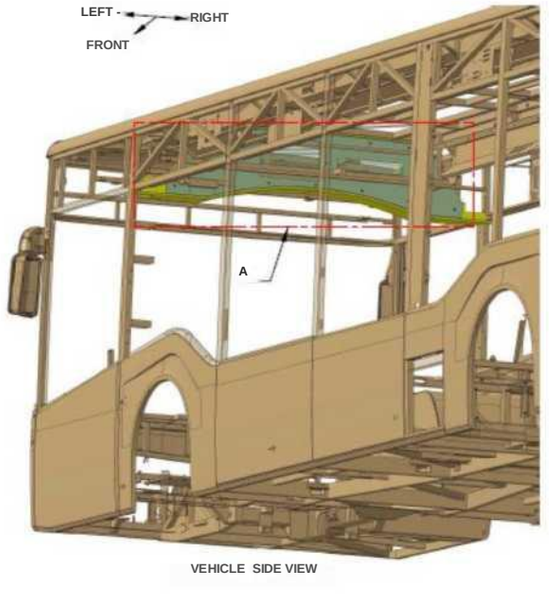
LEAF POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	929 - 070	387034237*	FRP, INNER UPPER CORNERREAR	1
1	929 - 070	387055935*	ABS, REAR CEILING	1
1	929 - 070	387608235*	FRP, INNER UPPER CORNER REAR	1
2	929 - 206	3019042194*	SCREW 4.2x19 DİN 7981 YELLOW	6
3	929 - 207	387015504*	CLOSING, HEADLIGHT PLASTIC	2

PREPARATION OF LCD FRP INSTALLATION

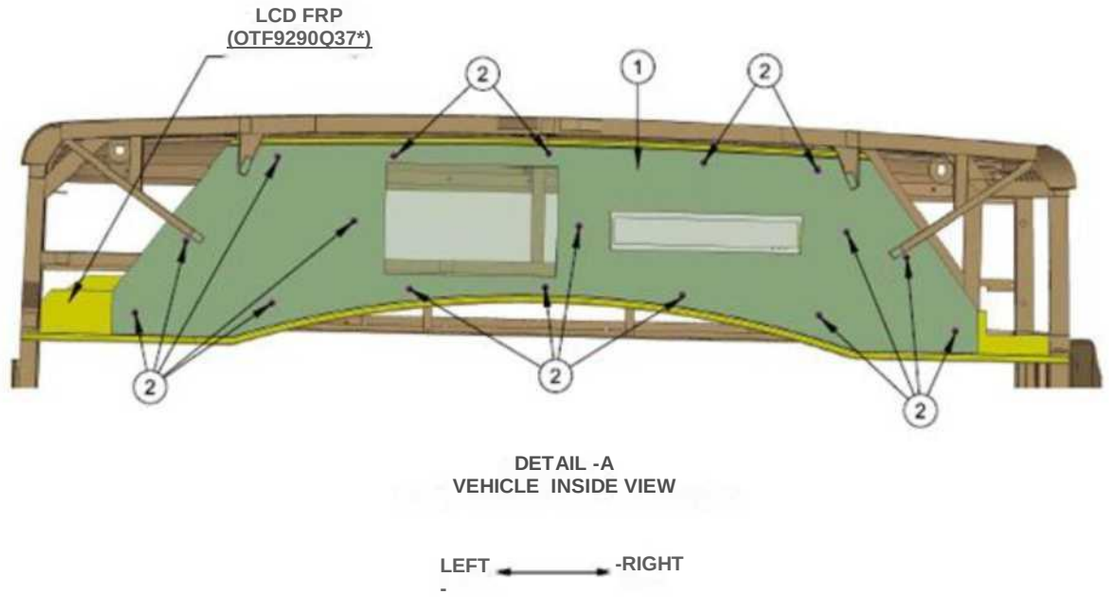


LEAF POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	929 - 006	387033028*	FRP, FRONT LCD	1
1	929 006	387421597*	FRP, FRONT LCD	1
2	929-015	387035147*	BRACKET , LCD FRP	3
3	929 - 202	3005800060*	NUT , FLN&TR M6X1, THICK D. DIN6923	6

LCD FLEX CLOSURE VEHICLE ASSEMBLY



VEHICLE SIDE VIEW



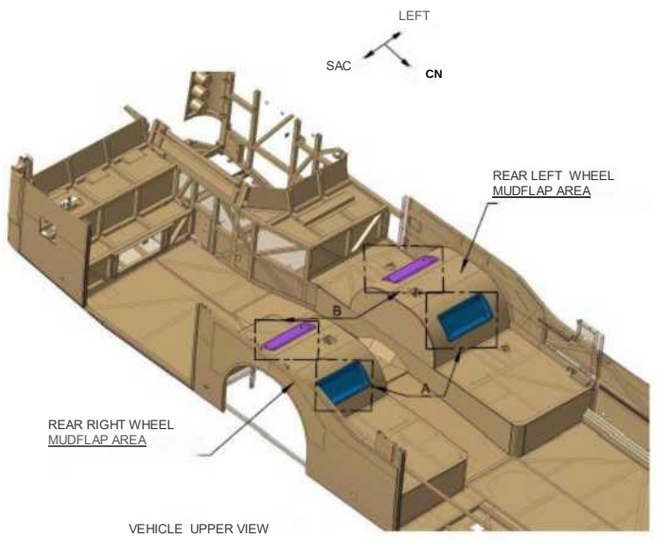
DETAIL -A
VEHICLE INSIDE VIEW

LEFT ◄——► -RIGHT
-

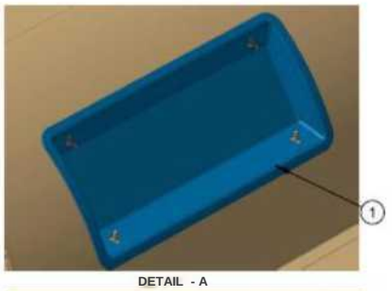
LEAF POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	929-013	387034427*	PLEXI PLATING , LCD	1
1	929-013	387038575*	PLEXI PLATING , FRONT CEILING	1
2	929-205	387020210*	DUBEL, LCD FRP	17

REAR WHEEL TOP ASSEMBLIES VEHICLE ASSEMBLY

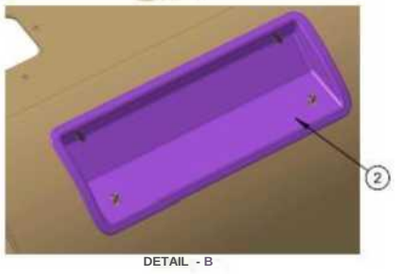
NOTE 1 AND 2 POSE ABS PLATINGS WILL BE SEEN ONLY AT THE PLACES SHOWN IN THE FIGURE.



VEHICLE UPPER VIEW



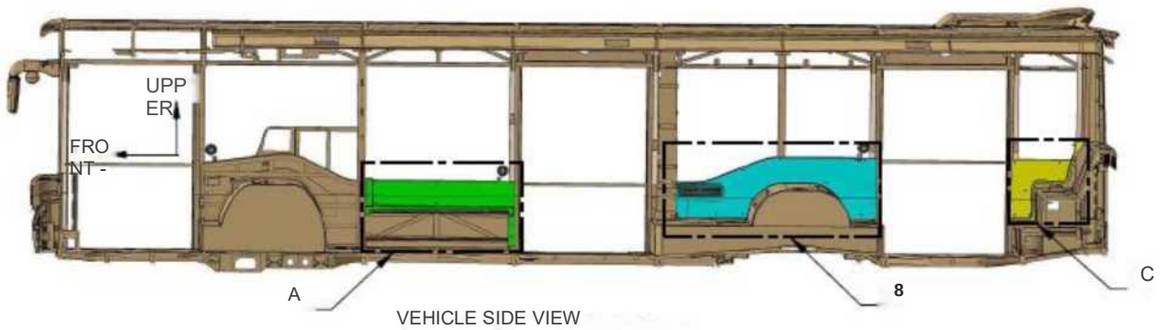
DETAIL - A



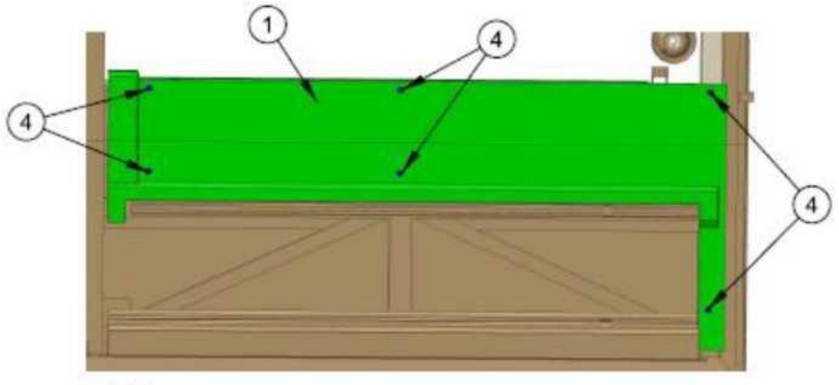
DETAIL - B

LEAF POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	929- 163	387038772*	ABS, FRONT, REAR WHEEL UPPER	2
2	929- 164	387038773*	ABS, REAR, REAR WHEEL UPPER	2

RIGHT FRONT MIDDLE AND TRIPLE SEAT SIDE FRP VEHICLE ASSEMBLY

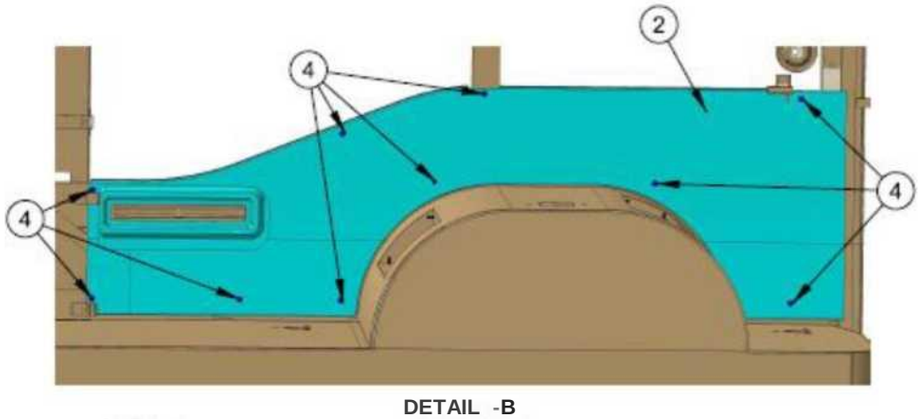


VEHICLE SIDE VIEW



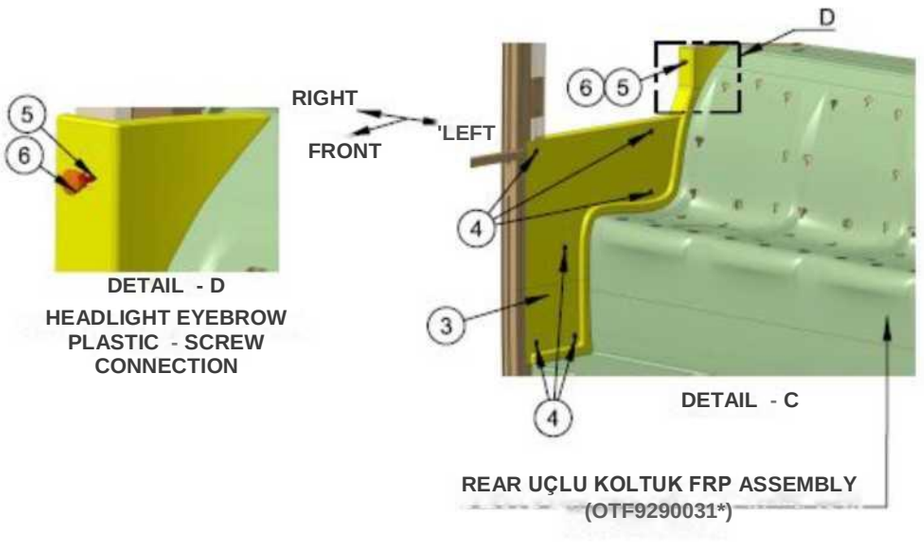
FRONT ←

DETAIL - A



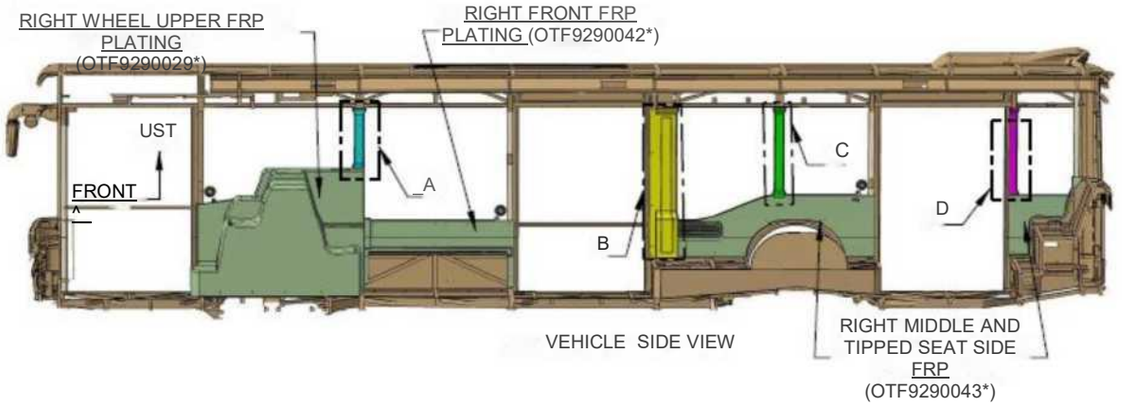
DETAIL -B

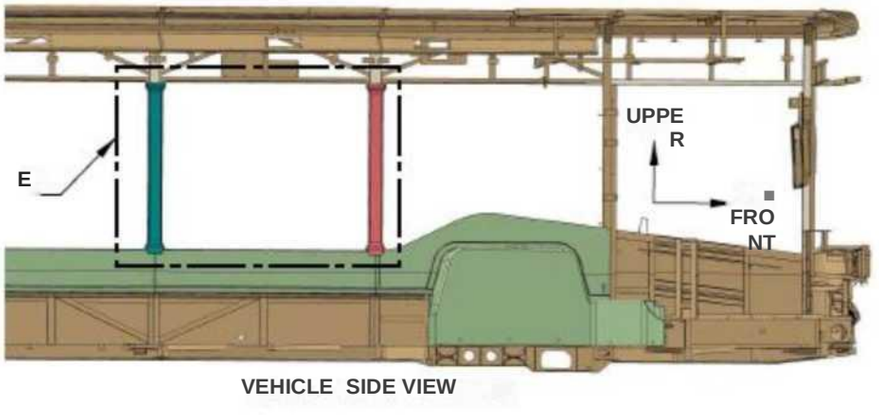
FRONT ←

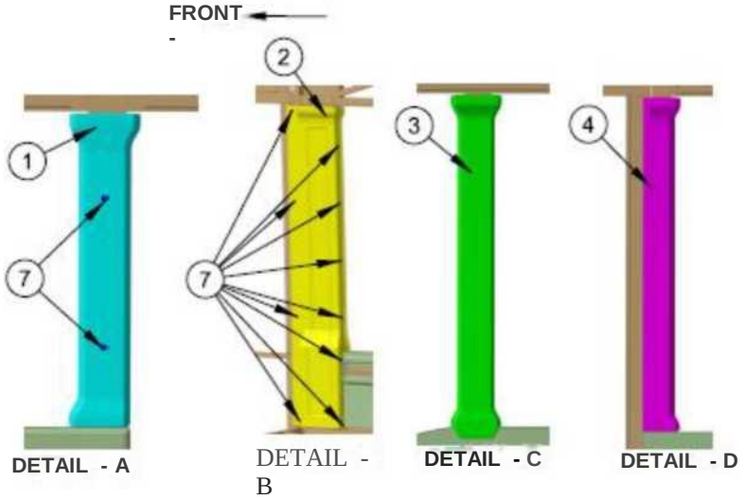


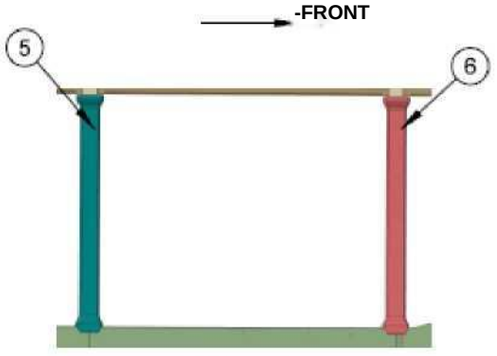
LEAF POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	929- 157	387033014*	FRP, RIGHT SIDE PANEL, FRONT	1
2	929- 158	387033015*	FRP, RIGHT SIDE PANEL, MIDDLE	1
3	929- 162	387034631*	FRP, REAR END SIDE SEAT	1
4	929-218	387031007*	CLIP , PANEL HOLDER - EVO 2	22
5	929-206	3019042192*	SCREW4.2x19 DİN 7981 YELLOW	1
6	929-223	387041212*	PLATING, HEADLIGHT PLASTIC	1

INSTALLATION OF THE RIGHT FRONT AND MIDDLE PILLAR ABS TO THE VEHICLE





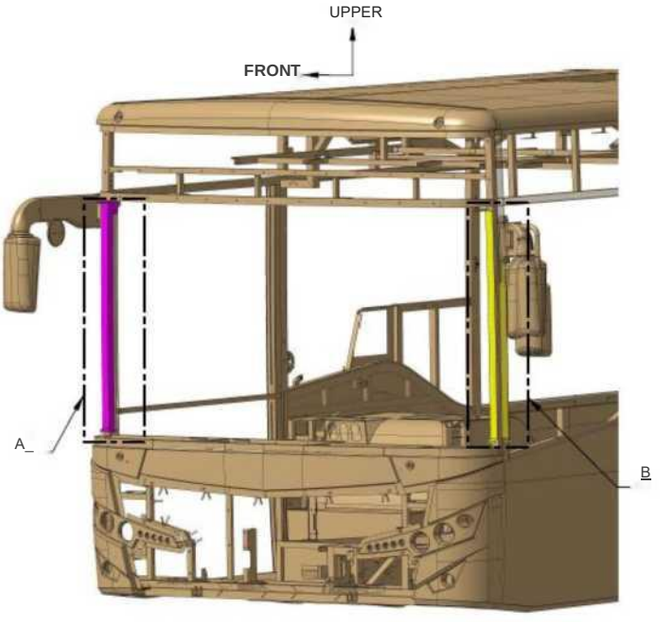




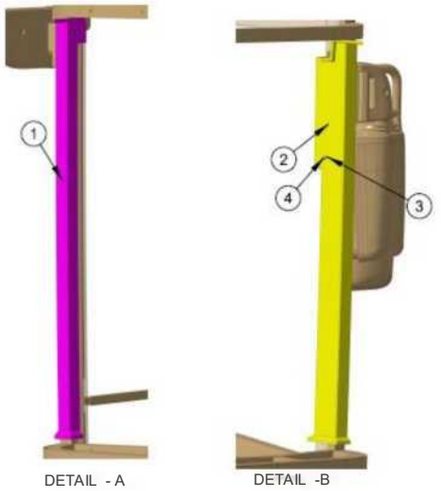
DETAIL - E

LEAF POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	929-071	387042288*	ABS PLATING , PILLAR RIGHT I	1
1	929-071	387046187*	ABS PLATING , RIGHT PILLAR	1
2	929 - 075	387034495*	ABS PLATING , PILLAR RIGHT 3	1
3	929 - 077	387034497*	ABS PLATING , PILLAR 4	1
4	929 - 079	387034607*	ABS PLATING , PILLAR RIGHT 6	1
5	929 - 074	387034494*	ABS PLATING , PILLAR LEFT 2	1
6	929 - 072	387034492*	ABS PLATING , PILLAR LEFT 1	1
7	929 - 203	3870220250*	CLIP , PANEL HOLDER , NATURAL	12

LEFT AND RIGHT ABS PILLAR VEHICLE ASSEMBLY



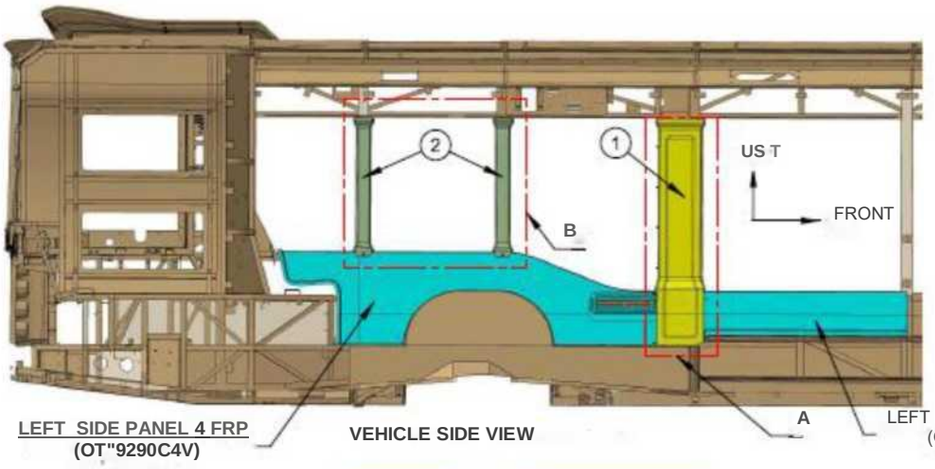
VEHICLE CROSS VIEW



DETAIL - A DETAIL -B

LEAF POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	929 - 009	387033031*	ABS. RIGHT A PILLAR	1
2	929 008	387033030*	ABS. LEFT A PILLAR	1
3	929 - 204	3017942192*	SCREW, LENTIL TOWEL HEAD 4.2	1
4	929 - 221	387026601*	ABS SCREW COVER, DARK GREY	1

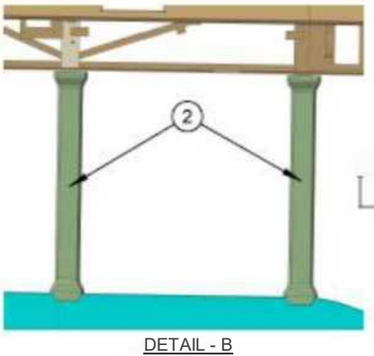
LEFT REAR PILLAR ABS VEHICLE MOUNTING



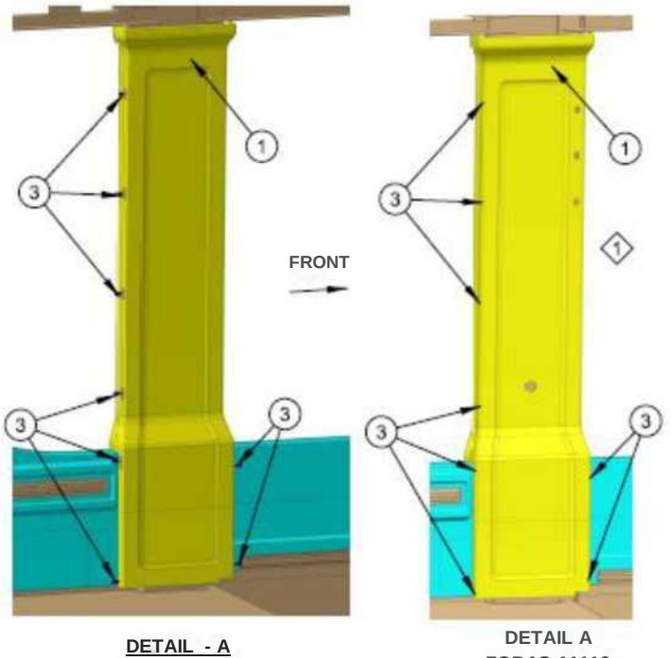
LEFT SIDE PANEL 4 FRP
(OT"9290C4V)

VEHICLE SIDE VIEW

LEFT SIDE PANEL 3 FRP
(OTF9290O41 *)



DETAIL - B

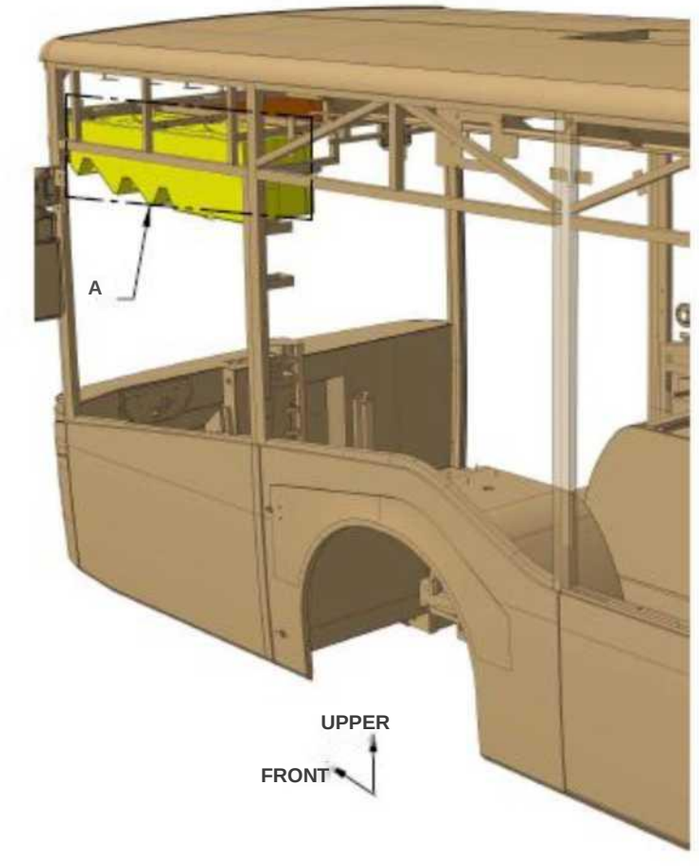


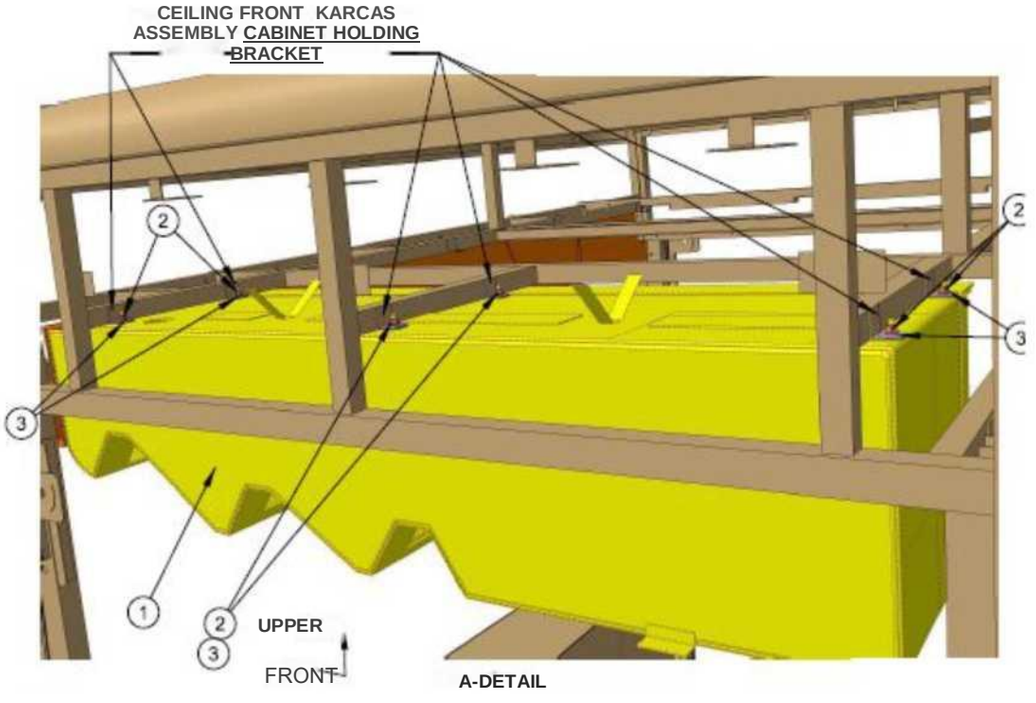
DETAIL - A

DETAIL A
ZOBAS-11119

LEAF POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	929 - 076	387034496*	ABS PLATING , PILLAR LEFT 3	1
1	929 - 076	387058161*	ABS PLATING ,PILLAR LEFT 3	1
1	929 - 076	387448200*	ABS PLATING ,PILLAR LEFT 3	1
2	929 - 077	387034497*	ABS PLATING , PILLAR 4	2
3	929 - 203	387022025*	CLIP , PANEL HOLDER , NATURAL	8

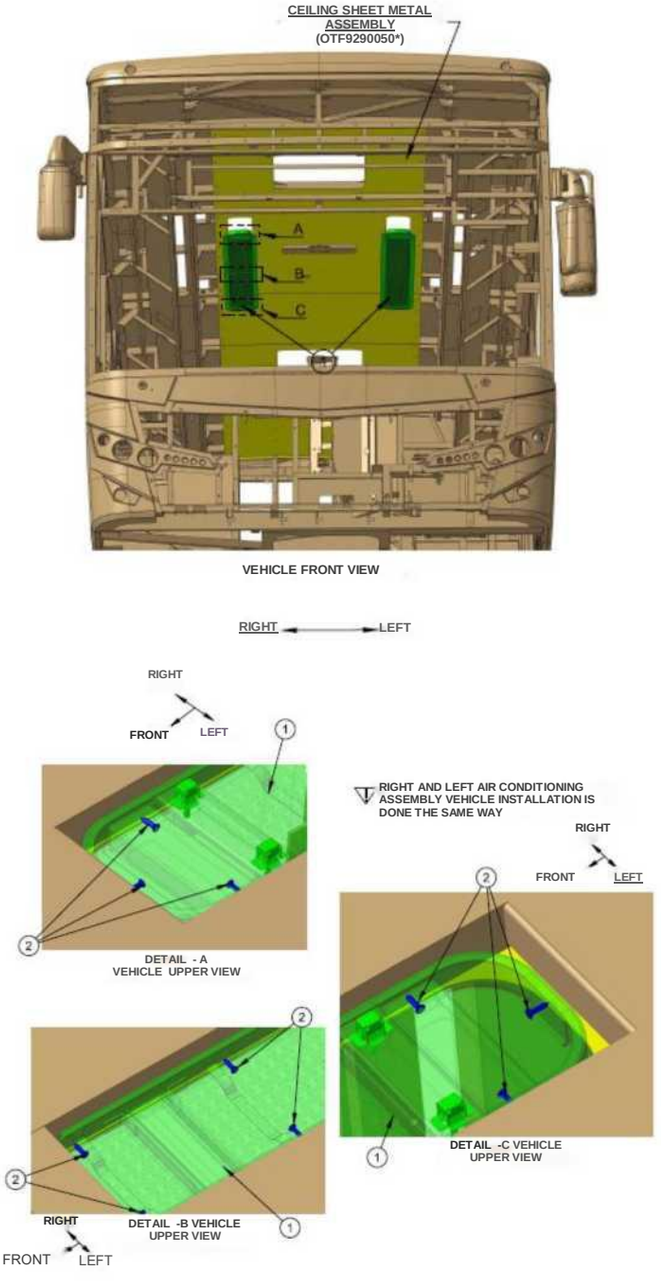
DRIVER TOP CABINET FRP INSTALLATION





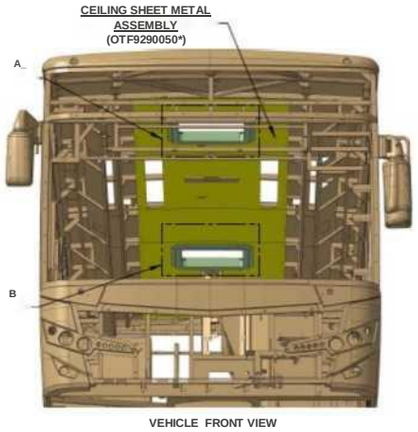
LEAF POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	929/003	387033025*	FRP, DRIVER TOP CABINET	1
1	929/003	387407432*	FRP, DRIVER TOP CABINET	1
1	929/003	387366119	FRP, DRIVER TOP CABINET	1
2	929/202	3005800060*	NUT , FLN&TR M6X1, THICK D. DIN6923	6
3	929/201	3011100082*	WASHER , FLAT D=8 DİN 9021	6

RIGHT AND LEFT AIR CONDITIONING ASSEMBLY VEHICLE INSTALLATION



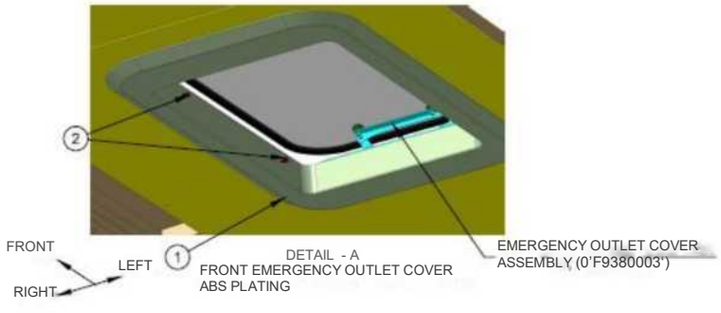
LEAF POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	929 - 085	387034240*	AIR EXTRACTION ASSEMBLY, AIR CONDITIONING	2
1	929 - 085	387046200*	AIR EXTRACTION ASSEMBLY, AIR CONDITIONING	2
2	929 - 208	3018339161*	SCREW	20

EMERGENCY EXIT GATE ABS COVER VEHICLE ASSEMBLY

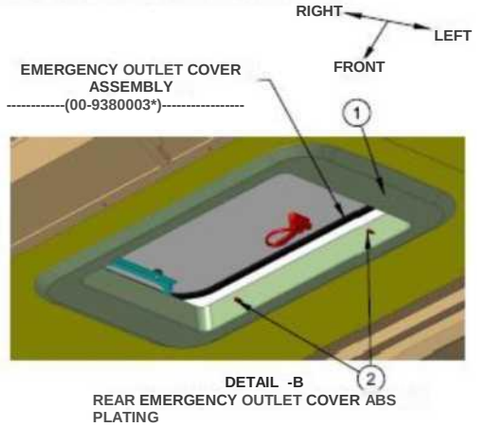


VEHICLE FRONT VIEW

RIGHT LEFT



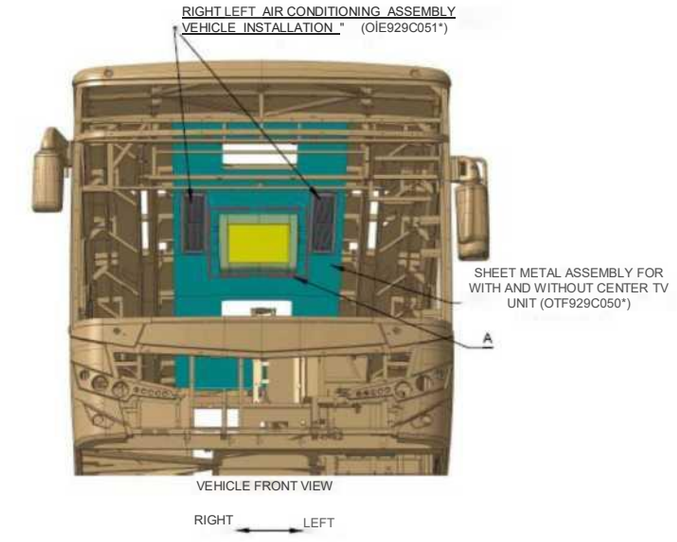
NOTE: THE SAME PANEL HOLDER IS USED TO THE FRONT AND REAR EMERGENCY EXIT COVER ABS PLATING.

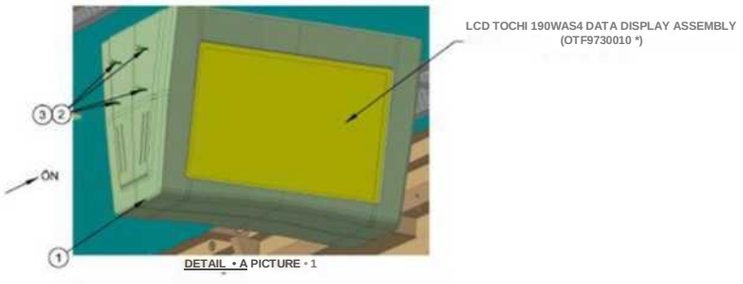


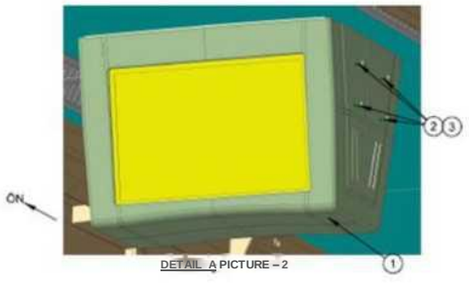
DETAIL -B
REAR EMERGENCY OUTLET COVER ABS PLATING

LEAF POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	929 - 081	387034235*	ABS PLATING , EMERGENCY OUTLET COVER	2
2	929 203	387022025*	CLIP , PANEL HOLDER . NATURAL	8

CENTRE TV UNIT ABS PLATING VEHICLE ASSEMBLY

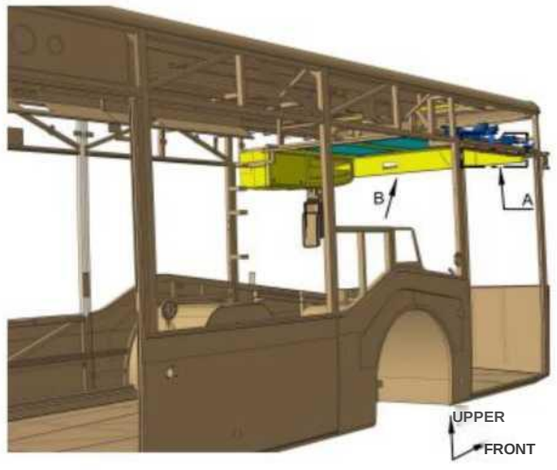


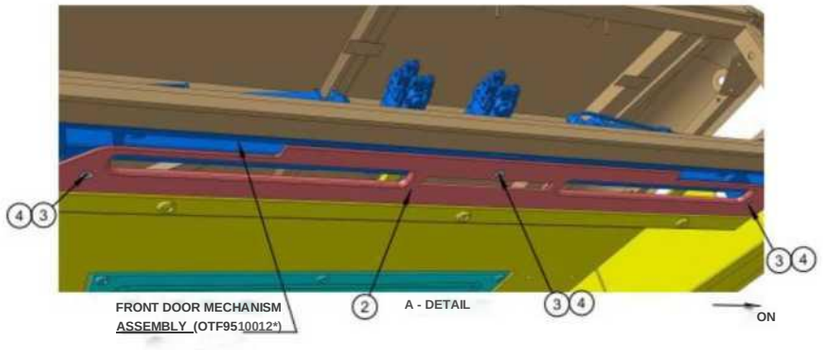


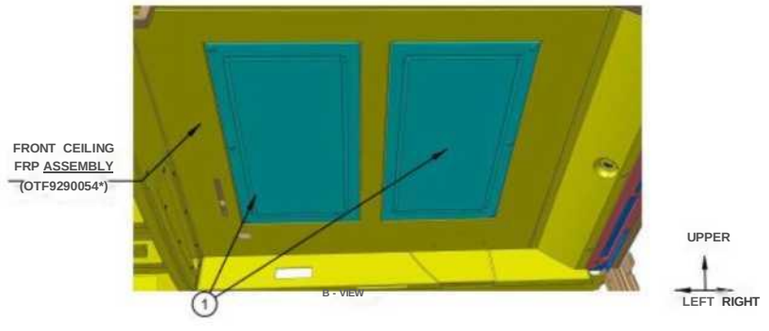


LEAF POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	929-080	387034249*	ABS PLATING , MIDDLE TV UNIT	1
2	929-206	3019042192*	SCREW 4.2x19 DİN 7981 YELLOW	8
3	929-221	387026601*	ABS SCREW COVER, DARK GREY	8

FRP OVER FRP DOOR AND FRP CEILING COVER INSTALLATION

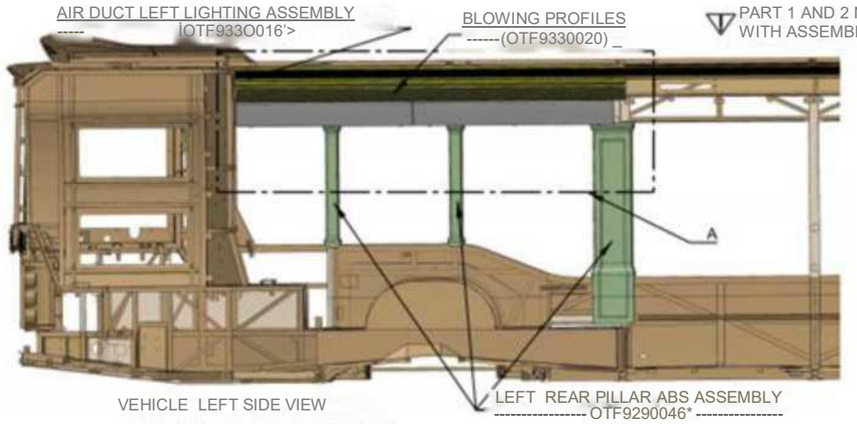




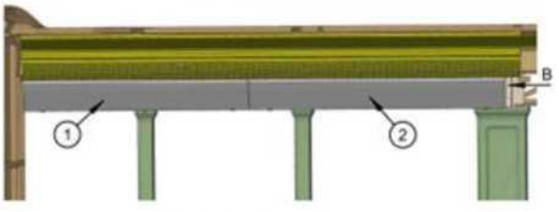


LEAF POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	929/007	387033029*	FRP. FRONT CEILING COVER	2
1	929/007	387055944*	ABS, FRONT CEILING COVER	2
2	929/002	387048728*	FRP, FRONT DOOR UPPER	1
3	92 9/206	301904219*	SCREW 4.2x19 DİN 7981 YELLOW	3
4	929/207	387015504*	PLATING HEADLIGHT EYEBROW PLASTIC	3

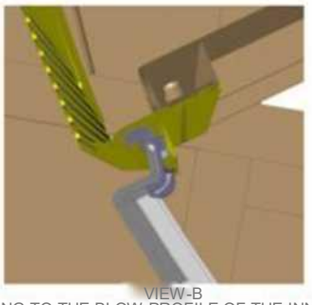
LEFT REAR INNER UPPER CORNER FRP VEHICLE INSTALLATION



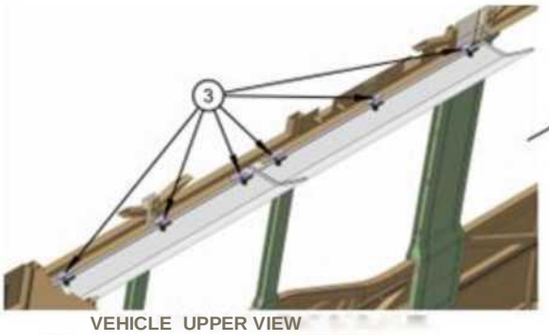
VEHICLE LEFT SIDE VIEW



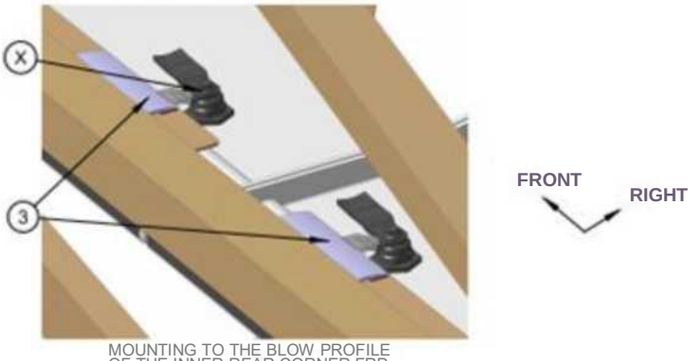
DETAIL - A



VIEW-B
MOUNTING TO THE BLOW PROFILE OF THE INNER UPPER CORNER FRP



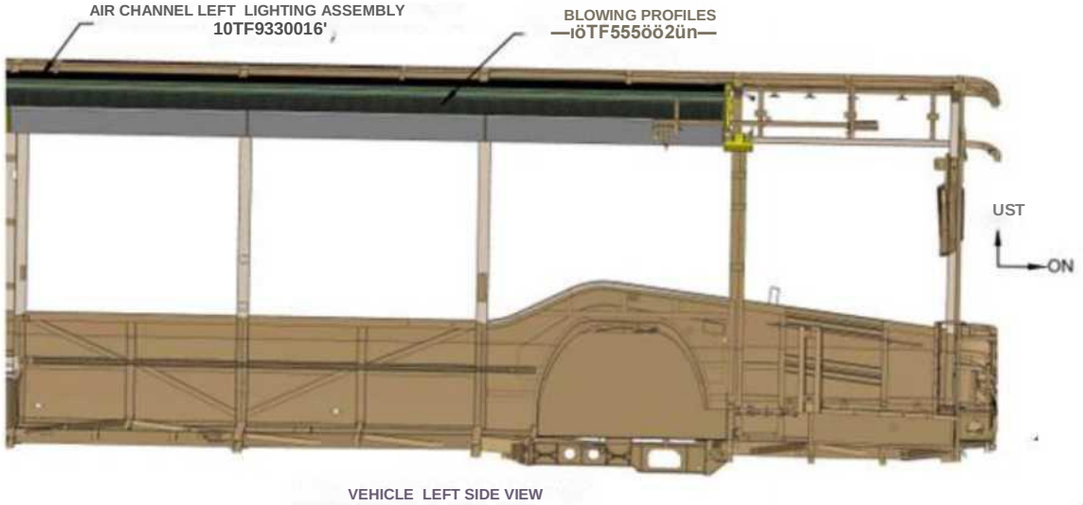
VEHICLE UPPER VIEW



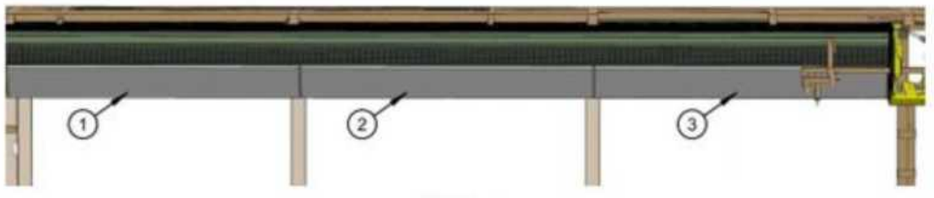
MOUNTING TO THE BLOW PROFILE
OF THE INNER REAR CORNER FRP

LEAF POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	929 - 068	387033085*	FRP, INNER UPPER CORNER LEFT 5	1
2	929 - 067	387033084*	FRP, INNER UPPER CORNER LEFT 4	1
3	929-310	387001922*	PVC PROFILE	3 M

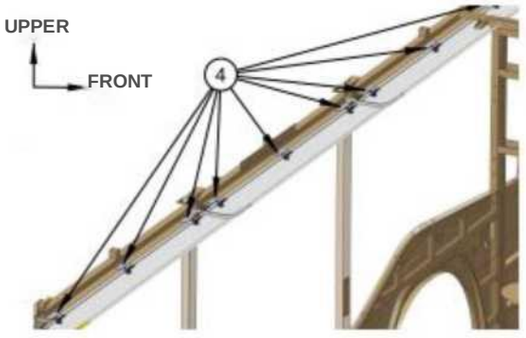
LEFT FRONT INNER UPPER CORNER FRP INSTALLATION ON THE VEHICLE



VEHICLE LEFT SIDE VIEW

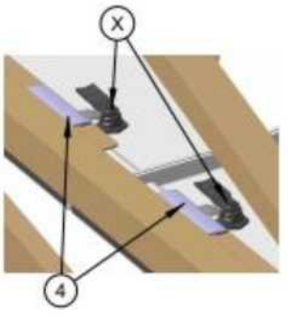


DETAIL - A

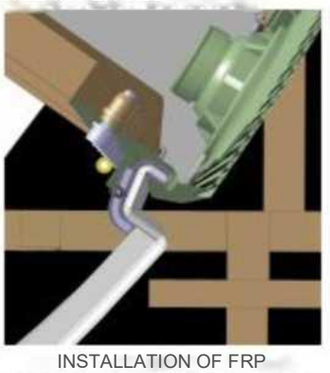


VEHICLE UPPER SIDE

IT IS ON THE ASSEMBLY NUMBERED PART 1-2-3 SHOWN BY X.



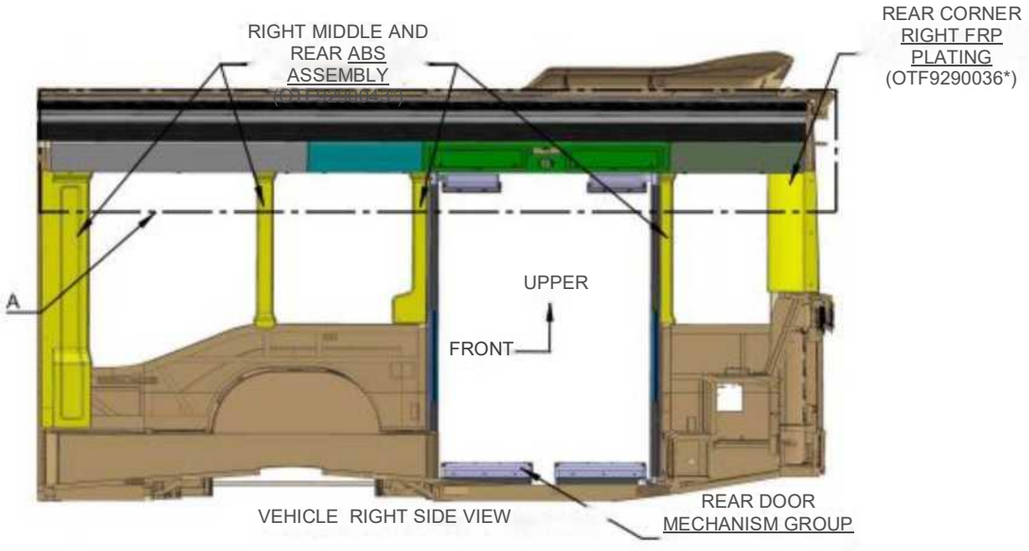
VEHICLE INSTALLATION OF THE LEFT INNER UPPER CORNER FRP

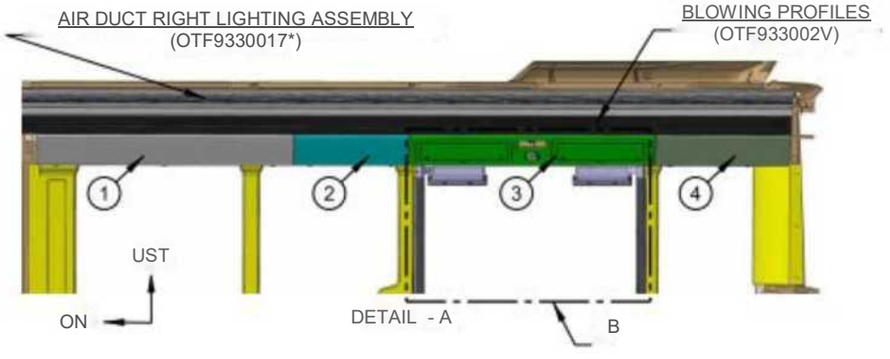


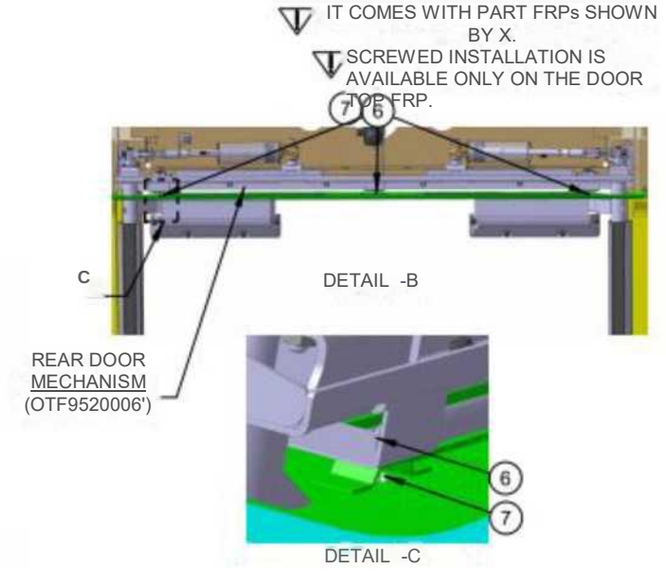
INSTALLATION OF FRP ASSEMBLY TO BLOW PROFILES

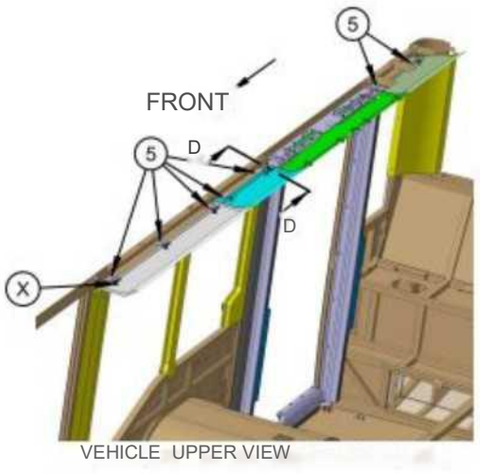
LEAF POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	929 -059	387033083*	FRF, INNER UPPER CORNER LEFT 3	1
2	929 -058	387033082*	FRP. INNER UPPER CORNER LEFT 2	1
3	929 - 057	387046189*	FRP, INNER UPPER CORNER LEFT	1
3	929 -057	387033081*	FRP, INNER UPPER CORNER LEFT 1	1
4	929-310	387001922*	PVG PROFILE	3 M

REAR RIGHT INSIDE UPPER CORNER FRP VEHICLE INSTALLATION









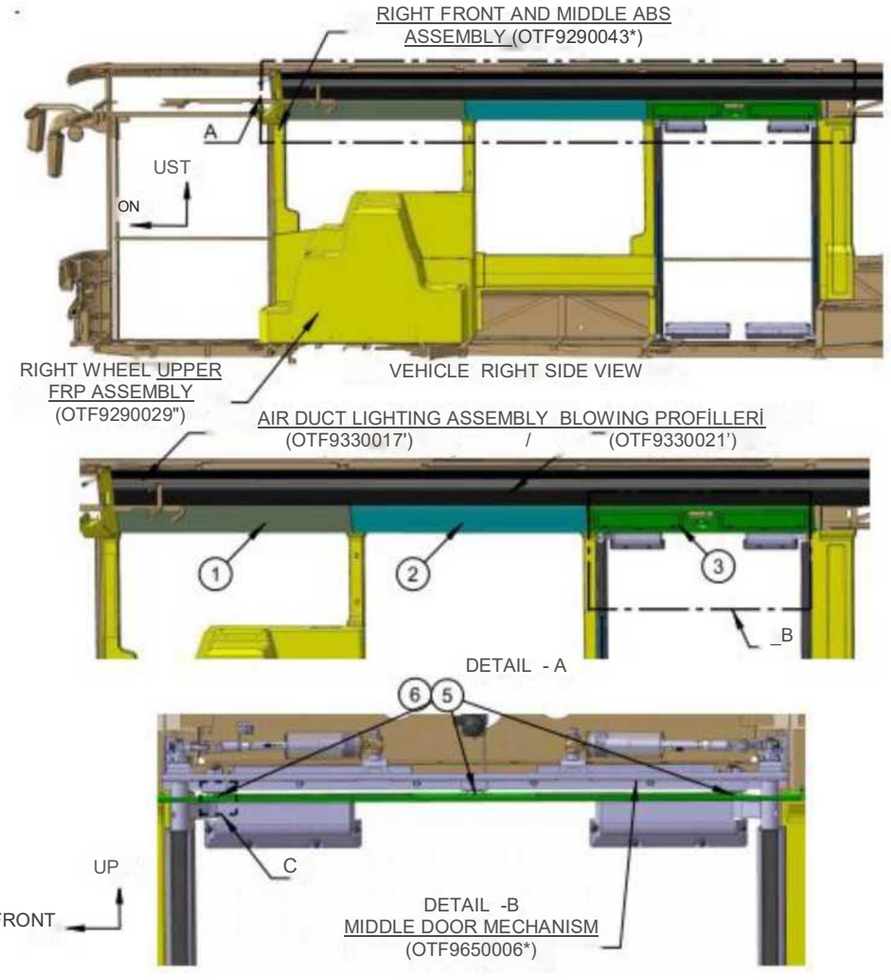
VEHICLE UPPER VIEW

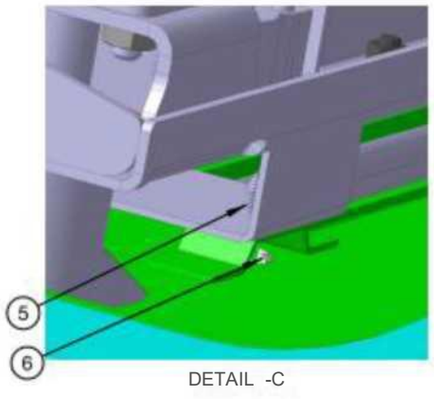


VIEW D - D
INSTALLATION OF RIGHT INNER UPPER
CORNER FRP TO AIR DUCT ASSEMBLY

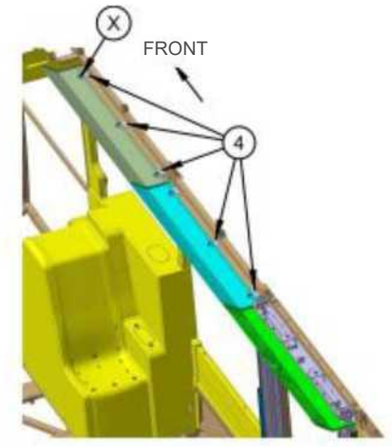
LEAFLET POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	929 - 054	367033064*	FRP. INNER UPPER CORNER RIGHT 3	1
2	929-055	387033065*	FRP. INNER UPPER CORNER RIGHT 4	1
3	929 - 053	387033063*	FRP, UPPER DOOR	1
4	929 - 056	387033067*	FRP, INNER UPPER CORNER RIGHT 5	1
5	929-310	387001922*	PVC PROFILE	3 M
6	929 - 206	3019042192*	SCREW 4.2x19 DİN 7981 YELLOW	3
7	929 - 207	387015504*	PLATING . HEADLIGHT ELBROW PLASTIC	3

FRONT RIGHT INSIDE UPPER CORNER FPRS INSTALLATION ON THE VEHICLE



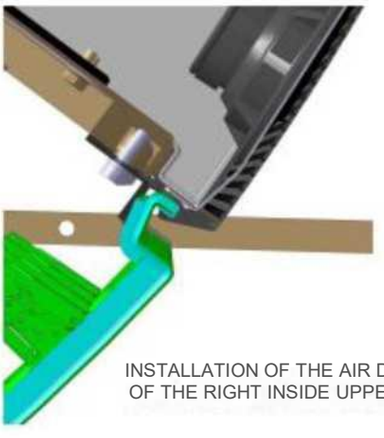


DETAIL -C



IT COMES WITH PART FRPs SHOWN WITH X

SCREW MOUNTING IS ONLY ON THE DOOR MOUNTED FRP



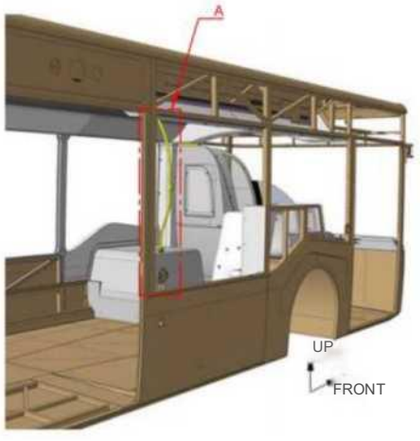
INSTALLATION OF THE AIR DUCT ASSEMBLY OF THE RIGHT INSIDE UPPER CORNER FRP

LEAF POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	929 - 051	3870330S1*	FRP. INNER UPPER CORNER RIGHT 1	1
2	929 - 052	387033002*	FRP. INNER UPPER CORNER RIGHT 2	1
3	929 -053	387033003*	FRP, UPPER DOOR	1
4	929-310	387001922*	PVG PROFILE	3 M
5	929 - 200	3019042192*	SCREW 4.2x19 DİN 7981 YELLOW	3
6	929 - 207	387015504*	PLATING HEADLIGHT ELBROW PLASTIC	3

DRIVER CABIN REAR PLATING ABS INSTALLATION

- MAKE SURE ABS FITS ON VEHICLE LEFT PILLAR.

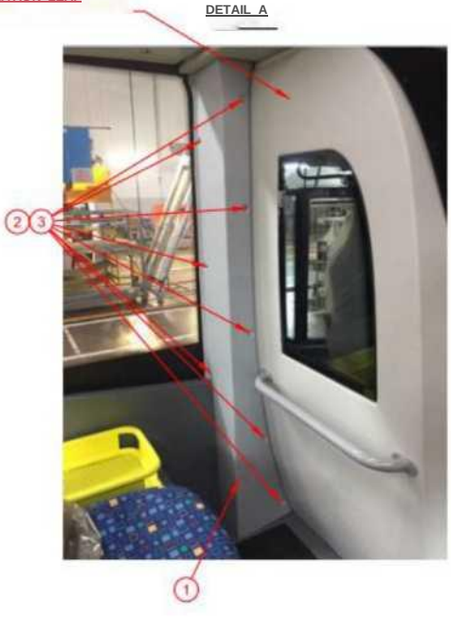
-DO NOT FORGET TO USE GLASSES





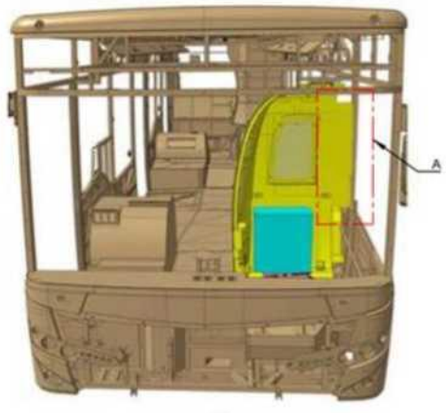
SEE . OTF740Q007 NO'LU OPERATION LEAF

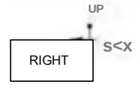
DETAIL A



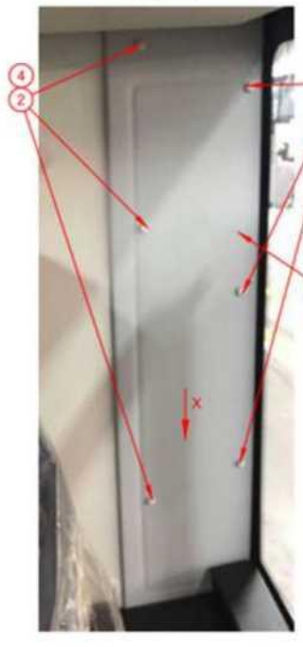
LEAF POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	929-010	3870330322*	ABS. LEFT B PILLAR	1
2	929-030	301354232301	SCREW	8
3	929 -035	38701117300*	COVER, SCREW 4, 2	8

DRIVER CABIN FRONT KAPA MA ABS INSTALLATION





DETAIL A



X VIEW





SEE OTF740000500 NO LU OPERATION LEAF

- MAKE SURE THE CONNECTION HOLES ON THE ABS FULLY COLLECT WITH THE PROFILES ON THE CARCAS.

-DO NOT FORGET TO USE GLASSES

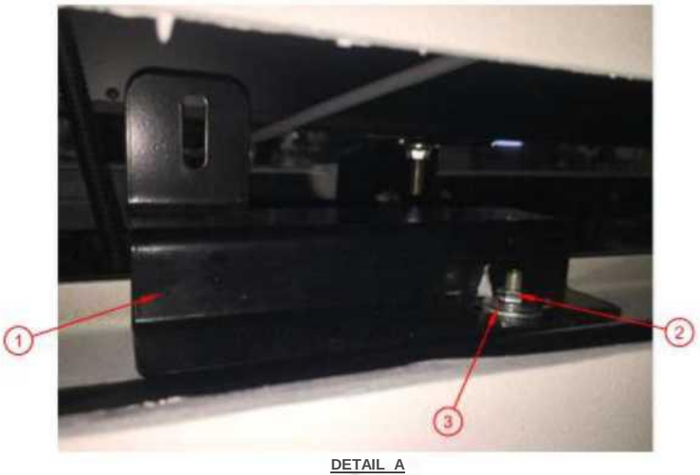
LEAF POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	929 - 012	387034609*	ABS. CABINET INSIDE OF PLATING	1
2	929 - 206	3019042192*	SCREW 4. 2x19 DİN 7961 YELLOW	3
3	929 - 030	3018542323*	SCREW	3
4	929 - 035	3870117300*	COVER, SCREW 4, 2	8

TACHOGRAPH BRACKET INSTALLATION

SEE . OTF929Q04001 NO OPERATION LEAFLET



VEHICLE INTERIOR VIEW



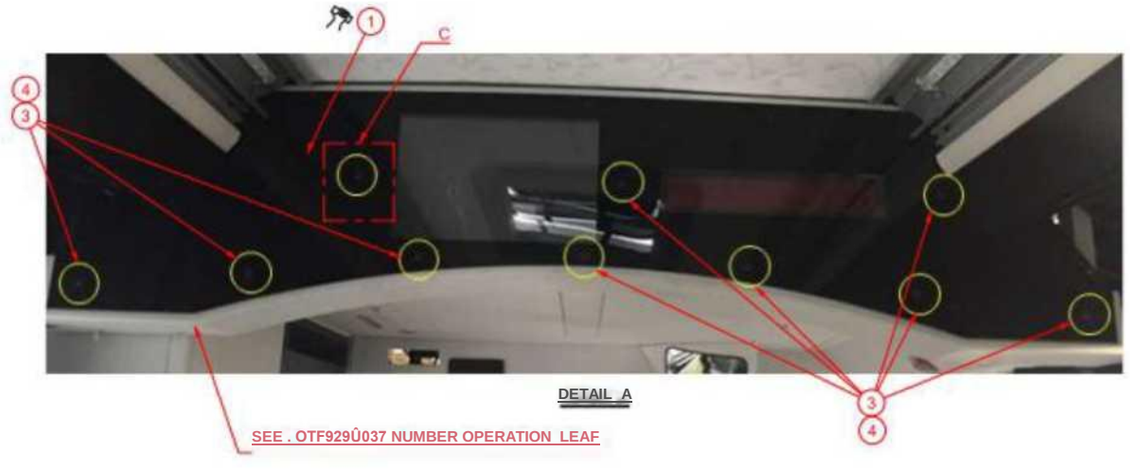
DETAIL A

LEAF POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	929-330	387054520*	BRACKET . TACHOGRAPH	1
2	929 - 202	3005800060*	NUT , FLN&TR M6X1, THICK D. DIN6923	1
3	929 - 201	3011100082*	WASHER , FLAT D=B DİN 9021	1

FRONT AND REAR FLEXI GLASS ASSEMBLIES



VEHICLE INTERIOR VIEW

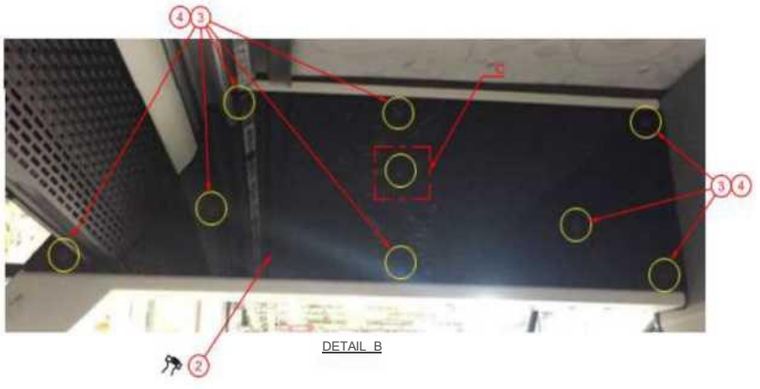


DETAIL A

SEE . OTF929Û037 NUMBER OPERATION LEAF

DETAIL C





DETAIL B

VEHICLE INSIDE REAR VIEW

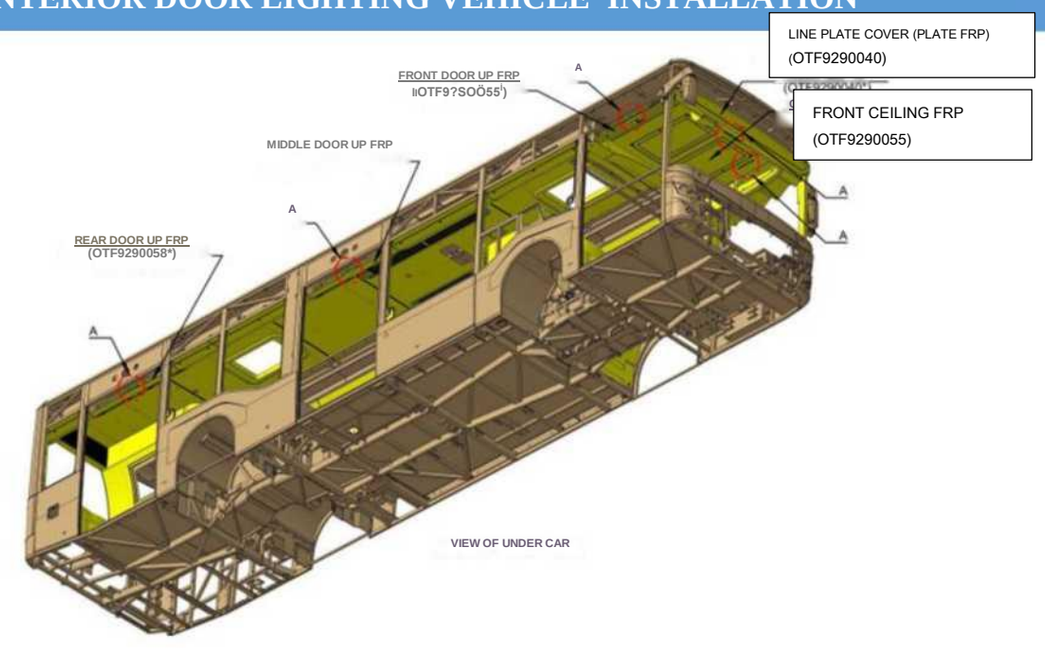


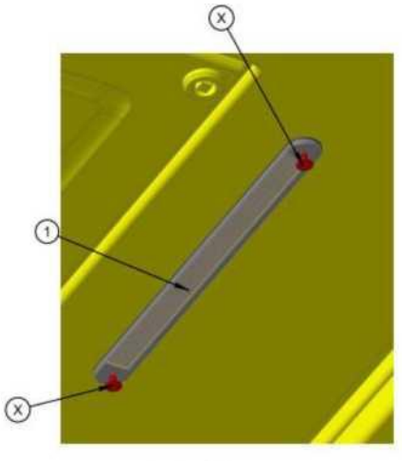
- MAKE SURE TO CLEAN DIRT, DUST AND DRY. NOTE THERE IS NO SCRATCH OR DEFORMATION ON THE PLEXI PLATING.

LEAF FOZ	GROUP / POSE	PART NO	COMPONENT'S NAME	NUMBER
1	929-013	337034427'"	**PLEXI** PLATING . **LCD**	11
2	929-084	3B7034433*	PLEXI PLATING , REAR UPPER FRP	1
2	929-084	397405374'	PLEXI PLATING , REAR UPPER FRP	1
3	929- 092	**387024991**	DUBEL, PLASTIC, BLACK	27
4	929- 093	367024992'	BOLT , PLASTIC. BLACK	27

CEILING LIGHTING AND SPEAKER INSTALLATION

INTERIOR DOOR LIGHTING VEHICLE INSTALLATION



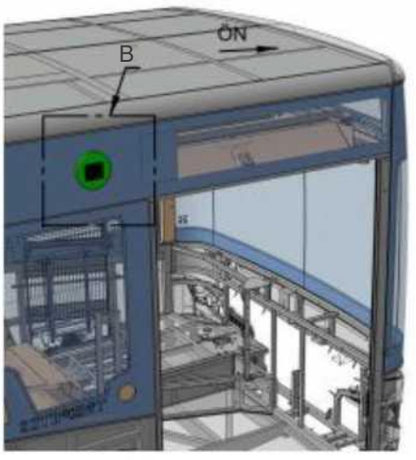


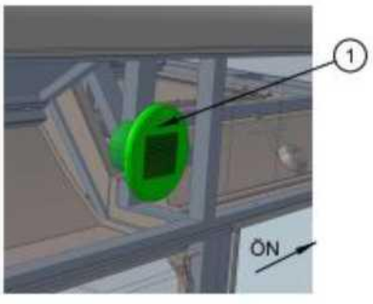
DETAIL A

X POSE SCREWS COME WITH DOOR INTERIOR LIGHTS

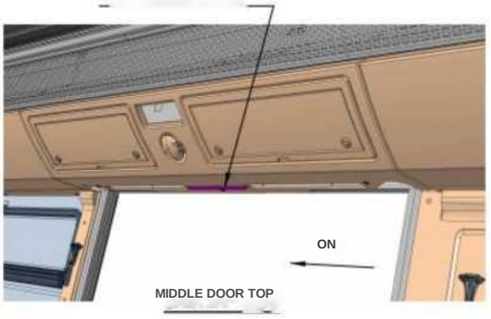
LEAF POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	930-001	387034245*	LIGHTING, DOOR INTERIOR	5

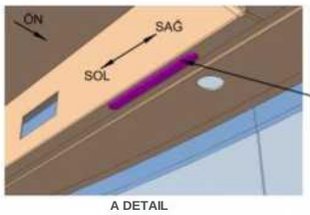
ANNOUNCEMENT SPEAKER MOUNTING





B DETAIL





A DETAIL

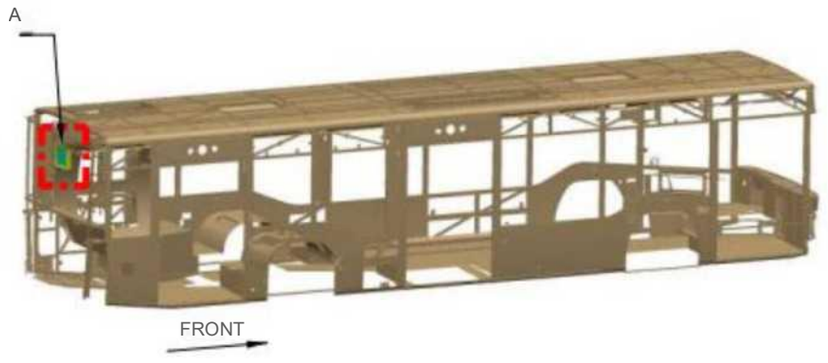


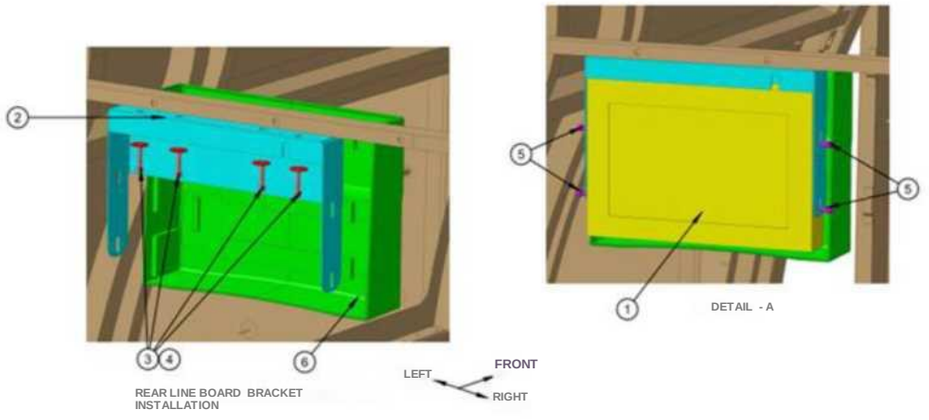
REAR DOOR TOP

LEAF POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	930 - 002	387035164*	SPEAKERS . D|S ANONS- FR13WP	1

INTERIOR COVERS AND LINE PLATES INSTALLATION

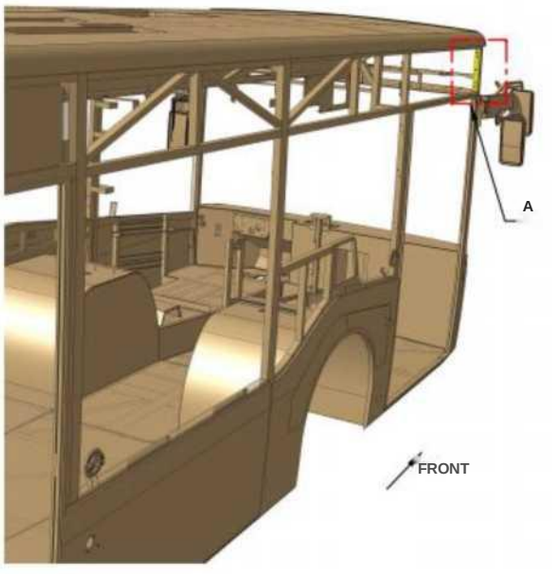
REAR DIGITAL LINE-PLATE VEHICLE INSTALLATION

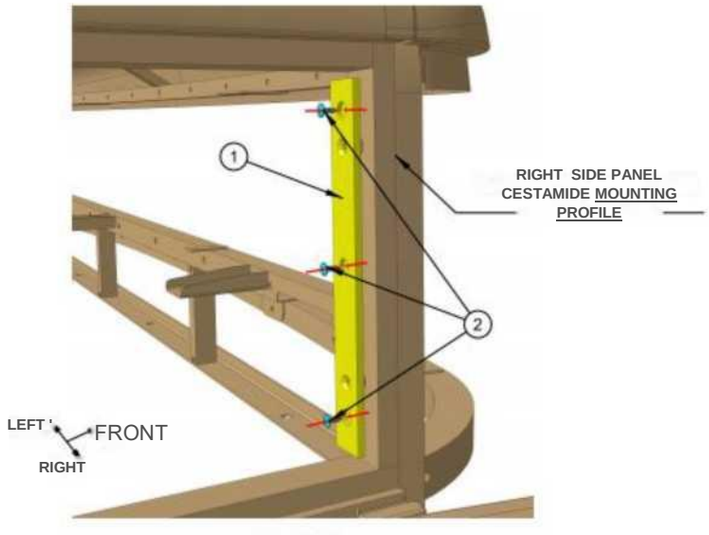




LEAF *POSE*	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	931 - 006	367021717*	LINE BOARD , REAR	1
2	931 - 007	387021665*	BRACKET . REAR LINE BOARD	1
3	931 - 014	3000906351*	BOLT , SLE M6X35, THICK D. DIN912	4
4	931-015	3011100061*	WASHER , FLAT D=6 DIN 9021	4
5	931-013	3015003203*	SCREW MBx20 DİN 7956	4
6	931 -029	387039211*	ABS PLATING , REAR LINE BOARD	1

SIDE DIGITAL LINE PLATE CESTAMIDE INSTALLATION

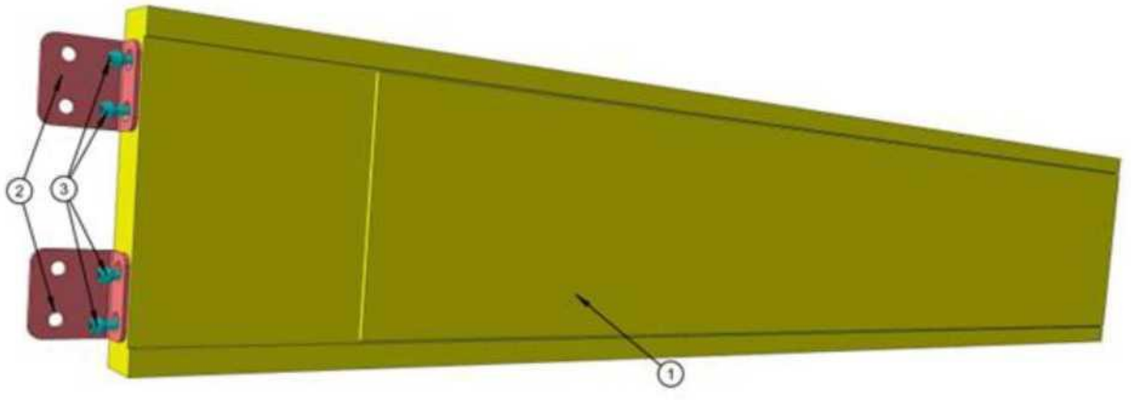




A - DETAIL

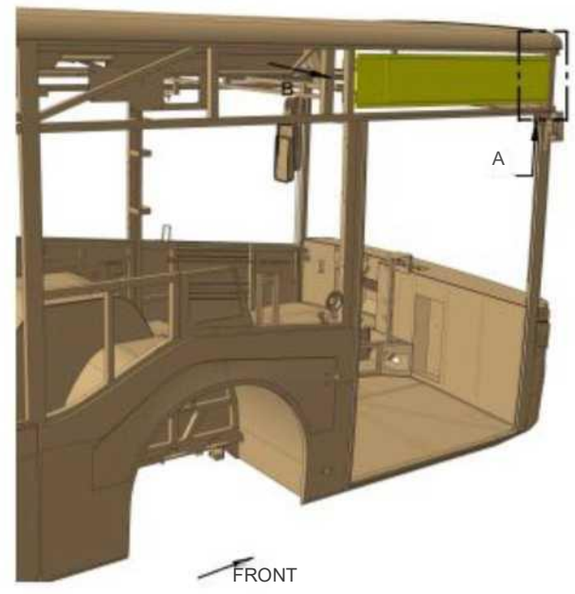
LEAF POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	931 -035	387033359*	CONNECTION CESTAMIDI	1
2	931 -011	301904219*	SCREW 4.2x19 DİN 7981 YELLOW	3

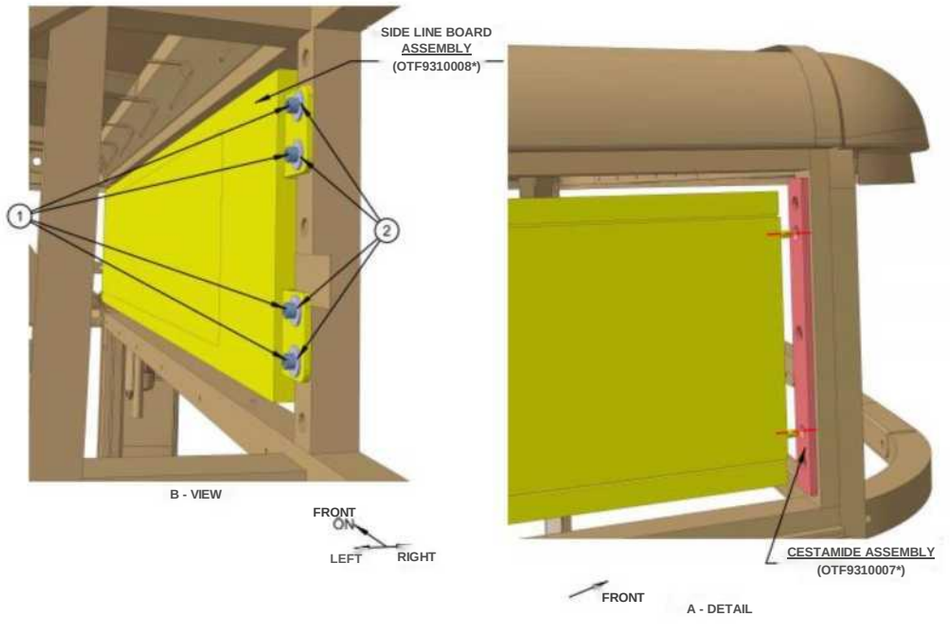
SIDE LINE PLATE PRE-PREPARATION INSTALLATION



LEAF POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	331 -003	387035180*	LINE BOARD , SIDE SINGLE COLOR	1
2	931 -019	387038646*	BRACKET . SIDE LINE BOARD	2
3	931 -065	3015208204*	SCREW, M8X20 DİN7987	4

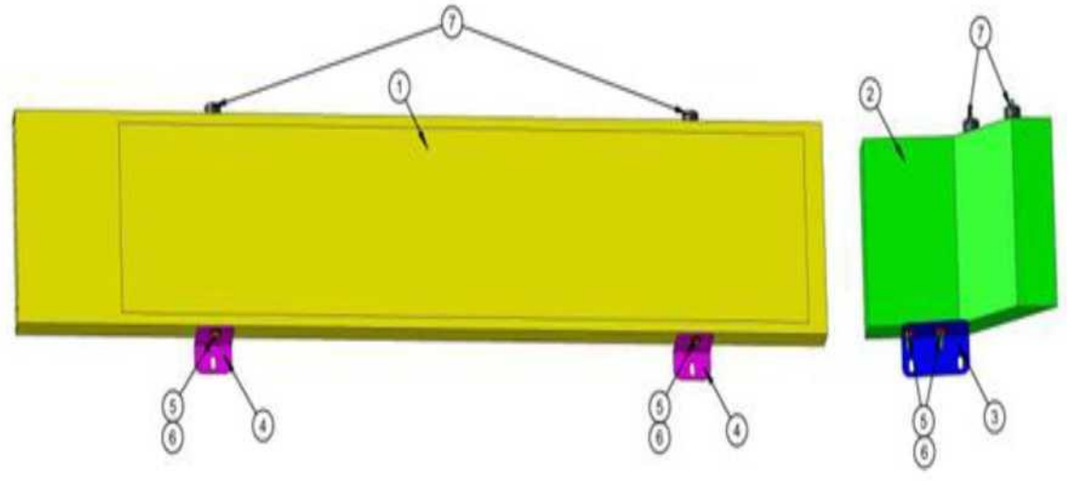
YAN LINE BOARD INSTALLATION





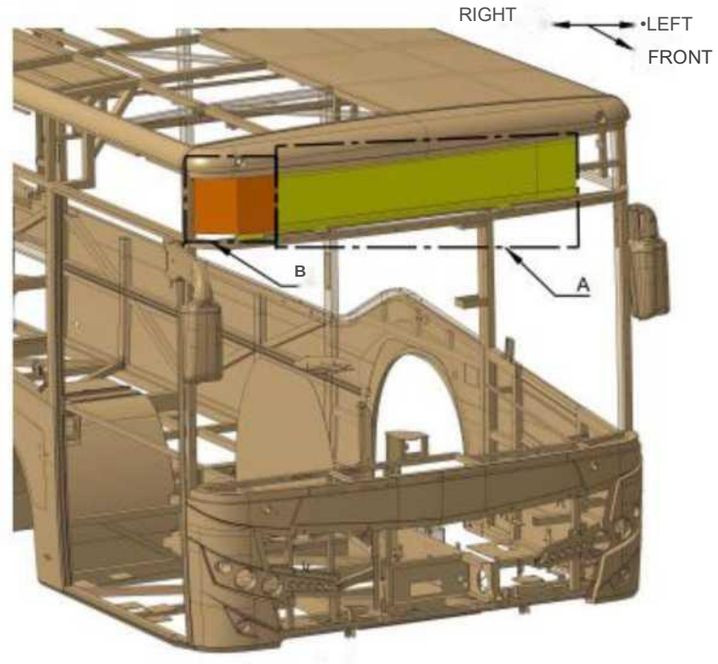
LEAF POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	931 -010	3000905154*	BOLT , SLB M8X15, THICK D. DİN912	2
2	931-008	3011100082*	WASHER , FLAT D=8 DİN 9021	2

FRONT AND CORNER DIGITAL LINE PLATE PRE-PREPARATION INSTALLATION

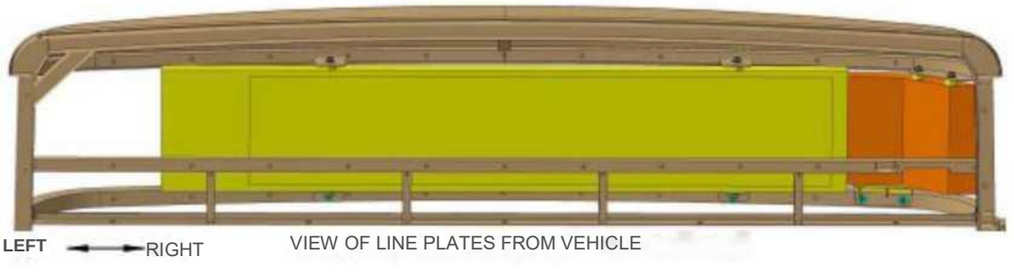


LEAF POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	331 - 002	387033352*	LINE BOARD , FRONT	1
1	931 - 002	387035179[1]	LINE BOARD , FRONT COLORFUL	1
2	931 - 005	387033353*	LINE BOARD , CORNER	1
3	931 -012	387033356*	CONNECTION BRACKET I, II	1
4	931 -017	387033355*	CONNECTION BRACKET I, I	2
4	331-017	387035538*	CONNECTION BRACKET I, I	1
5	931 -009	3005800084*	NUT . FLN&TR M8X1.25, THICK D. DİN 8923	4
6	931 -008	3011100082*	WASHER , FLAT D=8 DİN 9021	4
7	931 -018	387035598*	CESTAMIDE, LINE BOARD	4

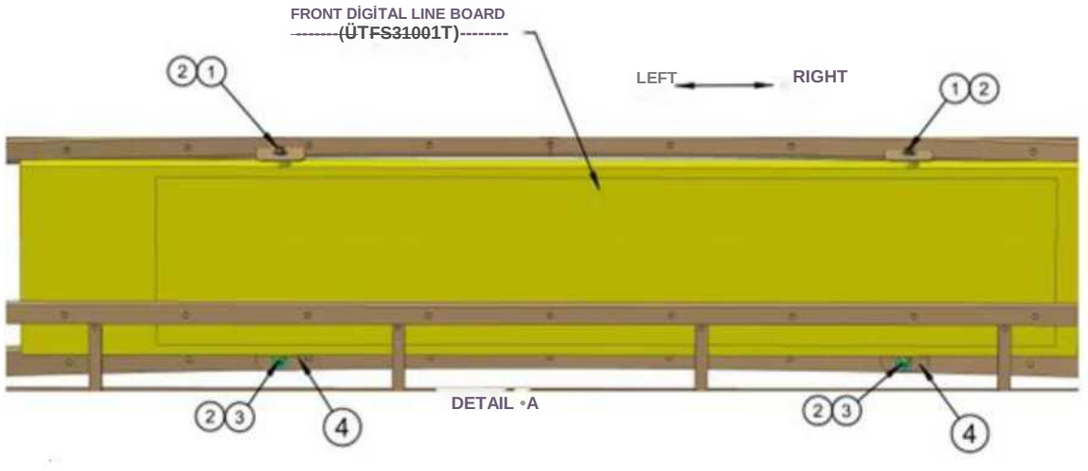
FRONT AND CORNER DIGITAL LINE PLATE VEHICLE INSTALLATION

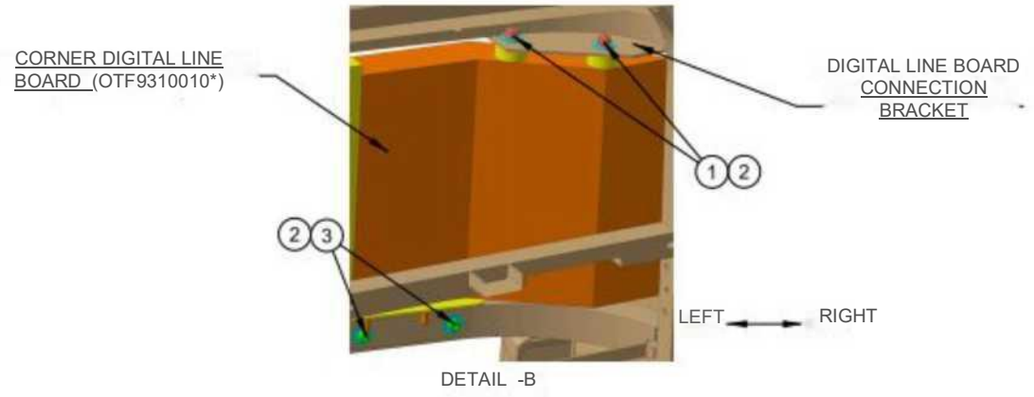


VEHICLE FRONT VIEW



VIEW OF LINE PLATES FROM VEHICLE

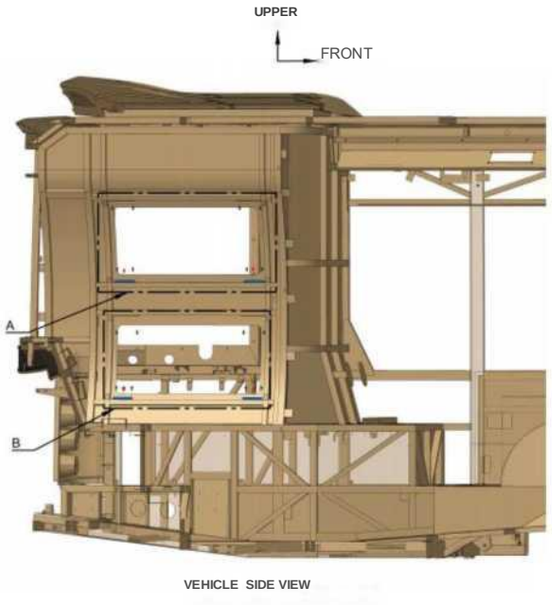




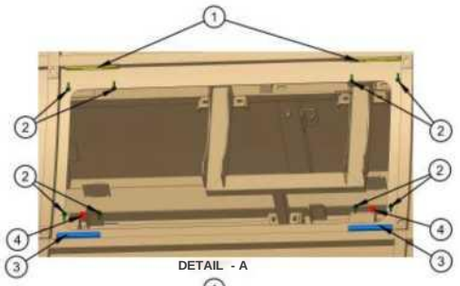
DETAIL -B

LEAFLET POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	931 -009	3005800084*	NUT , FLN&TR M8X1. 25, THICK D. DİN 692	4
2	931 -008	3011100062*	WASHER , FLAT D=8 DİN 9021	a
3	931 -010	3000908154*	BOLT , SLB M8X15, THICK D. DIN912	4
4	931 -018	307035598*	CESTAMIDE. LINE BOARD	2

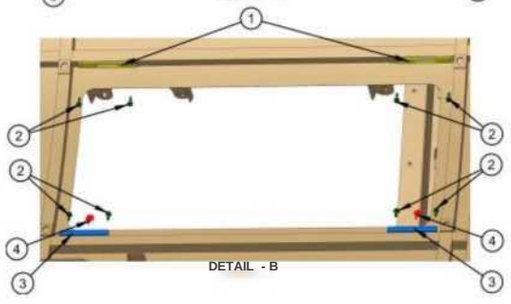
ENGINE ROOM MAINTENANCE COVER LOCK STRIKE AND BRACKET VEHICLE ASSEMBLY



VEHICLE SIDE VIEW



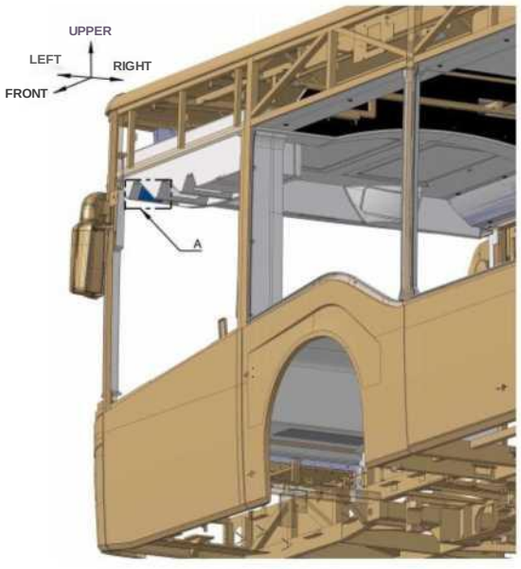
DETAIL - A



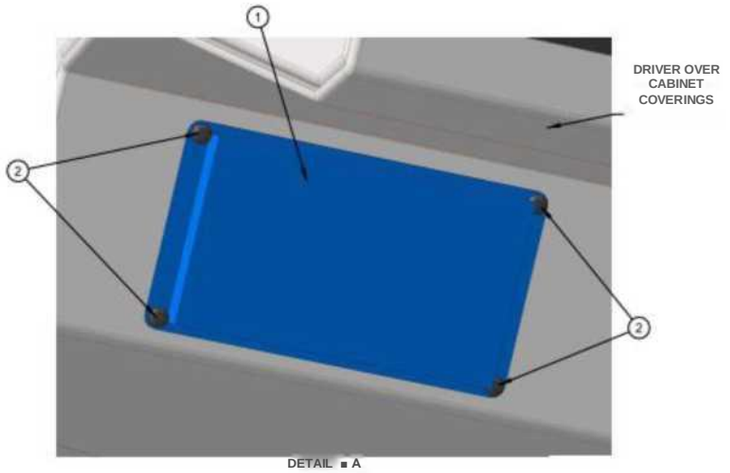
DETAIL - B

LEAF POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	931 - 023	387037244"	LOCK PROVISION	4
2	931 - 026	3001206166"	BOLT , FLN M6X1X16. THICK D. DIN6921	16
3	931 - 025	387037237"	BRACKET	4
4	931 - 026	387001692"	RUBBER STOPPER . SMALL	4

LINE PLATE CONTROL VEHICLE INSTALLATION



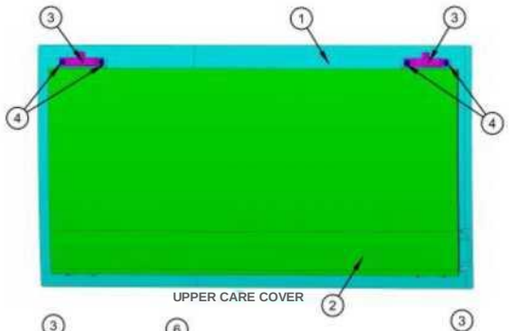
VEHICLE SIDE VIEW



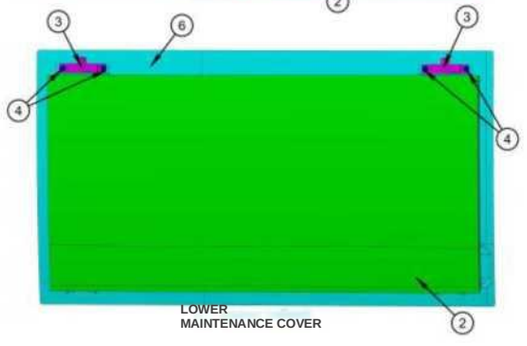
DETAIL ■ A

LEAF POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	931 - 004	387021712*	STEERING. LINE BOARD	1
1	931 - 004	387035333*	CONTROL PANEL, İETT LINE BOARD	1
1	931 - 004	387053525*	CONTROL PANEL, DOUBLE LINE BOARD	1
2	931 -016	301814295*	SELF-TAPPING SCREW	4

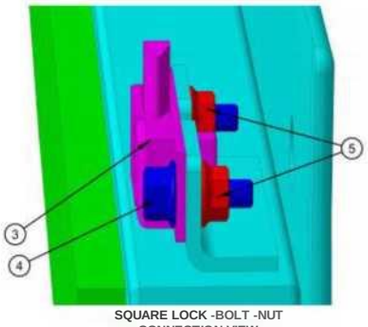
MAINTENANCE COVER ASSEMBLY



UPPER CARE COVER



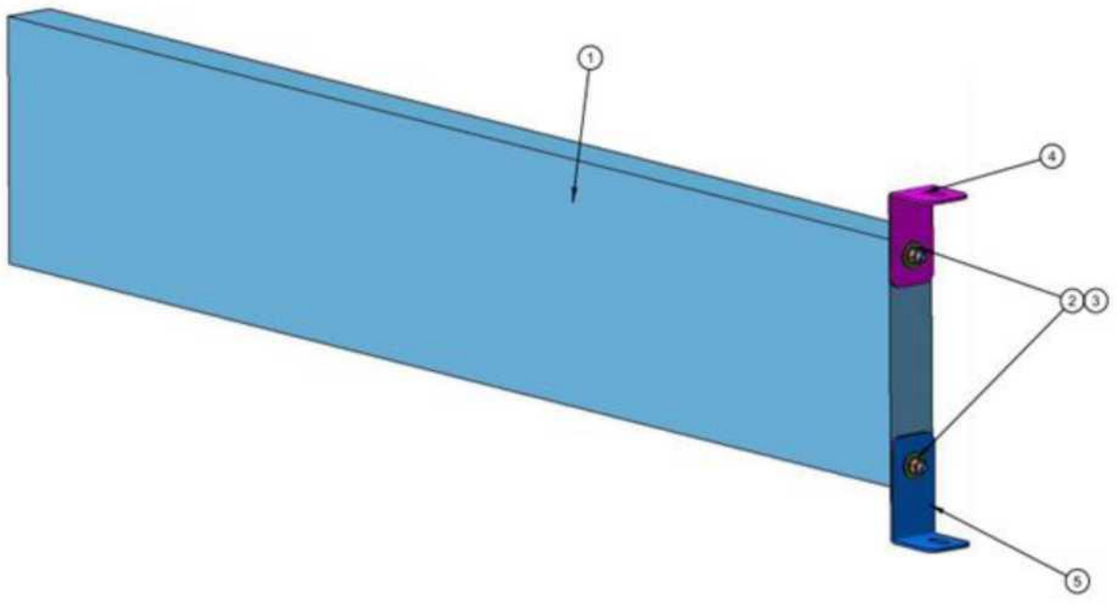
LOWER
MAINTENANCE COVER



SQUARE LOCK -BOLT -NUT
CONNECTION VIEW

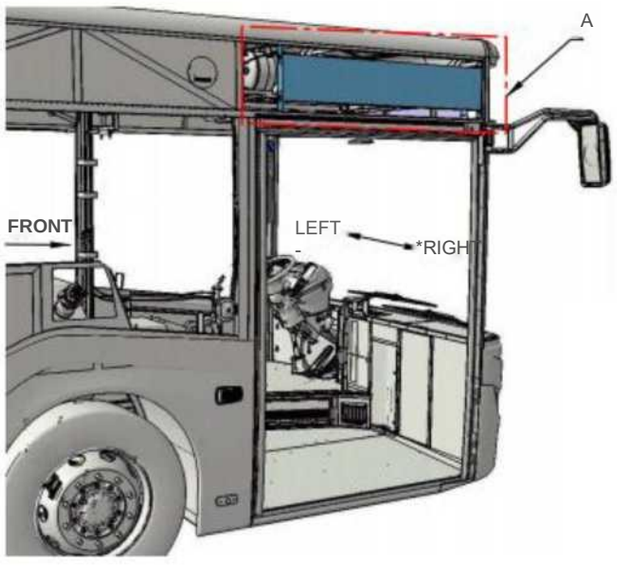
LEAF POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	931 -021	387035309*	MAINTENANCE COVER ASSEMBLY	1
2	931 - 060	387041378*	ISOLATION. MAINTENANCE COVER	2
2	931 - 066	387041378*	ISOLATION. MAINTENANCE COVER	2
3	931 - 024	387041498-	LOCK, SQUARE İETT	4
4	931 - 026	3001206166*	BOLT , FLN M6X1X16. THICK D. DİN6921	8
5	931 - 027	3005800064'	NUT . FLN&TR M6X1. THICK D. DIN6923	8
6	931 -020	387060059*	MAINTENANCE COVER KMP	1
6	931 -020	387036310'	MAINTENANCE COVER ASSEMBLY	1

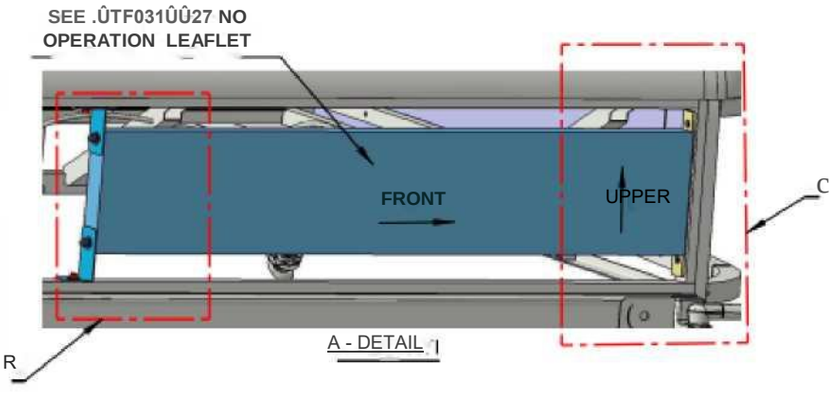
SIDE LINE PLATE PRE-PREPARATION INSTALLATION

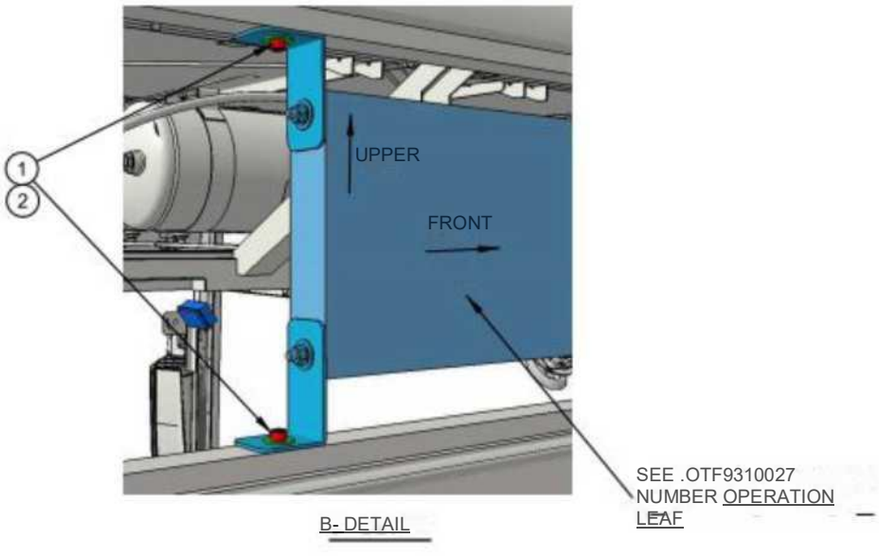


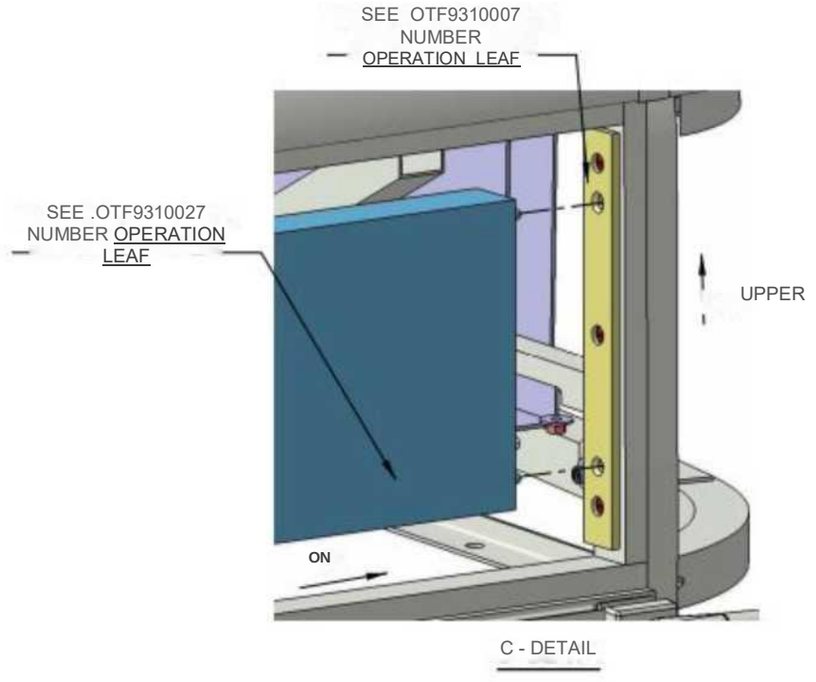
LEAF POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	931-003	387033354*	LINE BOARD , SIDE	1
2	931-008	3011100082*	WASHER . FLAT D=8 DİN 9021	2
3	931-009	3005800084*	NUT . FLN&TR M8X1.25, THICK D. DİN 6923	2
4	931-019	387033357*	CONNECTION BRACKET I, III CONNECTION BRACKET I. III	1
5	931 - 055	387033358*	CONNECTION BRACKET I, IV	1

SIDE LINE BOARD INSTALLATION



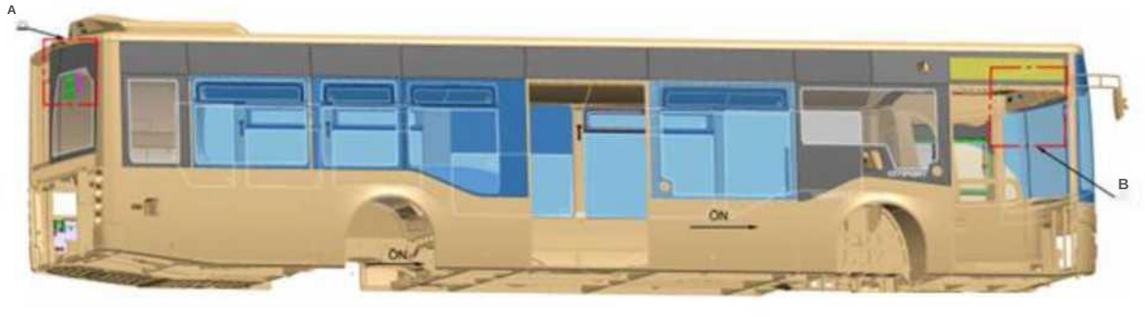


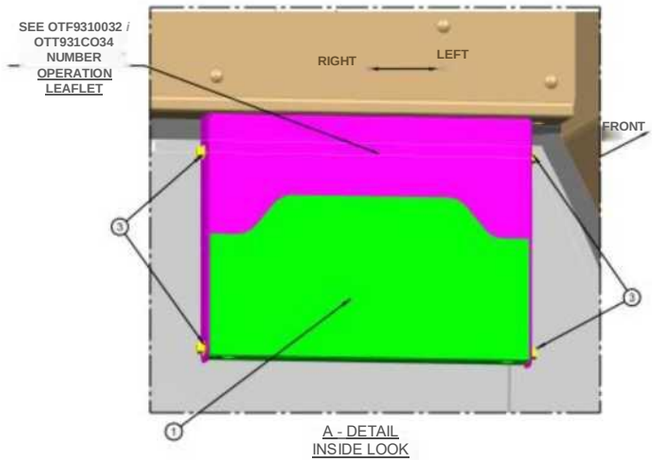




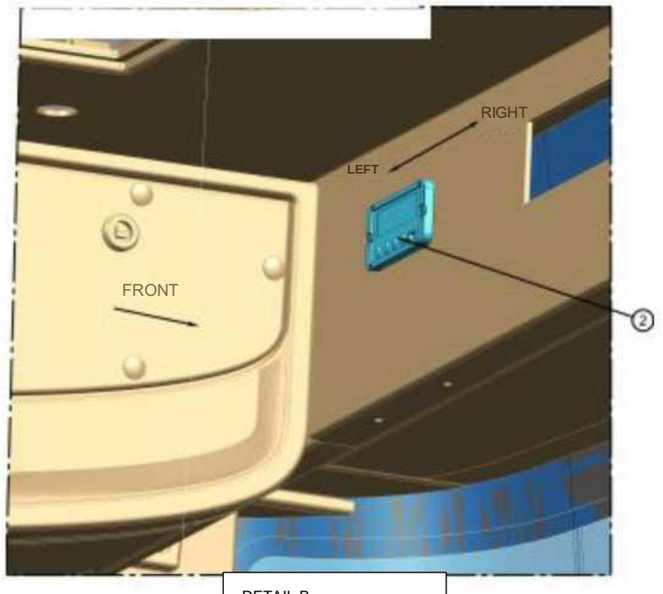
LEAF POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	931 - 008	3011100086*	WASHER , FLAT D=8 DİN 9021	2
2	931 -010	3000903154"	BOLT SLB M8X15, THICK D. DIN912	2

REAR LINE PLATE LINE CONTROL ASSEMBLY





A - DETAIL
INSIDE LOOK

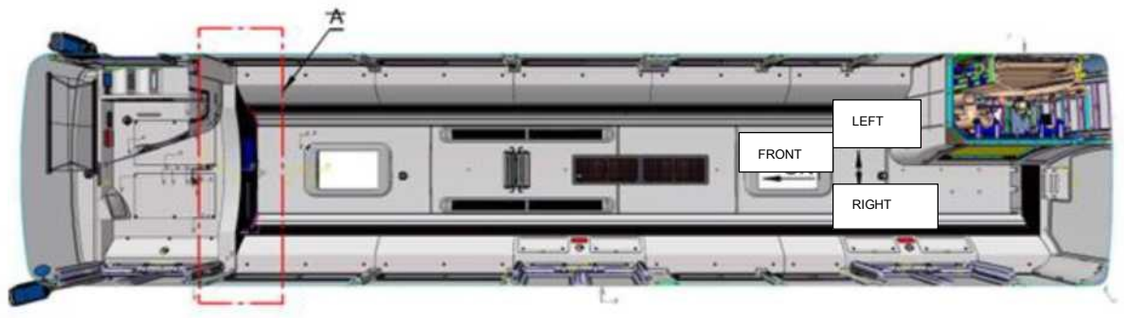


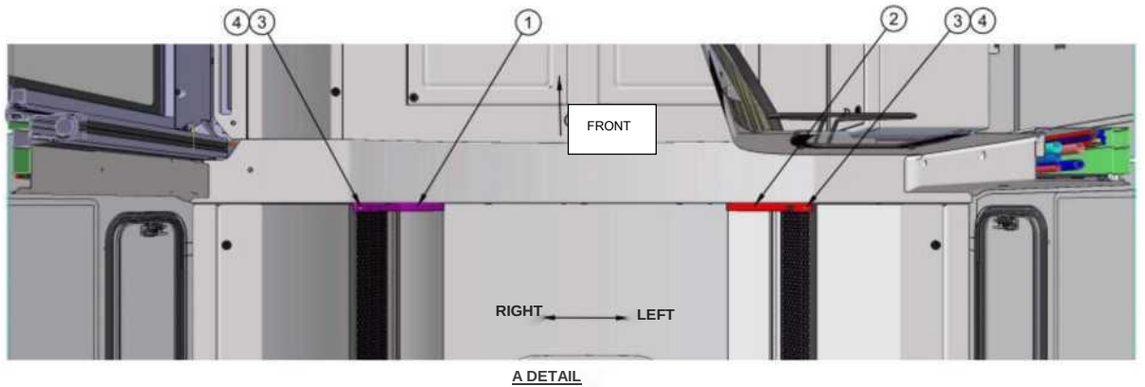
DETAIL B
INSIDE LOOK

LEAF POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	931 -003	307370679*	LINE BOARD . REAR, HANQVER	1
11	931 -006	397370079*	LINE BOARD . REAR. HANOVER	I
2	931 -004	397371434'	STEERING, LINE BOARD , HANOVER	1
3	931 -010	ÎD012M153*	BOLT , FLN M5X1. 26X16. THICK 0. DIN69E	4

HATSTAND AND AIR DUCT INSTALLATION

AIR DUCT END CLOSING ABS INSTALLATION

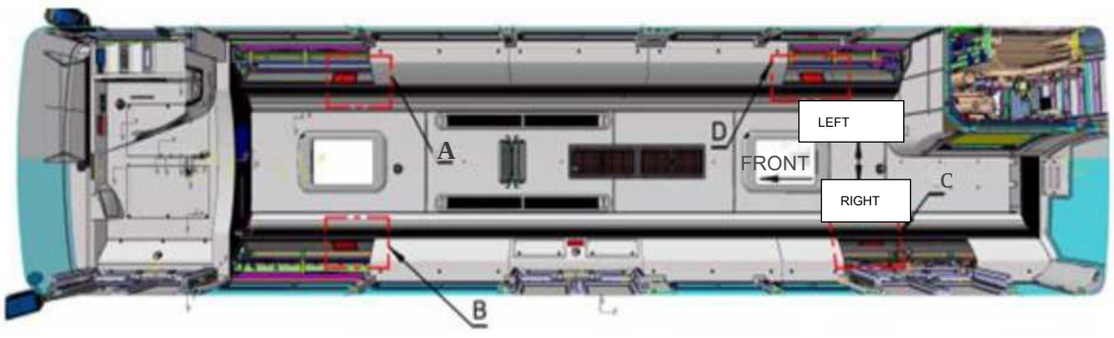


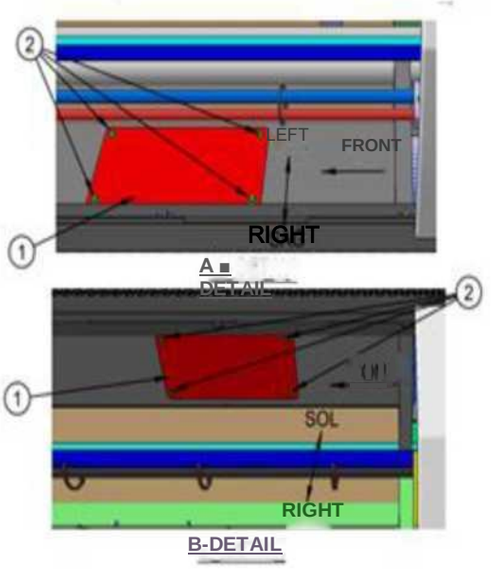


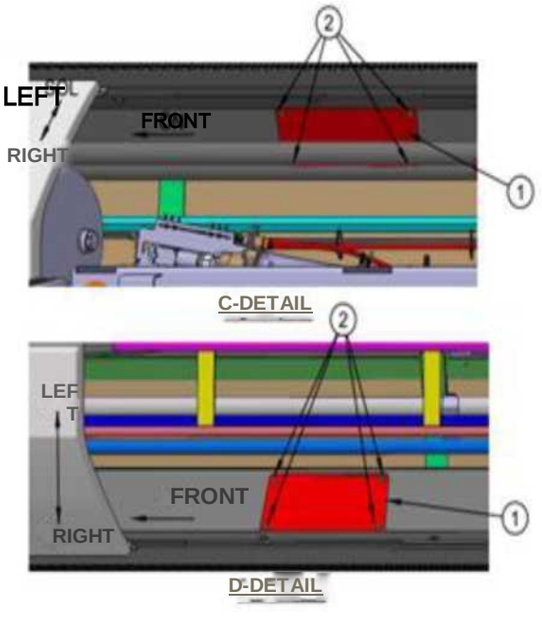
A DETAIL

LEAF POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	933 -134	387054293*	ABS, PLATING . EDGE. AIR DUCT , RIGHT	1
2	933 - 135	387054294*	ABS, PLATING . EDGE, AIR DUCT , LEFT	1
3	933 - 130	387026690*	ABS SCREW COVER. LIGHT GREY	2
4	933 - 139	3019042192*	SCREW 4. 2x19 DIN 7901 YELLOW	2

AIR CONDITIONING MAINTANENCE COVERS INSTALLATION

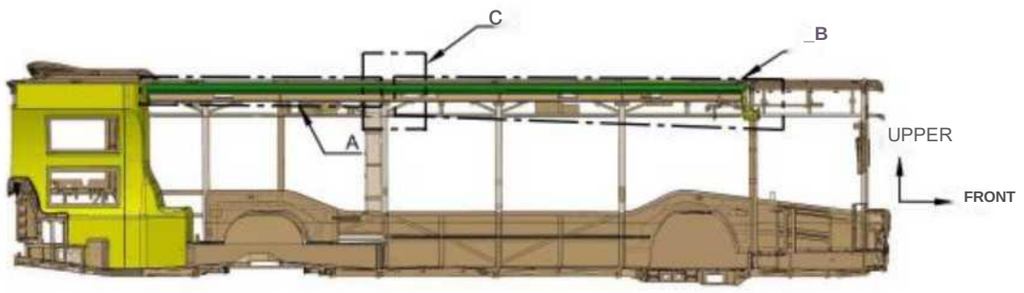




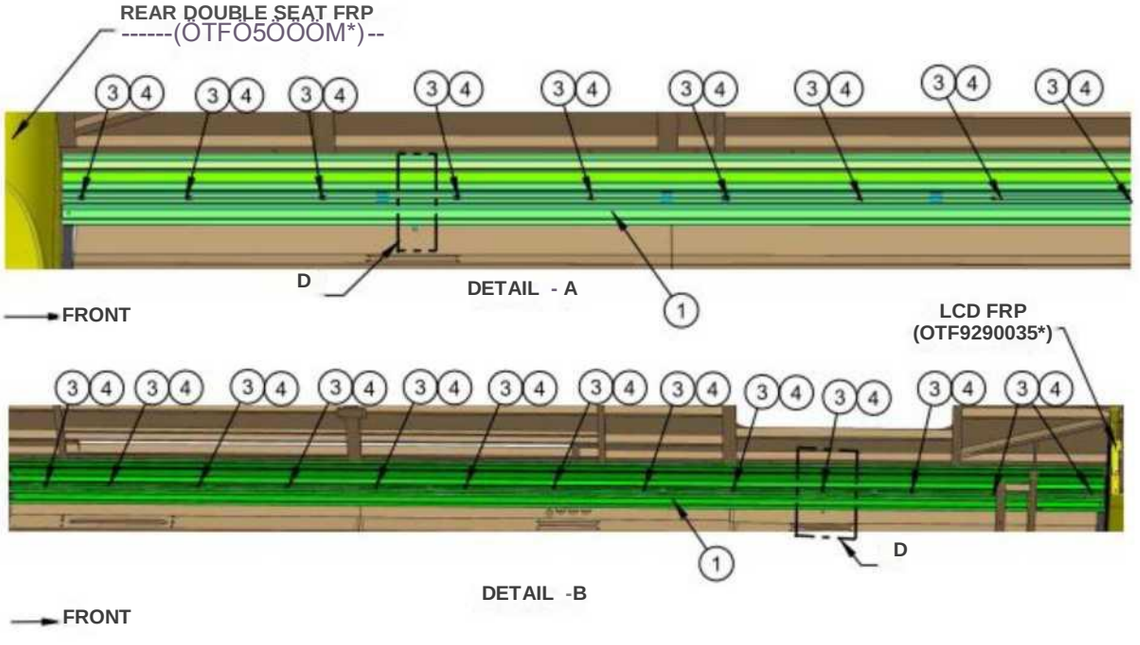


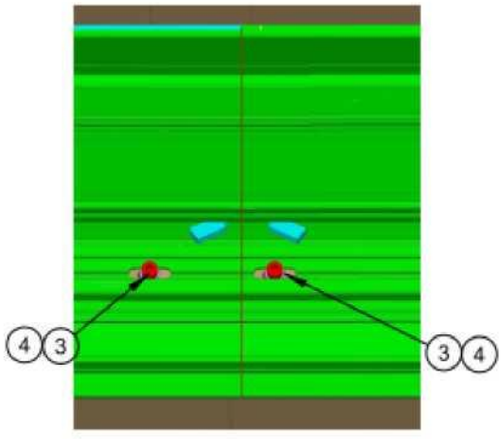
LEAF POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	933-120	387039045*	COVER, AIR CONDITIONING MAINTENANCE	4
2	933 -121	3001205124*	**BOLT** , FLN **M5X0. 8X12. THICK D.** DIN6921	**16**

LEFT 1-LEFT 2 AIR DUCT LIGHTING PROFILE VEHICLE INSTALLATION

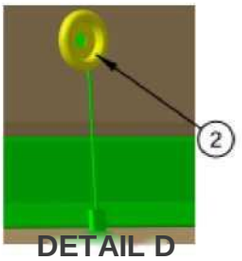


VEHICLE LEFT SIDE VIEW





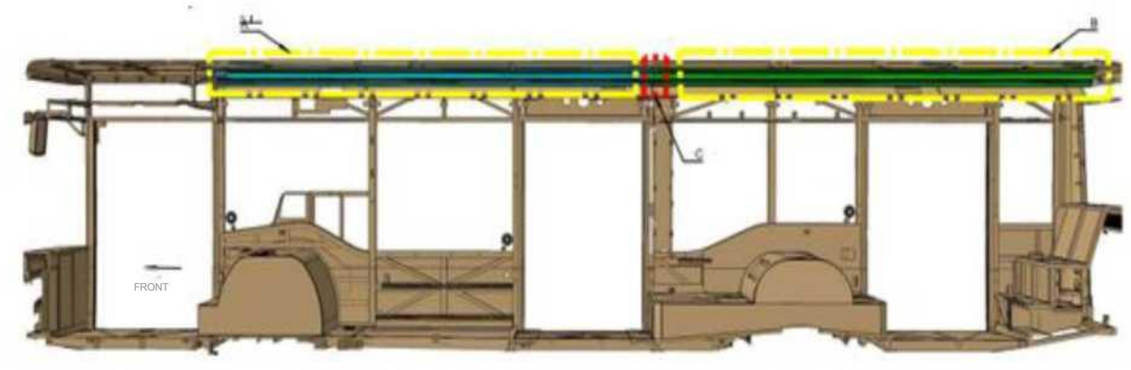
DETAIL -C

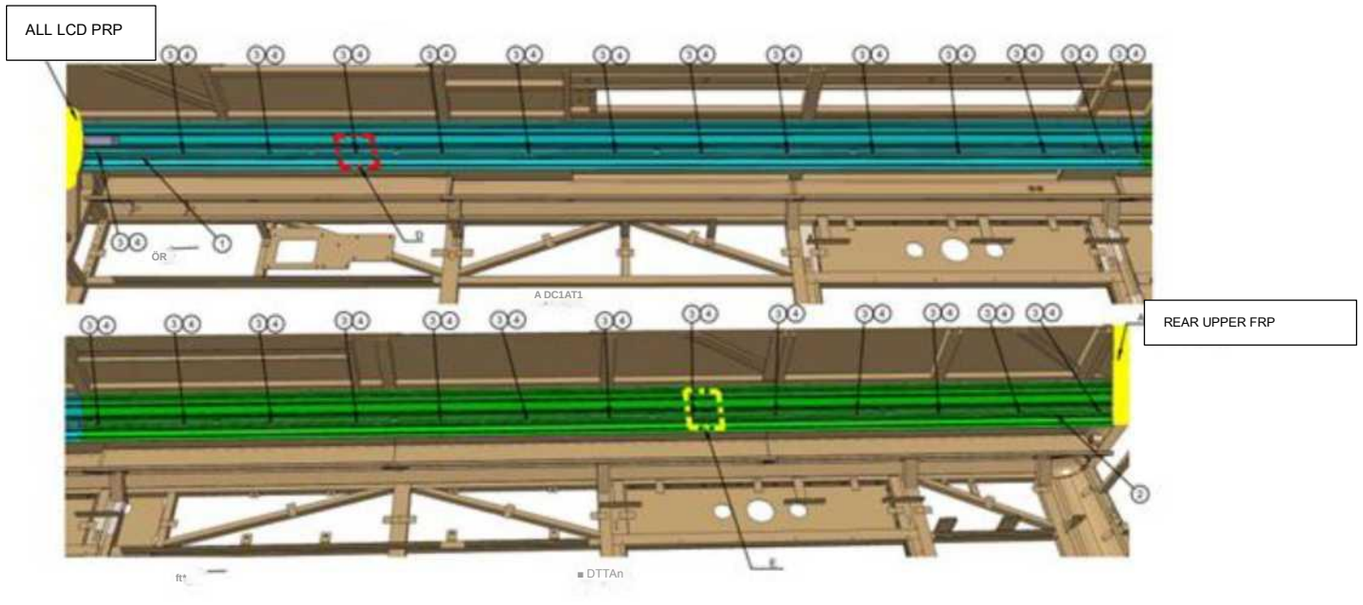


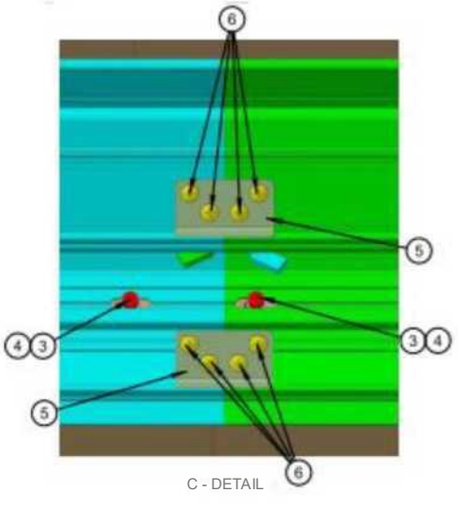
DETAIL D
VEHICLE OUT OF VIEW

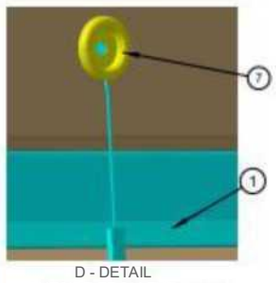
LEAF POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	933 - 026	387033097*	AL GROUP. AIR DUCT LEFT	1
1	933 - 026	387700934*	AL GROUP, AIR DUCT LEFT	1
1	933 - 026	387408377*	ALUMINUM GROUP , AIR DUCT LEFT	1
1	933 - 026	367371296*	ALUMINUM GROUP . AIR DUCT . LEFT	1
1	933 - 026	387452240*	AL GROUP. AIR DUCT LEFT . TWO DOORS	1
2	933 - 108	388881883*	GROMMET	2
3	933 - 104	3000906203*	BOLT SLB M6X20, THICK D. DIN912	22
4	933 - 105	3010000064*	WASHER , FLAT D=6 DİN 125	22

RIGHT ALUMINUM LIGHTING PROFILE AIR DUCT INSTALLATION

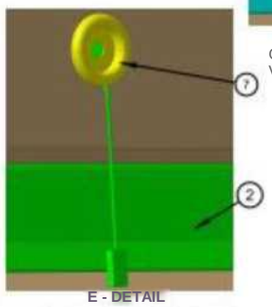








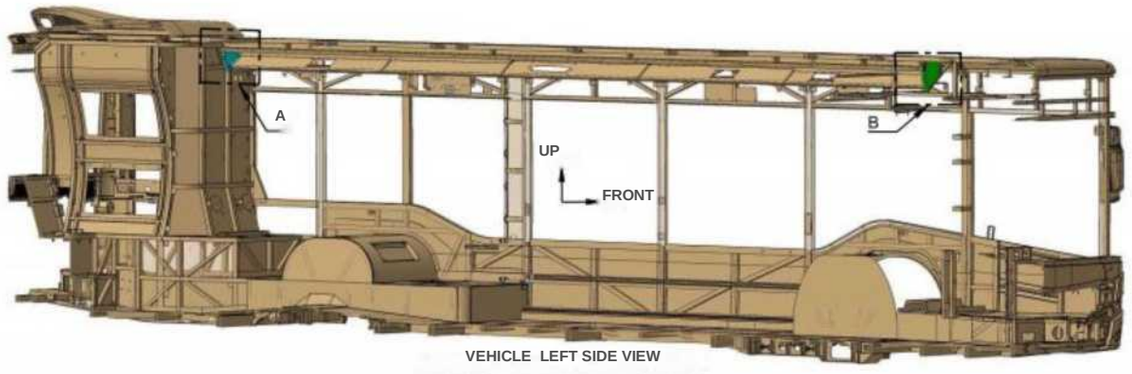
D - DETAIL
OUTSIDE FROM THE
VEHICLE TO INSIDE LOOK



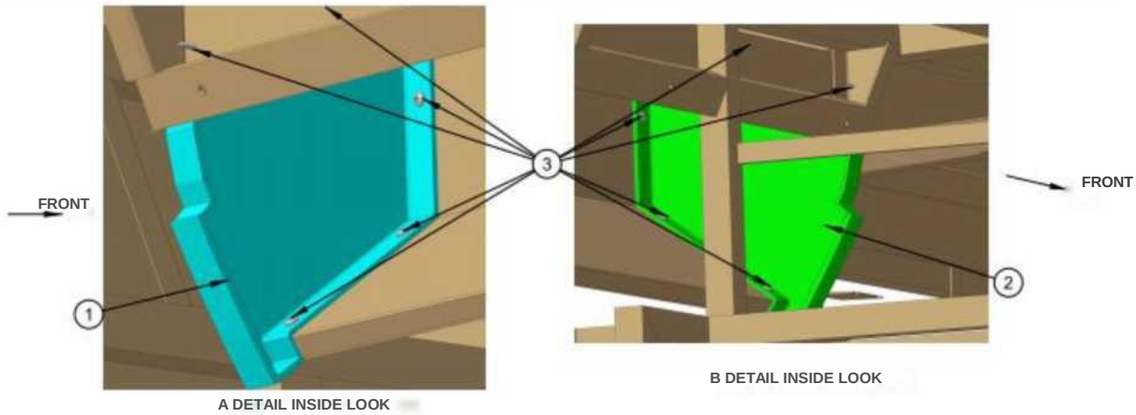
E - DETAIL
OUTSIDE FROM THE VEHICLE
TO INSIDE LOOK

LEAF POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	ADE 1
1	933 - 002	387033076'	AL LIGHTING PROFILE . AIR DUCT RIGHT 1	1
2	933-- 003	337038377'	AL LIGHTING PROFILE . AIR DUCT RIGHT 2	1
3	033 - 104	3000806203*	BOLT SLB MBX2Q. THICK D. DINS12	27
4	933 - 105	3010000064"	WASHER . FLAT D=B DİN 125	27
5	933- 012	387034813'	BRACKET . UST. AL LIGHTING PROFILE BİRLE	2
6	933 - 044	301904219'	SCREW 4.2x19 DİN TBB 1 YELLOW	8
7	933 - 108	388881883-	GROMMET	2

LEFT AIR DUCT TYPE 1 AND 2 ABS VEHICLE INSTALLATION



VEHICLE LEFT SIDE VIEW

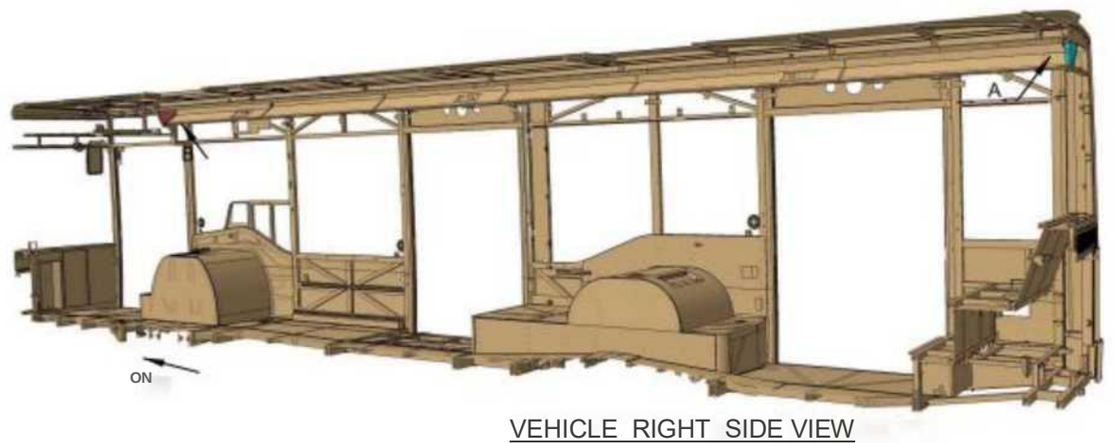


A DETAIL INSIDE LOOK

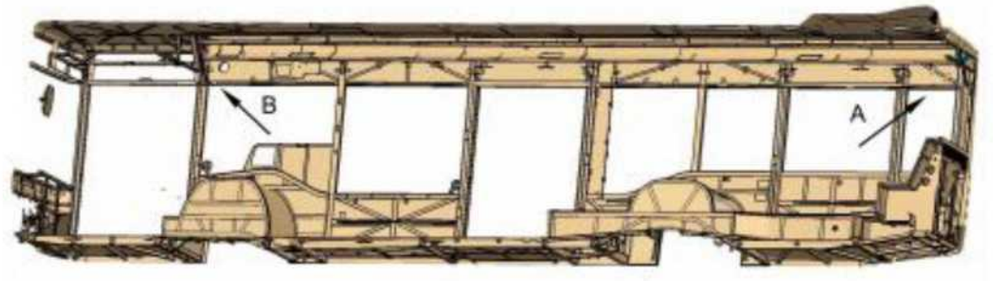
B DETAIL INSIDE LOOK

LEAF POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	933 - 100	337033072*	ABS, AIR DUCT INLET TYPE 1	1
2	933-101	387033073*	ABS, AIR DUCT INLET TYPE 2	1
2	933-111	307050327*	ABS, AIR DUCT INLET, LEFT	1
3	933 - 103	3018948253*	SCREW	10

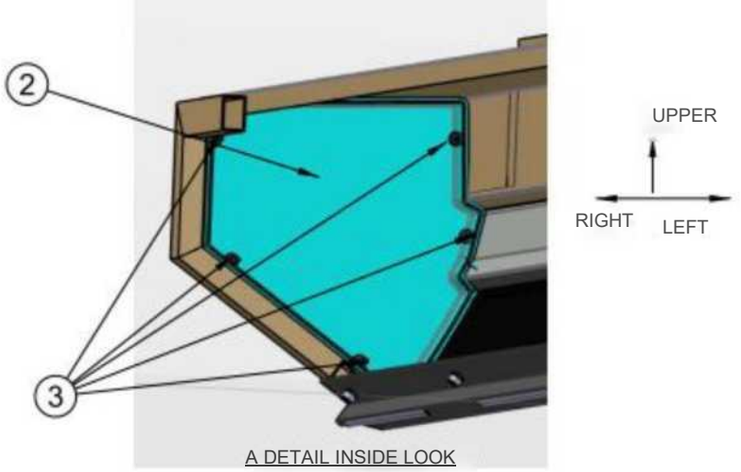
RIGHT ABS AIR DUCT INLET INSTALLATION



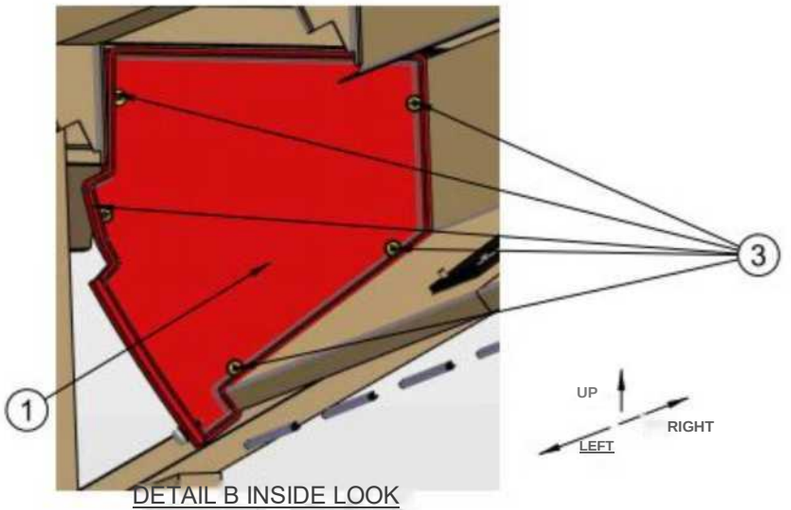
VEHICLE RIGHT SIDE VIEW



CITIPORT TWO DOORS



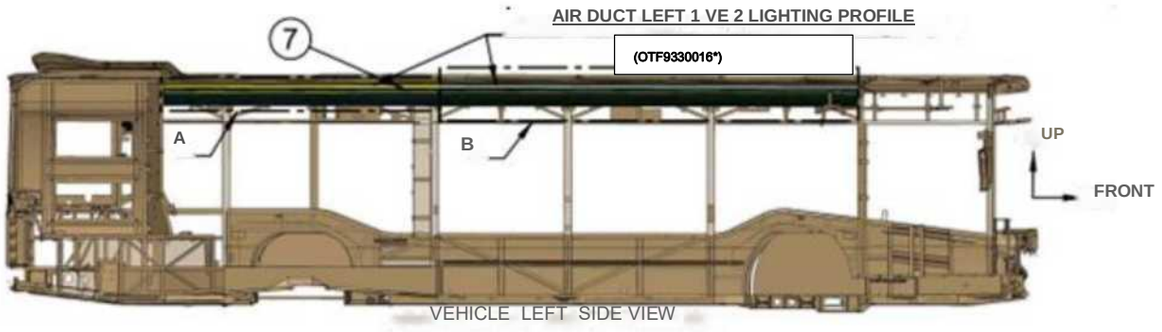
A DETAIL INSIDE LOOK



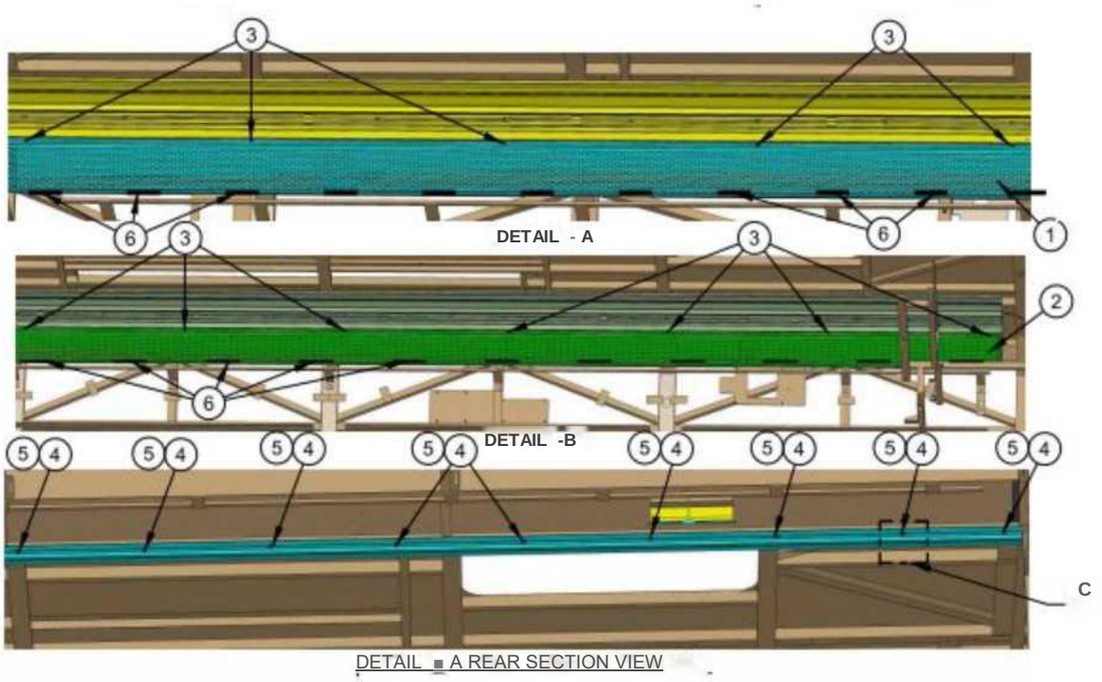
DETAIL B INSIDE LOOK

LEAF **POSE**	GROUP/POSE	PART NO	COMPONENT'S NAME	**NUMBER**
1	933 -100	387033072*	ABS, AIR DUCT INLET TYPE 1	1
1	933 - 140	387058326*	ABS. AIR DUCT INLET, RIGHT	1
2	933 - 101	387033073*	ABS, AIR DUCT INLET TYPE 2	1
2	933 - 141	387058327*	ABS, AIR DUCT INLET, LEFT	1
3	933-103	301894825*	SCREW	10

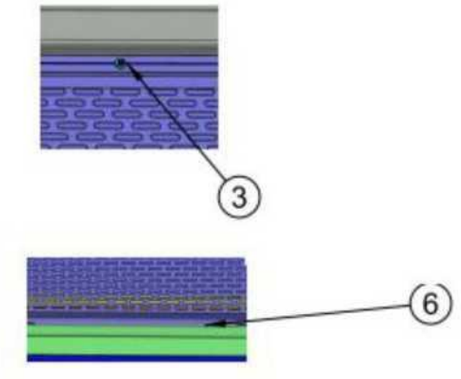
LEFT AIR DUCT BLOW PROFILE ASSEMBLY INSTALLATION TO THE VEHICLE

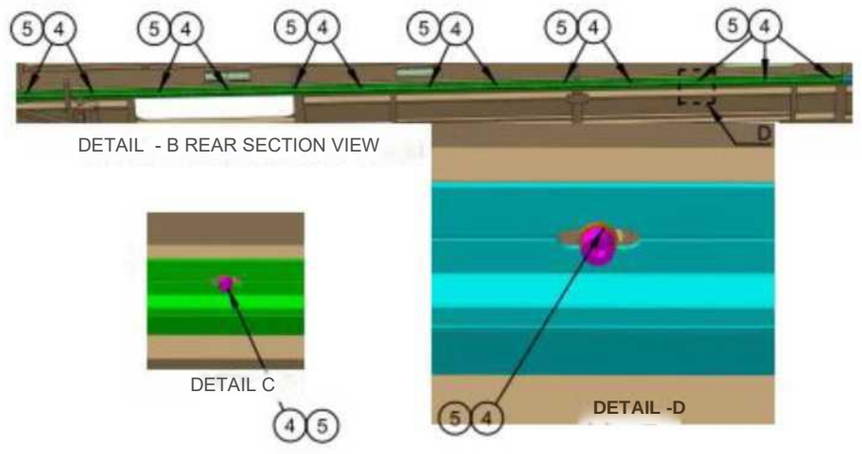


VEHICLE LEFT SIDE VIEW



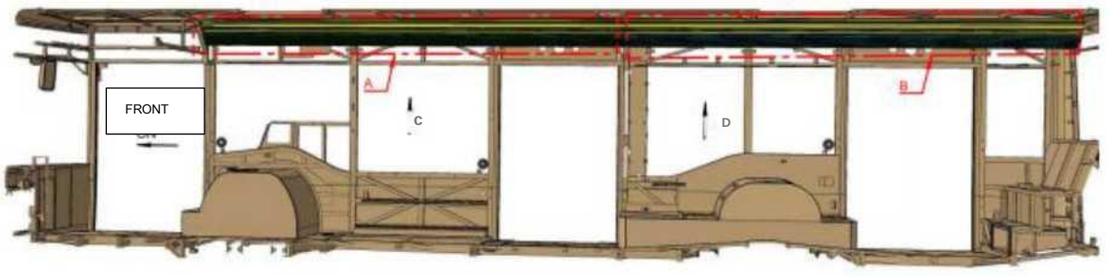
DETAIL ■ A REAR SECTION VIEW

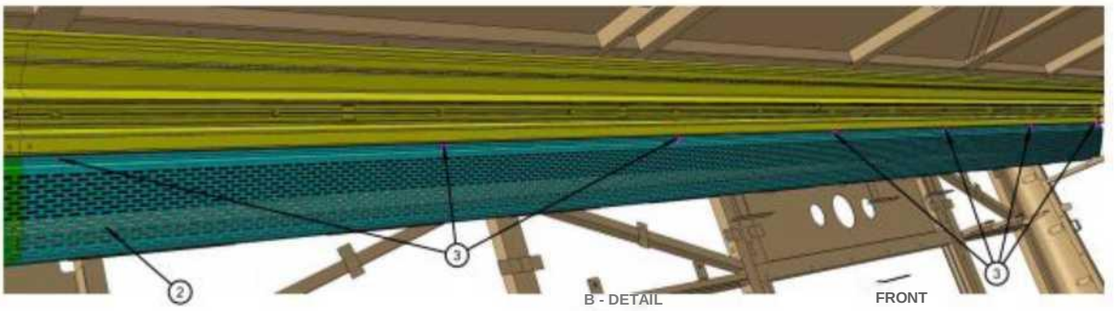


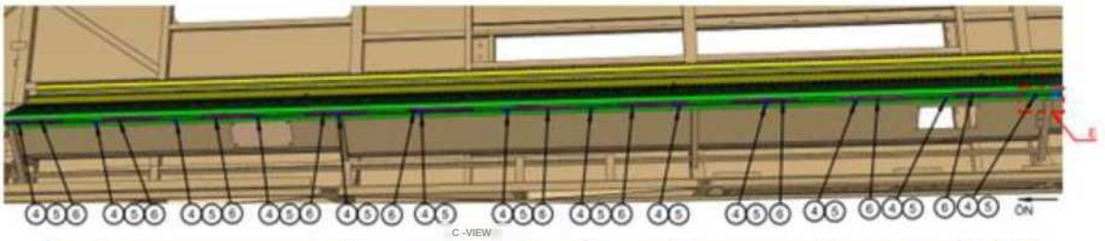


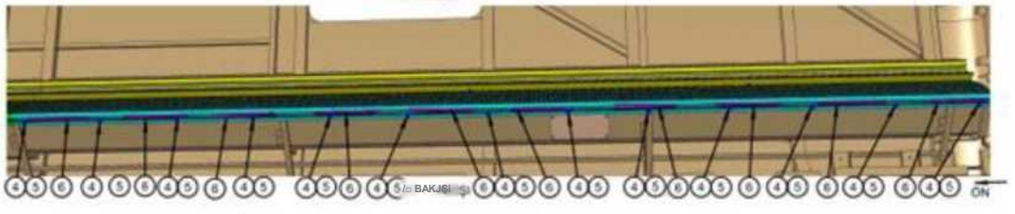
LEAF POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	933-039	387038383*	AL BLOWING PROFILE KOMP, AIR DUCT LEFT	1
2	933 -034	387038382*	AL BLOWING PROFILE KOMP, AIR DUCT LEFT	1
3	933 - 106	3870077460*	SCREW 3,9 X 13;YSB SELF DRILL BIT	12
4	933 - 104	3000906203*	BOLT , SLB M6X20, THICK D. DIN912	22
5	933 - 105	3010000064*	WASHER , FLAT D-6 DİN 125	22
6	933 - 102	387051714*	SUNGER PU. AIR DUCT	20
7	933 - 026	387700934*	AL GRUBU, AIR DUCT LEFT	1
7	933 - 026	387488185*	AL GRUBU, AIR DUCT LEFT	1

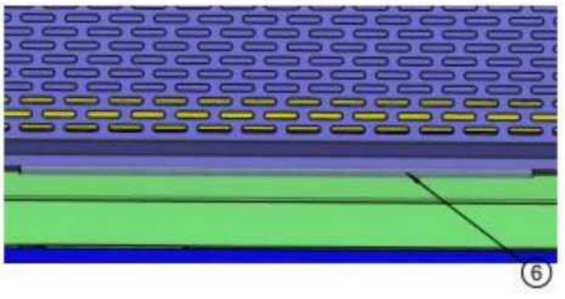
RIGHT AIR DUCT ALUMINUM BLOW PROFILE INSTALLATION

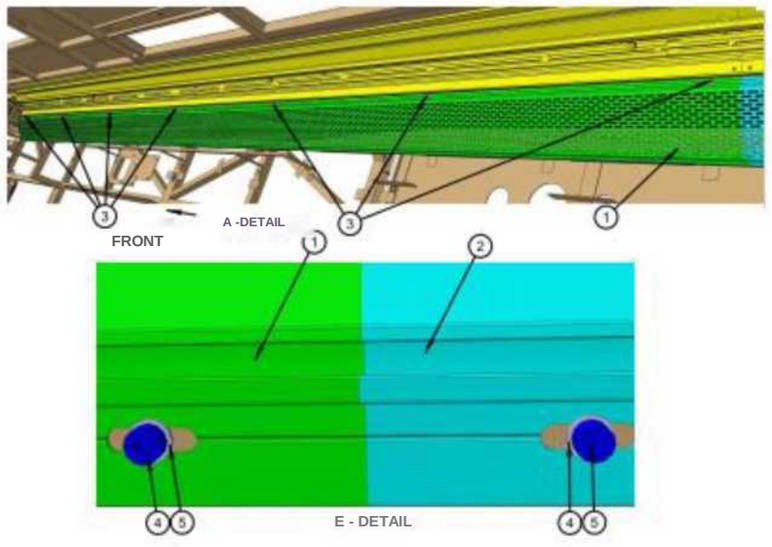






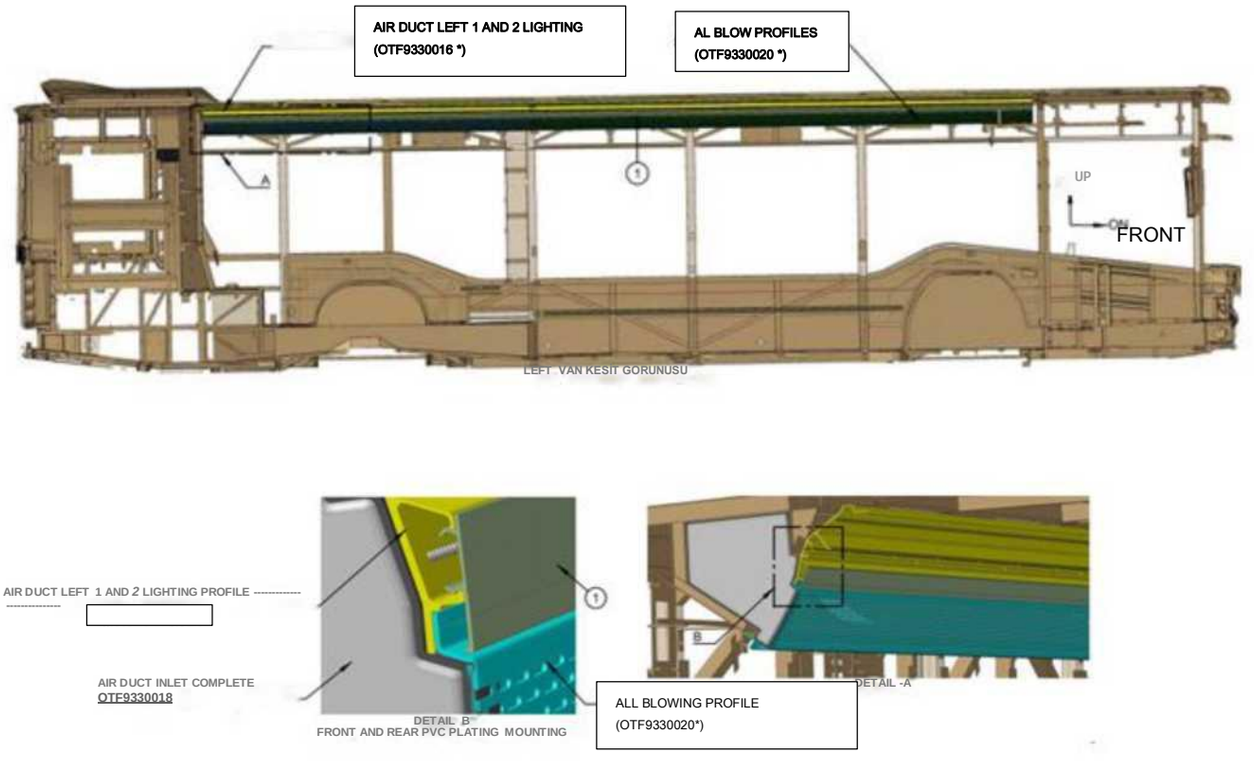






LEAF POSE	GROUP-POSE	PART NO	COMPONENT'S NAME	NUMBER
1	033 - 033	387034010*	AL BLOWING PROFILE . AIR DUCT 1	1
3	933 - ÛS	387007740*	SCREW 3.0 X 13 YSB SELF DRILL BIT	14
4	033 - 104	3000006203*	BOLT SLB M6X20. THICK D. DIN012	20
5	933 - 105	3010000084*	WASHER *FLAT* D=6 DIN 12S	26
6	933 - 102	387051714'	SPONGE PU. AIR DUCT	20

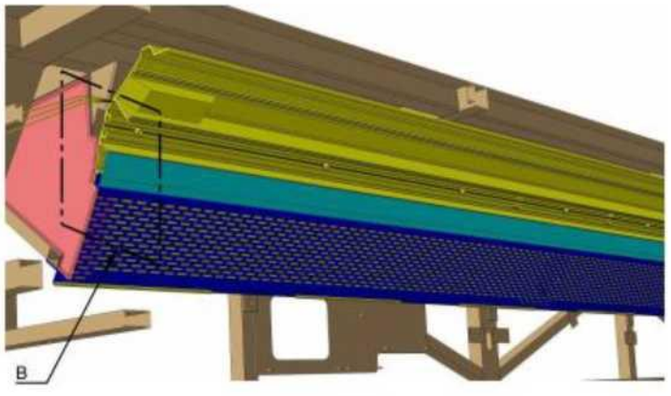
LEFT PVC PLATING VEHICLE ASSEMBLY



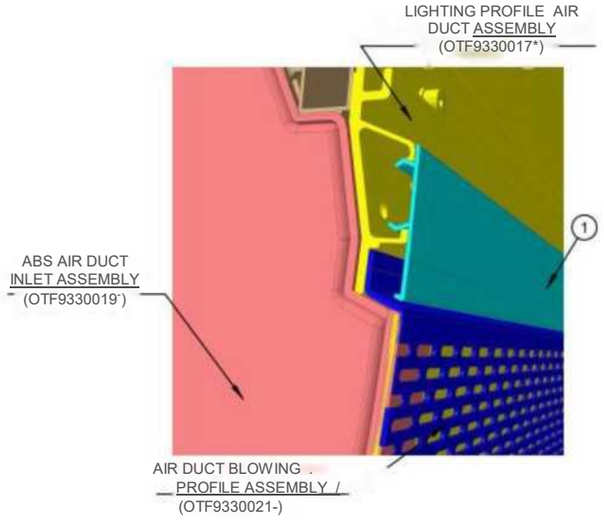
LEAF POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	933 -030	387033101*	PVC PLATING , AIR DUCT AL LEFT	1

AIR DUCT PVC PLATING ALUMINUM RIGHT MOUNTING





A - DETAIL



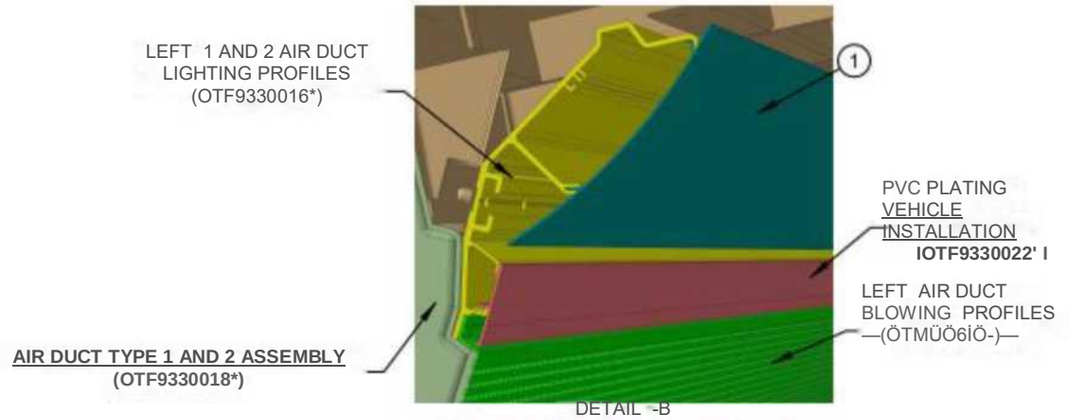
B - DETAIL

LEAF POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	933 - 00 B	387033100*	PVC PLATING . AIR DUCT AL RIGHT	1

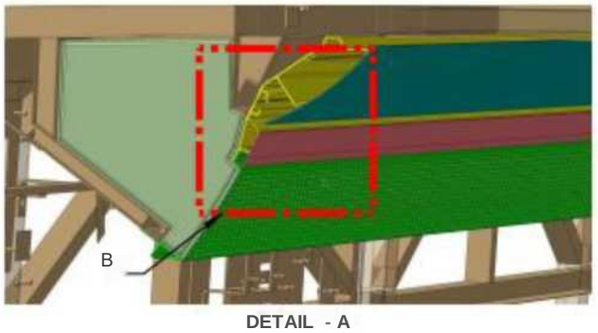
LEFT PVC LENS ASSEMBLY VEHICLE ASSEMBLY



VEHICLE LEFT SIDE VIEW



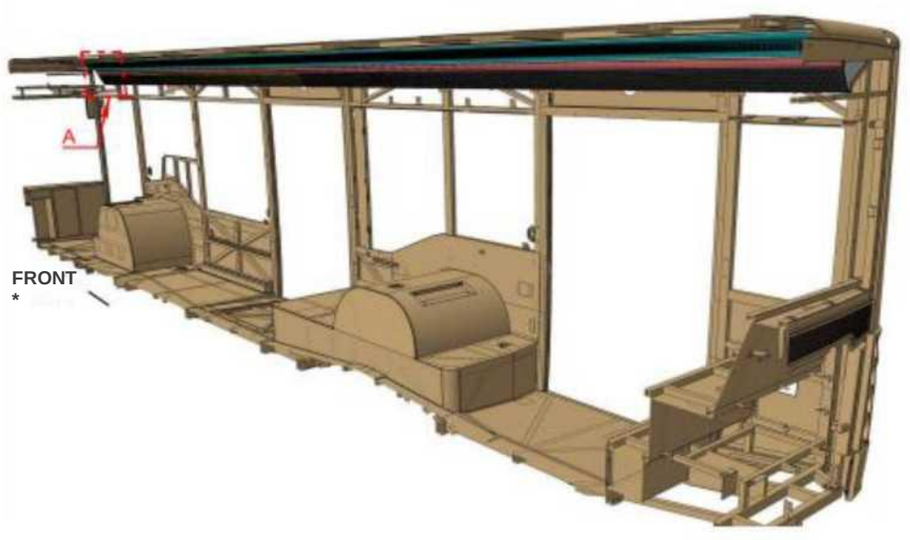
DETAIL -B
PC LENS ASSEMBLY MOUNTING SHAPE

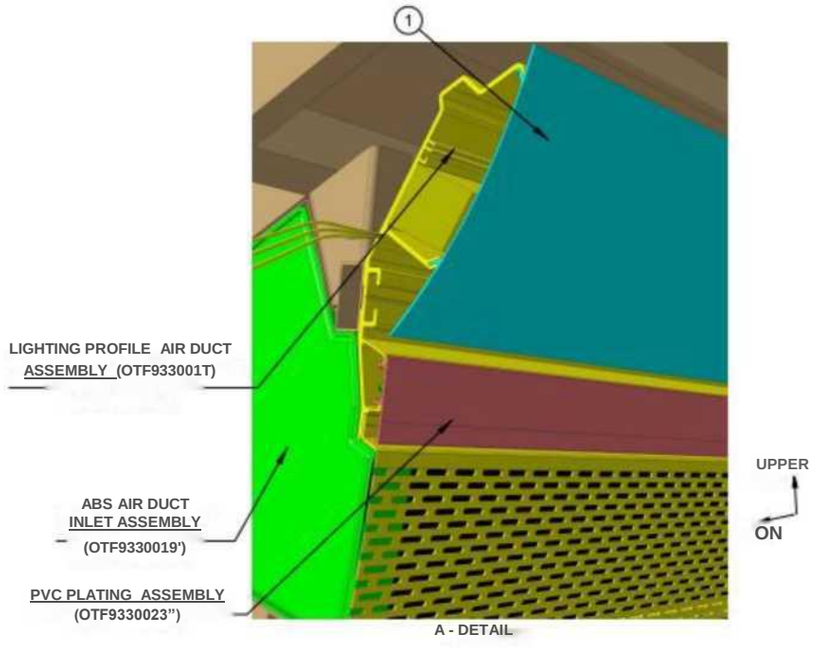


DETAIL - A

LEAF POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	933-029	387D33099*	PVC LENS, AIR DUCT AL LEFT	1

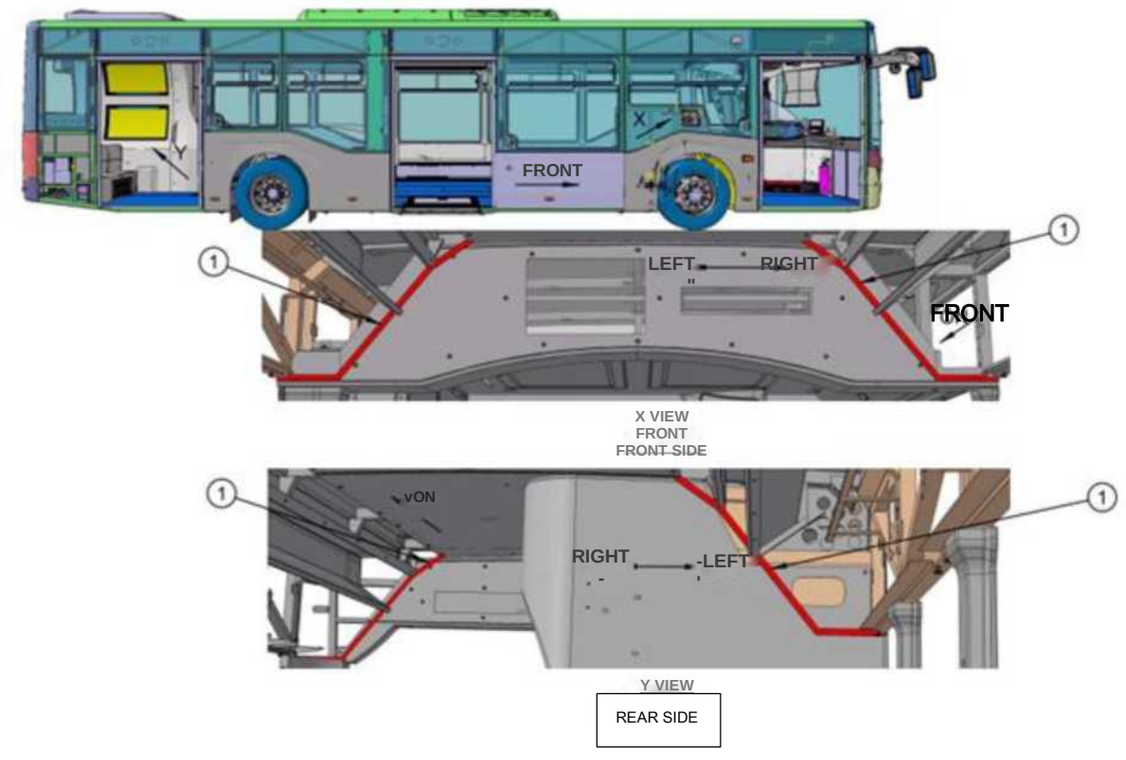
RIGHT AIR DUCT PVC LENS INSTALLATION





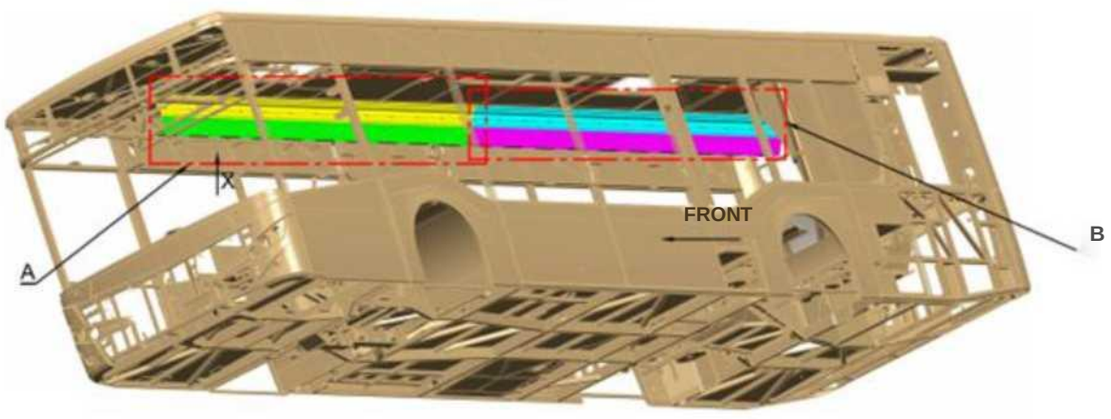
LEAFLET POSE	(GROUP-POSE	PART NO	COMPONENT'S NAME	NUMBER
1	933 - 005	387033098*	PC LENS. AIR DUCT AL RIGHT	1

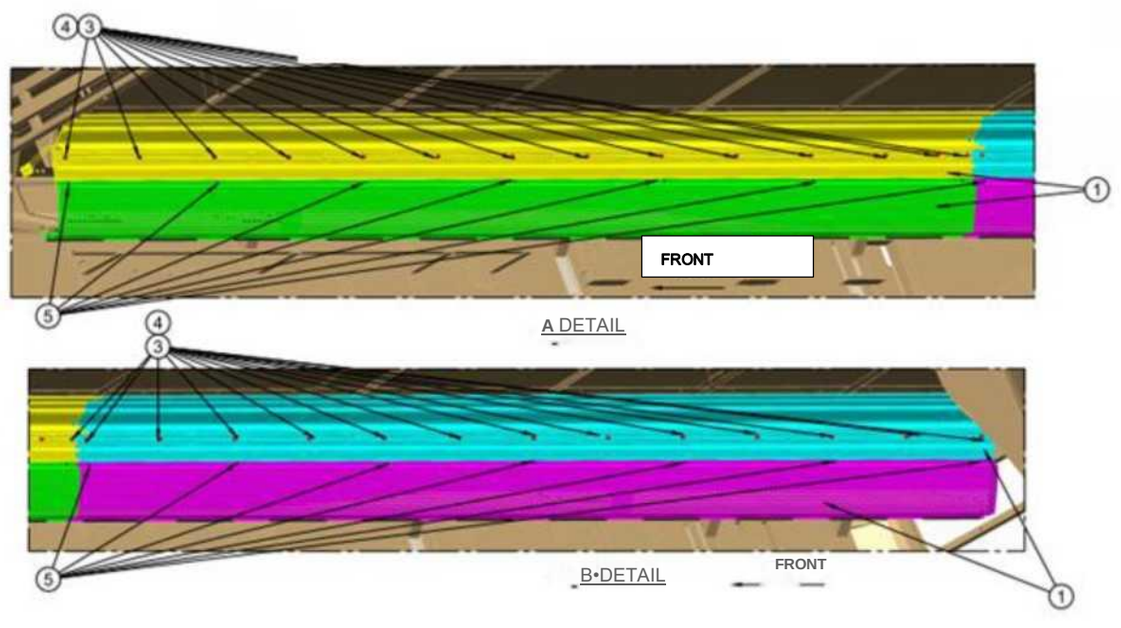
AIR DUCT SPONGE PLATING INSTALLATION

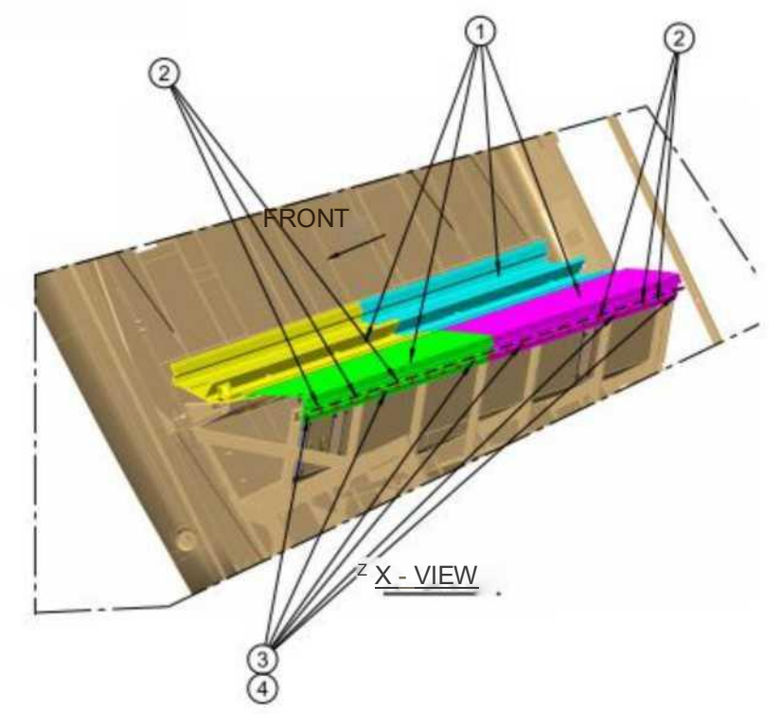


LEAF POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	933 - 107	387038379*	SPONGE, PLATING	4

RIGHT AIR DUCT ALUMINUM BLOW PROFILE INSTALLATION

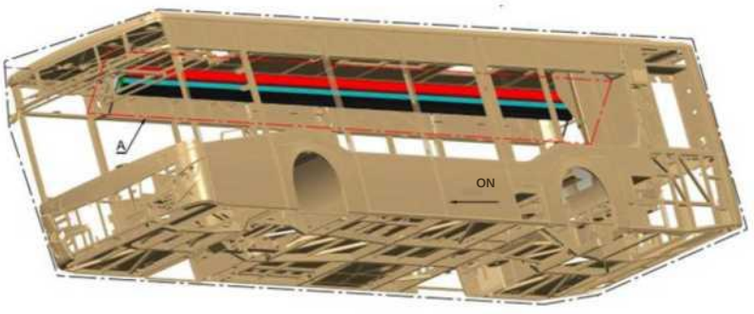


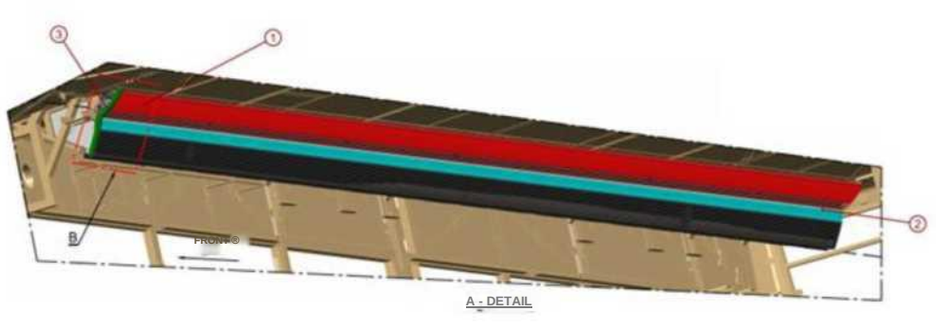




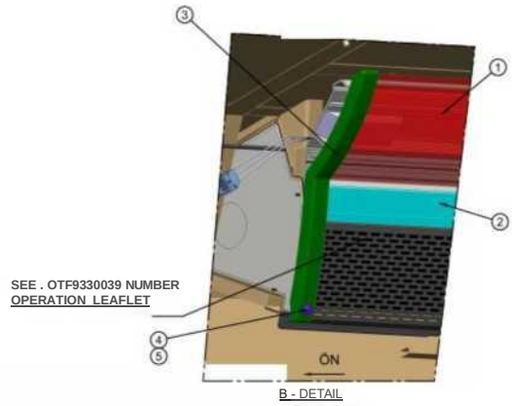
LEAF POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	933-001	387352008*	AL GROUP. AIR DUCT 1 RIGHT	1
1	933-001	367452239'	AL GROUP . AIR DUCT RIGHT TWO DOORS	1
1	933-001	367700933*	AL GROUP . AIR DUCT RIGHT	1
2	933 - 202	3B7019529'	WICK FRP	25
2	933- 102	367051714-	SPONGE PU. AIR DUCT	11
3	933-104	3000906203*	BOLT , SLB M6X20, THICK D. DIN912	53
4	933-105	3010000064*	WASHER , FLAT D=6 DIN125	53
5	933-106	3670077400*	SCREW. 3.9X13	14

RIGHT AIR DUCT PLATING INSTALLATION





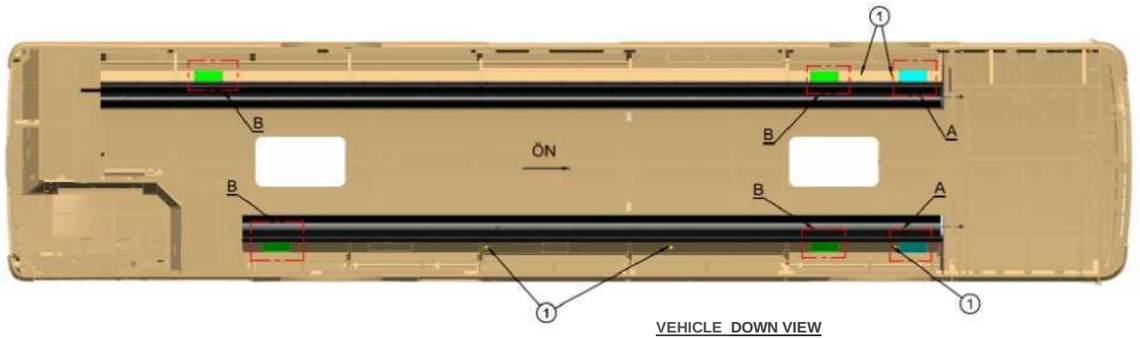
A - DETAIL



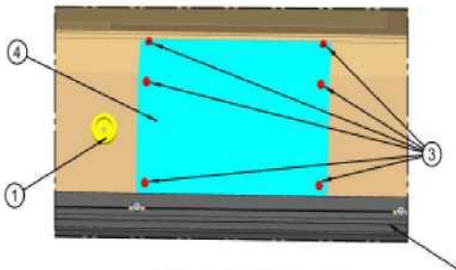
B - DETAIL

LEAF POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	933-005	387033088*	PC LENS, AIR DUCT AL RIGHT	1
2	933-006	307033100*	PVC PLATING AIR DUCT AL RIGHT	1
3	933- 134	387054283"	ABS. PLATING EDGE, AIR DUCT , RIGHT	1
4	933- 134	3E7326600	ABS SCREW COVER, LIGHT GREY	1
5	933-138	3018042192*	SCREW 4.2X19 DIN 7881 YELLOW	1

AIR DUCT MAINTENANCE COVERS INSTALLATION

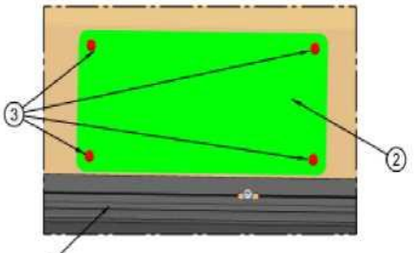


VEHICLE DOWN VIEW



A ■ DETAIL BOTTOM VIEW

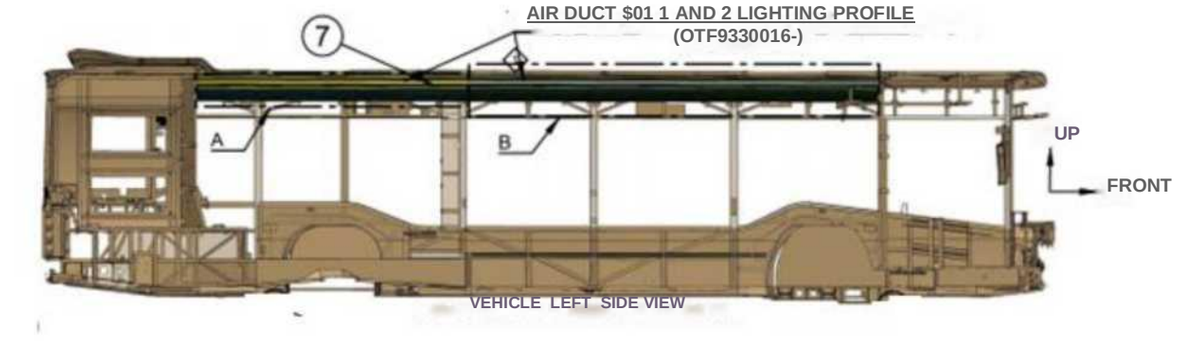
SEE . OTF9330039
NUMBER X, OPERATION
LEAF

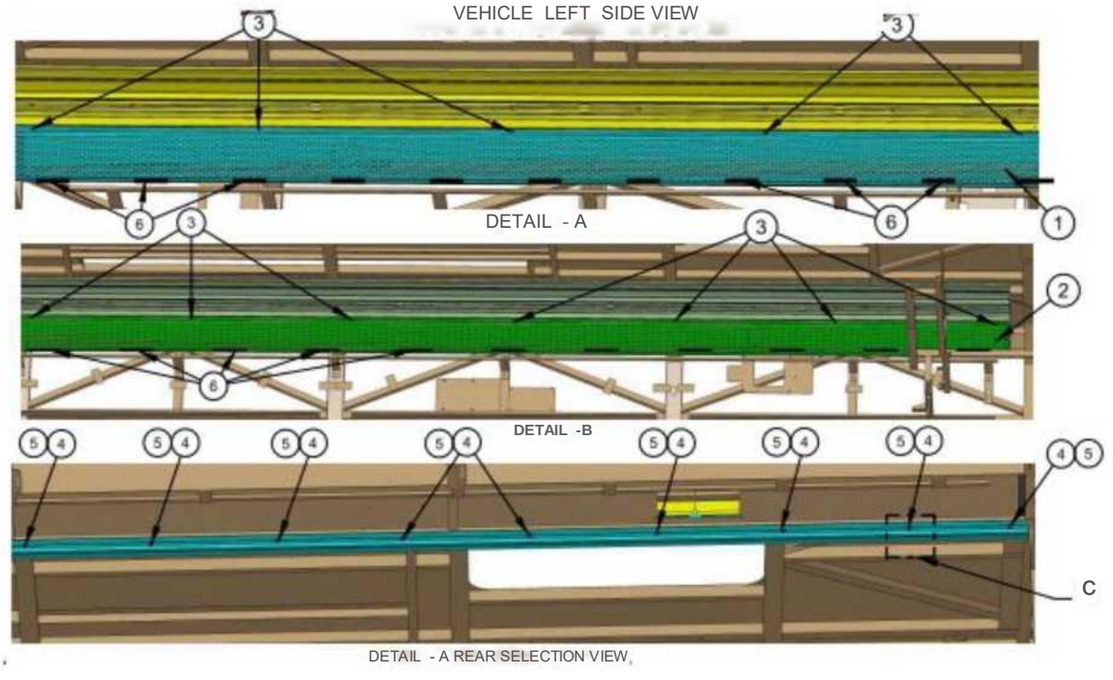


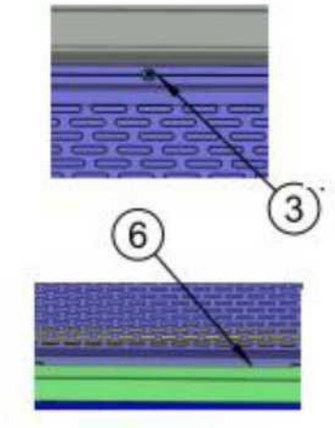
B-DETAIL BOTTOM VIEW

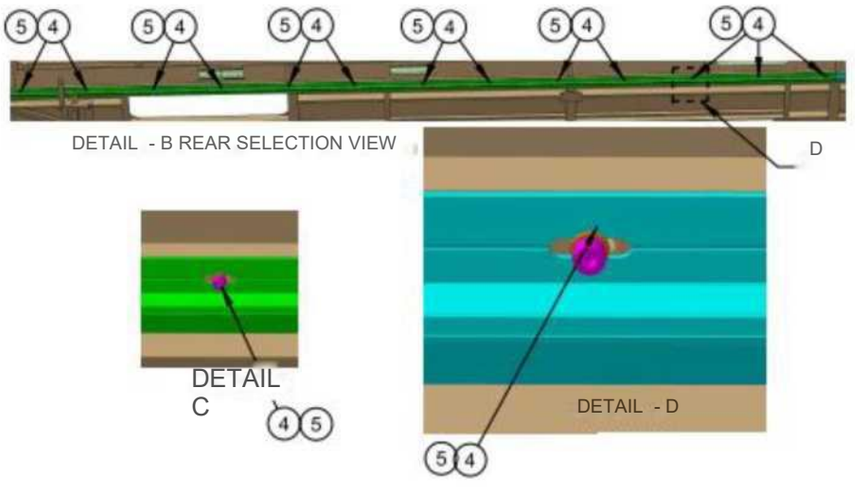
LEAF POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	433-104	333341433*	GROMMET	5
2	933-121	3B7D39D45*	COVER MAINTENANCE AIR CONDITIONING	**4**
3	**433-121**	3041205124*	BOLT . FLN M 5X0. 8X12. THICK D. **DIN6921**	**20**
4	M3- 142	3B7Q6930S*	SHEET METAL, COVER FAN	1

LEFT AIR DUCT BLOW PROFILE ASSEMBLY INSTALLATION TO THE VEHICLE





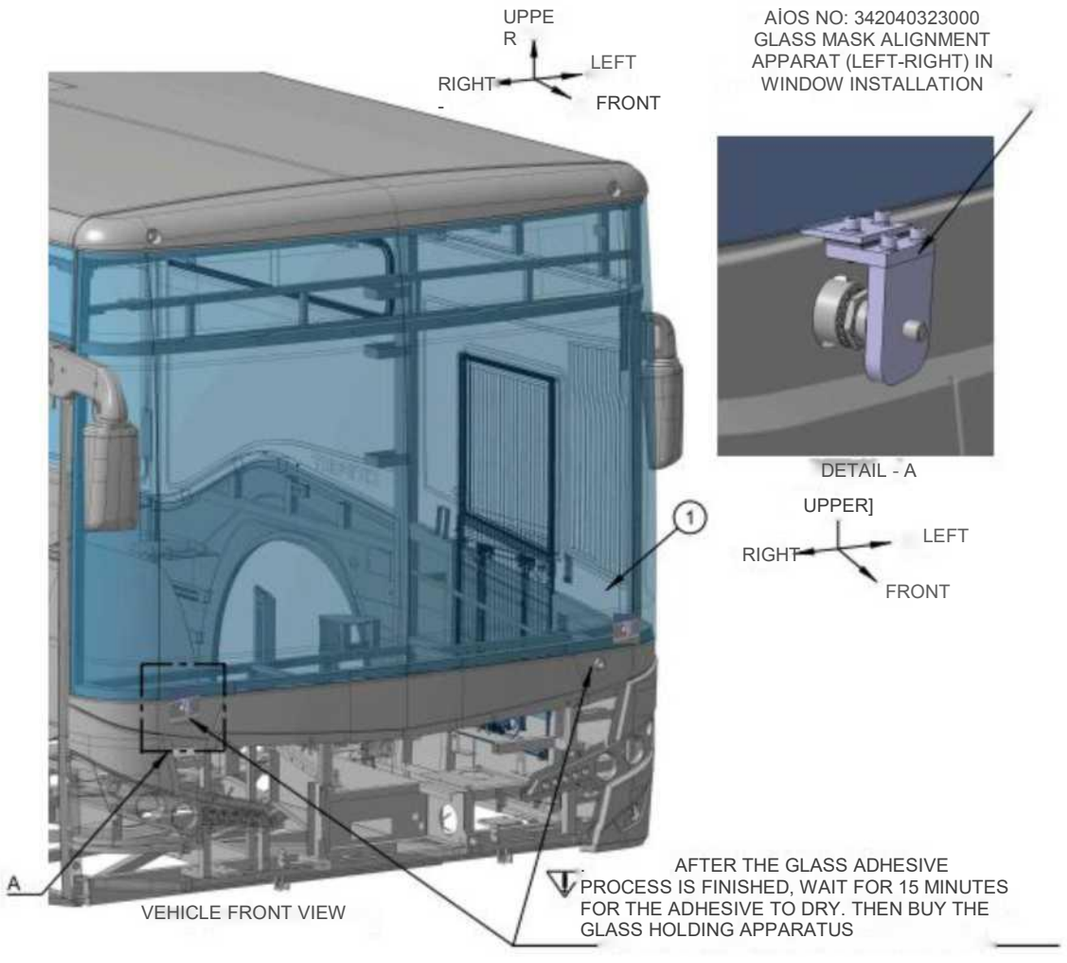




LEAF POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	933 - 039	387038383*	AL BLOWING PROFILE KOMP, AIR DUCT LEFT	1
1	933 - 039	387700939*	ALMN. BLOWING PROFILE KOMP, AIR KAN.LEFT 2	1
2	933 - 034	387038382*	AL BLOWING PROFİLE KOMP. AIR DUCT LEFT	1
2	933- 034	387700938*	ALMN. BLOWING PROFILE KOMP, AIR KAN.LEFT 1	1
3	933-106	3870077480*	SCREW 3,9 X 13;YSB SELF DRILL BIT	12
4	933-104	3000906203*	BOLT , SLB M6X20, THICK D. DİN912	22
5	933-105	3010000084*	WASHER , FLAT D=B DİN 125	22
6	933-200	387019529*	WICK, FRP	38
6	933- 102	387051714*	SPONGE PU, AIR DUCT	20
7	933- 026	387700934*	AL GROUP, AIR DUCT LEFT	1
7	933 - 026	387033097*	AL GROUP, AIR DUCT LEFT	1

GLASS GROUP INSTALLATION

FRONT GLASS VEHICLE INSTALLATION



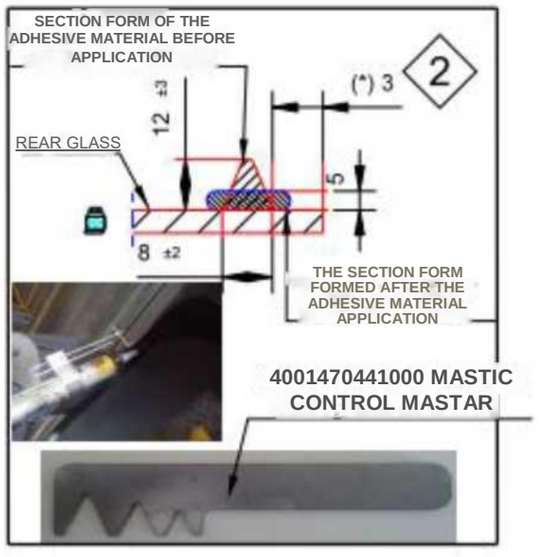
GLASS AND MASK WITH CLEANER OIL DUST RUST VB. CLEAN WELL TO NO SMASH. (940-090 CLEANER GLASS METAL).

DRY THE SURFACES CLEANED WITH CLEANER WITH A CLOTH OR PAPER NAPKIN WHICH DOESN'T LEAVE DRY AND COTTONS.

PRIMARY UNIQUE AND LONG SERIES (WITHOUT GO-TO-COME) APPLY BOTH GLASS AND MASKA AS THIN FILM LAYER. (940/240 PRIMER)

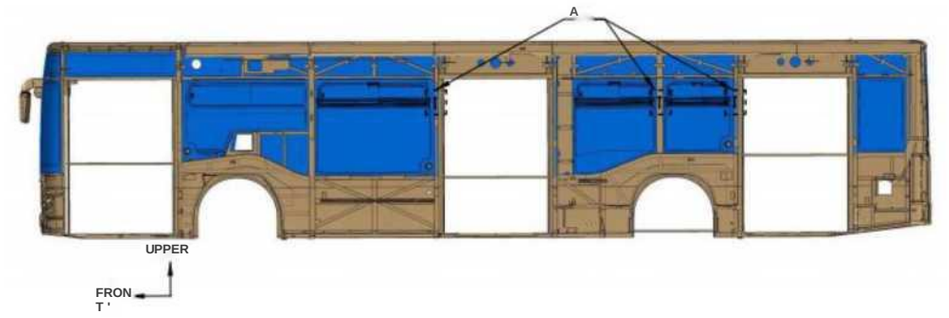
WAIT UNTIL PRIMER DRYES (5 MINUTES IN SUMMER, 8 MINUTES IN WOMEN) AND DAY TO IMMEDIATE ADHESIVE (940/089 MASTIC).

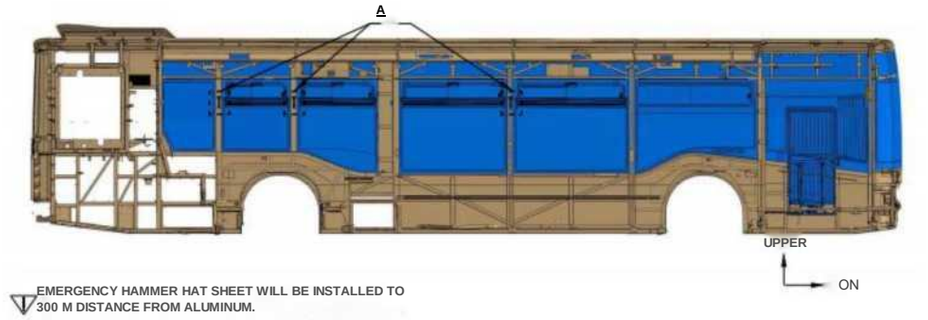
AFTER THE PRIMER IS APPLIED TO THIS REGION, HAND OIL ETC. CONTACT WITH POWDER, OIL STAIN ETC. KEEP IT CLEAN WITHOUT COMING.



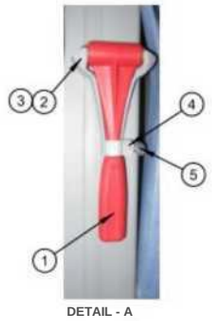
LEAFLET POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	934 - 001	387045468*	GLASS.FRONT	**1**
1	934 - 001	387370652*	GLASS. FRONT	**1**
1	934 - 001	307487995*	GLASS. FRONT	**1**
1	934 - 001	387045469*	GLASS, FRONT	**1**

EMERGENCY HAMMER VEHICLE INSTALLATION





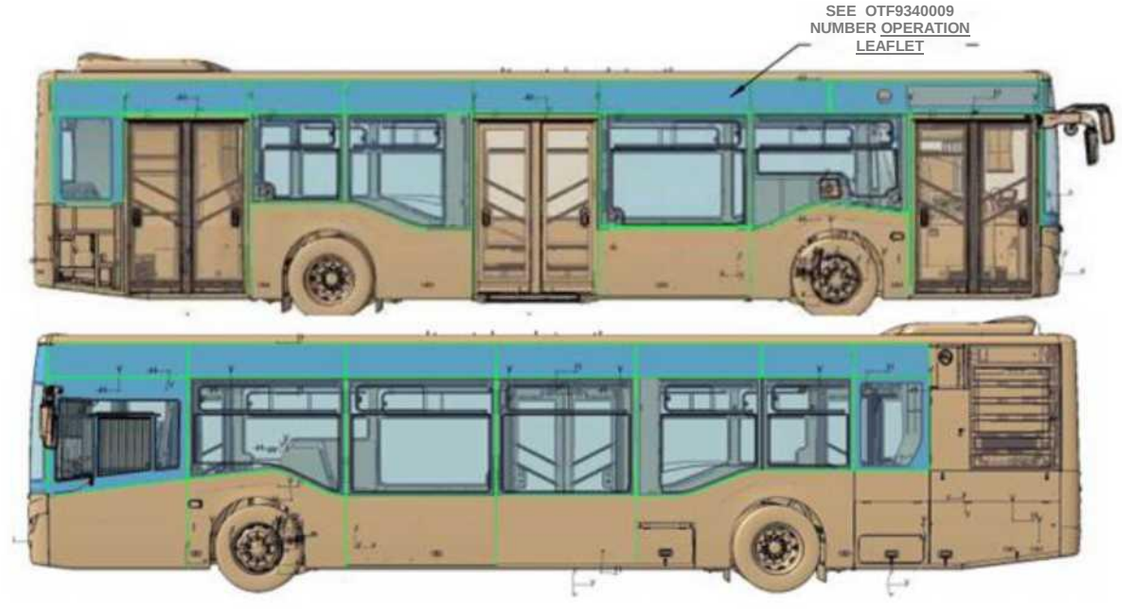
EMERGENCY HAMMER HAT SHEET WILL BE INSTALLED TO 300 M DISTANCE FROM ALUMINUM.



DETAIL - A

LEAFLET POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	934-061	387004869*	EMERGENCY HAMMER HAPPICH	6
2	934 - 062	387004370*	EMERGENCY HAMMER JACK HAPPICH	6
3	934 - 060	3018135253*	SCREW M3.5X25	12
4	934 - 063	377774401*	SEAL WIRE(X11-000-002-027}	0,75 M
5	934 - 064	377774400*	TWO HOLE SEAL(HW52-001)1999-92000015	6

:GLASS FILLER INSTALLATION



THE RIGHT SIDE IS SHOWN AS AN EXAMPLE. THE SAME PROCESS WILL BE APPLIED TO ALL GLASSES FOR THE LEFT SIDE.

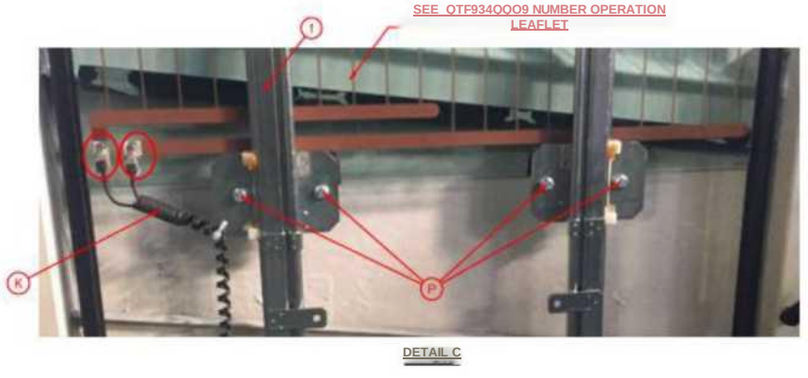
GREEN COLORED REGIONS SHOWN WITH MASTIC MATERIAL ARE FILLED. (940 -088 MASTIC)

THE OVERFLOW MASTIC IS TAKEN BY SCRAPPING TIP.

IT IS CORRECTED WITH POTATO.

AUTOMATIC DRIVER GLASS MECHANISM INSTALLATION







-_MAKE SURE THE CONNECTION HOLES ON THE ELECTRIC MECHANISM AND ON THE GLASS ASSEMBLY COLLECT.

-_MAKE SURE THE DRIVER GLASS IS FULLY PUT ON THE BRACKETS.

-_MAKE SURE THAT THE FEMALE TERMINAL ENDS FULLY FIT THE MALE TERMINAL ENDS.

•_THE SOCKETING IS DONE AFTER THE ASSEMBLY OF THE CABLES COMING FROM THE LEFT CEILING INSTALATION ON THE VEHICLE CARCASS.

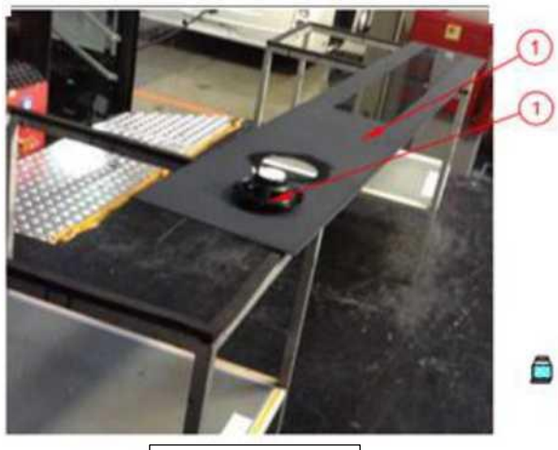






LEAFLET POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	934-006	307032719	GLASS ASSEMBLY. ELECTRIC CONTROLLED	1
2	934- 010	3001206166-	BOLT . FLN M6X1X16 THICK D. DIN6921	2
3	934-015	50970T0300'	PL. STRIP CLAMP - 250	1

FRONT DOOR UPPER GLASS OUTDOOR SPEAKER INSTALLATION



DETAIL A

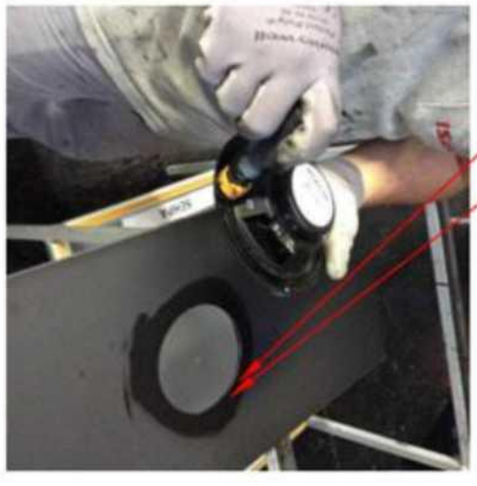


DETAIL A

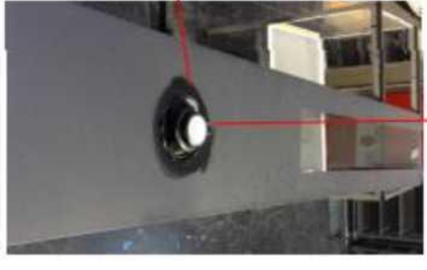
940/089 POSE
387053327 NUMBERED
MASTIC IS TAKEN WITH TECK DRIVE.

CLEANER NUMBER 940/090 POSE LU 387053325. IT IS CLEANED BY USING 0,33 ML WITH GLASS / METAL.

940/240 POSE 387053324 * NUMBERED PRIMER, GLASS / MET. BLACK 0,25 ML IS USED.

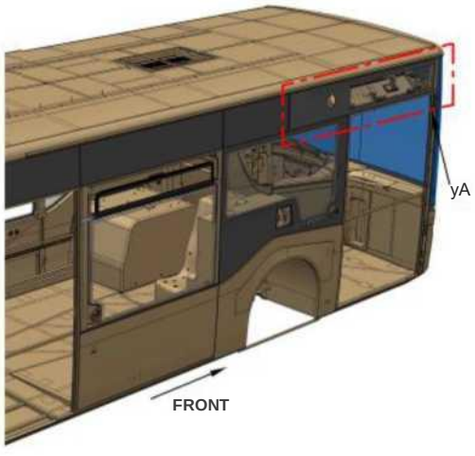


SPEAKER TERMINAL DIRECTION IN CITIPORT MODELS



SPEAKER TERMINAL DIRECTION IN CITIBUS MODELS.

1) ALL WITH CLEANER. DUST VB. SHOULD BE CLEANED.
2) PRIMER SHOULD BE APPLIED ONE WAY AND WITHOUT GOING. PRIMER'S DRYING TIME IS 8 MINUTES IN SUMMER, 5 WINTER.
3) THE DIRECTION OF THE SPEAKER IS SPECIFIED IN LEAFLET CITIPORT AND CITIBUS MODELS.







LEAFLET POSE	GROUP/POSE	387035984*	COMPONENT'S NAME	NUMBER	ADDITIONAL INFO
1	934 - 050	387032700*	GLASS. FRONT DOOR UPPER, PLAQUE . RIGHT	1	CITIPORT / CITIPORT S / CITIPORT CNG
1	934 - 050	387035984*	GLASS, FRONT DOOR UPPER, PLAQUE . RIGHT II	1	CITIPORT/CITIPORT CNG
1	934 - 050	387370651*	GLASS. FRONT DOOR UPPER, PLAQUE , RIGHT	1	CITIPORT 18M 1

VEHICLE DRIVER GLASS CONTROL

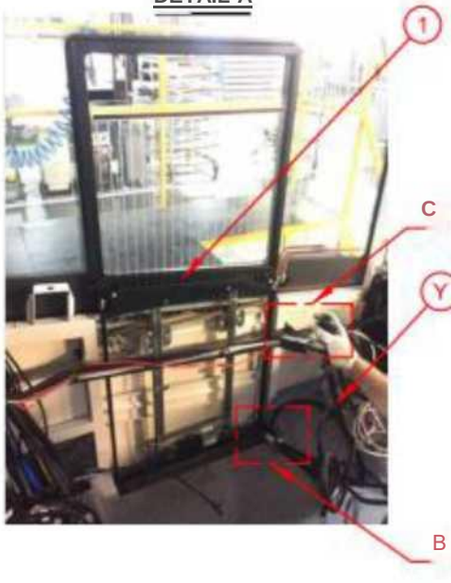


(VEHICLE SIDE VIEW)

DETAIL B



DETAIL A



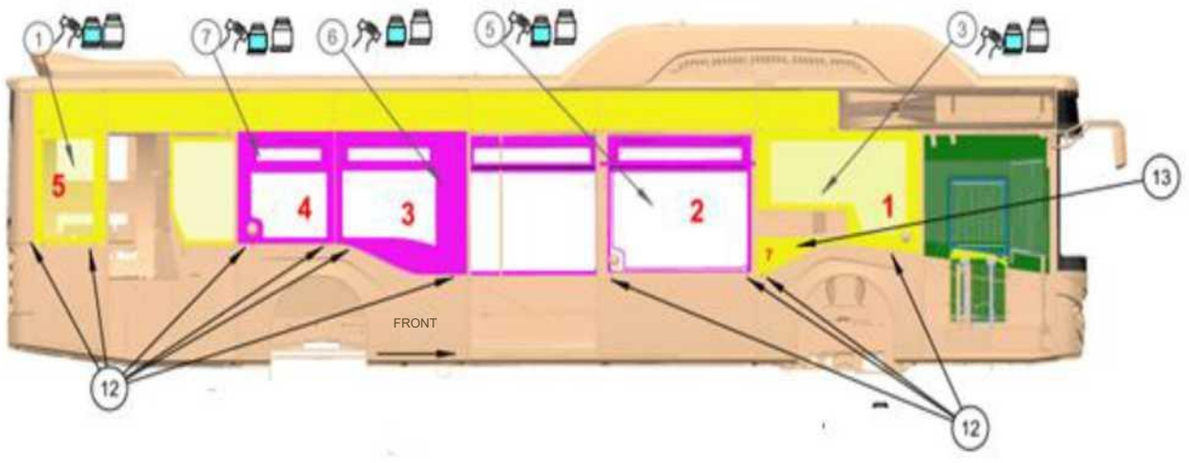


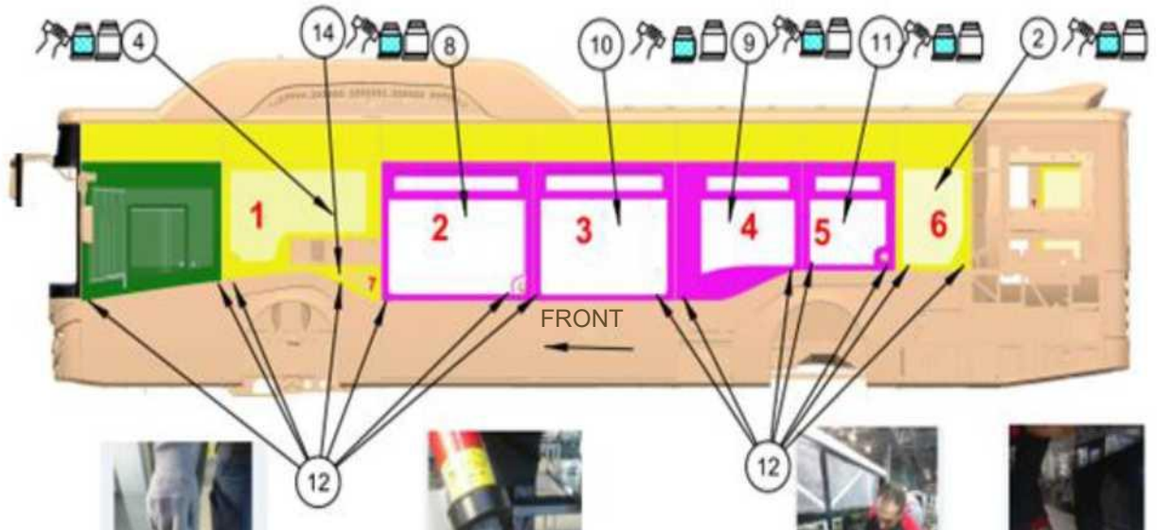


MAKE SURE THAT YOU ARE FULLY IN THE SOCKET OUT OF THE MEN'S SOCKET. SEE OTF934002500 LEAFLET FOR AUTOMATIC DRIVER GLASS INSTALLATION.

LEAFLET POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	934 - 006	3870327191*	**CALI ASSEMBLY, ELECTRIC CONTROLLED**	1

SIDE LOWER GLASS VEHICLE INSTALLATION.







PICTURE • A



PICTURE - B



PICTURE - C



PICTURE - D

AS A REFERENCE TO LOWER GLASSES FOR INSTALLATION OF ALL GLASS SETS (93 * 005 387045607101 GLASS, SET SIDE, FUME TOOL) DETAILED GLASS INSTALLATION OF RELATED GLASS SET IS SHOWN. FOR INSTALLING OTHER GLASS SETS, THIS INSTALLATION SEQUENCE SHOULD BE USED IN A SİMILAR WAY.

CLEAN THE GLASS AND MASK WITH THE CLEANER SO THAT NO OIL, DUST, RUST ETC.
(940'090 CLEANER GLASS. METAL)

DRY SURFACES CLEANED WITH CLEANER WITH A CLOTH OR PAPER NAPKIN WHICH DOESN'T LEAVE DRY AND COTTONS

AS SHOWN IN PICTURE-A FROM THE EDGE SIDE OF THE GLASS 10 MM FROM THE PRIMARY ONE SIDED AND LONG STRIPES> USE (WITHOUT GO-TO-COME) ON THE GLASS AND VEHİCLE WITH A THIN FILM.

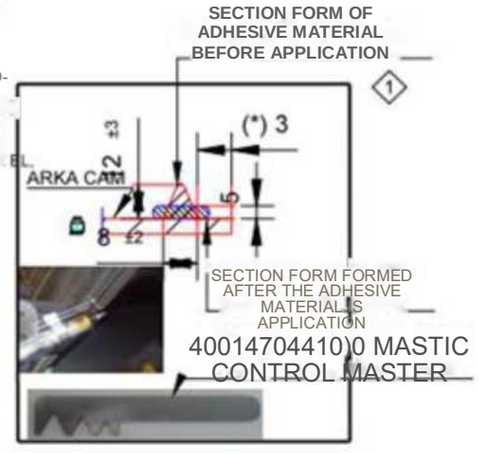
WAIT UNTIL THE PRIMER IS DRY (5 MINUTES IN SUMMER, 8 MINUTES IN WOMEN) AND GO TO THE BONDING PROCESS IMMEDIATELY. DO NOT ALLOW TO CONTACT THIS AREA WITH OIL ETC AFTER THE PRIMER IS APPLIED. MAKE IT CLEAN THERE ARE NO DUST, OIL, STAINS ETC.

WITH THE ADHESIVE SEALANT TO THE PARTS NUMBER 1 2 3 4 SHOWN IN PICTURE-B, MAKE THE SEALING PROCESS FROM THE EDGE PART OF THE GLASS 10 MM FROM THE INSIDE OF THE GLASS. ALSO APPLY MASTIC PULLING TO THE PROFILES ON CARCASS SHOWN IN PICTURE-C (940089 MASTIC)

MAKE IT STAY FIXED IN THE REGIONS SHOWN BY MAKING LIGHT TO CONTACT THE MASTIC TO THE REGIONS SHOWING THE WEDGES WITH 5 POSITION NUMBER.

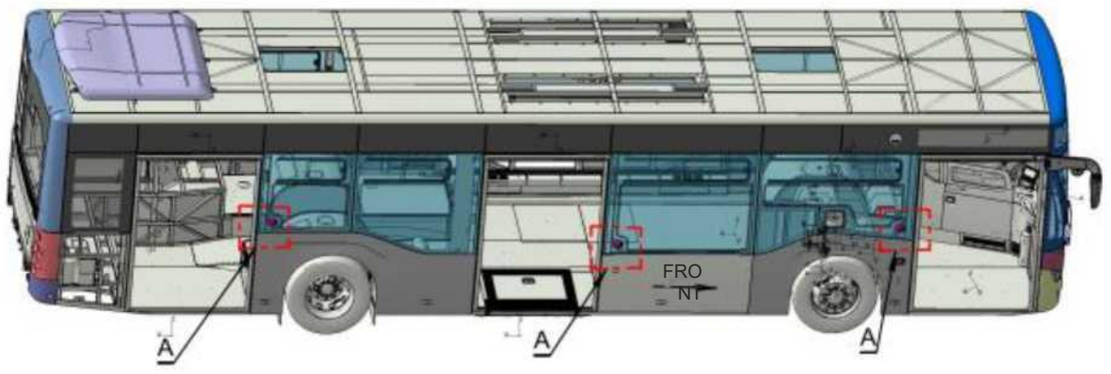
PLACE THE PARTS 1 2 AND 3 4 AS SHOWN IN THE PICTURE, WITH THE HELP OF THE VANUSES, THROUGH THE 5 POSITION WEDGES.

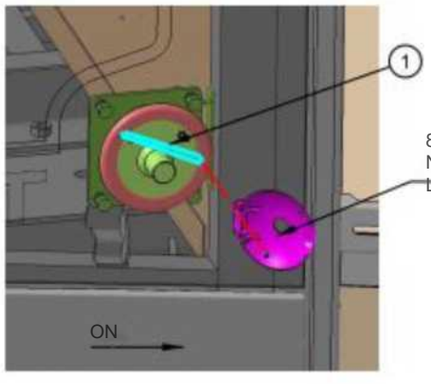
FIX THE SIDES OF THE GLASS WITH THE FIXING WEDGE AT EQUAL SPACES AS SHOWN IN THE PICTURE.



LEAF LET POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	934 - 024	367032705*	GLASS. BEHIND THE REAR DOOR. LOWER, FUME	1
2	934 - 036	387032714*	GLASS . BACK FRONT, . LOWER, LEFT , FUME	1
3	934-021	387044194*	GLASS . ONDOOR REAR LOWER, SAG	1
4	934 - 029	387044550*	GLASS. BACK OF DRIVER' GLASS , LOWER. LEFT	1
5	934 - 041	387041290*	GLASS. MIDDLE DOOR FRONT, LOWER RIGHT VASIST . FUME	1
6	934-043	387041292*	GLASS. O.DOOR REAR LOWER. RİGHT, VASIST FUME	1
7	934 - 045	387041294*	GLASS, REAR, LOWER, LİTTLE, RİGHT, VASIS FUME	1
8	934 - 042	387041291*	GLASS MIDDLE FRONT, LOWER, LEFT , VASİST FUME	1
9	934 - 044	387041293*	GLASS. FRONT.DOOR REAR LOWER. LEFT . VASIST FUME	1
10	934 - 040	387041280*	GLASS. OPPOSITE MIDDLEDOOR. LOWER, VASIST. FUME	1
11	934 - 046	387041295*	GLASS. REAR, LOWER. LİTTLE LEFT , VASIST FUME	1
12	934 - 065	387004698*	GLASS ASSEMBLY MOUNTING	22
13	934 - 066	387044195*	GLASS, FRONTDOOR REAR, LOWER. RİGHT	1
14	934 - 067	387044551*	GLASS. DRIVER' GLASS REAR, LOWER. LEFT	

EMERGENCY EXIT CAP SEALING WIRE INSTALLATION



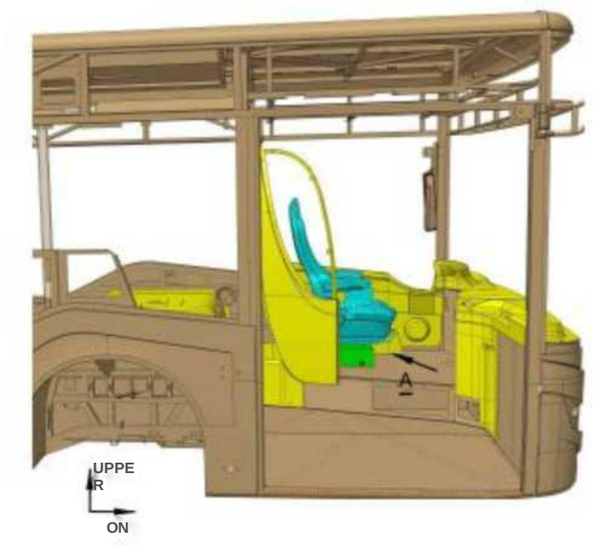


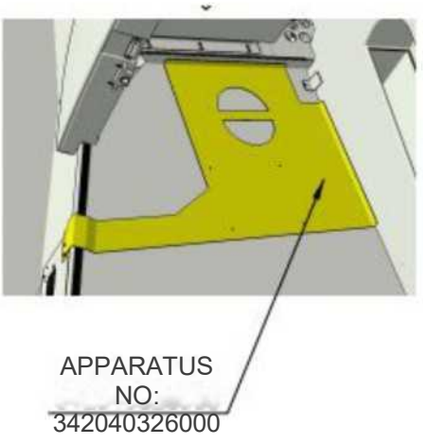
DETAIL A

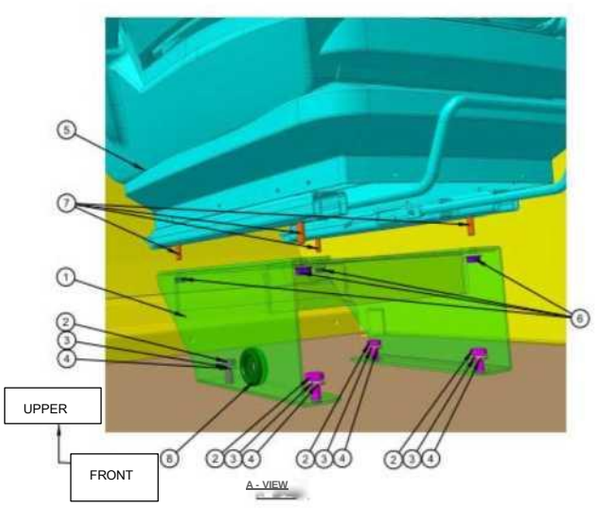
LEAFLET POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	934 - 063	377774401*	**SEAL WIRE**	1

INSTALLATION OF SEATS AND CHAIRS

DRIVER SEAT INSTALLATION

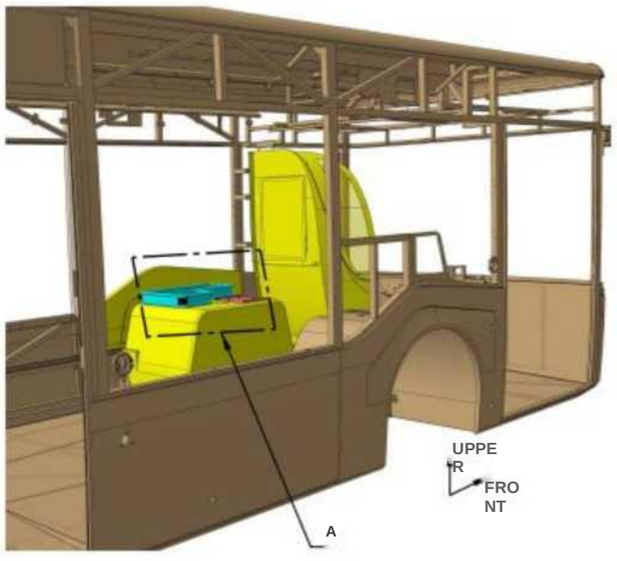


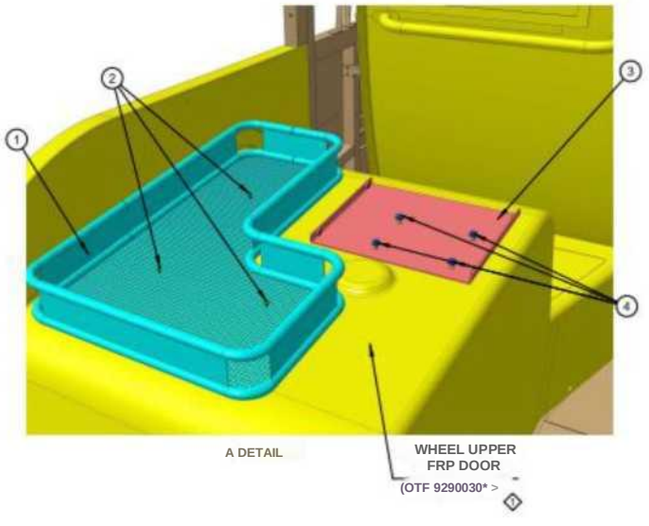




LEAFLET POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	935 - 017	387S69378*	BRACKET . CONNECTION . DRIVER SEAT. ISRI	1
2	935 - 018	3000210306*	BOLT . AKB M1OX1.25X3O THİN O. DIN961	4
3	935 - 020	301O1OO106*	WASHER , SPRINGY D = 1O DİN 127	4
4	935 - 019	3010000104*	WASHER , FLAT 0=10 DİN 125	4
5	935 - 200	387339543001 *	SEAT. ISRI. KEMERSİZ. 6860/885 NTS, VO	1
6	935 - 016	3005000004*	NUT , FLN&TR M8X1.25, THICK D. DİN 6923	4
T	935 - 010	3000108256*	BOLT AKB M8X1.25X25 THICK D. DIN933	4
S	935 - 021	388881883*	GROMMET	1

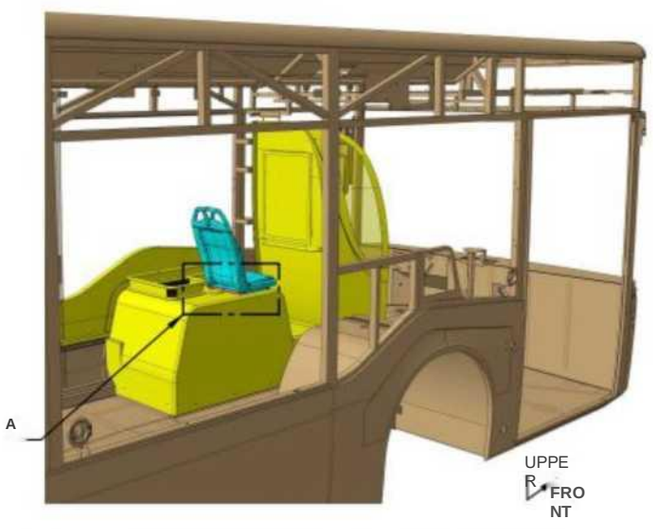
SIDE SEAT PACKAGE, SINGLE SEAT BRACKET INSTALLATION

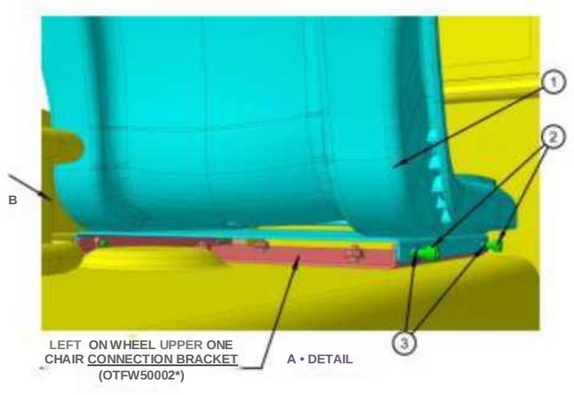


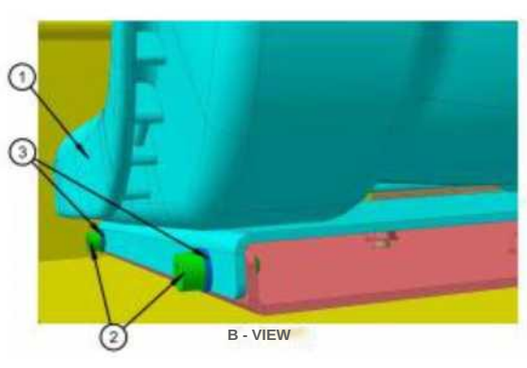


LEAF POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	935 - 066	387041141*	PACKAGE COMPARTMENT, SEAT SIDE, YELLOW, RAL 1016	1
2	935 -087	301894619*	SELF TAPPING SCREW 4,8 x 19, STAR CYLINDER	3
3	935 -015	387020596*	BRACKET , LOWER, SINGLE SEAT CONNECTION	1
4	935 - 009	3005800081*	NUT . FLN&TR M8X1.25, THICK D. DİN 6923	4

LEFT FRONT WHEEL UPPER SINGLE SEAT INSTALLATION

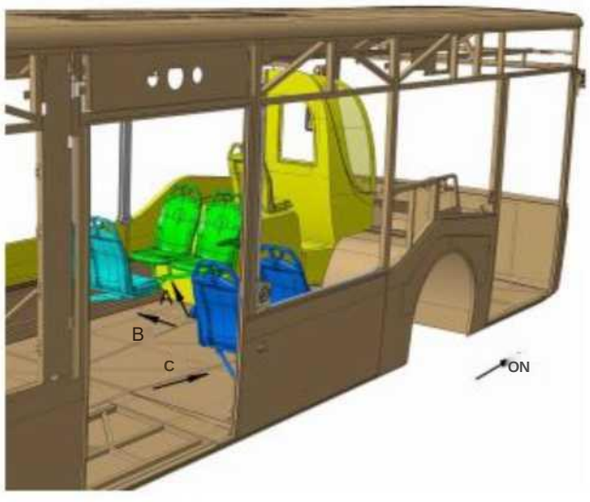


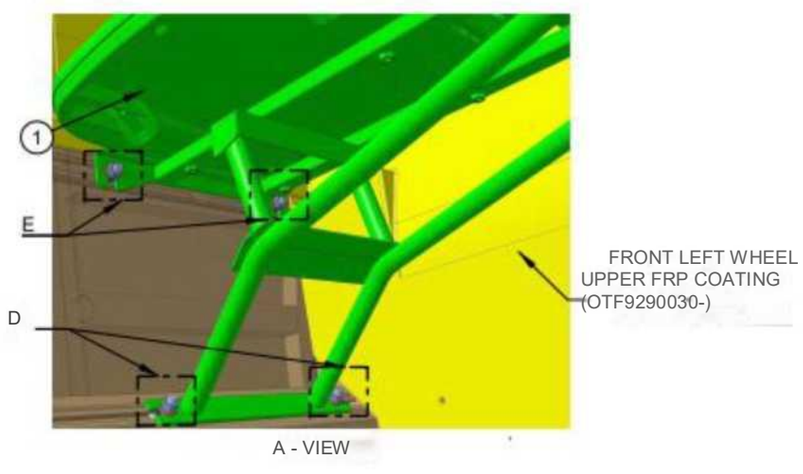




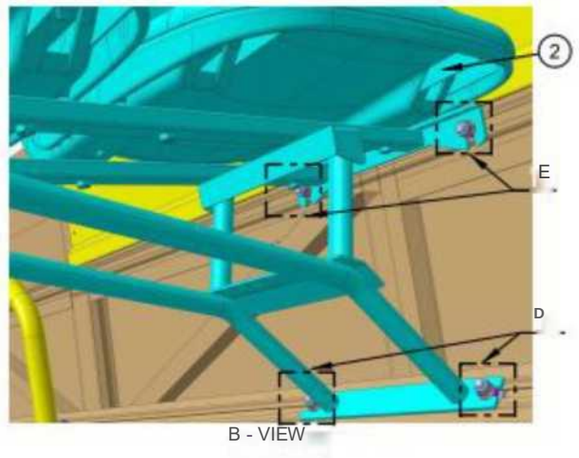
LEAF POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	935 - 201	387038686'	SINGLE SEAT, ON WHEEL UPPER, LEFT	1
2	935-013	3000908206*	BOLT , SLB M8X20, THICK D. DIN912	4
3	935 -014	3010100086*	WASHER , SPRINGY D=8 DİN 127	4

FRONT RIGHT AND LEFT BACK SEAT ASSEMBLY

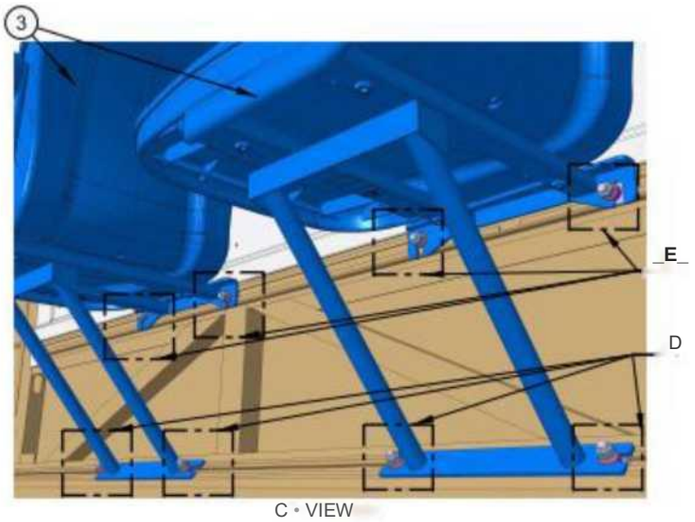




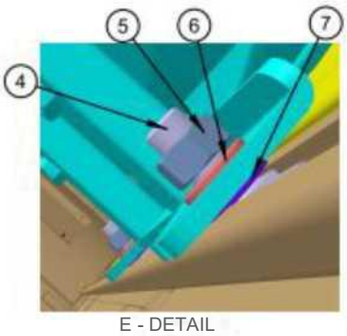
A - VIEW



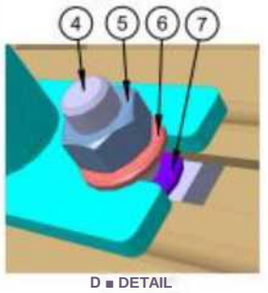
B - VIEW



C • VIEW



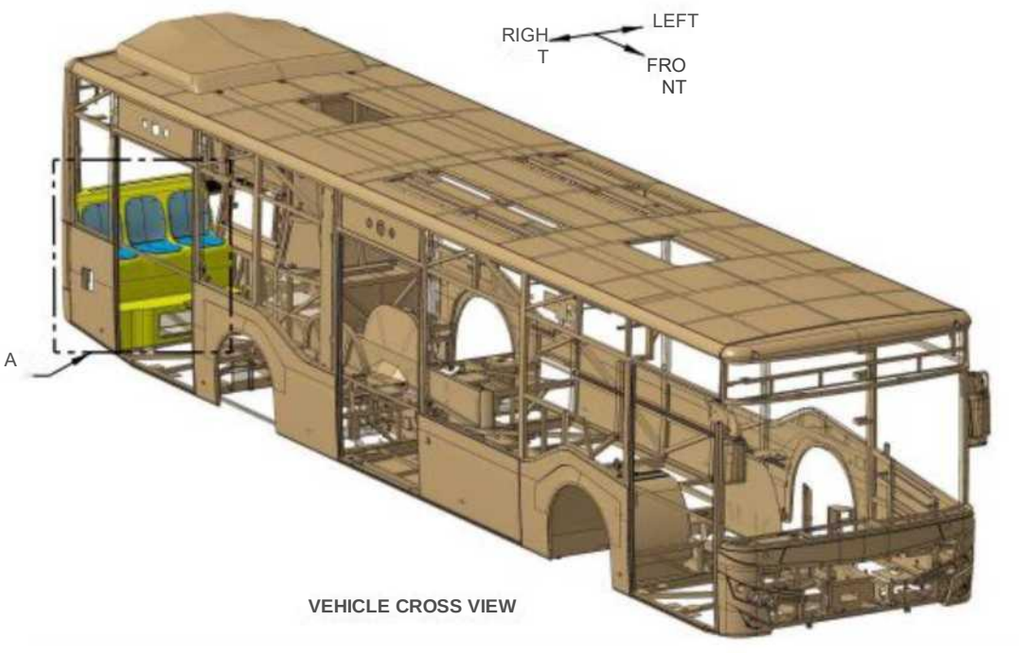
E - DETAIL



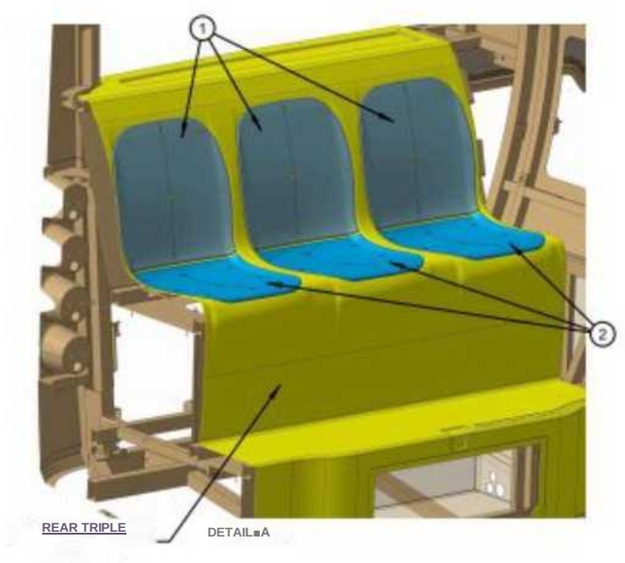
D ■ DETAIL

LEAFLET POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	935 - 203	387038688*	SEAT. DOUBLE, PRIORITY, RIGHT ,	1
2	935 - 206	387038691*	DOUBLE SEAT, FRONT LEFT	1
3	935 - 207	387038692*	SEAT, SINGLE, PRIORITY. RIGHT	2
4	935 - 004	3888849412*	BOLT	16
5	935 - 007	3005100106*	NUT , AKB M10X1.25, THIN D. □İN934	16
6	935 - 005	3010000104*	WASHER , FLAT D=10 DİN 125	16
7	935 - 006	3005100106*	WASHER . SPRINGY D=10 DİN 127	16

BACKREST AND SEAT PAD VEHICLE ASSEMBLY

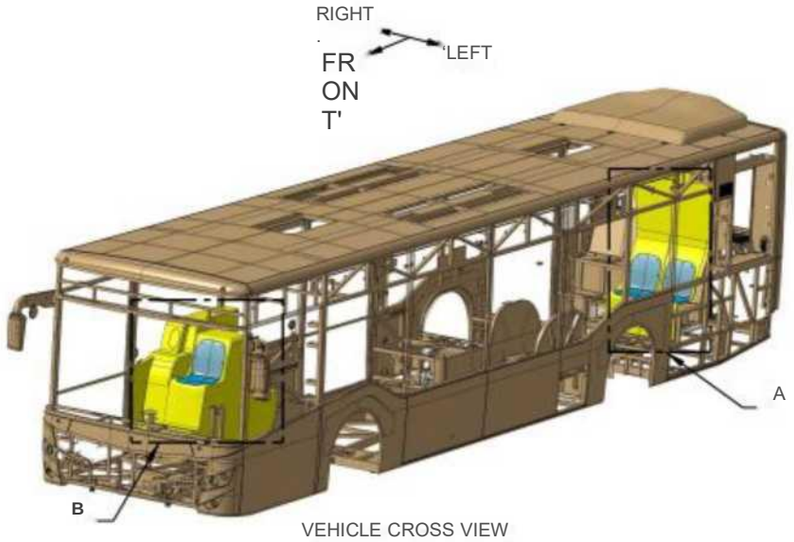


VEHICLE CROSS VIEW

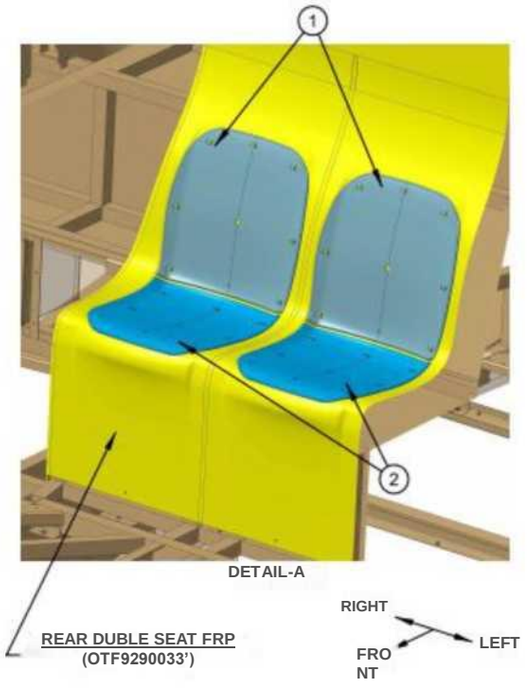


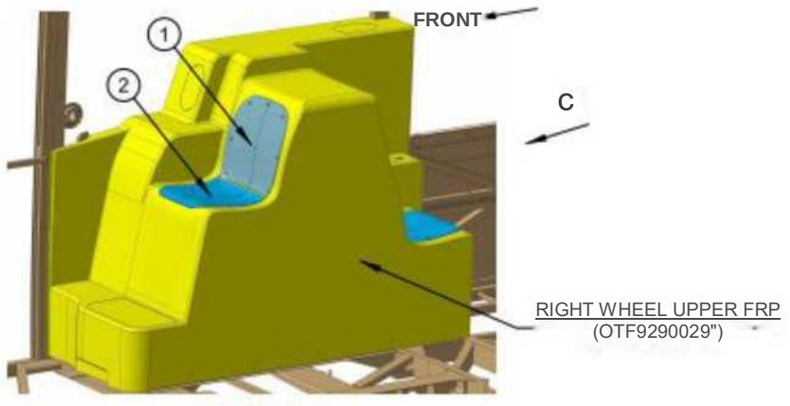
LEAF POSE	GROUP-POSE	PART NO	COMPONENT'S NAME	NUMBER
1	935 - 420	387036778*	BACKPED	3
2	935 - 421	387036781*	SEAT PED	3

REAR DOUBLE SEAT FRP RIGHT WHEEL TOP FRP PADS VEHICLE MOUNTING

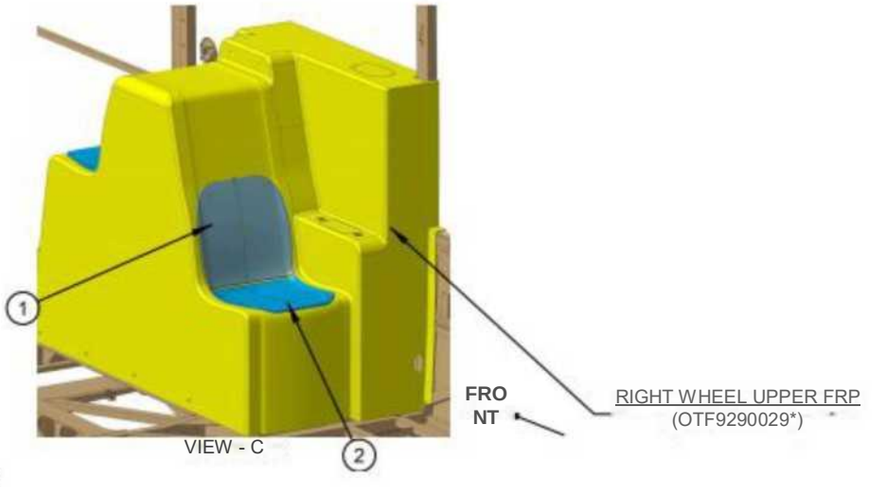


VEHICLE CROSS VIEW





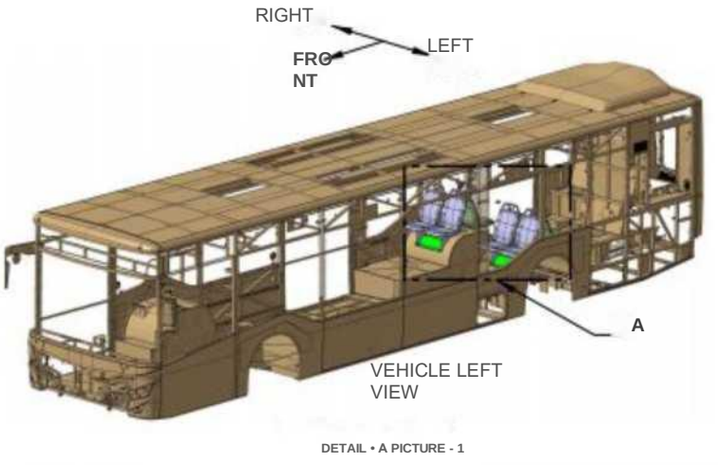
DETAIL - B



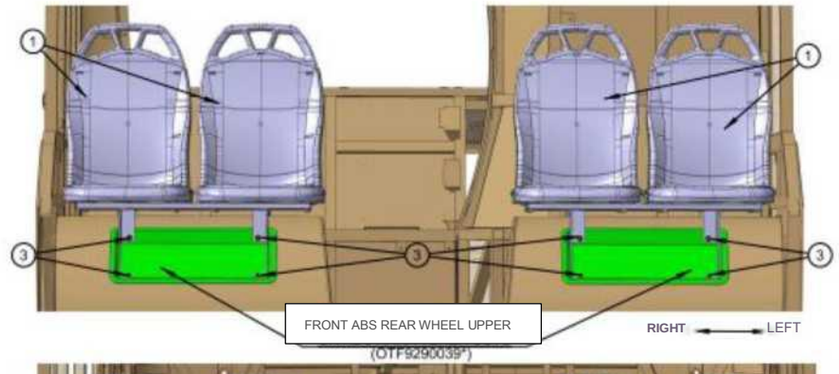
VIEW - C

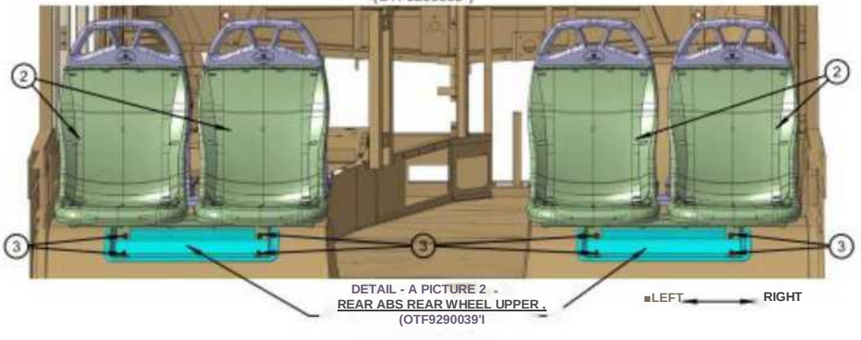
LEAF POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	935 -420	397035775*	BACKPED	4
2	935 - 421	397036781*	SEAT PED	4

VEHICLE INSTALLATION OF DOUBLE FLAT AND DOUBLE REVERSE REAR WHEEL-MOUNTED SEATS



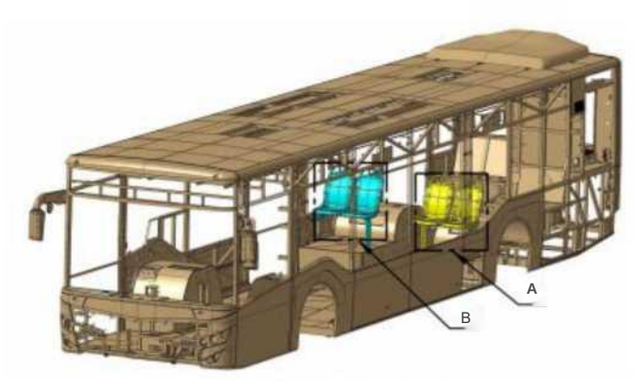
DETAIL • A PICTURE - 1



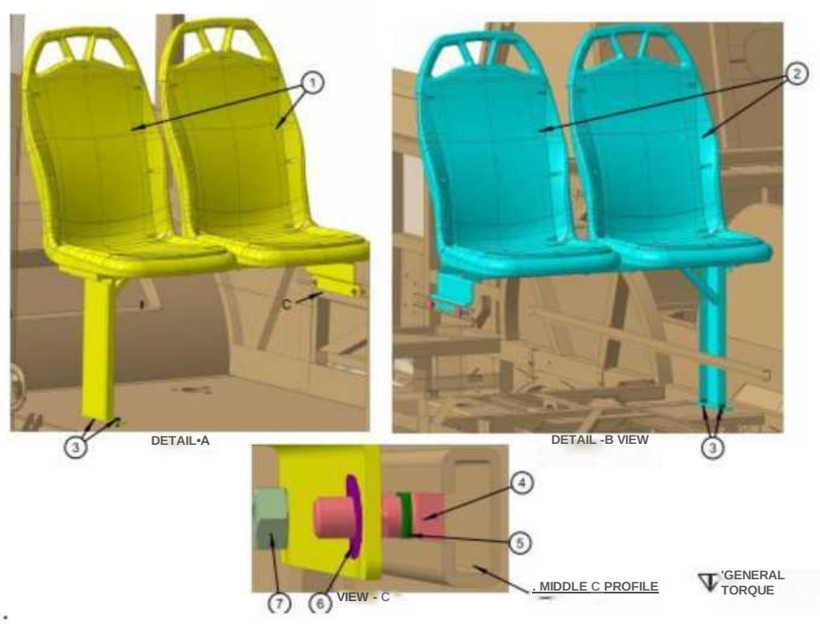


	LEAFLET POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
	1	935 - 211	387038696*	**SEAT. DOUBLE, STRAIGHT , REAR WHEEL UPPER**	4
	2	935 - 212	387038697*	**SEAT. DOUBLE, REVERSE, REAR WHEEL UPPER**	4
	3	935 - 009	3005800084*	NUT , FLN&TR M8X1.25, THICK D. DIN 6S23	16

VEHICLE INSTALLATION OF LEFT AND RIGHT BOTH REAR FRONT SEATS



VEHICLE CROSS VIEW

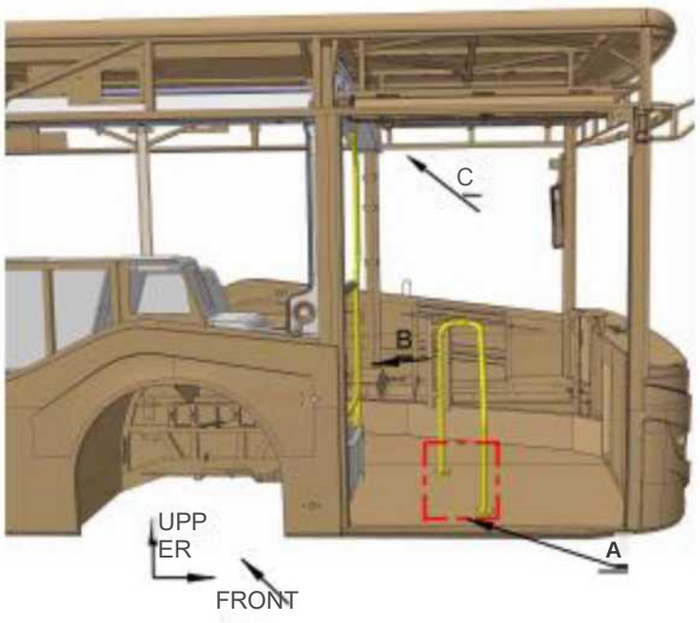


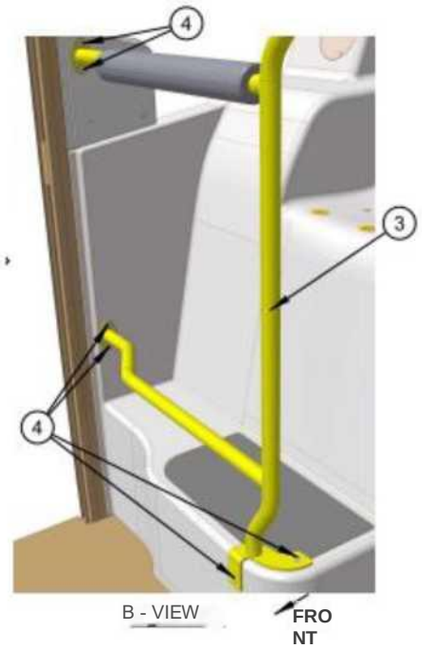
DETAIL•A

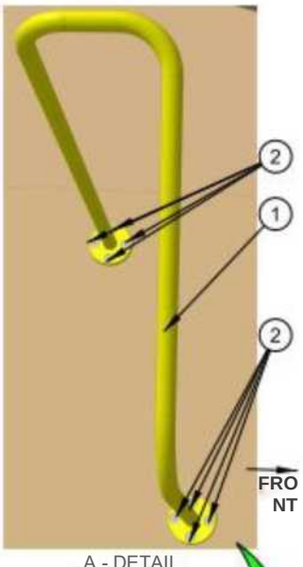
DETAIL -B VIEW

LEAFLET POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	935 - 210	387038695*	SEAT DUBLE. REAR WHEEL FRONT. LEFT	1
2	935 - 209	3870386941*	SEAT, DUBLE, REAR WHEEL FRONT, RIGHT	1
3	935 - 008	3001208306*	BOLT , FLN M8X 1.25X30, THICK D. DIN6921	4
4	935 - 004	3888849412*	BOLT	4
5	935 - 005	3010100106*	WASHER , SPRINGY D=10 DİN 127	4
6	935 -005	3010000104*	**WASHER , FLAT D-10 DİN 125**	4
7	935 - 007	3005100106*	NUT , AKB M1 0X1.25, THİN D. DIN934	4

FRONT DOOR ENTRANCE CORRUGAL AND HORIZONTAL SAW INSTALLATION

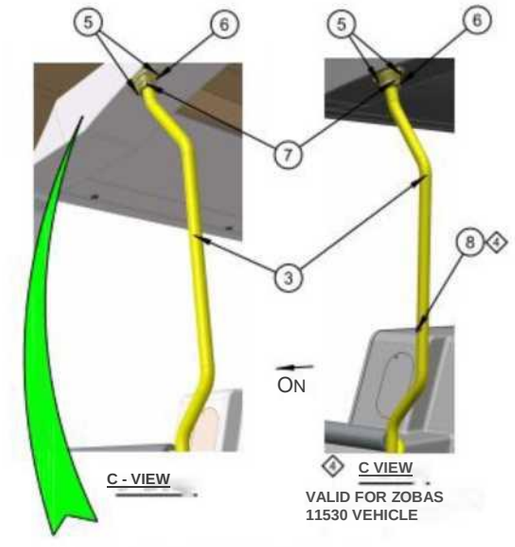








APPARATUS NO:
342040327800

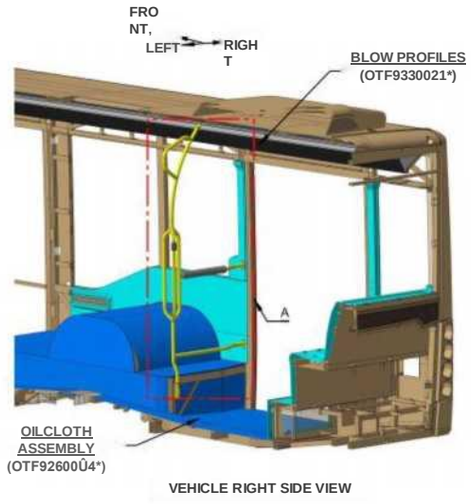




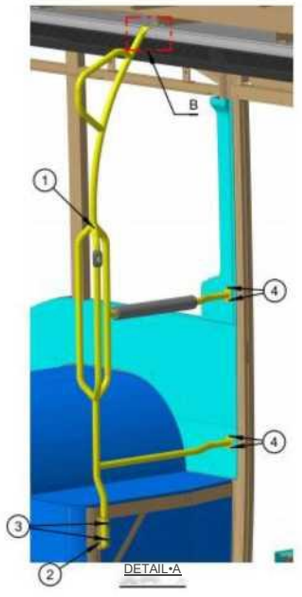
s APPARATUS NO:
38704024!

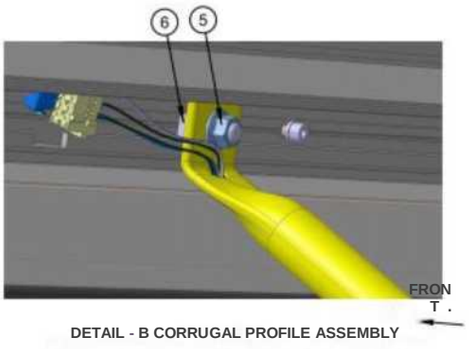
LEAFLET POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER	ADDITIONAL INFO
1	935 - 056	387044018*	BOMBPROOF , FRONT DOOR INPUT	1	CITIPORT/ZOBAS 11530
1	935 - 056	387055881*	BOMBPROOF , FRONT DOOR INPUT	1	CITIPORT -S
2	935 - 068	3000906351*	BOLT , SLB M6X35, THICK D. DIN912	B	
3	935 - 030	387032812*	BOMBPROOF , FRONT VEILING	1	
3	935 - 030	387055873*	BOMBPROOF , FRONT VEILING	1	CITIPORT -S
3	935 - 030	387487555*	BOMBPROOF . FRONT VEILING. RAL 1016		ZOBAS 11530
4	935 - 063	301700620*	SCREW LOWER CORNER PITTED	6	
5	935 - 022	3000906201*	BOLT , SLB M6X20, THICK D. DIN912	2	
6	935 - 064	387038816*	FLANS, TIRE WEDGE. YELLOW RAL 1016	1	
6	935 - 064	387055877*	FLANS, TIRE WEDGE	1	CITIPORT -S
7	935 - 065	388889163*	TIRE BED	1	
8	935 - 092	387001882*	STOPPER	1	ZOBAS 11530

REAR DOOR FRONT FACE MOUNTING TO THE VEHICLE



VEHICLE RIGHT SIDE VIEW

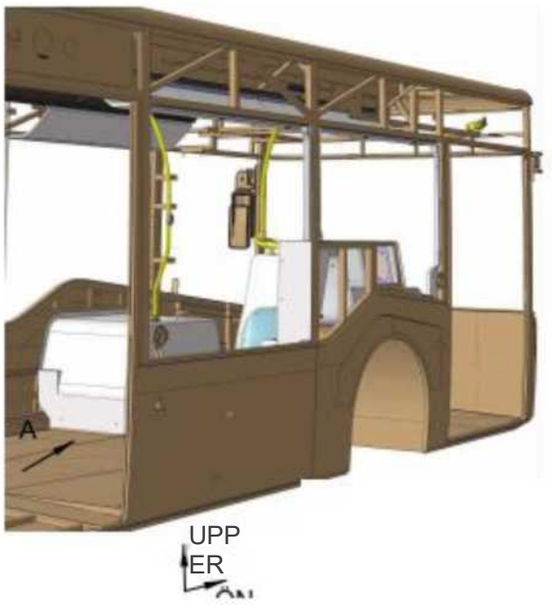


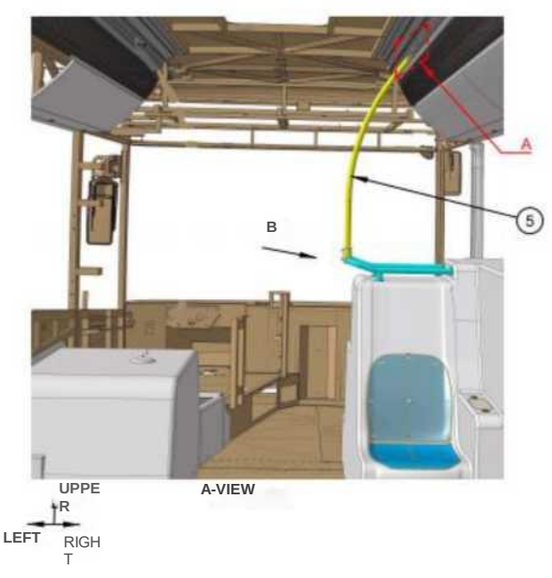


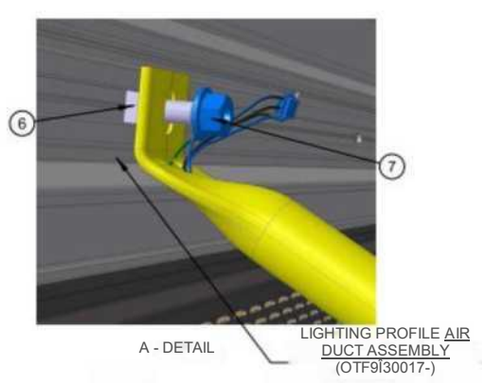
DETAIL - B CORRUGAL PROFILE ASSEMBLY

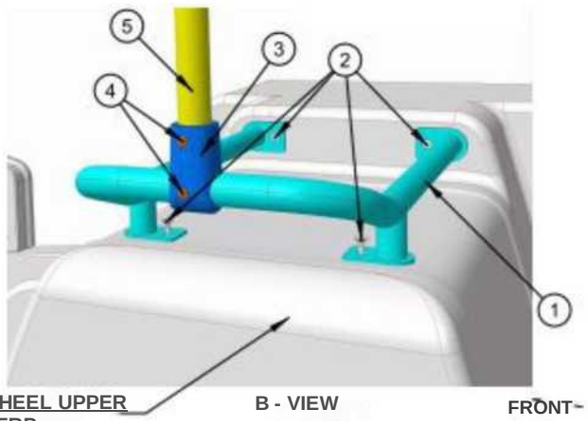
LEAFLET POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	935 -051	387036083*	BOMBPROOF, COVER, FRONT, REAR DOOR	1
1	935 - 051	387055888*	BOMBPROOF , COVER, FRONT, REAR DOOR	1
2	935 - 069	387038818*	BOMBPROOF CONNECTION BRACKET. YELLOW RAL 1016	1
3	935 - 070	3000906603*	BOLT . SLB M6X60. THICK D. DIN912	2
4	935 -082	3017006206*	SCREW,CHAMFER BIT FLAT B,HOLLOWED	4
5	935-011	3005800106*	NUT . FLN&TR M10X1.5, THICK D. DIN 6923	1
6	935 - 060	3870062310*	SPECIAL BOLT	1

FRONT RIGHT BOMBPROOF MOUNTING



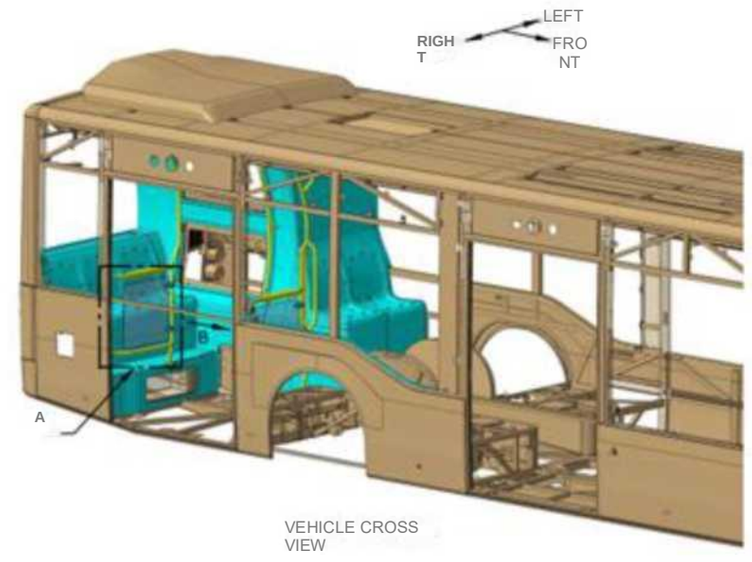




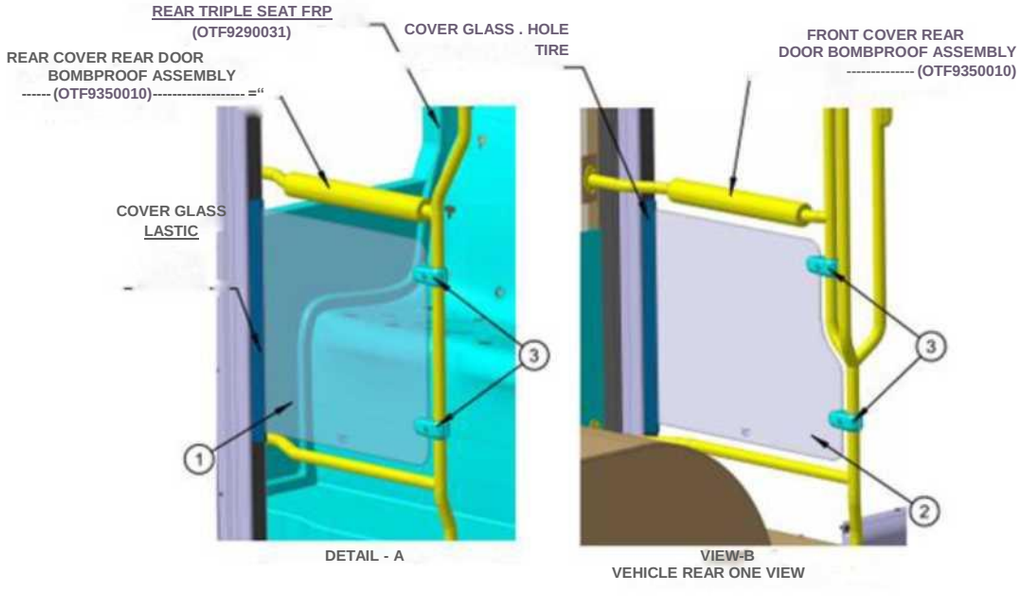


LEAFLET POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	935-031	387032899*	BOMBPROOF, MIDDLE FRP UPPER. LEFT	1
1	935 -031	387056940*	BOMBPROOF . MIDDLE FRP UPPER, LEFT	1
2	935 -063	3017006206*	SCREW,HAVSA FLAT B, HOLLOWED	4
3	935 - 071	3670368200*	CLAMP , GAP 30 ,YELLOW,RAL 1016	1
3	935 - 071	387055579*	CLAMP , GAP 30	1
4	935 - 073	3025205200*	RIVET, POP, 5X20	2
5	935 - 054	387038704*	BOMBPROOF . RIGHT WHEEL UPPER	1
5	935 - 054	387055886*	BOMBPROOF . RIGHT WHEEL UPPER	1
6	935 -060	367006231*	SPECIAL BOLT	1
7	935 -011	3005800106*	NUT , FLN&TR M10X1.5, THICK D. DİN6923	1

REAR BOMBPROOF GLASS AND HOLDER ASSEMBLY



VEHICLE CROSS VIEW

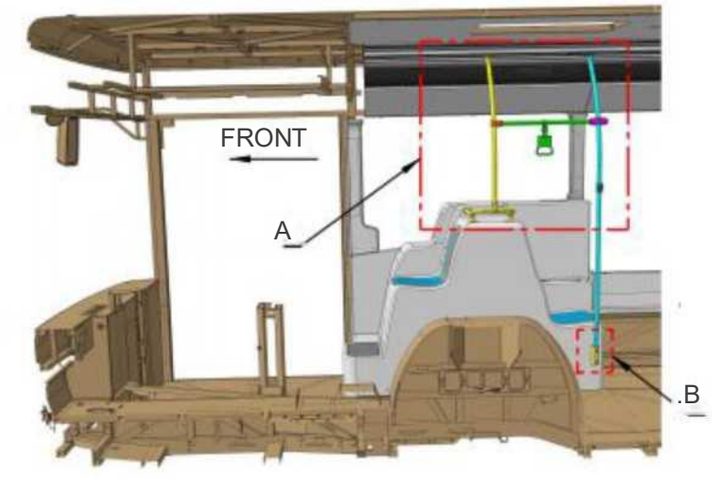


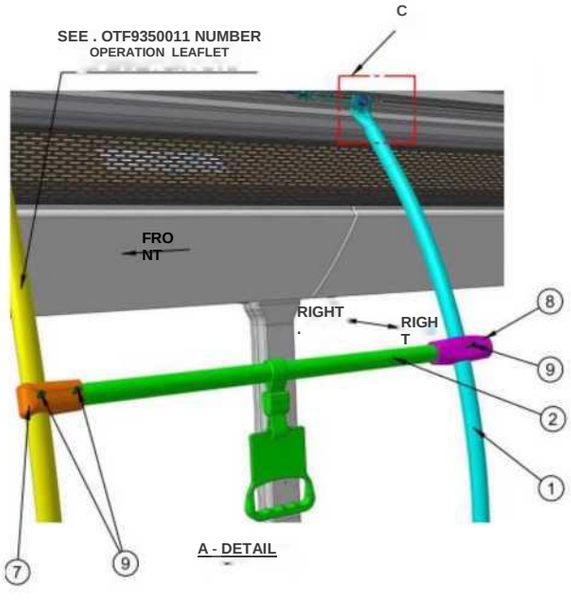
DETAIL - A

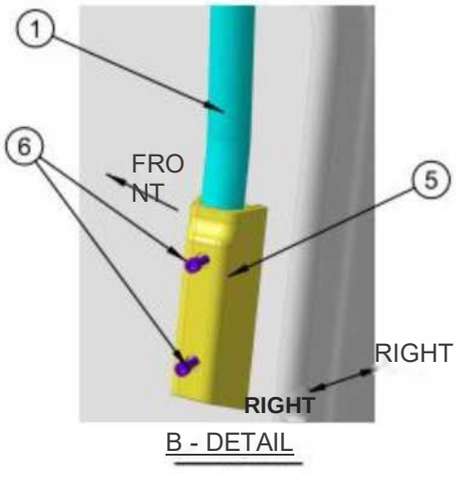
VIEW-B
VEHICLE REAR ONE VIEW

LEAFLET POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	935 - 076	387041234*	COVER GLASS, LAMİNE, FRONT AND REAR DOOR	1
2	935 - 079	337041237*	COVER GLASS, MIDDLE BACKDOOR.AND REAR K.O	1
3	935 -009	387046937*	CLAMP , GLASS HOLDER	4

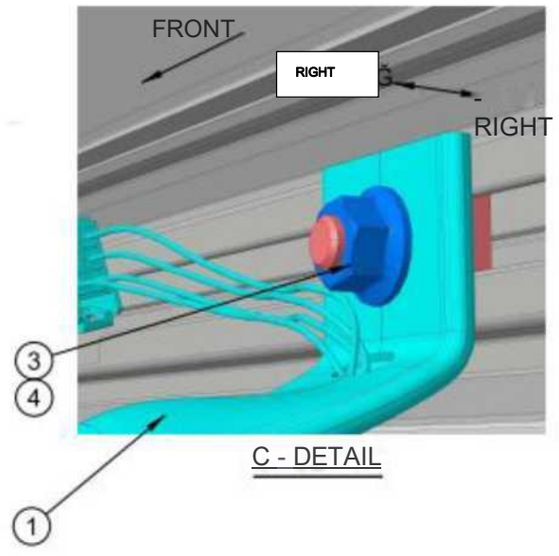
RIGHT FRONT HORIZONTAL BOMBPROOF ASSEMBLY







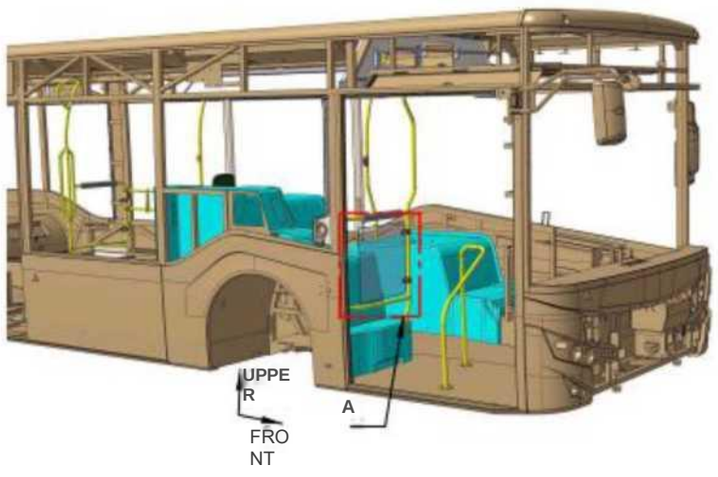
B - DETAIL

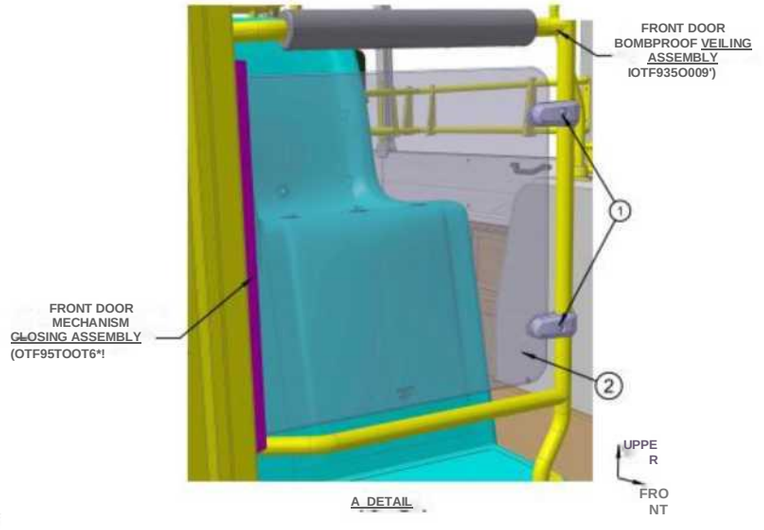


C - DETAIL

LEAFLET POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	935 - 033	387032811'	BOMBPROOF, FRP WHEEL UPPER.RIGHT	1
2	935 - 034	387032892'	BOMBPROOF, ON HORIZONTAL , RIGHT	1
3	935 - 060	3870062310*	SPECIAL BOLT	1
4	935 - 011	3005800106*	NUT , FLN&TR M10X1.5, THICK D. DİN 6923	1
5	935 - 069	387038818'	BOMBPROOF CONNECTION BRACKET, SARİ RAL 1016	1
6	935 - 070	3000906603*	BOLT , SLB M6X60, THICK D. DIN912	2
7	935 - 071	387038820*	CLAMP , CAP 30 . YELLOW,RAL 1016	1
8	935 - 072	387038827*	CLAMP , SPECIAL , CAP 30, YELLOW, RAL 1016	1
9	935 - 073	302520520'	RIVET POP, 5X20	3

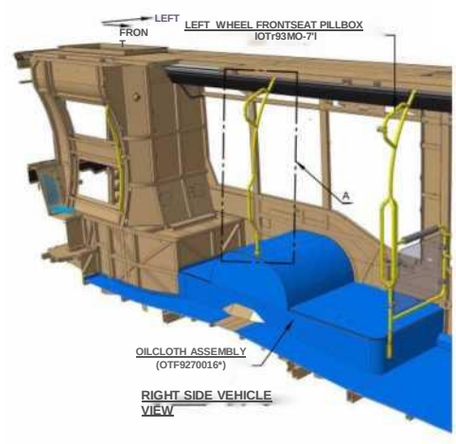
FRONT DOOR INSPECTION GLASS INSTALLATION

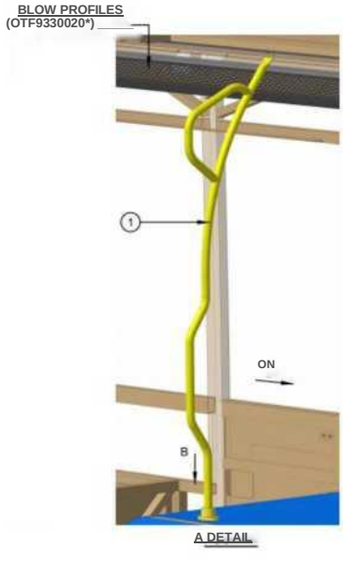


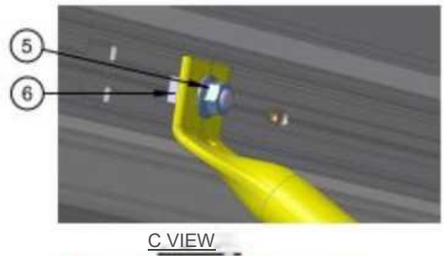


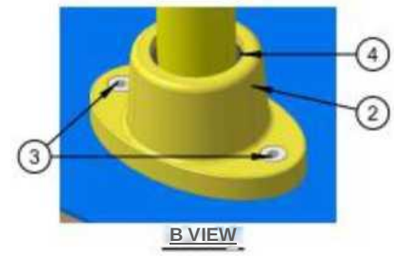
LEAFLET POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER	ADDITIONAL INFO
1	935 - 080	387046937*	CLAMP , GLASS HOLD RAL 1016	2	
1	935 - 080	387055882"	CLAMP , GLASS HOLD	2	CITIPORT S
2	935 - 076	387053000"	COVER GLASS, LAMINE, FRONT AND REAR DOOR	1	CITIPORT S
2	935 - 076	387041234"	COVER GLASS, LAMINE, FRONT AND REAR DOOR	1	

LEFT REAR MOUNTING OF VERTICAL GUARD ON THE WHEEL



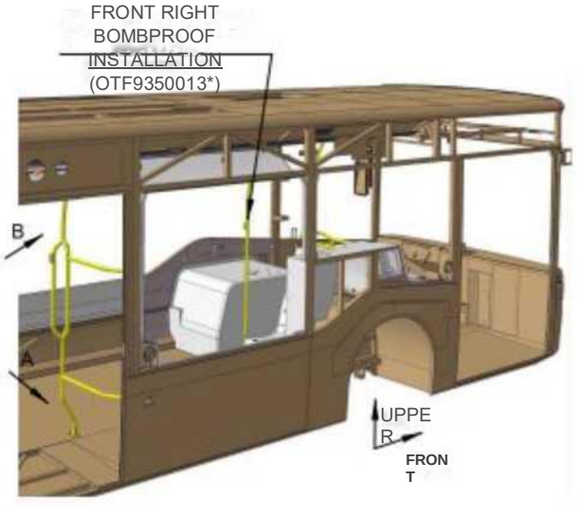


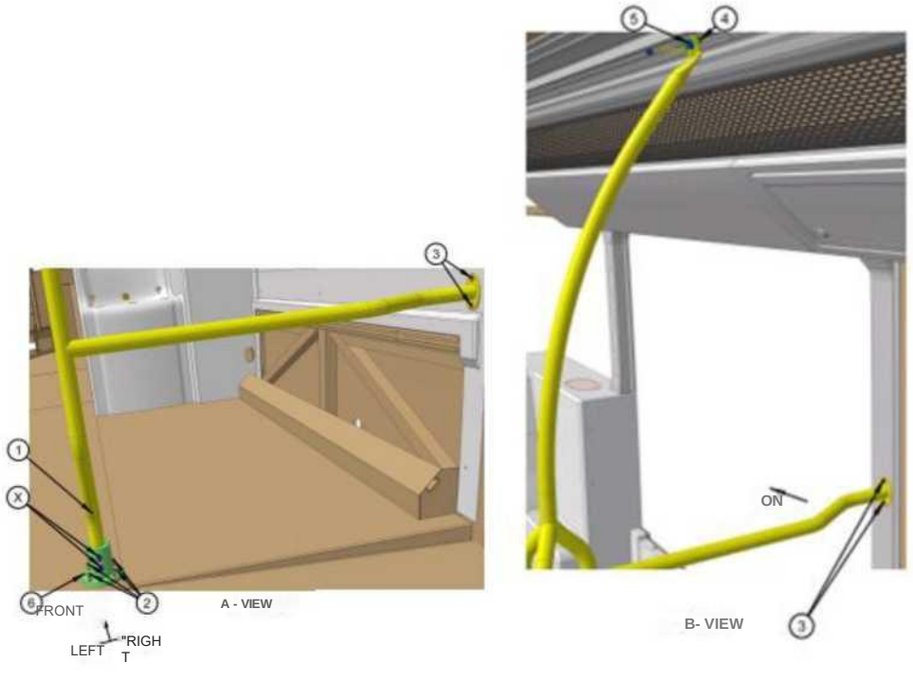




LEAFLET POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER	ADDITIONAL INFO
1	935 - 050	387037870'	BOMBPROOF, VERTICAL , REAR WHEEL UPPER	1	
1	935 - 050	387055889*	BOMBPROOF, VERTICAL, REAR WHEEL UPPER	1	CITIPORT - S
1	935 - 050	387058741*	BOMBPROOF, VERTICAL, LEFT , REAR WHEEL UPPER	1	ZOBAS- 11091
1	935 - 049	387515245*	BOMBPROOF, VERTİCAL, REAR WHEEL UPPER. RAL101	1	ZOBAS - 1150
2	935 - 064	387038816*	FLANS, TIRE WEDGE, YELLOW RAL 1016	1	
2	935 - 064	387055877'	FLANS, TIRE WEDGE	1	CITIPORT - S
3	935 - 066	3000906201*	BOLT , SLB M6X20, THICK D. DIN912	2	
4	935 - 065	388889163*	TIRE BED	1	
5	935-011	3005800101*	NUT , FLN&TR M10X1.5, THICK D. DİN 6923	1	
6	935 - 060	3870062310*	SPECIAL BOLT	1	

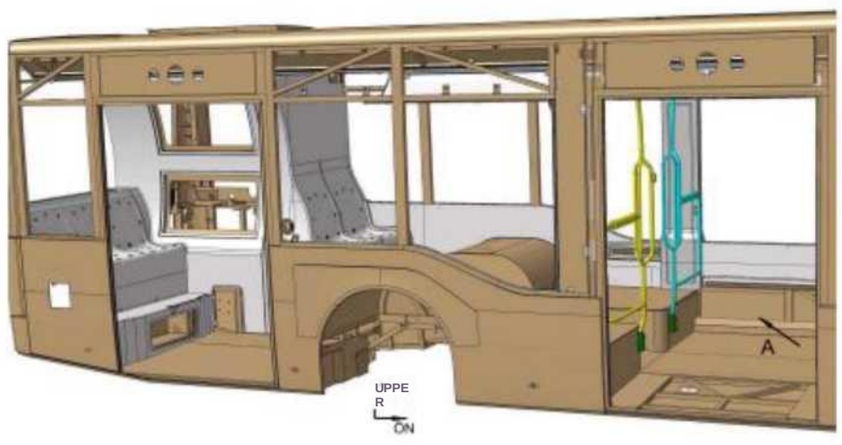
INSTALLATION OF MIDDLE DOOR FRONT HOLDER GUARD

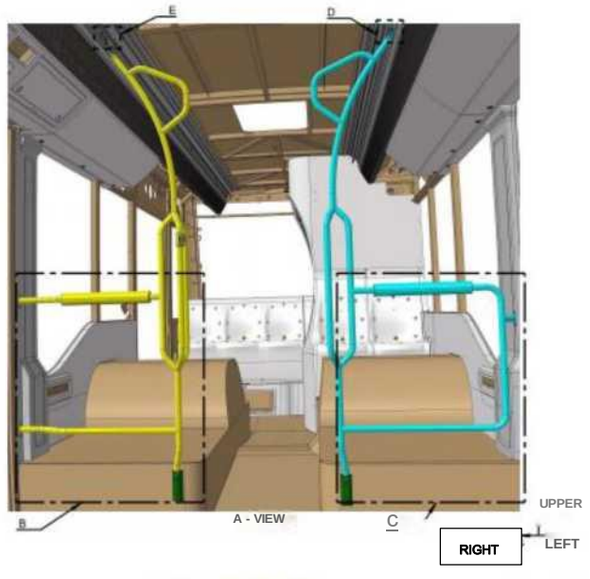


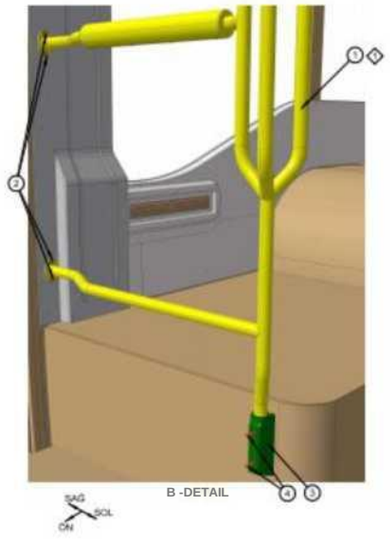


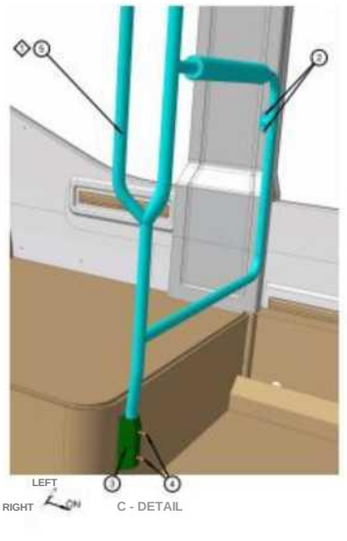
LEAFLET POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER	ADDITIONALINFO
1	935 - 040	387036084*	BOMBPROOF, COVER, MIDDLE DOOR, **FRONT**	1	
1	935 - 040	387055883	BOMBPROOF, COVER, MIDDLE DOOR. FRONT	1	**CITIPORT -** S
2	935 - 068	3000906356*	BOLT , SLB M6X35, THICK D. **DIN912**	4	
3	935 - 063	3017006206*	SCREW.CHAMFER BIT FLAT B.HOLLOWED	4	
4	935 - 060	3870062310*	SPECIAL BOLT	1	
5	935 - 011	3005800106*	NUT . FLN&TR M10X1.5, THICK D. DİN 6923	1	
6	935 - 067	387038819-	BOMBPROOF BAG.LOWER BRKT. **YELLOW** RAL 1016	1	
6	935 - 067	387055878-	CONSERVATIVE . BOMBPROOF LOWER CONNECTION	1	**CITIPORT -** S

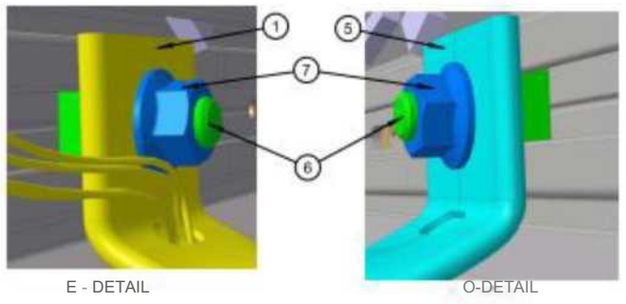
LEFT WHEEL SEAT FRONT AND MIDDLE DOOR REAR GAUGE BOMBPROOF INSTALLATION







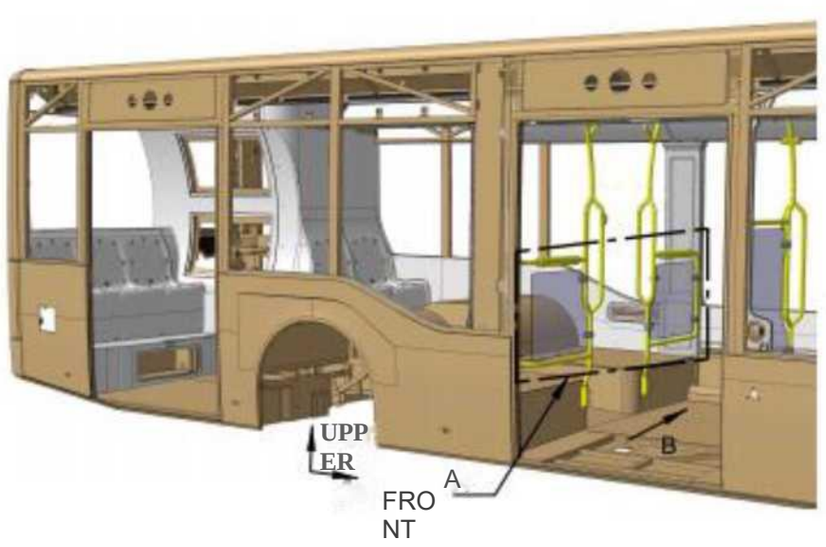


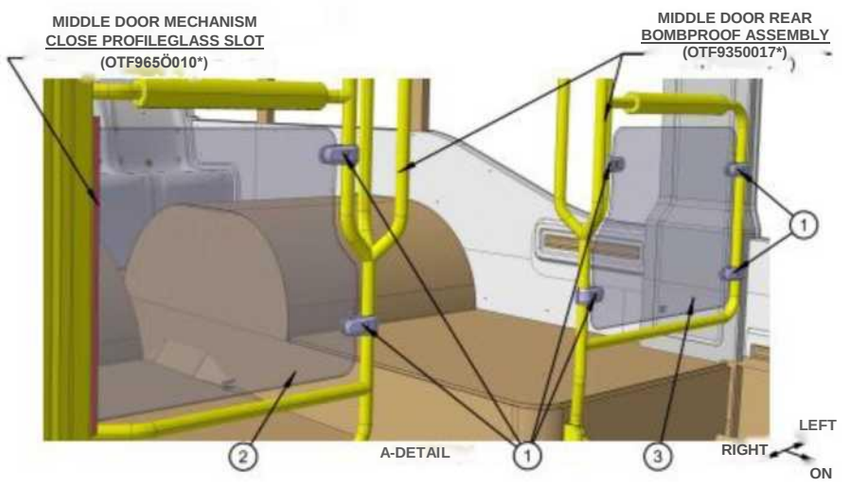


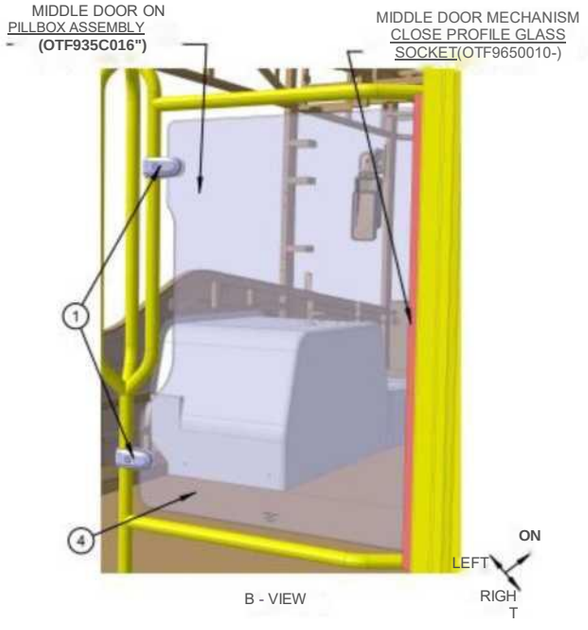
E - DETAIL O-DETAIL

LEAFLET POSE	GROUP.POSE	PART NO	COMPONENT'S NAME	NUMBER
1	935-041	387036082"	BOMBPROOF. COVER, MIDDLE DOOR. REAR	1
1	935-0*1	387065887'	BOMBPROOF VEILING. FRONT DOOR, REAR	1
1	933 - 0*1	387059734*	BOMBPROOF, COVER, MIDDLE DOOR. REAR	1
2	935 - 063	3017005206"	SCREW.CHAMFER FLAT B,HOLLOWED	6
3	93S - 069	367038816'	BOMBPROOF CONNECTION BRACKET. YELLOW RAL1016	2
4	935 - 070	3000906603"	BOLT , SL0 M6X60, THICK D. OIN912	4
5	935 - 0*5	387032827'	BOMBPROOF. LEFT REAR WHEEL FRONT SEAT	1
5	935 - 0*5	3B7058737'	BOMBPROOF, LEFT REAR WHEEL FRONT SEAT	1
6	935 - 060	M7QW2ST	SPECIAL BOLT	2
7	935-061	3ÛÛ58Û01Û6'	NUT . FLN6TR MI 0X1.5. THICK D. DİN 9923	2

MIDDLE DOOR AREA BOMBPROOF GLASS INSTALLATION

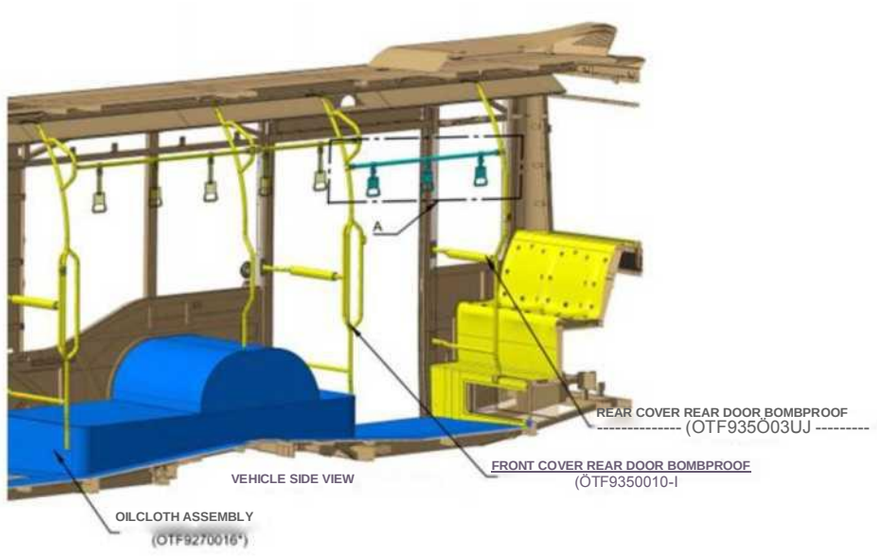


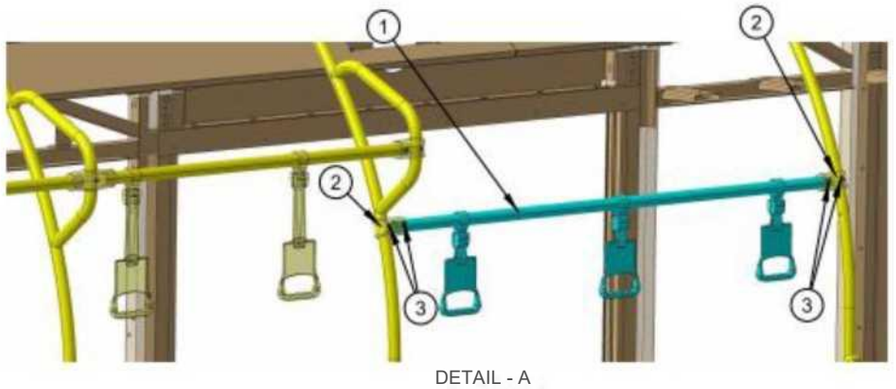




LEAFLET POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	935 - 080	3870469370*	CLAMP . GLASS HOLDER RAL 1016	8
2	935 - 079	387041237*	COVER GLASS MIDDLE BACK DOOR .AND REAR SEAT FRONT	1
3	935 -078	387041238*	COVER GLASS, LEFT REAR WHEEL SEAT FRONT	1
4	935 - 077	387041235*	BOMBPROOF GLASS, LAMINE, MIDDLE DOOR FRONT	1

REAR DOOR HORIZONTAL BOMBPROOF INSTALLATION

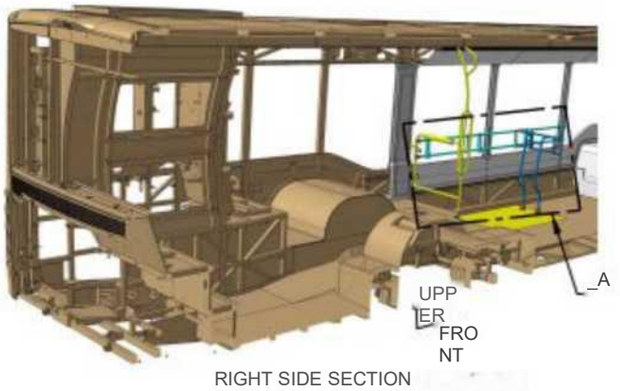




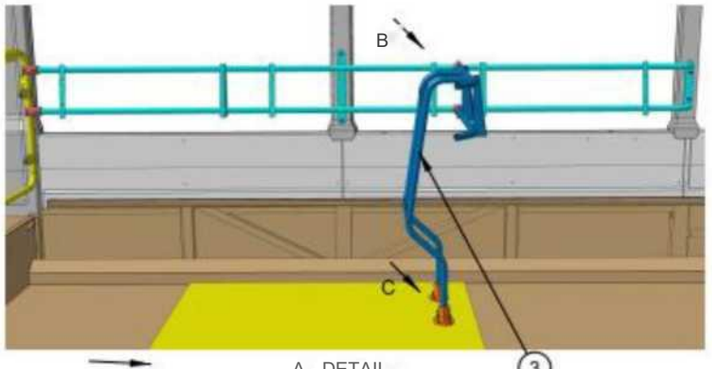
DETAIL - A

LEAF POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	935 -055	387039418*	BOMBPROOF, HORIZONTAL , MIDDLE AND REAR DOOR FRONT	1
2	935 - 071	387038820*	CLAMP , CAP 30 , YELLOW, RAL 1016	2
2	935 -071	387055879*	CLAMP , CAP 30	2
3	935 - 073	3025205200*	RİVET, POP, 5X20	4

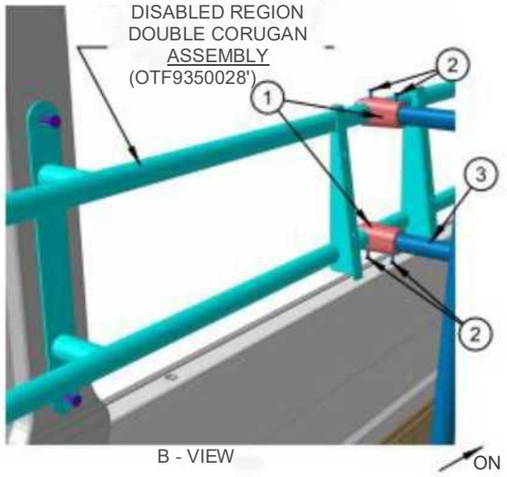
DISABLED AREA BOMBPROOF INSTALLATION



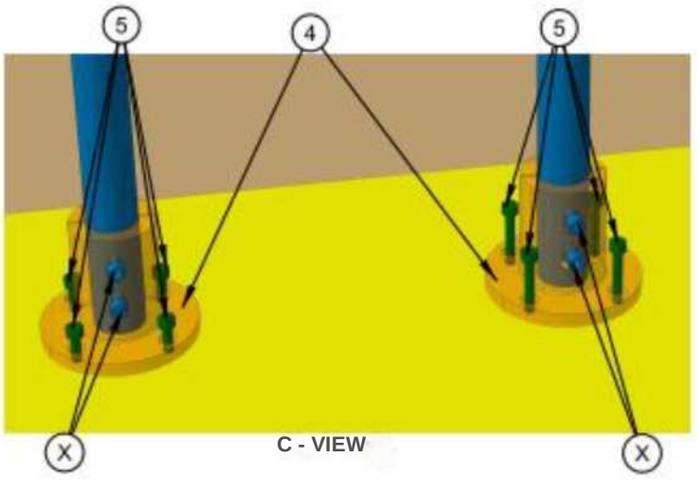
RIGHT SIDE SECTION



A - DETAIL



B - VIEW



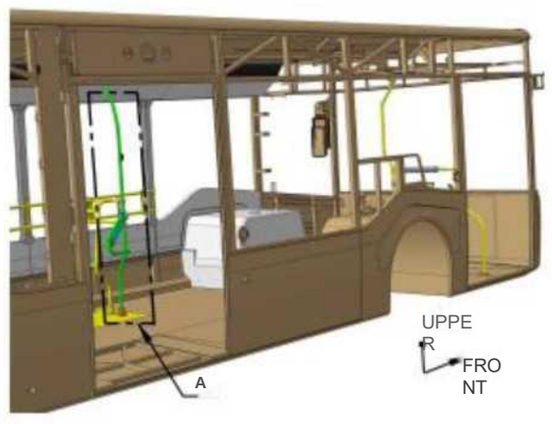
C - VIEW

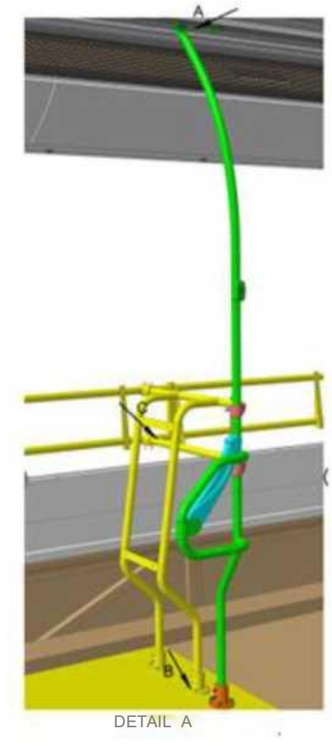


APPARATUS NO:
342040327100

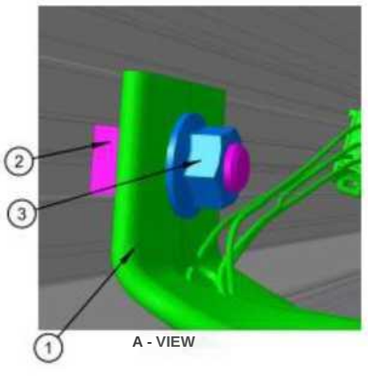
LEAFLET POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	935-071	3870388200*	CLAMP CAP 30 .YELLOW.RAL 1016	2
2	935 - 073	3025205200*	RIVET, POP. 5X20	4
3	935 - 043	367036079*	BOMBPROOF. WHEELCHAIR AND BACK PED	1
4	935 - 067	387038819*	BOMBPROOF BAG.LOWER BRKT, YELLOW RAL 1016	2
5	935 - 068	3000906356*	BOLT , SLB MSX35, THICK D. DIN912	8

LEFT DISABLED AREA VERTICAL BOMBPROOF INSTALLATION

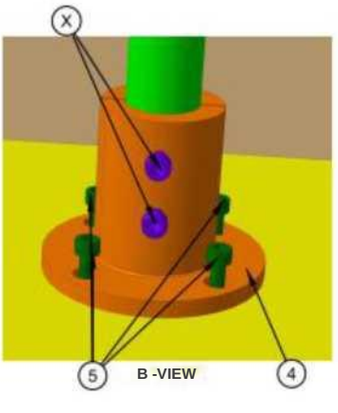




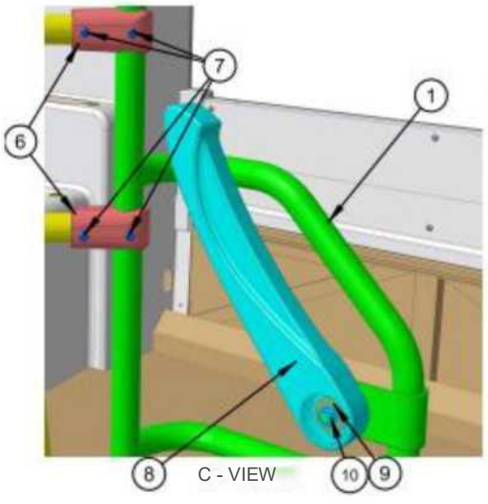
DETAIL A

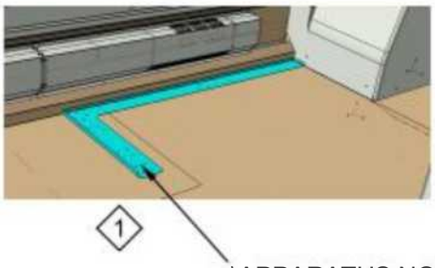


A - VIEW



B -VIEW

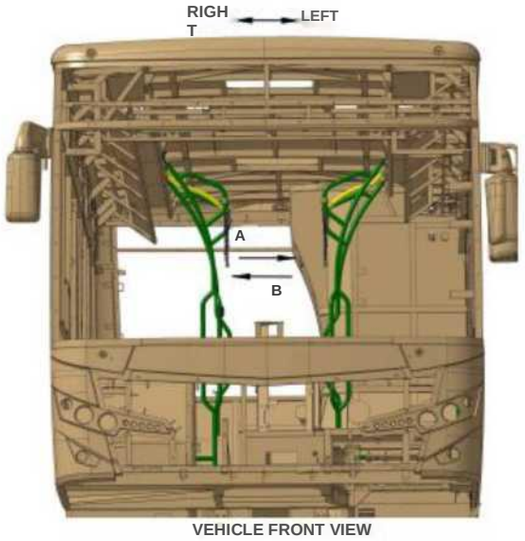




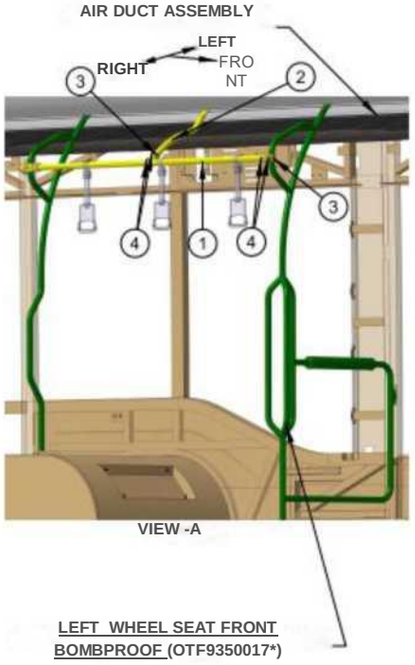
\APPARATUS NO:
342040327100

LEAFLET POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	935 - 042	387032817*	BOMBPROOF. LEFT THE REGION OF THE DISABLED, VERTICAL	1
2	935 - 060	387006231*	SPECIAL BOLT	1
3	935 -011	3005800106*	NUT , FLN&TR M10X1.5, THICK D. DİN 6923	1
4	935 - 067	387038819*	BOMBPROOF BAG.LOWER BRKT, YELLOW RAL 1016	1
5	935 - 068	3000906356*	BOLT . SLB M6X35, THICK D. DIN912	4
6	935 -071	387036820*	CLAMP . CAP 30 .YELLOW.RAL 1016	2
7	935 - 073	302520520*	POP RIVET, STEEL (5x20}	4
8	935 -083	387020601*	MITT, ASSEMBLY , 125 DEGREE	1
9	935 -084	3870149070*	WASHER	1
10	935 - 085	3008600106*	NUT , PL.EMN. M10. THICK D. DIN985	1

RIGHT AND LEFT MIDDLE HORIZONTAL AND MIDDLE REINFORCEMENT BOMBPROOF VEHICLE ASSEMBLY

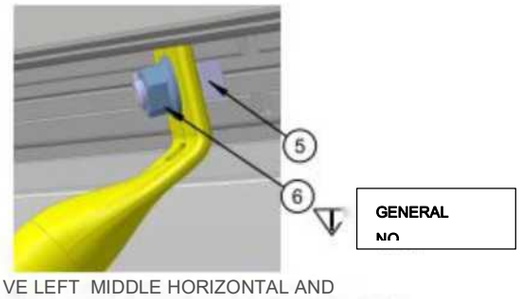


VEHICLE FRONT VIEW

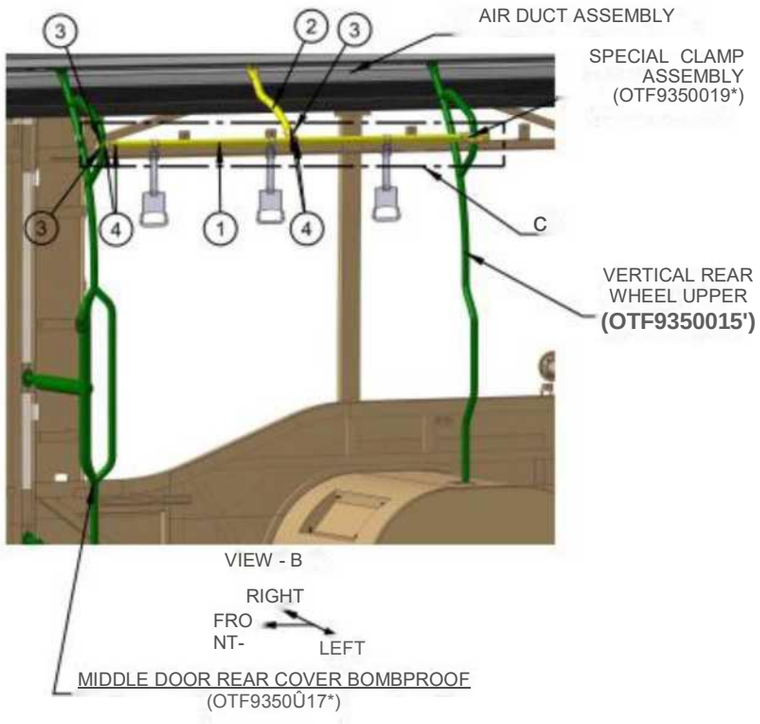


VIEW -A

LEFT WHEEL SEAT FRONT BOMBPROOF (OTF9350017*)



RIGHT VE LEFT MIDDLE HORIZONTAL AND INTERMEDIATE REINFORCEMENT BOMBPROOF AIR DUCT ASSEMBLY STYLE



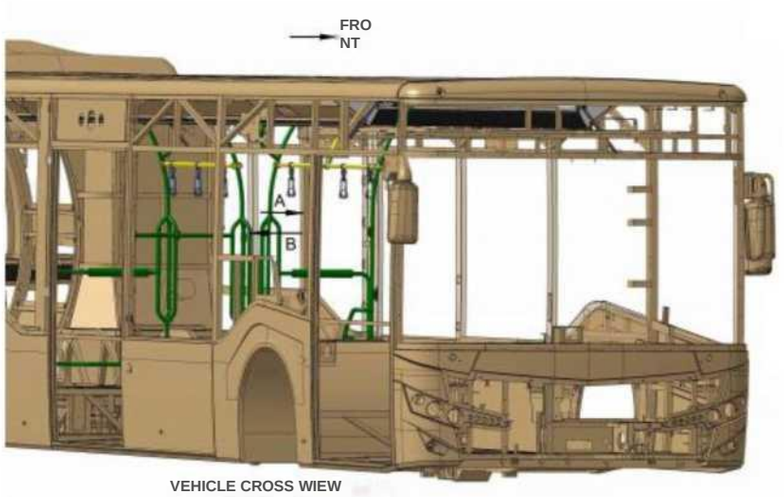


DETAIL -C

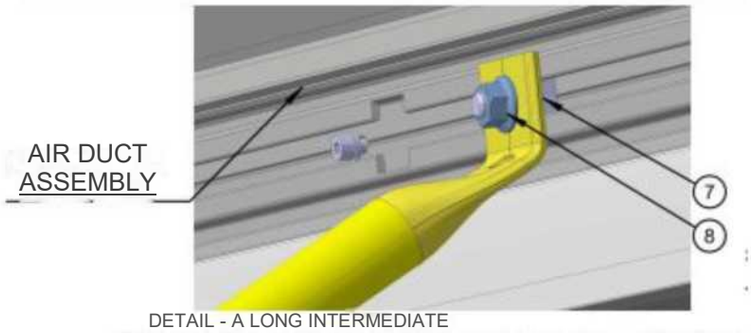
NOT: NOTE: RIGHT AND LEFT HORIZONTAL AND INTERMEDIATE BOMBPROOF INSTALLATION IS THE SAME WAY.

LEAFLET POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	835 - 046	387032819*	BOMBPROOF. MIDDLE HORIZONTAL , REAR	2
2	935 -039	387038705*	BOMBPROOF. INTERMEDIATE REINFORCEMENT , REAR	2
3	935 - 071	387038820*	CLAMP , CAP 30 .YELLOW.RAL 1016	4
4	935 - 073	302520520*	RIVET, POP, 5X20	8
5	935 - 060	3870062310*	SPECIAL BOLT	2
6	935 - 011	3005800106*	NUT , FLN&TR M10X1.5, THICK D. DİN 6923	2

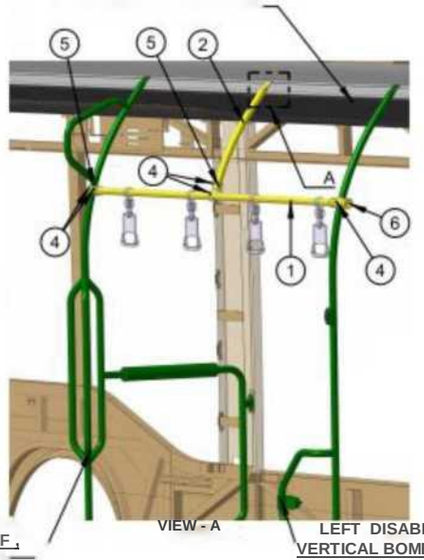
LEFT DISABLED AREA TOP LONG INTERMEDIATE REINFORCEMENT AND INTERMEDIATE AND REAR DOOR FRONT PROTECTION CAR INSTALLATION



VEHICLE CROSS WIEW



DETAIL - A LONG INTERMEDIATE REINFORCEMENT BOMBPROOF AIR DUCT ASSEMBLY STYLE
AIR DUCT ASSEMBLY

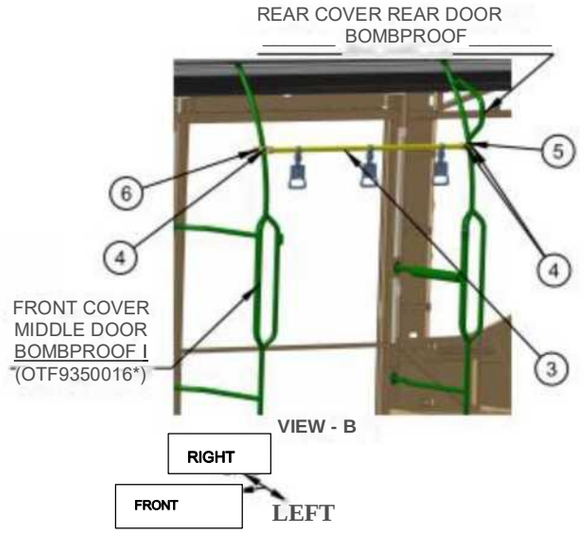


LEFT **WHEEL** SEAT
FRONT BOMBPROOF ,
(OTF9350017*)

VIEW - A

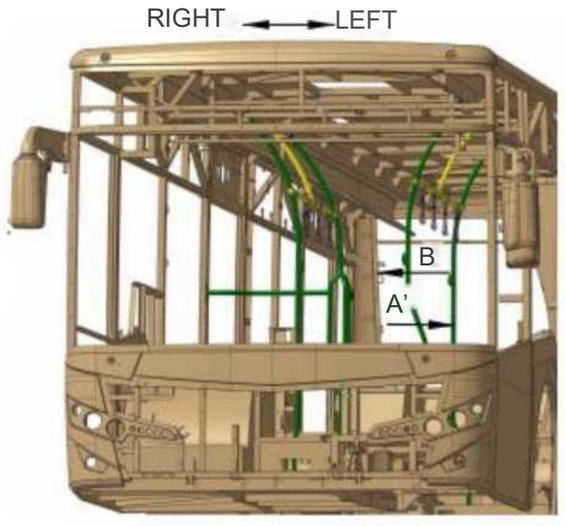
LEFT DISABLED ZONE \
VERTICAL BOMBPROOF
(OTF9350021-)



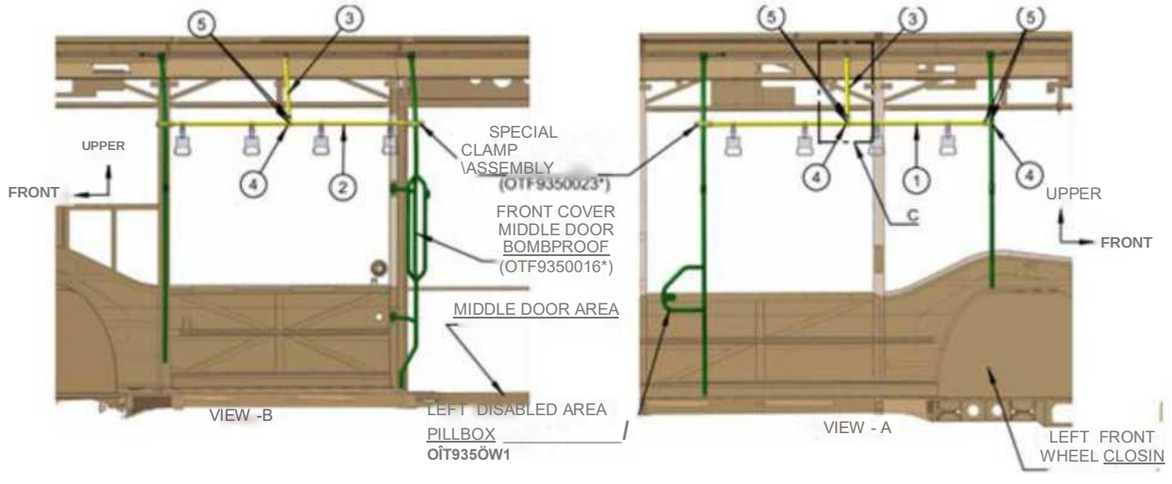


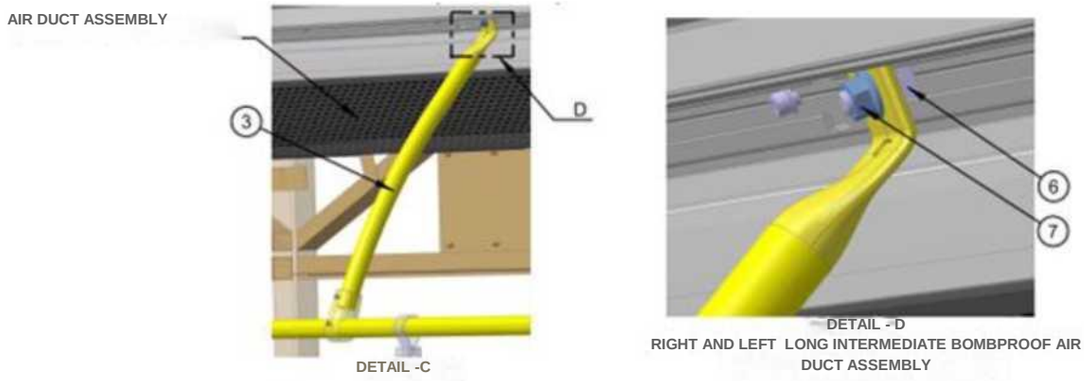
LEAFLET POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER	ADDITIONAL INFO
1	935 -037	387032905*	BOMBPROOF, LEFT , DISABLED ZONE . HORIZONTAL	1	
1	935 - 037	387056944*	KORUGAN, LEFT , DISABLED ZONE . HORIZONTAL	1	CITIPORT - S
2	935 - 038	387036066*	BOMBPROOF. INTERMEDIATE REINFORCEMENT . LONG	1	
2	935 - 038	387055875*	BOMBPROOF, INTERMEDIATE REINFORCEMENT , LONG	1	CITIPORT - S
3	935 -055	387039418*	BOMBPROOF. HORIZONTAL , MIDDLE AND REAR FRONT DOOR	1	
4	935 - 073	302520520'	POP RIVET. STEEL (5x20)	8	
5	935 - 071	387038820*	CLAMP , CAP 30 YELLOW.RAL 1016	3	
5	935 - 071	387055879*	CLAMP , CAP 30	3	CITIPORT - S
6	935 - 072	387038827*	CLAMP , SPECIAL , CAP 30, YELLOW, RAL 1016	2	
6	935 - 072	387055880*	CLAMP , SPECIAL , CAP 30	2	CITIPORT - S
7	935 - 060	3870062310*	SPECIAL BOLT	1	
8	935 - 011	3005800106*	NUT . FLN&TR M10X1.5, THICK D. DİN 6923	1	

LEFT FRONT HORIZONTAL, RIGHT CENTER HORIZONTAL, LONG INTERMEDIATE BOMBPROOF INSTALLATION TO THE VEHICLE



VEHICLE FRONT VIEW

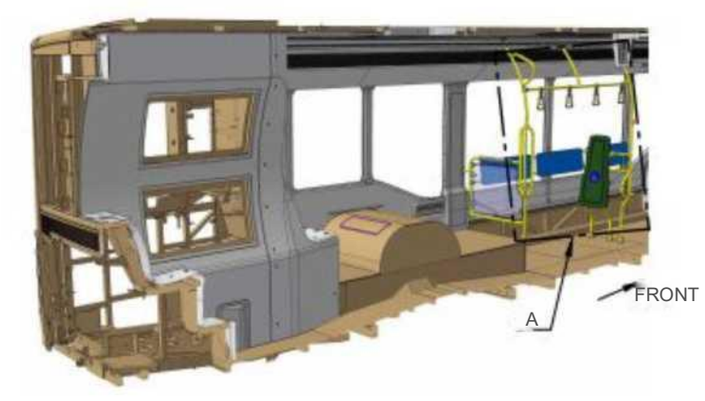


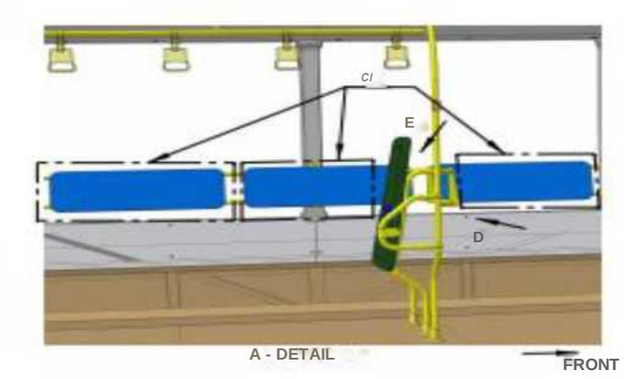


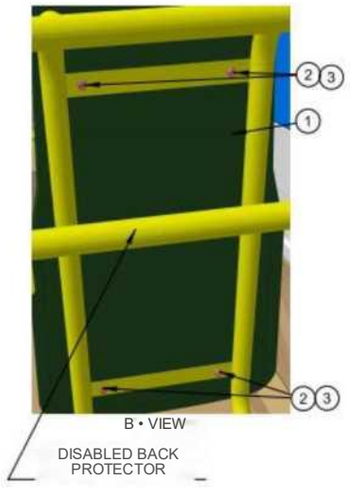
RIGHT AND LEFT LONG INTERMEDIATE BOMBPROOF AIR DUCT ASSEMBLY

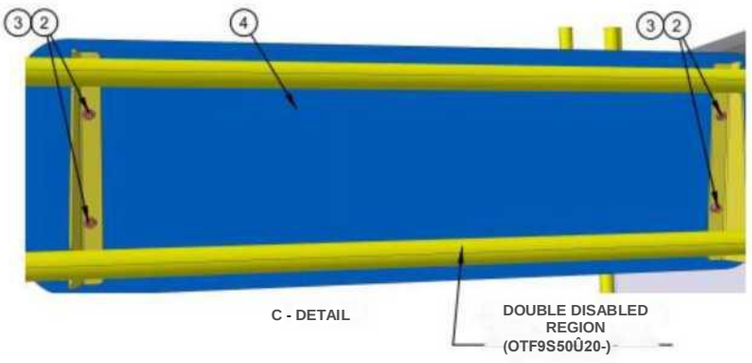
LEAFLET POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER	ADDITIONAL INFO
1	935 - 035	387032813*	BOMBPROOF, LEFT , FRONT, HORIZONTAL	1	
1	935-035	387056943*	BOMBPROOF, LEFT , FRONT, HORIZONTAL	1	CITIPORT - S
2	935 - 036	387032814'	BOMBPROOF, MIDDLE HORIZONTAL . RIGHT	1	
2	935 - 036	387055885*	BOMBPROOF, MIDDLE HORIZONTAL , RIGHT	1	CITIPORT - S
3	935 - 038	387036066*	BOMBPROOF, INTERMEDIATE REINFORCEMENT , LONG	2	
3	935 - 038	387055875*	BOMBPROOF, INTERMEDIATE REINFORCEMENT , LONG	2	CITIPORT - S
4	935 - 071	387038820*	CLAMP . CAP 30 .YELLOW.RAL 1016	3	
4	935-071	387055879*	CLAMP . CAP 30	3	CITIPORT - S
5	935 - 073	302520520*	RIVET. POP, 5X20	16	
6	935 - 060	3870062310*	SPECIAL BOLT	2	
7	935-011	3005800101*	NUT . FLN&TR M10X1.5, THICK D. DİN 6923	2	

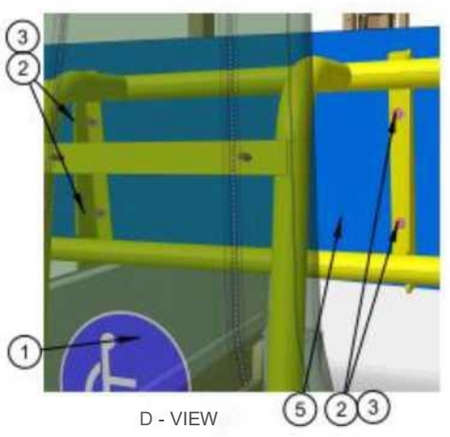
WHEELCHAIR AND PASSENGER BACKREST ASSEMBLY





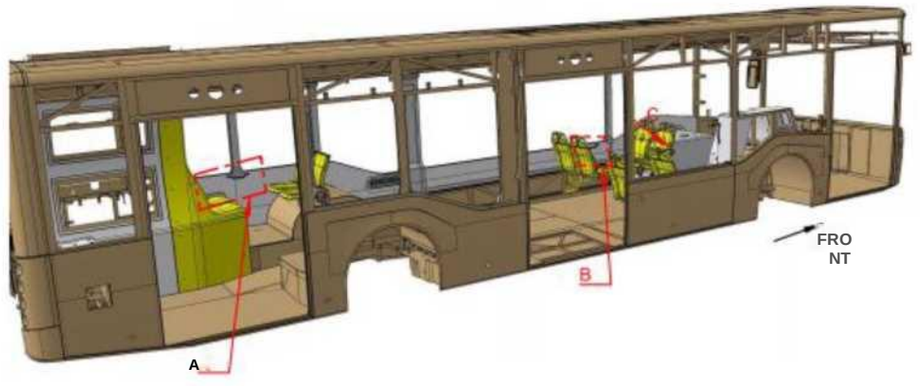


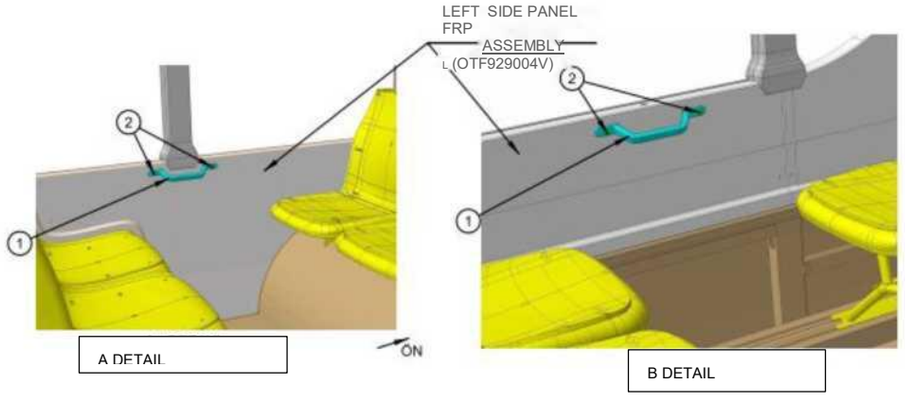


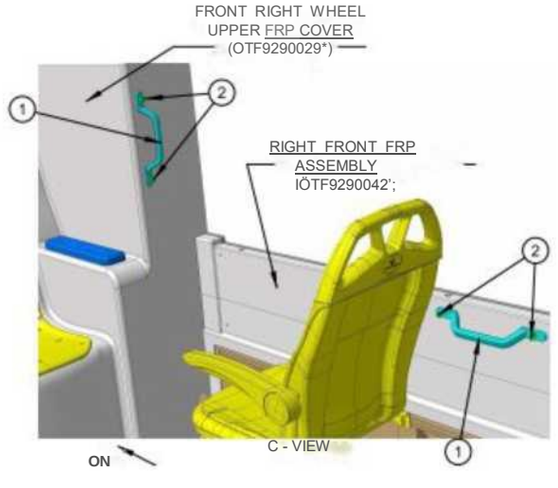


LEAFLET POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	935 - 226	387038701*	SUPPORT, WHEELCHAIR	1
2	935 - 022	3000906204*	BOLT , SLB M6X20, THICK D. DIN912	20
3	935 - 023	3040000061*	WASHER , FLAT D=6 DİN 125	20
4	935 - 225	387033700*	SUPPORT, LONG, BACK , PASSENGER	3
5	935 - 227	387038702*	SUPPORT, SHORT, BACK, PASSENGER	1

ALUMINUM HANDLE INSTALLATION

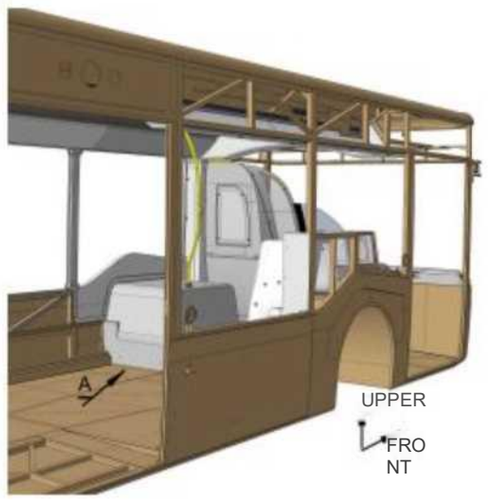


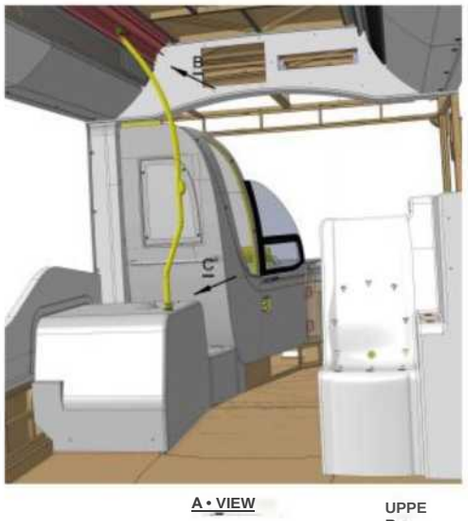


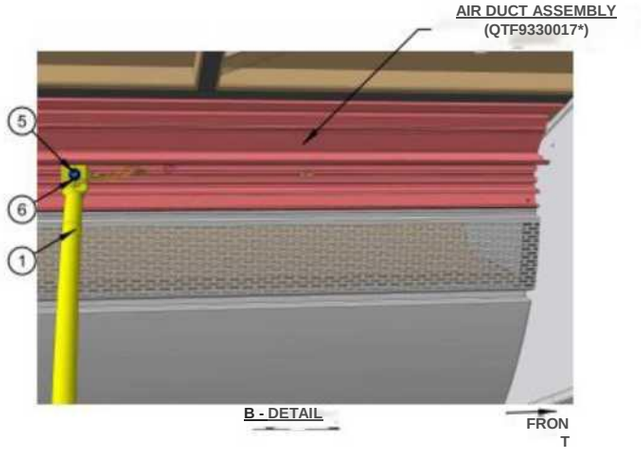


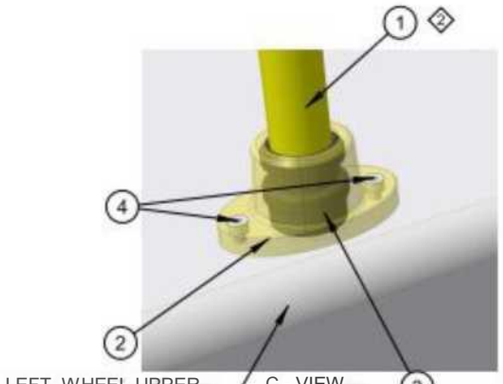
LEAFLET POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	935-031	387020547*	**HANDHOLD. ALUMINIUM**	4
2	935 - 063	301700620*	SCREW,CHAMFER BIT FLAT B,HOLLOWED	8

MIDDLE FRP TOP LEFT BOMBPROOF INSTALLATION





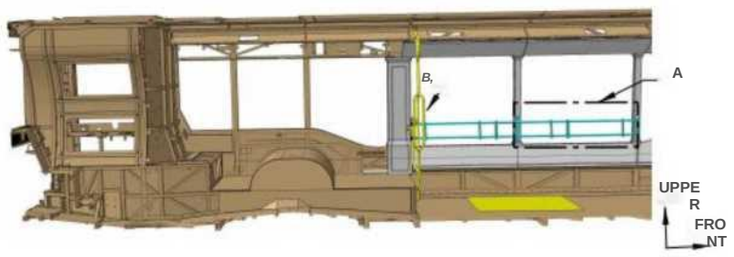


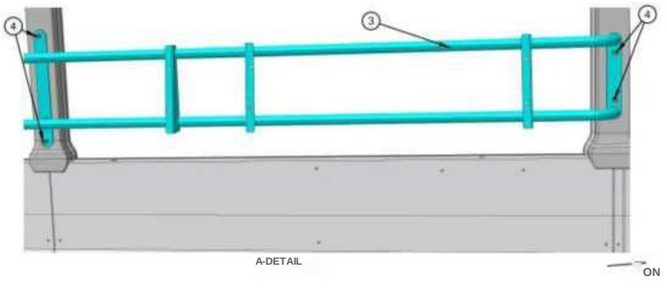


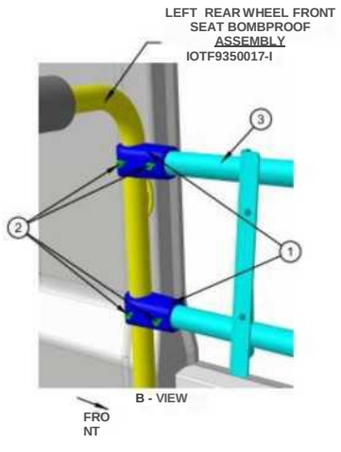
LEFT WHEEL UPPER FRP
(OTF9290030*)

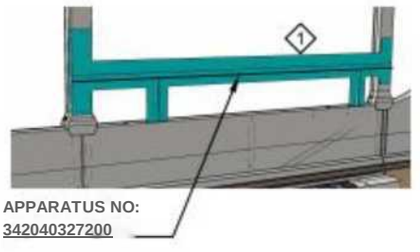
LEAF LET POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	935 -031	387032899*	BOMBPROOF, MIDDLE FRP UPPER, LEFT	1
1	935 - 031	387364638*	BOMBPROOF, MIDDLE FRP UPPER, LEFT , RAL1003	1
1	935 - 031	387058724*	BOMBPROOF, MIDDLE FRP UPPER, LEFT , RAL 1003	
2	935 - 064	387038816*	FLANS, TIRE WEDGE LU, YELLOW RAL 1016	1
3	935 - 06 5	388689163*	TIRE BED	1
4	935 - 066	3000906201*	BOLT SLB MSX20, THICK D. DIN912	2
5	935 - 060	387006231*	SPECIAL BOLT	1
6	935 - 061	3005800106*	NUT , FLN&TR M10X1.5, THICK D. DİN 6923	1

DISABLED AREA DOUBLE BOMBPROOF INSTALLATION



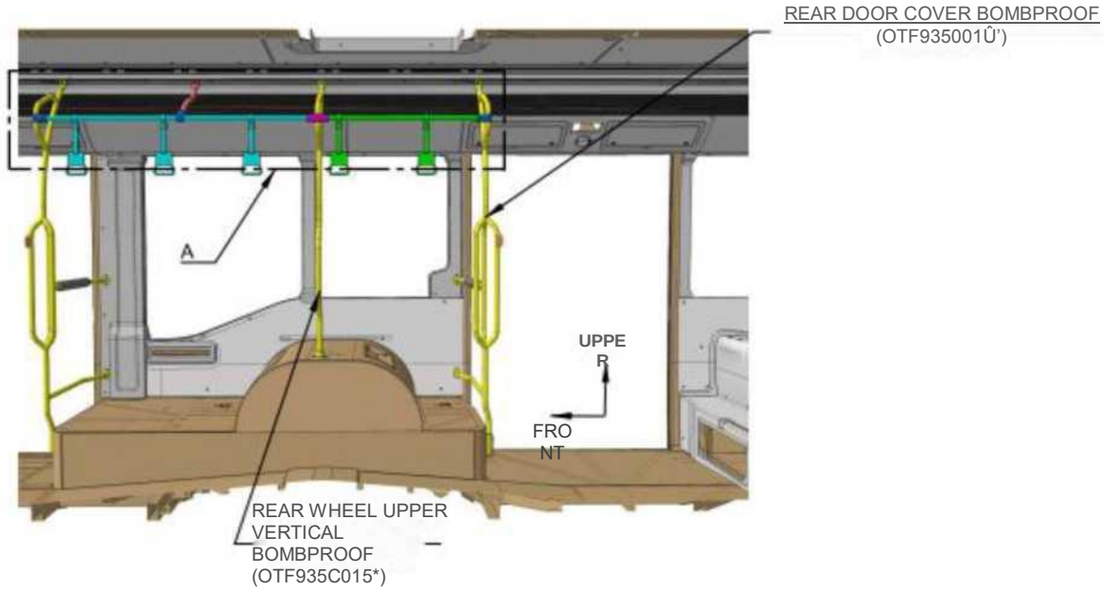


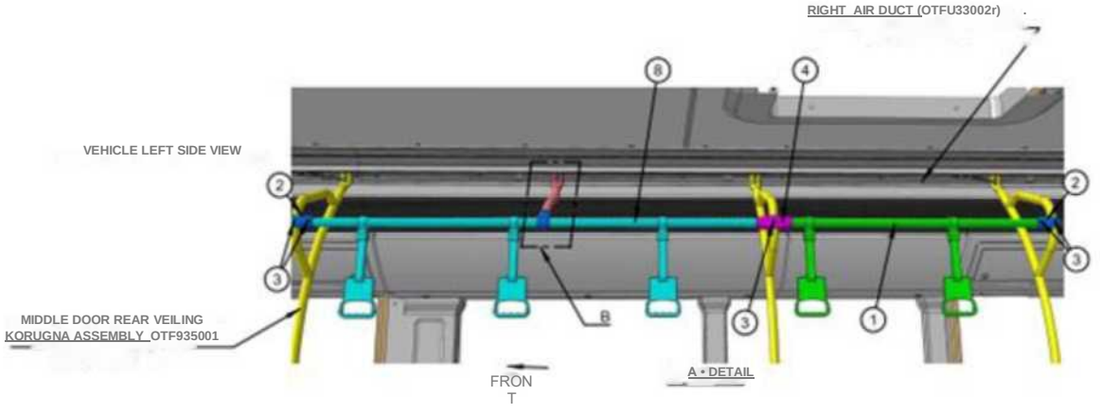


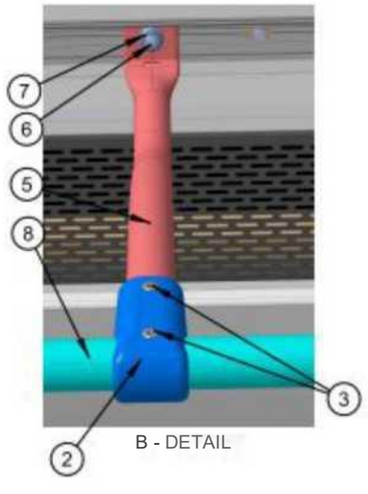


LEAFLET POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	935 -071	3870388200*	CLAMP . CAP 30 .YELLOW.RAL 1016	2
2	935 - 073	3025205200*	RIVET. POP. 5X20	4
3	935 - 044	387037877*	BOMBPROOF, DOUBLE, DISABLED AREA	1
4	935 - 063	3017006206*	SCREW,CHAMFER BIT FLAT B,HOLLOWED	4

RIGHT REAR HORIZONTAL BOMBPROOF INSTALLATION

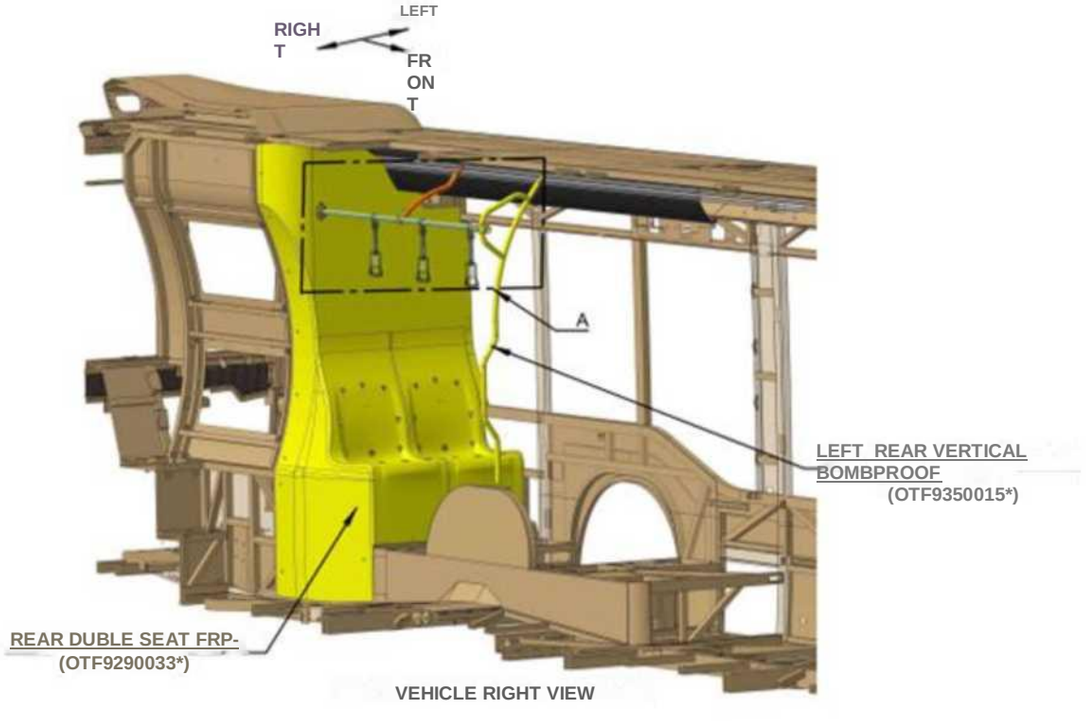




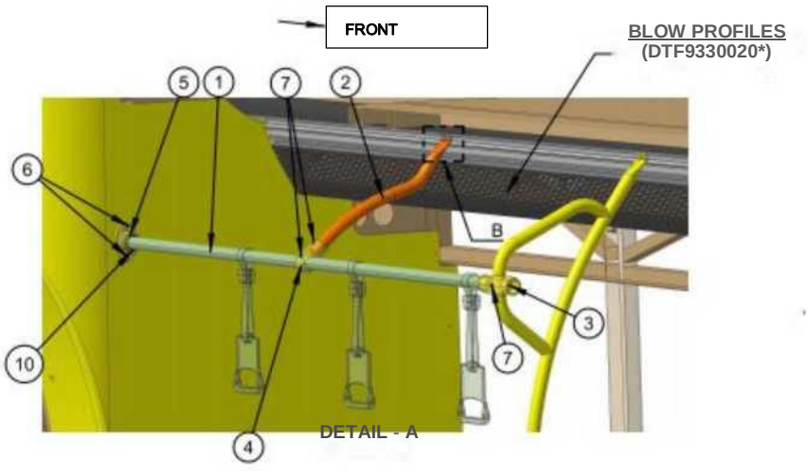


LEAFLET POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER	ADDITIONAL INFO
1	935-048	387036075*	BOMBPROOF. RIGHT. REAR. HORIZONAL	1	
2	935-071	387038820*	CLAMP . CAP 30 .YELLOW.RAL 1016	1	
2	935-071	387055879*	CLAMP , CAP 30	1	CITIPORT - S
3	935 - 073	302520520*	POP RIVET, STEEL (5 x 20)	3	
4	935 - 072	387038827*	CLAMP , SPECIAL , CAP 30. YELLOW, RAL 1016	1	
5	935 - 039	387038705*	BOMBPROOF. INTERMEDIATE REINFORCEMENT . REAR	1	
5	935-039	387055876*	BOMBPROOF. INTERMEDIATE REINFORCEMENT . REAR	1	CITIPORT - S
6	935 - 060	3870062310*	SPECIAL BOLT	1	
7	935-011	3005800101*	NUT , FLN&TR M10X1.5, THICK D. DİN 6923	1	
8	935 - 046	387032819*	BOMBPROOF, MIDDLE BED, REAR	1	
8	935 - 046	387055890*	BOMBPROOF, MIDDLE BED, REAR	1	CITIPORT-S

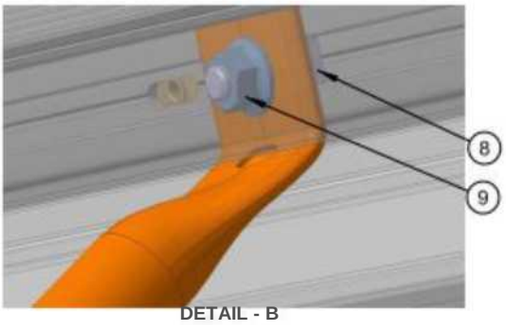
LEFT REAR HORIZONTAL AND INTERMEDIATE BOMBPROOF INSTALLATION



VEHICLE RIGHT VIEW



DETAIL - A



DETAIL - B

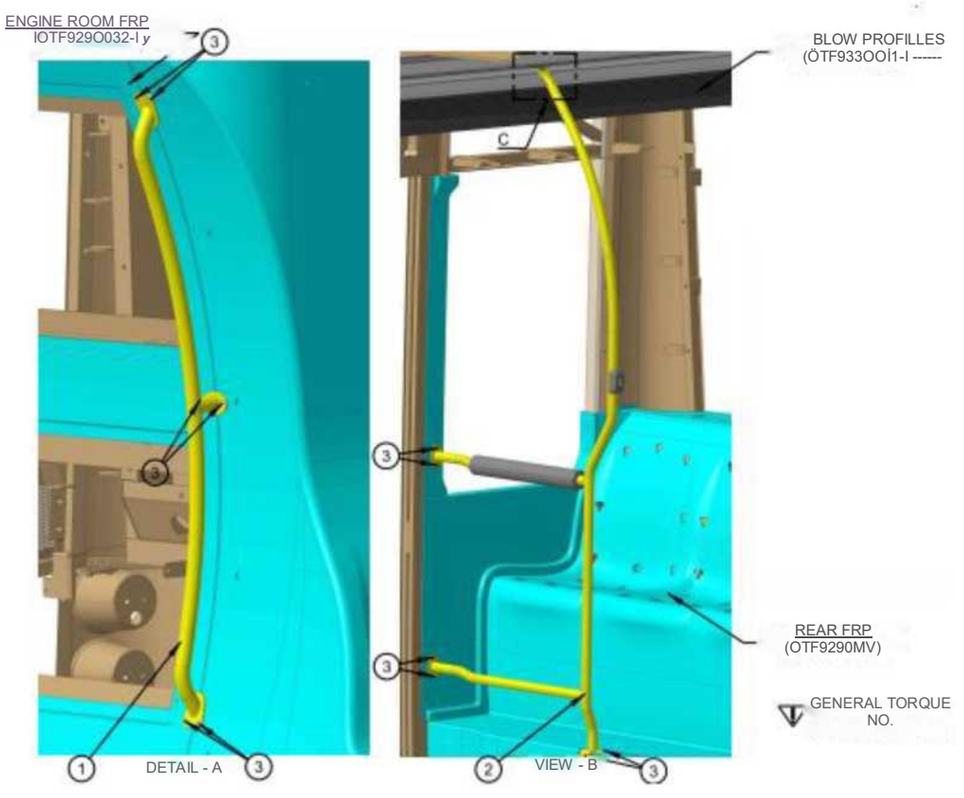
LEAFLET POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	935 - 049	387032826*	BOMBPROOF. LEFT REAR. HORIZONAL	1
2	935 -039	387038705[1]	BOMBPROOF. INTERMEDIATE REINFORCEMENT . REAR	1
3	935 - 072	387038827*	CLAMP , SPECIAL , CAP 30, YELLOW, RAL 1016	1
4	935 - 071	387038820*	CLAMP , GAP 30 ,YELLOW,RAL 101S	1
5	935 - 064	387038816*	FLANS, TIRE WEDGE, YELLOW RAL 1016	1
6	935 - 022	3000906201*	BOLT SLB M6X20, THICK D. DIN912	2
7	935 -073	302520520*	RIVET, POP. 5X20	3
8	935 - 060	3870062310*	SPECIAL BOLT	1
9	935 -011	3005800106*	NUT , FLN&TR M10X1.5, THICK D. DİN 6923	1
10	935 - 065	388889163*	TIRE BED	1

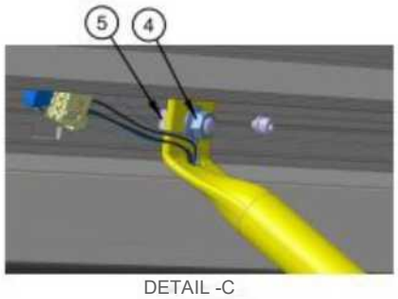
REAR DOOR SAW AND MOTOR ZONE BOMBPROOF INSTALLATION





VEHICLE RIGHT VIEW

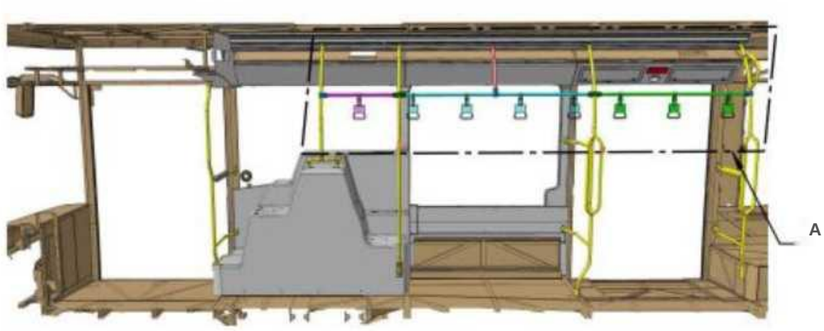


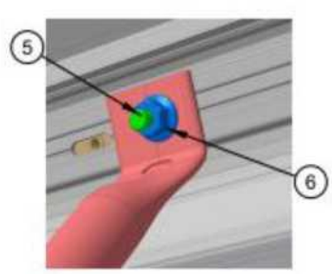


DETAIL -C

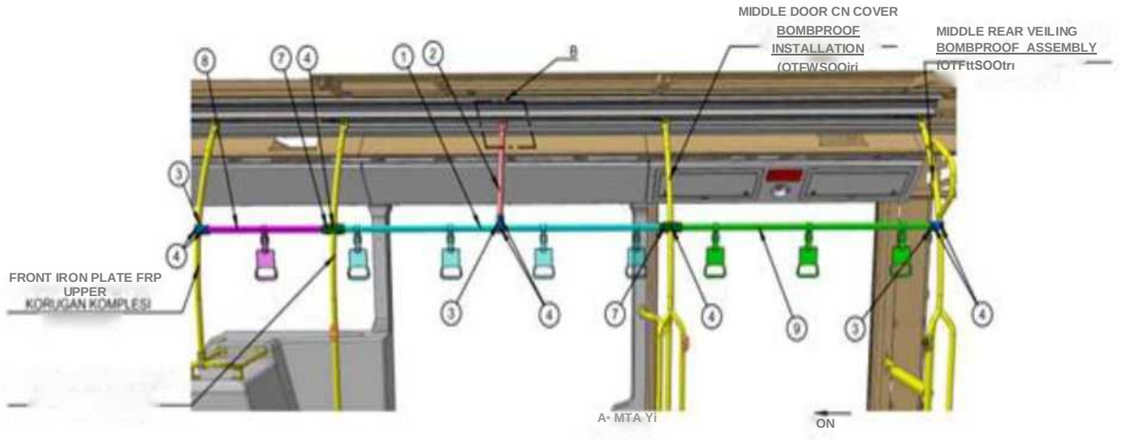
LEAFLET POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	935 -053	367037332*	BOMBPROOF, ENGINE ROOM	1
2	935 - 052	387036056*	BOMBPROOF. COVER, REAR, REAR DOOR	1
3	935 -063	3017006201*	SCREW LOWER CORNER PITTED	12
4	935-011	3005800106*	NUT . FLN&TR M10X1.5, THICK D. DİN 6923	1
5	935 - 060	3870062310*	SPECIAL BOLT	1

MIDDLE HORIZONTAL RIGHT BOMBPROOF INSTALLATION



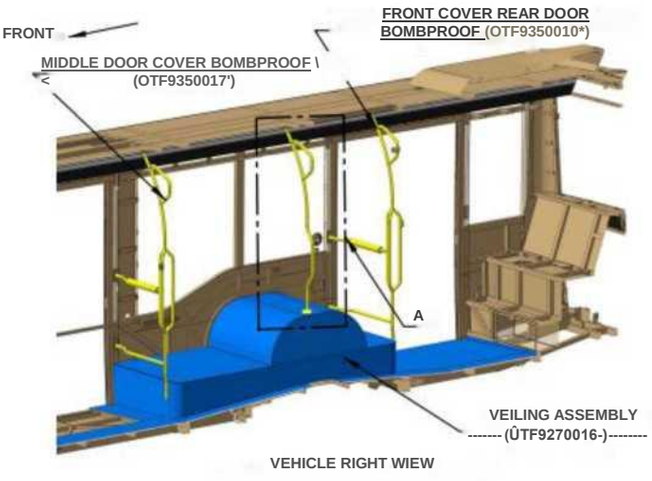


B - DETAIL

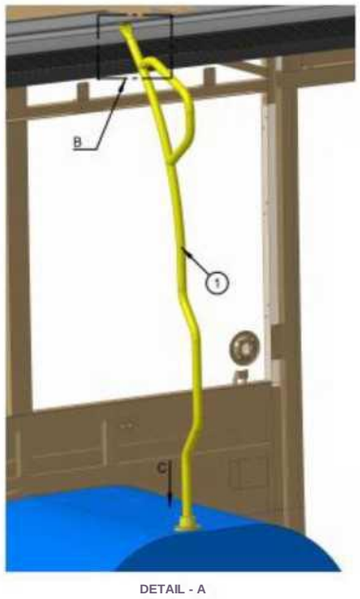


LEAFLET POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER	ADDITIONAL INFO
1	935 - 036	387032814*	BOMBPROOF, MIDDLE HORIZONAL, RIGHT	1	
1	935 - 036	387055885*	BOMBPROOF, MIDDLE HORIZONAL, RIGHT	1	CITIPORT - S
2	935 - 038	387036066*	BOMBPROOF, INTERMEDIATE REINFORCEMENT , LONG	1	
3	935 - 071	387038820*	CLAMP , GAP 30 .YELLOW.RAL 1016	3	
4	935 - 073	302520520*	POP RIVET. STEEL (5 x 20)	7	
5	935 - 060	387006231*	SPECIAL BOLT	1	
6	935 -061	3005800106*	NUT , FLN&TR M10X1.5, THICK D. DİN 6923	1	
7	935 - 072	387038827*	CLAMP , SPECIAL , CAP 30, YELLOW, RAL 1016	2	
8	935 - 034	387032892*	BOMBPROOF, FRONT HORIZONAL, RIGHT	1	
8	935 - 034	387055874*	BOMBPROOF, FRONT HORIZONAL, RIGHT	1	CITIPORT - S
9	935 - 055	387039418*	BOMBPROOF, HORIZONAL , MIDDLE AND REAR DOOR FRONT	1	

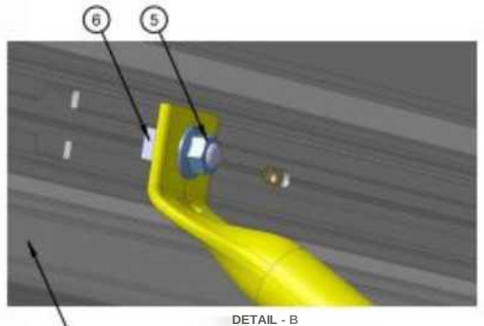
VERTICAL BOMBPROOF INSTALLATION ON RIGHT REAR WHEEL



VEHICLE RIGHT WIEW

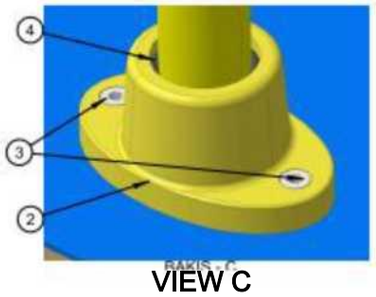


DETAIL - A



DETAIL - B

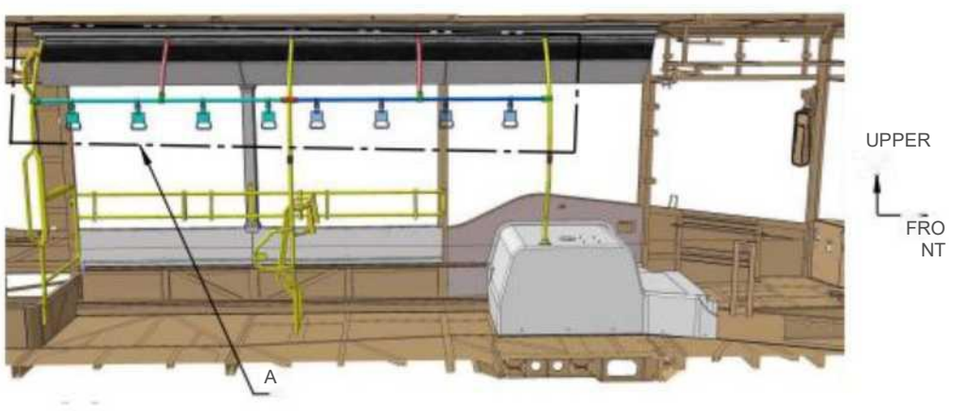
BLOWING PROFILLES



VIEW C

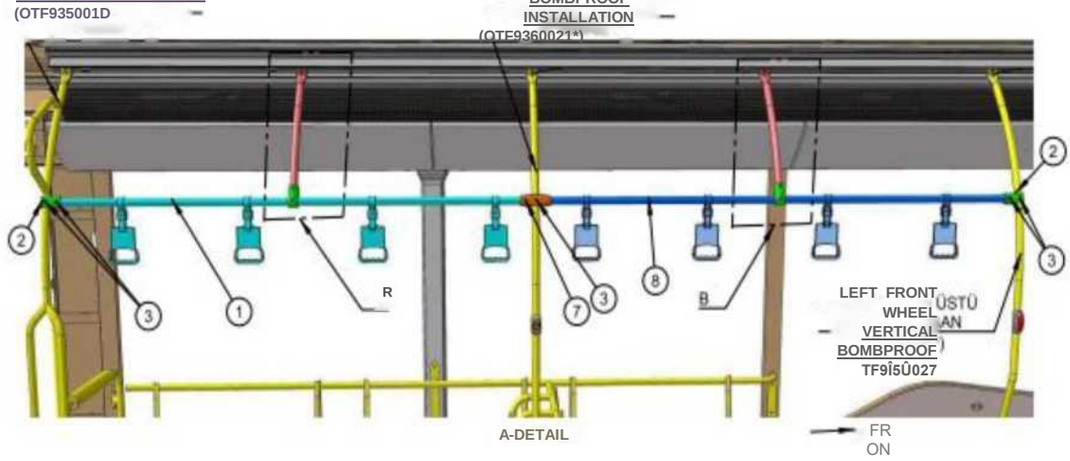
LEAFLET POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	935 -050	387037870*	BOMBPROOF. VERTICAL, REAR WHEEL UPPER	1
2	935 - 064	367036616*	FLANS, TIRE WEDGE, YELLOW RAL1016	1
3	935 - 066	3000906201*	BOLT , SLB M6X20, THICK D. DIN912	2
4	935 - 065	368889163*	TIRE BED	1
5	935-061	3005800101*	NUT , FLN&TR M10X1.5, THICK D. DİN 6923	1
6	935 - 060	3870062310*	SPECIAL BOLT	1

LEFT DISABLED ZONE HORIZONTAL BOMBPROOF INSTALLATION

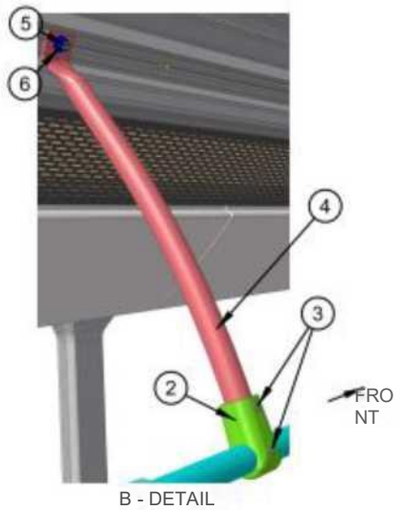


LEFT WHEEL FRONT SEAT BOMBPROOF ASSEMBLY (OTF935001D

DISABLED ZONE VERTICAL BOMBPROOF INSTALLATION (OTF9360021*)



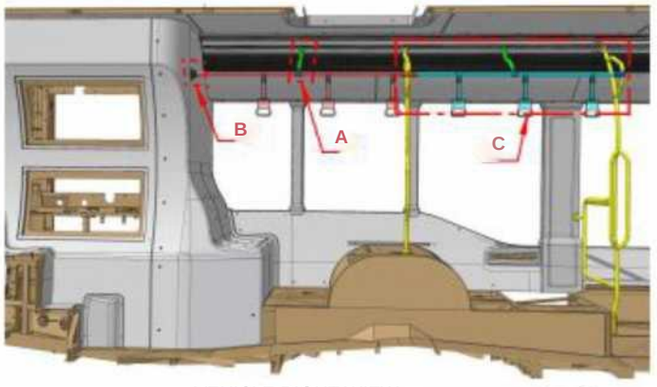
A-DETAIL



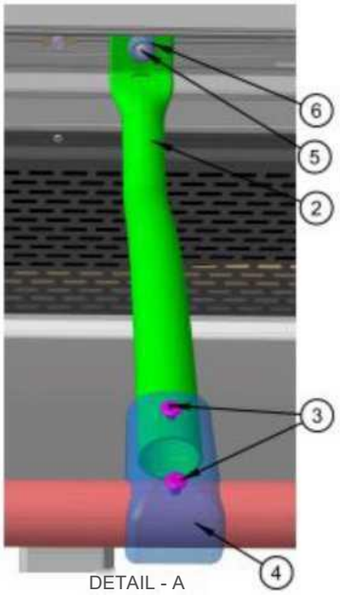
B - DETAIL

LEAFLET POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER	ADDITIONAL INFO
1	935-037	387032905*	BOMBPROOF, LEFT , DISABLED ZONE , HORIZONTAL	1	
1	935 - 037	387056944*	BOMBPROOF, LEFT , DISABLED ZONE , HORIZONTAL	1	CITIPORT - S
2	935 - 071	387038820*	CLAMP . CAP 30 ,YELLOW,RAL 1016	4	
3	935 - 073	302520520*	POP RIVET, STEEL (5 X 20)	8	
4	935 - 038	387036066*	BOMBPROOF. INTERMEDIATE REINFORCEMENT . LONG	1	
5	935 - 060	387006231*	SPECIAL BOLT	2	
6	935 -061	3005800106*	NUT , FLN&TR M10X1.5, THICK D. DİN 6923	2	
7	935 - 072	387038827*	CLAMP , SPECIAL , CAP 30, YELLOW, RAL 1016	1	
8	935 -035	387032813*	BOMBPROOF, LEFT , FRONT, HORIZONTAL	1	
8	935 - 035	387056943*	BOMBPROOF, LEFT , FRONT, HORIZONTAL	1	CITIPORT - S

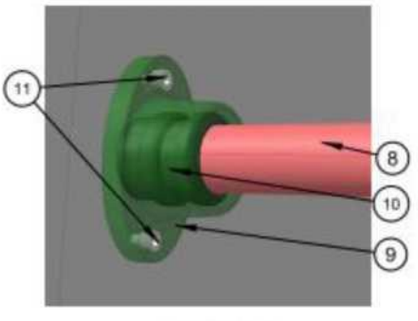
REAR, MIDDLE HORIZONTAL AND INTERMEDIATE BOMBPROOF INSTALLATION



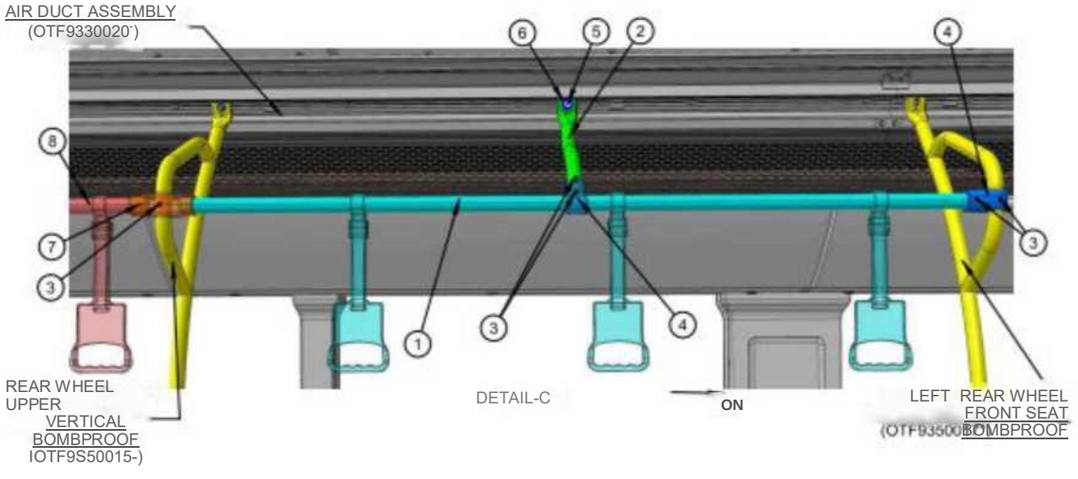
VEHICLE RIGHT WIEW



DETAIL - A

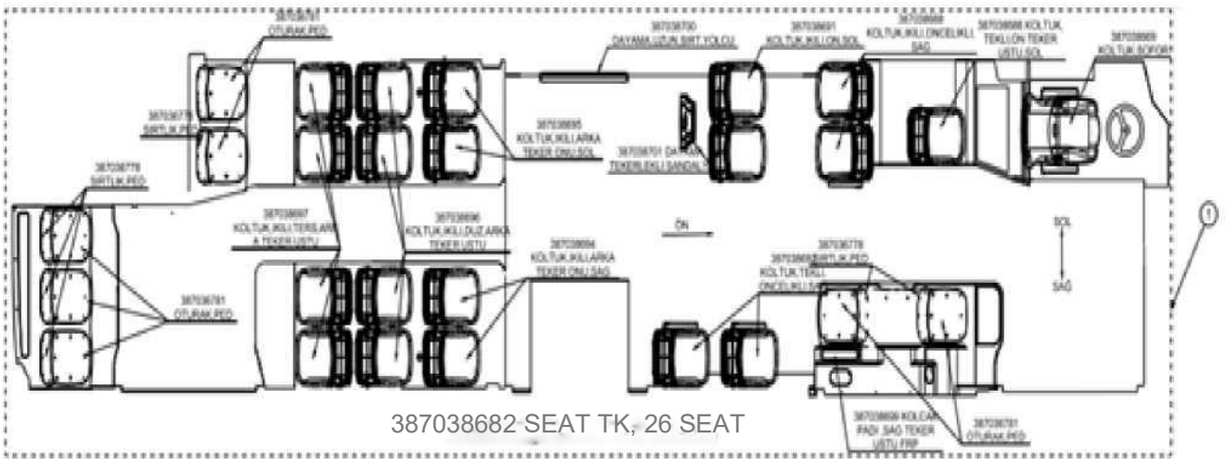


DETAIL - B

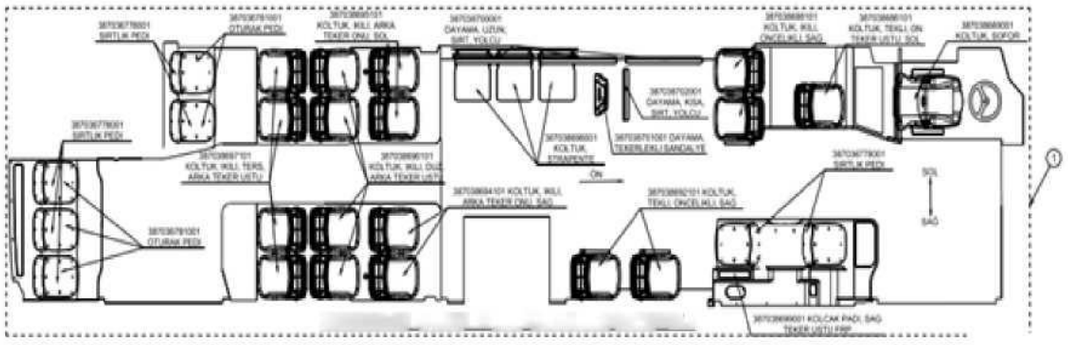


LEAFLET POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	935 - 04 B	387032819*	BOMBPROOF. MIDDLE HORIZONTAL . REAR	1
2	935-039	387038705*	BOMBPROOF. INTERMEDIATE REINFORCEMENT , REAR	1
3	935 - 073	3025205200*	POP RIVET, STEEL (5 X 20)	4
4	935 -071	3870388200*	CLAMP , CAP 30 .YELLOW.RAL 1016	2
5	935 - 060	3870062310*	SPECIAL BOLT	1
6	935-011	3005800106*	NUT , FLN&TR M10X1.5, THICK D. DİN 6923	1
7	935 - 072	387038827*	CLAMP , SPECIAL , DIAMETER 30, YELLOW RAL 1016	1
8	935 - 049	387032828*	BOMBPROOF, LEFT REAR, HORIZONTAL	1
9	935 - 064	387038816*	FLANS, TIRE WEDGE LU. YELLOW RAL 1016	1
10	935 - 065	388889153*	TIRE BED	1
11	935 - 022	3000906204*	BOLT SLB M6X20, THICK D. DIN912	2

SEAT LAYOUT

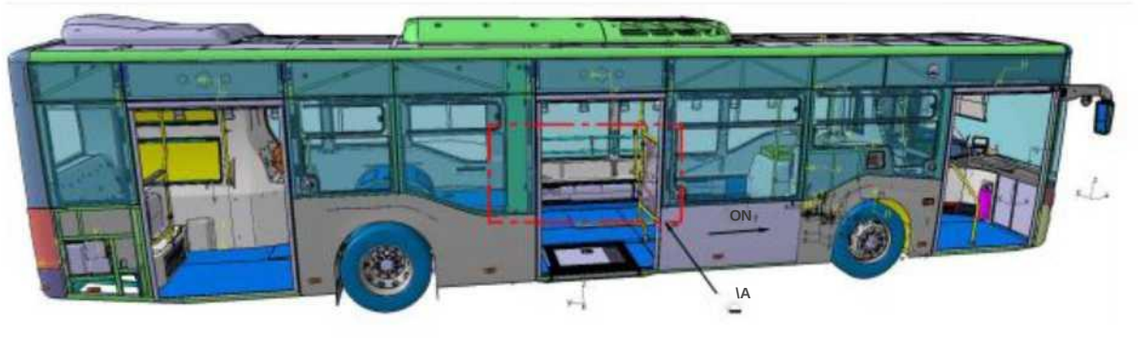


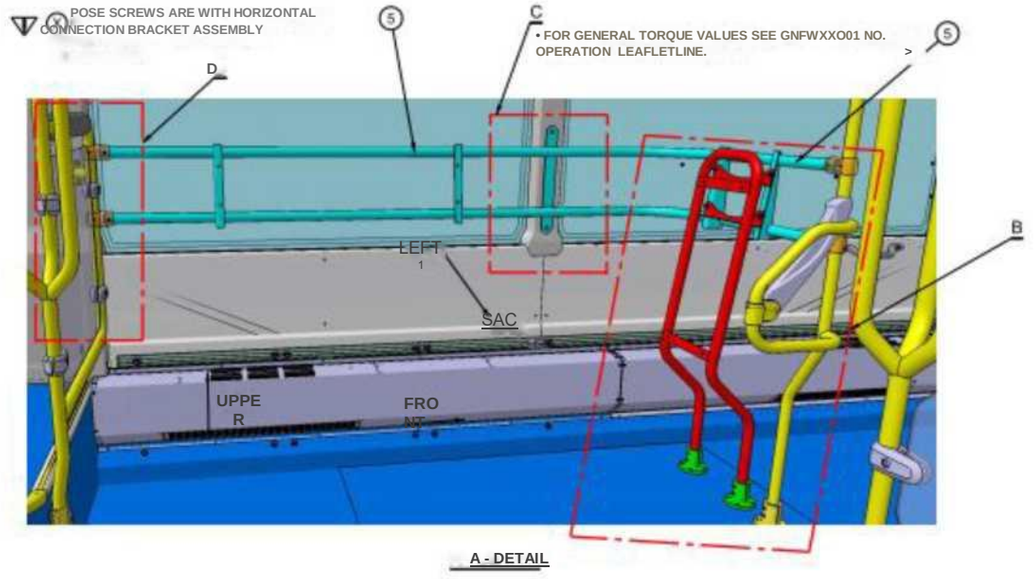
387038682 SEAT TK, 26 SEAT

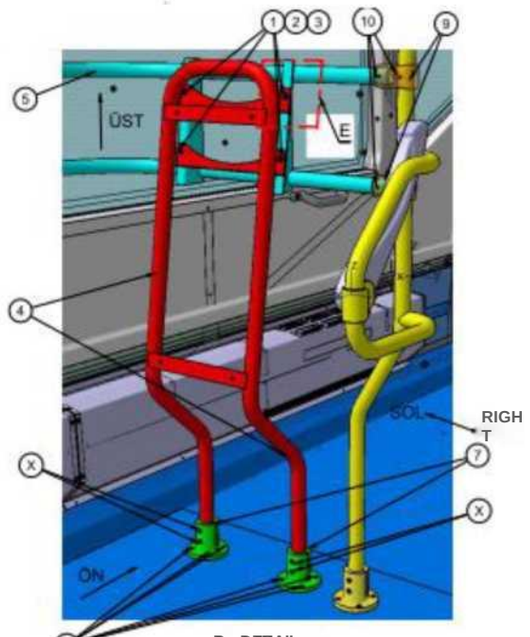


LEAFLET POSE	GROUP-POSE	PART NO	COMPONENT'S NAME	NUMBER
1	935 / 001	3870386B2*	SEAT TK, 26 SEAT	1
1	935 / 001	387038685*	SEAT TK, 27 SEAT (3 STRAPEN WIRE)	

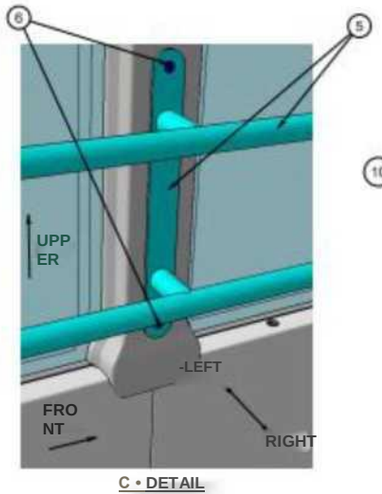
DISABLED AREA BOMBPROOF INSTALLATION



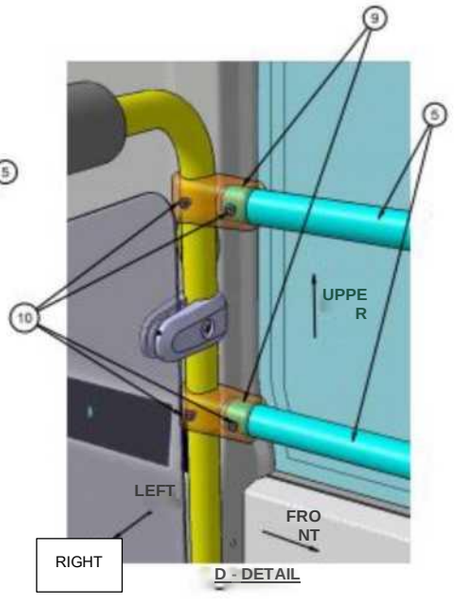




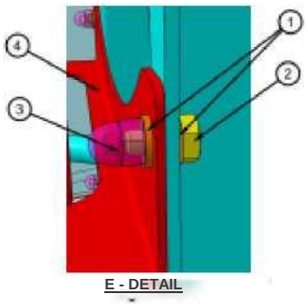
B - DETAIL



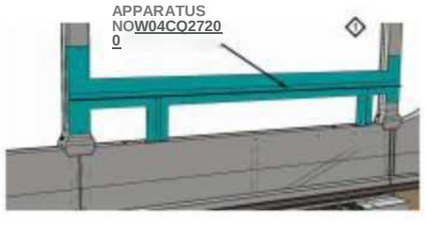
C • DETAIL



D - DETAIL



E - DETAIL



LEAFLET POSE	GROUP-POSE	PART NO	COMPONENT'S NAME	NUMBER
1	935 - 023	3010000061*	WASHER , FLAT D-S DİN 125	B
2	935 - 024	3000106121'	BOLT , AKS M0X1X12, THICK D DIN933	4
3	935 - 020	3007000061*	NUT FLN MflX1. THICK D. DİN 1587	4
4	955 - 043	3870395TE'	BOMBPROOF. WHEELCHAIR AND BACK PED	1
5	935 - 044	3B7039579-	BOMBPROOF. DOUBLE DISABLED REGION	1
6	935 - 003	3017006201*	SCREW LOWER CORNER PITTED	2
7	935 - 067	387038819	BOMBPROOF BAG.LOWER BRKT. YELLOW RAL 1016	2
a	935 - 068	3000906351*	BOLT . SLB M&X35. THICK D. DIHB12	8
9	935 - 071	387038820	CLAMP , GAP W .YELLOW.RAL 1Q1C	i
10	935 - 073	302520520-	POP RIVET, STEEL (5 x20)	B

PACKAGE COMPARTMENT INSTALLATION



DETAIL A

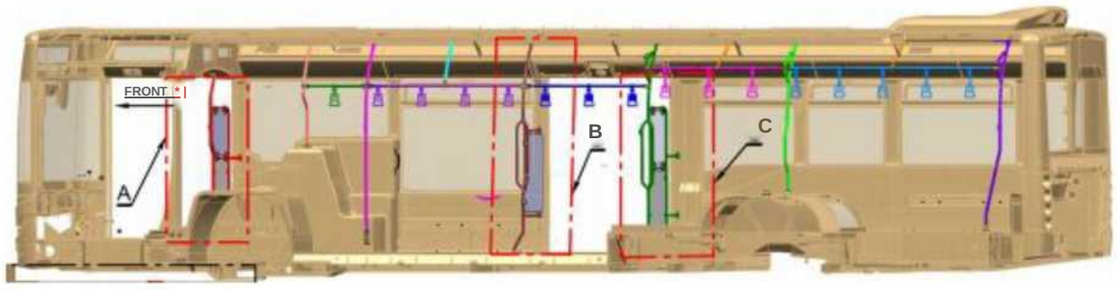


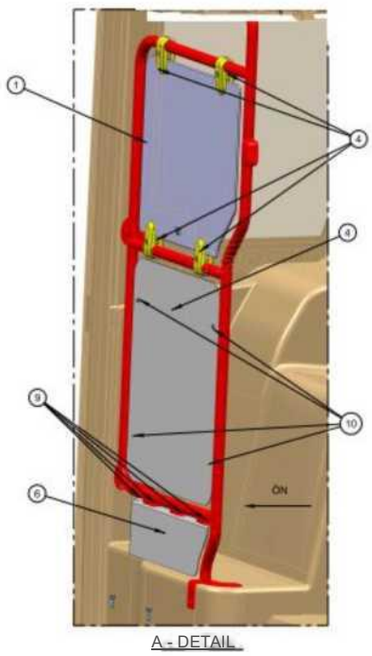
SEE OTF929003Q NO LU OPERATION LEAF

-MAKE SURE THE PACKAGE SECTION HAS FULLY ADJUSTED THE DISTANCES. -MAKE SURE THE CONNECTION HOLES ARE PARALLEL TO EACH.

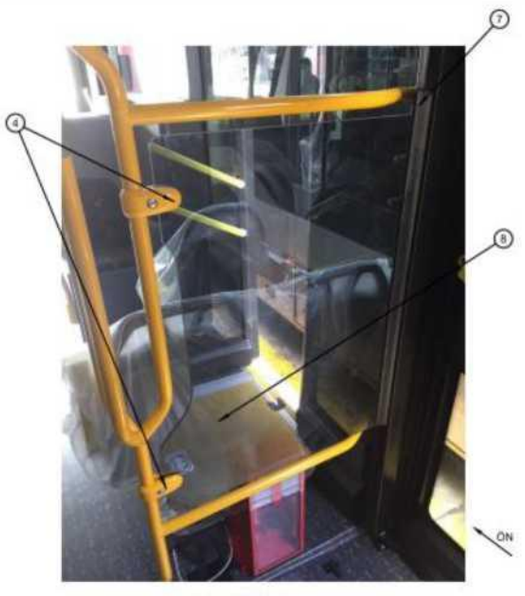
LEAFLET POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	035 - 0fl6	387041141*	PACKAGE AREA , SEAT SIDE	1
2	935 - 087	3018948161*	SELF TAPPING SCREW 4.6x19, STAR CYLINDER	3

COVER GLASS INSTALLATION

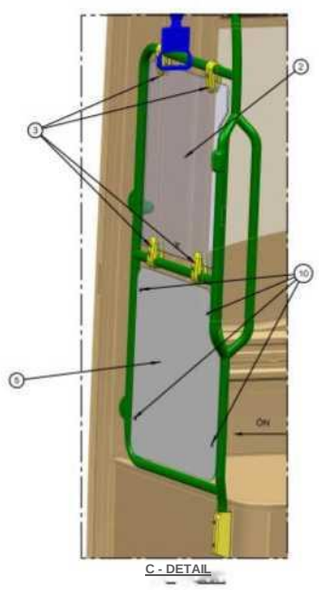




A - DETAIL



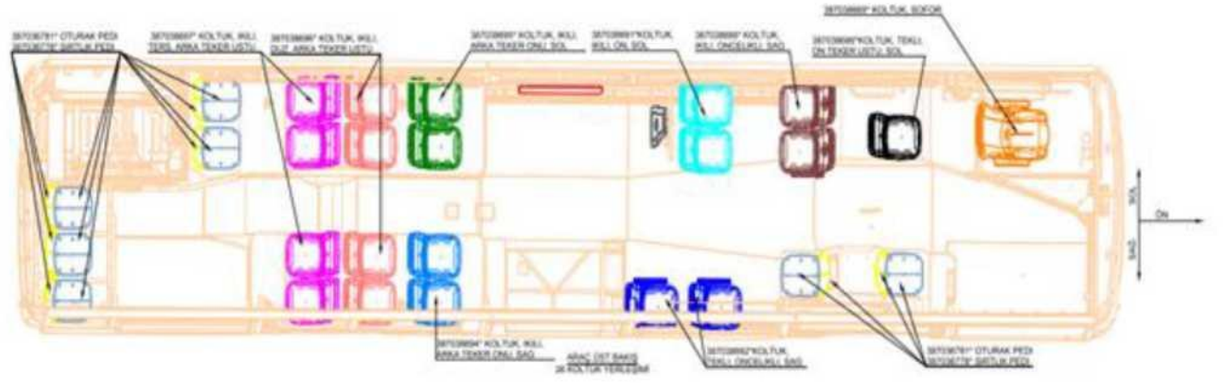
B - DETAIL

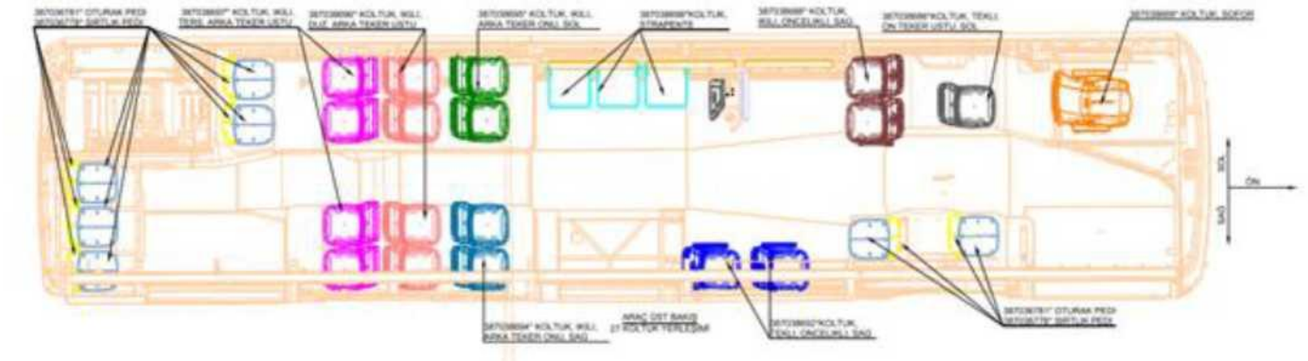


C - DETAIL

LEAFLET POSE	GROUP-POSE	PART NO	COMPONENT'S NAME	NUMBER
1	935-076	387363958'	COVER GLASS, LAMUNE. FRONT DOOR	1
2	935-079	397303963*	COVER GLASS. LAMINE. MIDDLE DOOR FRONT	1
3	935-080	387046937'	CLAMP , GLASS HOLD	10
4	935- 154	36730.3635*	SHEET. FRONT COVER	1
5	935-155	387363962'	SHEET, MIDDLE DOOR REAR COVER	1
6	935- 156	387303965'	SHEET. RIGHT FRONT BOMBPROOF. LOWER	1
7	935- 065	303089163'	TIRE BED	1
8	935-077	387041235'	COVER GLASS, LAMINE. MIDDLE DOOR FRONT	1
9	935-022	3000906204"'	BOLT . SLB M6X20. THICK D. DIN912	4
10	935 - 027	3015006121*	SCREW M 6X12 DİN 7646 (4091)	8

SEAT LAYDOWN

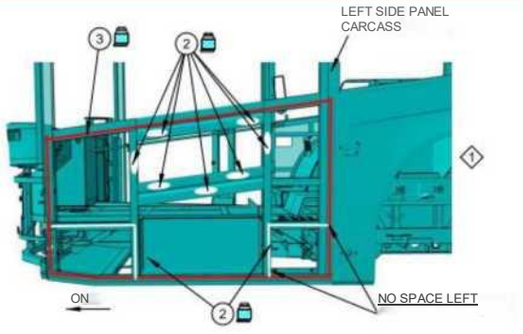


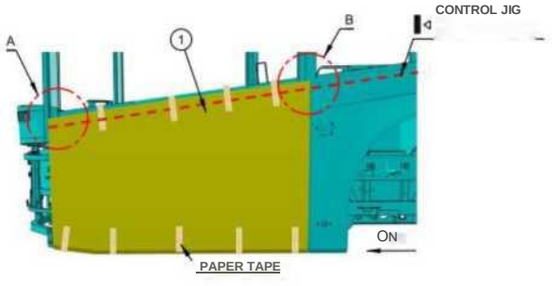


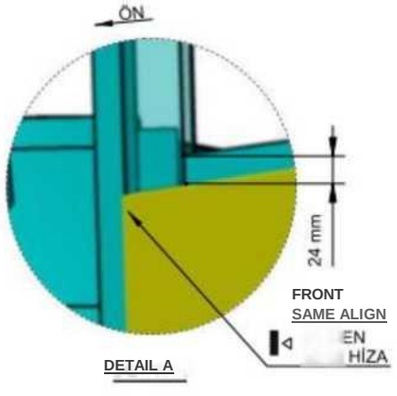
LEAFLET POSE	GROUP-LEAF	PART NO	COMPONENT'S NAME	NUMBER
1	035-001	3970586021*	SEAT TK, 26	1
2	035 - 001	3970586051*	SEAT TK, 27	1

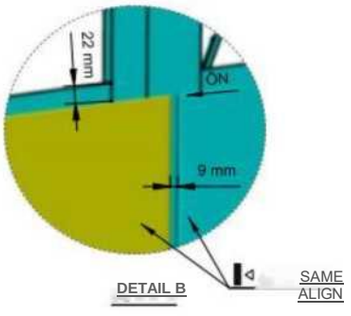
EXTERIOR TRIM INSTALLATION

SIDE FRP FRONT LEFT MOUNTING









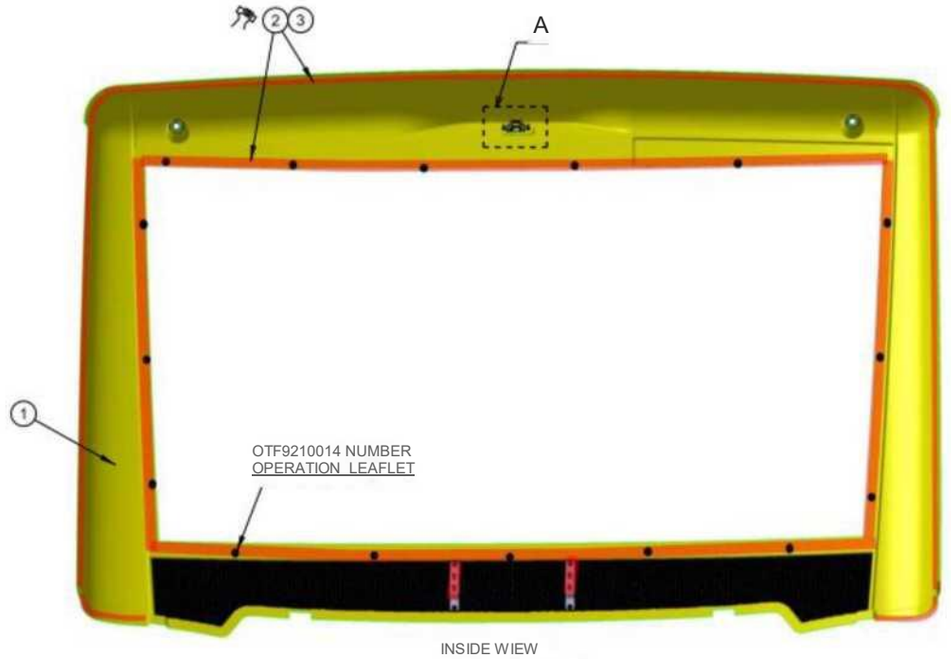
1- RELATED INSTRUCTIONS; MOVE ACCORDING TO T-OU-21 3.

2- DO NOT MOVE THE MASTIC APPLIC OUTSIDE THE ADHESION AREA

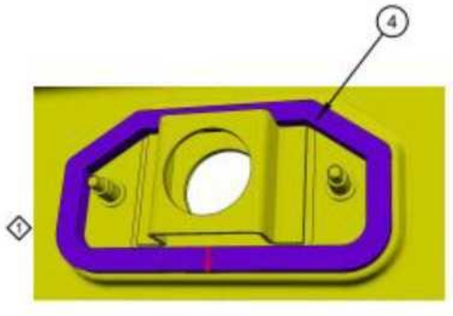
3- MASK THE REGIONS WITH PAPER TAPE WITH MASTIC OVERFLOW

LEAFLET POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	936 - 920	387039464*	SIDE FRP. FRONT, LEFT	1
2	940 - 022	387036482*	MASTIC FILLER TEROSON RB 2759AF (570ML)	1
3	940 - 250	387031749*	MAŞTIC. SIKAFLEX 260N (27, 6 KG. Bucket)	1

PREPARING THE MASK REAR ASSEMBLY



INSIDE WIEW

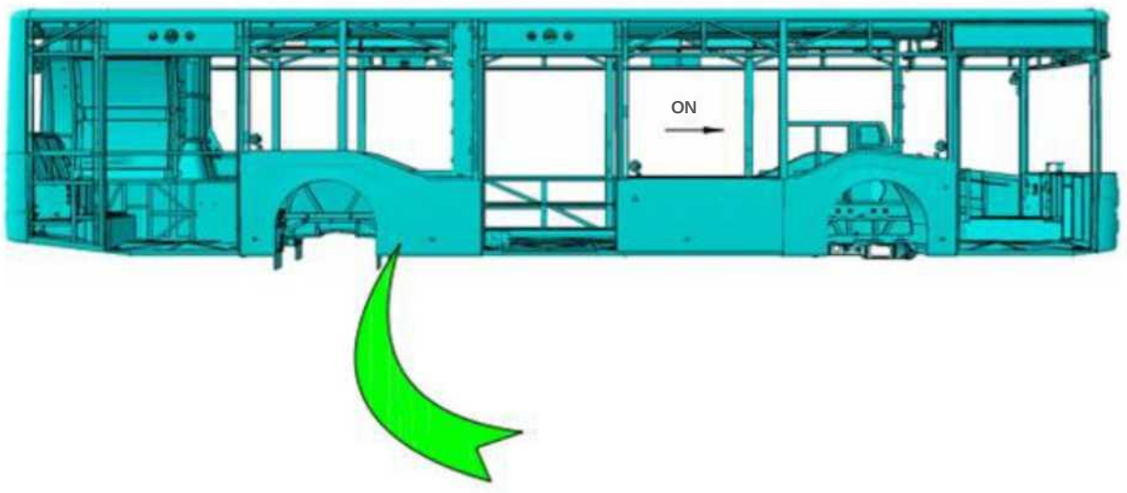


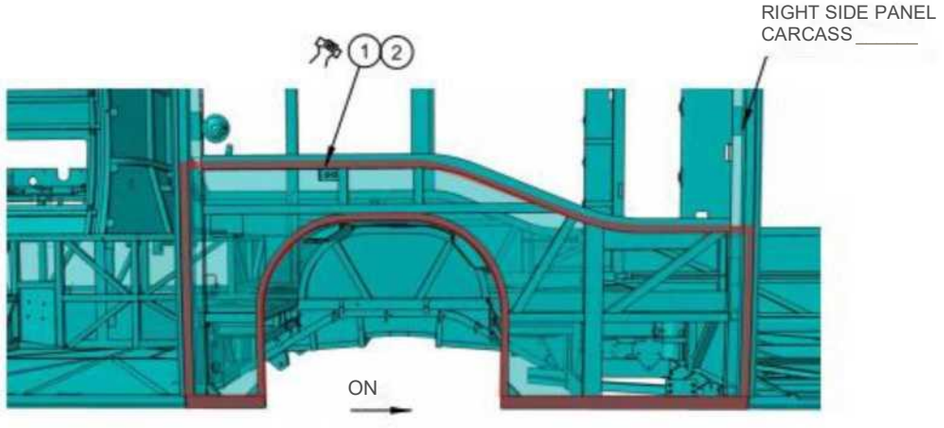
DETAIL - A

THE SEALING BAND (35 CM) SHOULD BE STICKED TO LOOK DOWN AS DETERMINED IN THE DETAIL.

LEAFLET POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	836 - 015	384314090*	MASK, REAR	1
2	940 - 090	387015452*	CLEANER, S|KA ACTIVATOR-100(1000ML	1
3	940 - 240	387053324*	PRIMER, GLASS/MET. BLACK	1
4	836-936	387001354*	SEALING BAND	1

PREPARATION FOR FENDER REAR RIGHT INSTALLATION



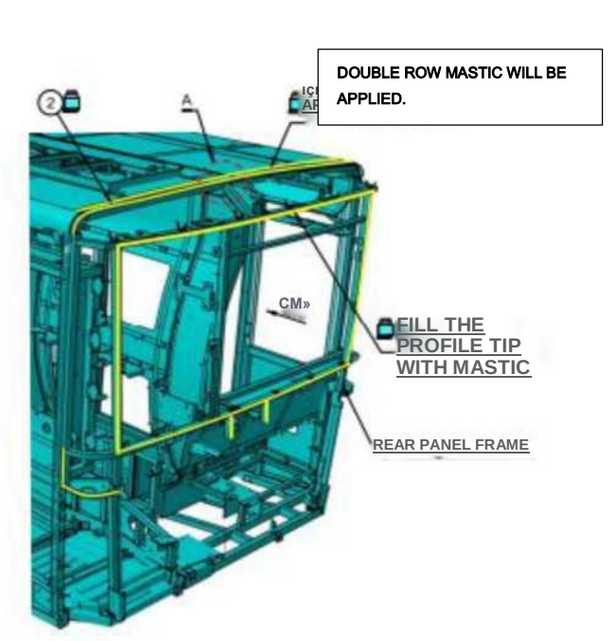


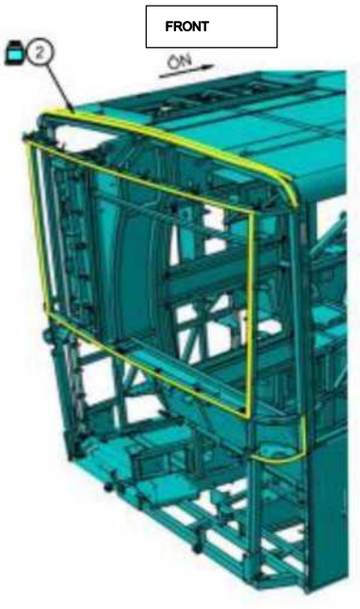
1- RELATED INSTRUCTIONS; MOVE BY T-OU-213.

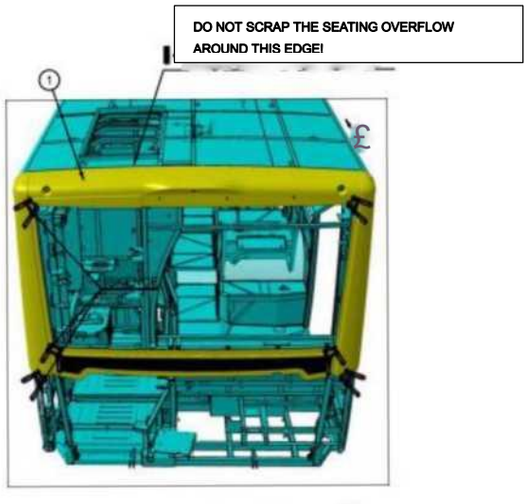
2- DO NOT MOVE THE PRIMER APPLICATION OUTSIDE THE ADHESION AREA.

LEAFLET POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	940-090	387016452*	CLEANER, S|KA ACTIVATOR - 100(1000 ML.	1
2	940 - 240	367053324*	PRIMER, GLASS/MET. BLACK	1

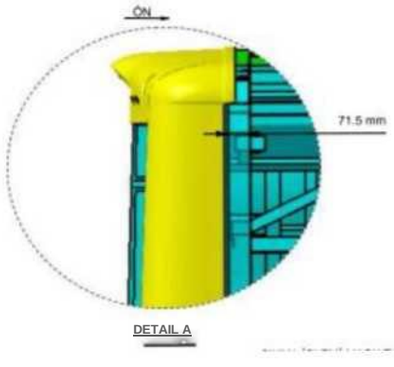
REAR MASK INSTALLATION

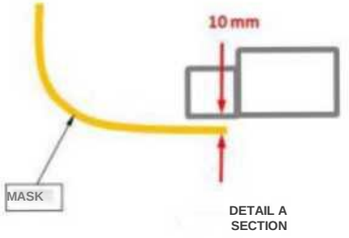


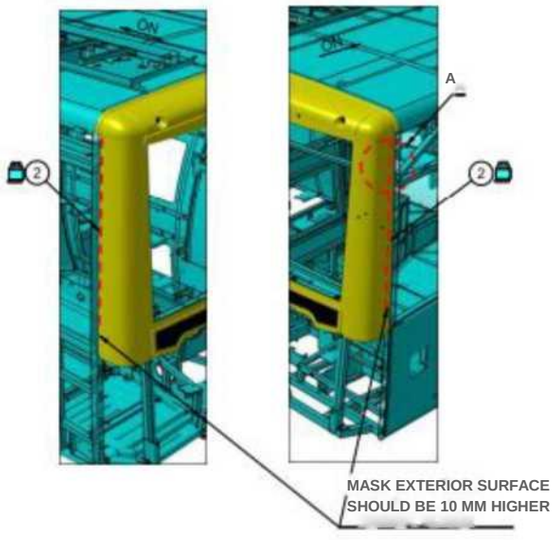


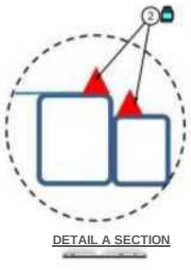


3 POSITION MATERIAL WILL BE PLACED BETWEEN MASK AND PROFILE.











ı- **RELATED INSTRUCTION: MOVE BY T-OU-213.**

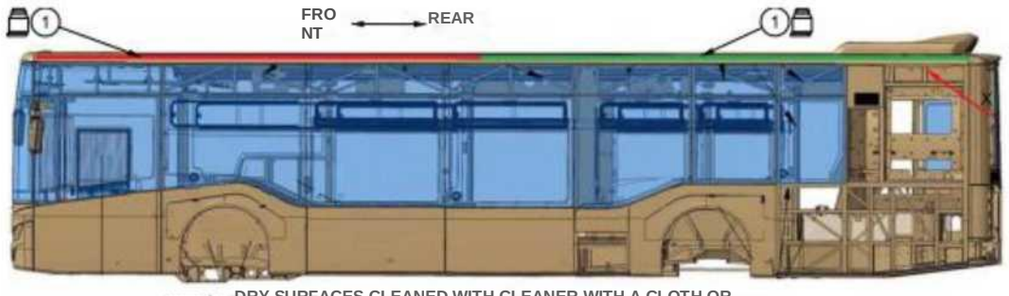
2- **DO NOT MOVE THE MASTIC APPLIC OUTSIDE THE ADHESION AREA**

3-MASK WITH PAPER BAND FOR THE REGIONS WITH MASTIC OVERFLOW

■ **TIGHTENING WILL BE DONE UNTIL THE MASK WEDGE CONTACT. LOCKING BAR CLAMPS AT THE LOWER CORNER IS TO ADJUST THE PARALLELING OF THE SIDE EDGE OF THE MASK**
-IT SHOULD NOT BE CARRY OUT OF THE WEDGES

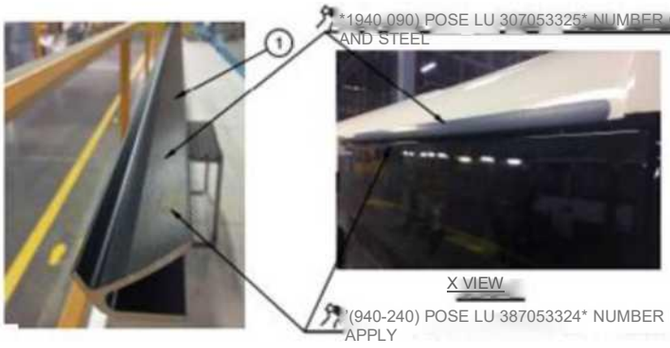
LEAFLET POSE	GROUP-PDSE	PART NO	COMPONENT'S NAME	NUMBER
1	036 - 015	384314050"	MASK, REAR	1
2	040-250	387031740'	MASTIC SIKAFLEX 3EON (27,6	1
3	936-067	387018198*	WEDGE . MASK DISTANCE ADJUSTMENT	20

RAIN GUTTER PROFILE VEHICLE ASSEMBLY



DRY SURFACES CLEANED WITH CLEANER WITH A CLOTH OR PAPER NAPKIN WHICH DOESN'T LEAVE COTTONS.

WAIT UNTIL THE PRIMER DRIES (WRITE - FIFTH-5 - 8 MINUTES) AND GO TO THE BONDING PROCESS IMMEDIATELY.

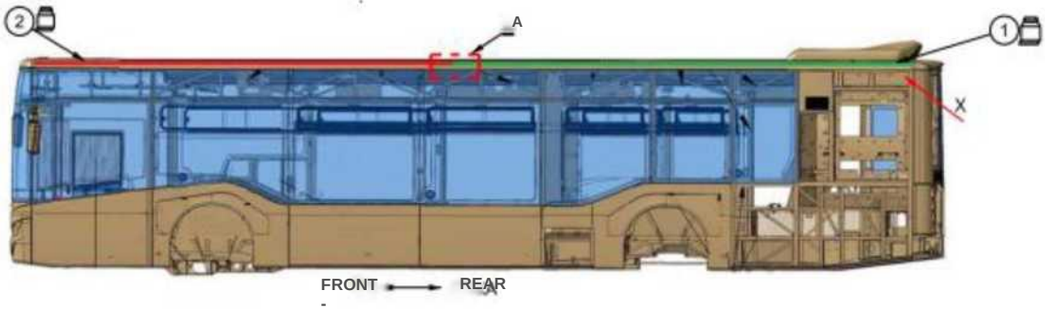


1940 090) POSE LU 307053325 NUMBER CLEANERİ GLASS AND STEEL

DRY SURFACES CLEANED WITH CLEANER WITH A CLOTH OR PAPER NAPKIN WHICH DOESN'T DRY AND COTTON

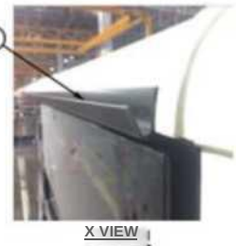
WAIT UNTIL THE PRIMER DRYES (WRITE -5 CLOSE TO 8 MINUTES) AND IMMEDIATELY APPLY THE BONDING PROCESS.

'(940-240) POSE LU 387053324* NUMBER PRIMER CAWMET BLACK WILL APPLY



(940089) POSE 387053327* NUMBER MASTIC. TECK DRIVE



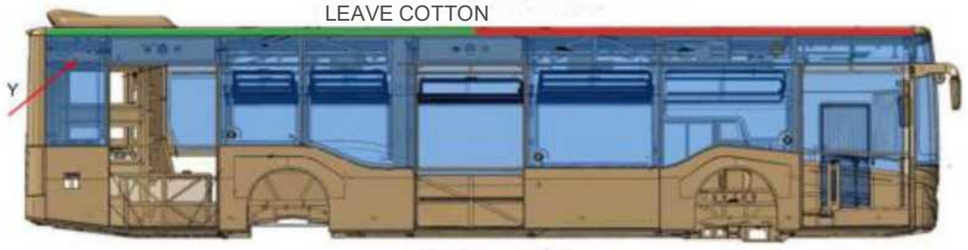




BE CAREFUL OR DO NOT MOVE THE SEAL TO THE PROFILE SIDES WHEN MAKING THE MATCH SQUEEZING PROCESS.

JOINT POINTS OF THE PROFILES SHOULD BE ZERO TO EACH OTHER AS SHOWN IN THE DETAIL.

DRY SURFACES CLEANED WITH CLEANER WITH A CLOTH OR PAPER NAPKIN WHICH DOESN'T DRY AND LEAVE COTTON



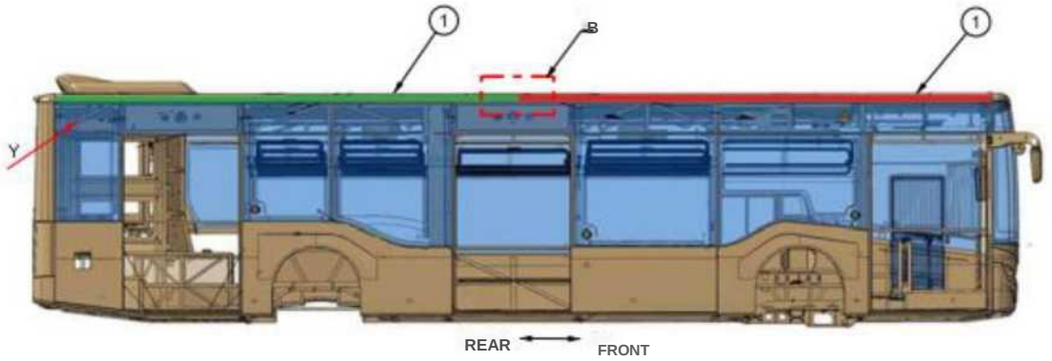


WAIT UP TO PRIMER DRY (SUMMER - 5 MINUTES • 8 MINUTES) AND GO TO THE BONDING PROCESS IMMEDIATELY



DRY THE SURFACES CLEANED WITH THE CLEANER WITH A CLOTH OR PAPER NAPKIN WHICH DOESN'T LEAVE DRY AND COTTONS.

WAIT UNTIL THE PRIMER DRIES (SMMURR - 8 MINUTES TO THE 5th PART) AND GO TO THE BONDING PROCESS IMMEDIATELYY VIEW»





r»UV089| POSE_387053327* NUMBER MASTIC, TECK DRIVE

Y VIEW

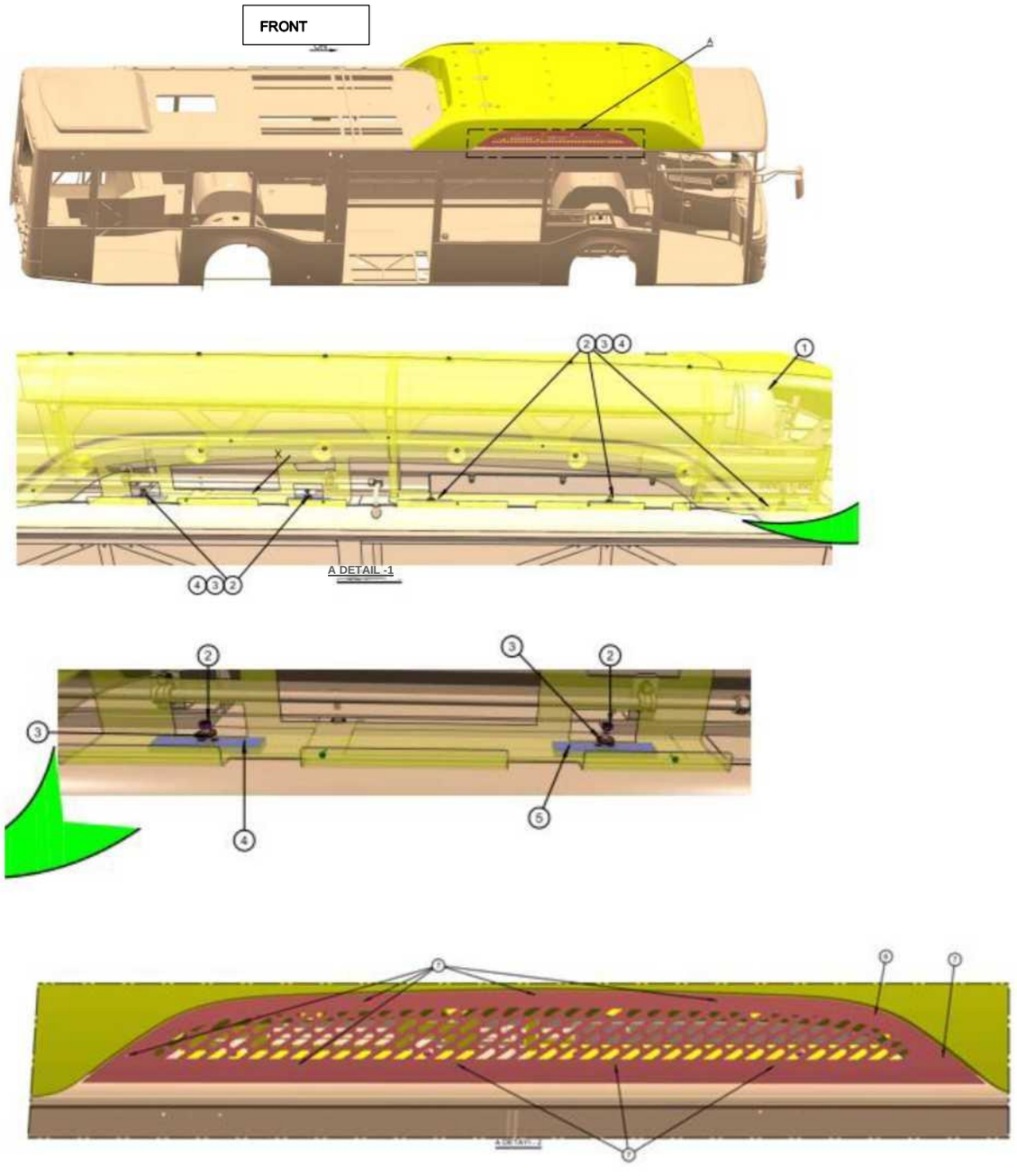
B DETAIL

BE CAREFUL NOT MOVE THE MASTIC TO THE EDGE SECTIONS OF THE PROFILE WHEN DOING THE SEALANT SQUEEZING PROCEDURE

JOINT POINTS OF THE PROFILES SHOULD BE ZERO TO EACH OTHER AS SHOWN IN DETAIL B

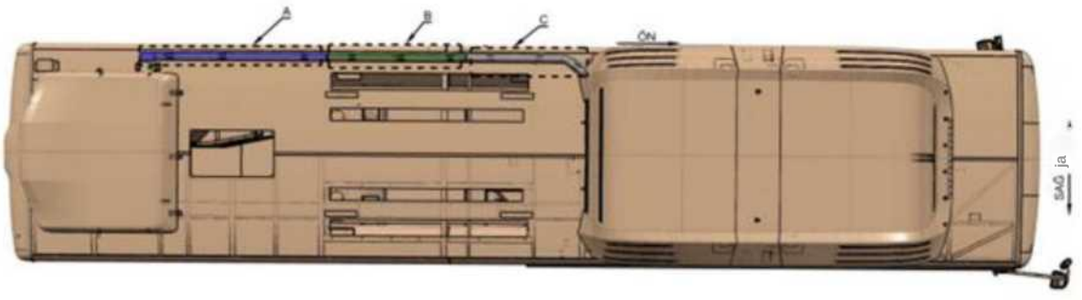
LEAFLET POSE	GROUP'POSE	PART NO	COMPONENT'S NAME	NUMBER
1	936 - 045	3970411630"	RAIN GUTTER PROFILE	4

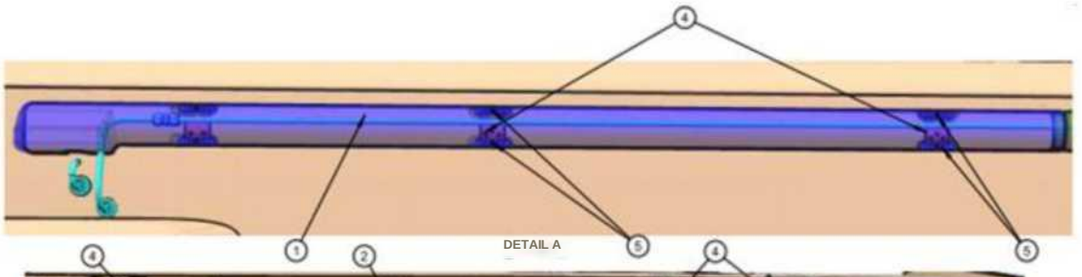
CNG COVER INSTALLATION



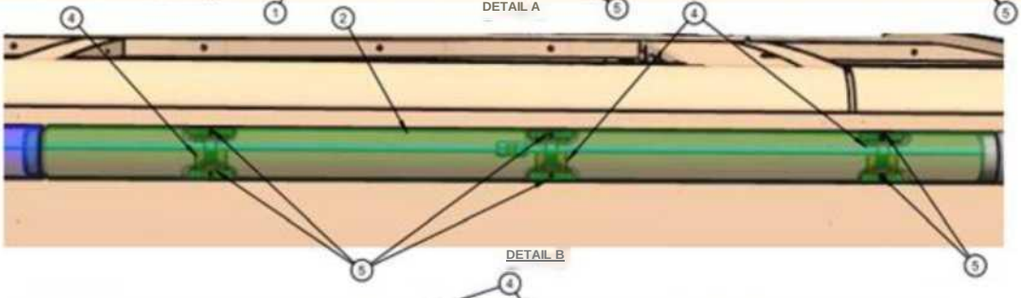
LEAF-POSE	GROUP-POSE	PART NO	COMPONENT'S NAME	NUMBER
1		384312212*	REAR COVER	T
11		3B43122H7*	FRONT COVER.	H
2		3005000086*	NUT . AKB M8X1. 25, THICK D DIN934	1O
3		301 11 1ODDB<-	WASHER , FLAT IO=-& DIN9021	10
-4		3B**3 13532*	KESTAMITE	1O
5		3643 1 2 586*	SIDE IRON PLATE	2
B		3S7BÛÖ27S*	SCREW. SMART 41.2X19. DİN 7504	9

CNG FUEL PIPES FRP CLOSING INSTALLATION

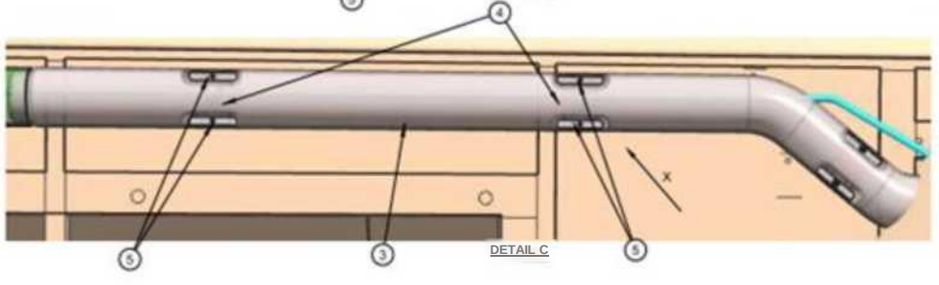




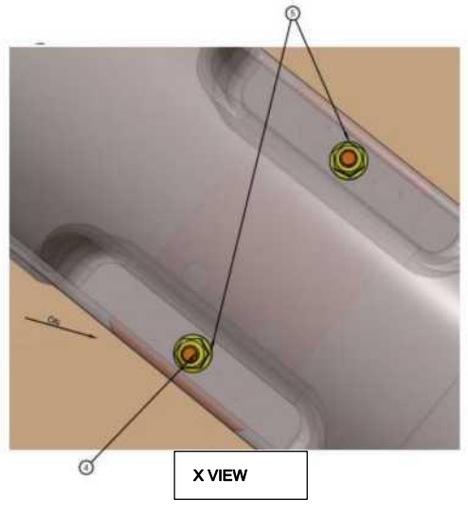
DETAIL A



DETAIL B



DETAIL C

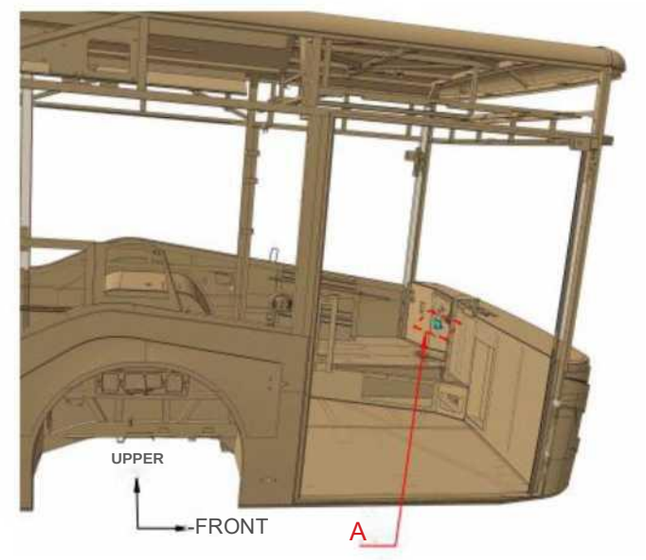


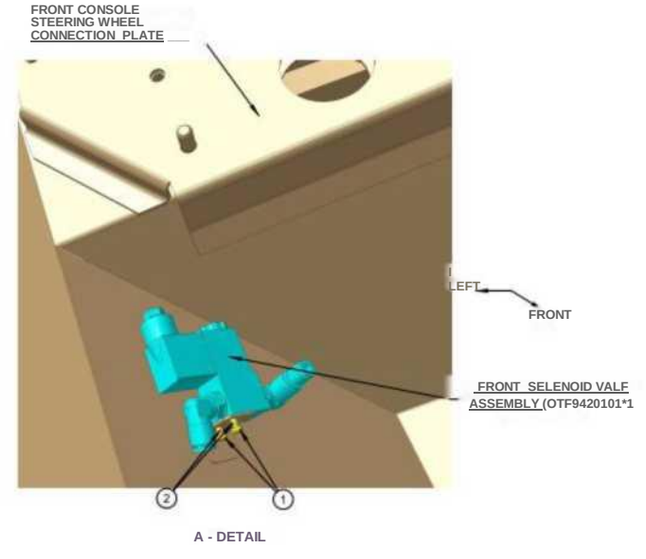
X VIEW

LEAF-POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	036- 254	3870450554'	FRP PIPE PROTECTION	1
2	036- 255	387044814	FRP PIPE PROTECTION	1
3	936- 256	387045055*	FRP, PIPE PROTECTION	1
4	BS- 25F,	387044834	BRACKET , PIPE HOLDER	7
5	93B- OTO	30058000054	NUT FILNS.TR M5X0.6 THICK D. DİN&B2 3	14

AI SYSTEM

FRONT SELENOID VALF ASSEMBLY INSTALLATION

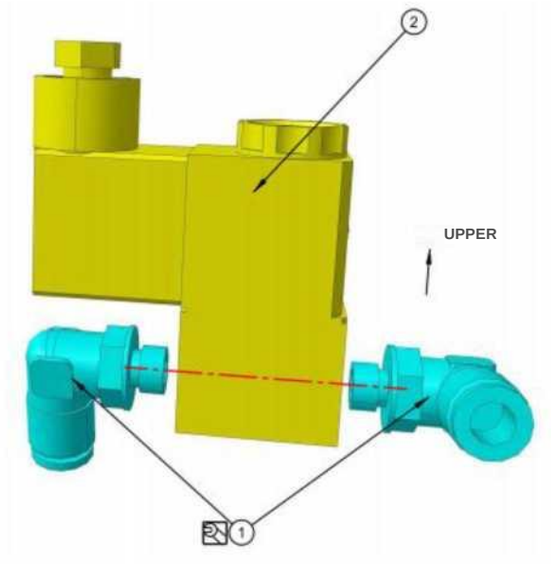


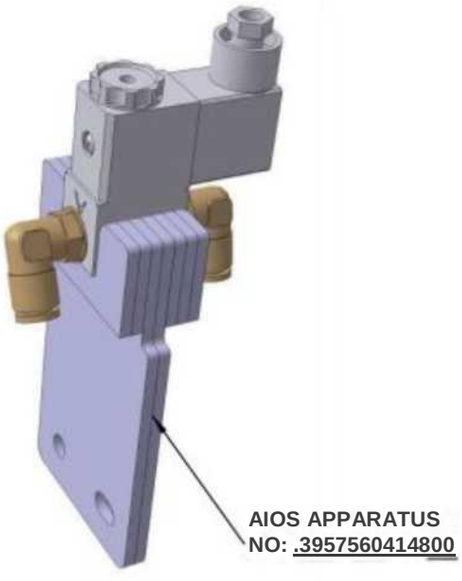


A - DETAIL

LEAFLET POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	942 - 142	3015004064*	BOLT M4X6	2
2	942 - 165	3010100044*	WASHER , SPRINGY D=4 DİN 127	2

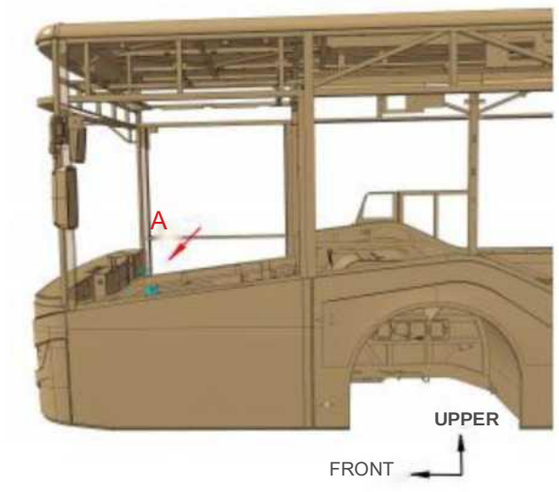
FRONT SELENOID VALF ASSEMBLY INSTALLATION

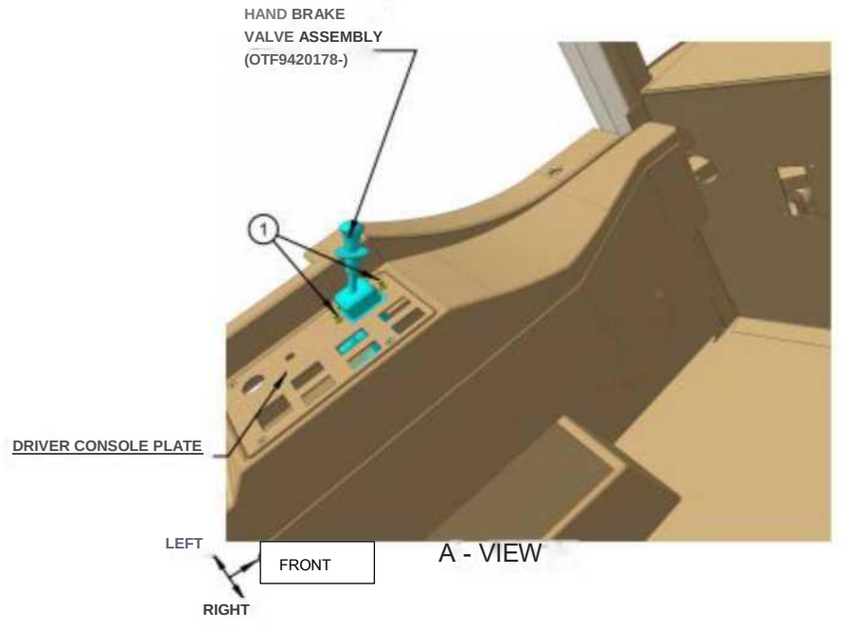




LEAFLET POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	942 - 114	387059000*	CONNECTOR, ELBOW 1/8XT8	2
2	942 - 046	387001947*	SELENOID VALF ASSEMBLY	1

HAND BRAKE VALVE ASSEMBLY INSTALLATION

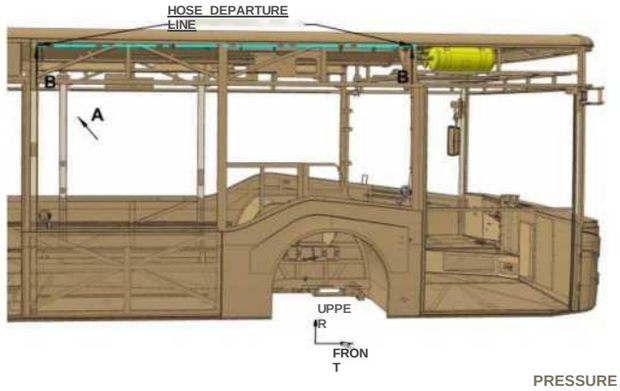


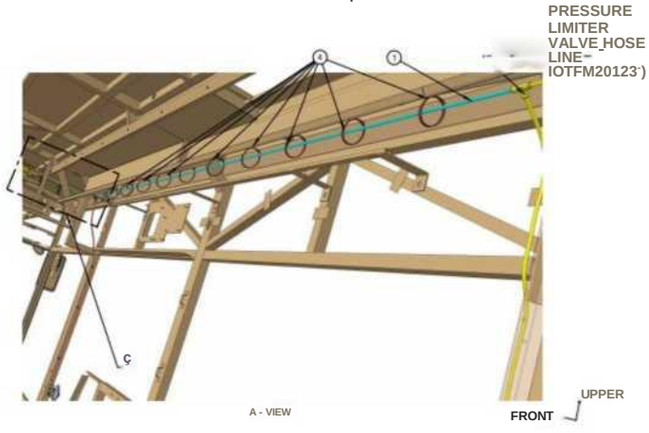


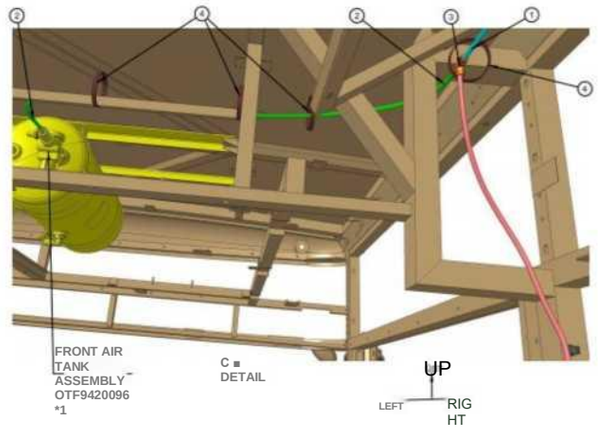
A - VIEW

LEAFLET POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	942 - 125	3015406254	PHILLIPS SCREW, M6x1 DİN 7988	2

CHASSIS HOSE LINE AIR TANK INSTALLATION

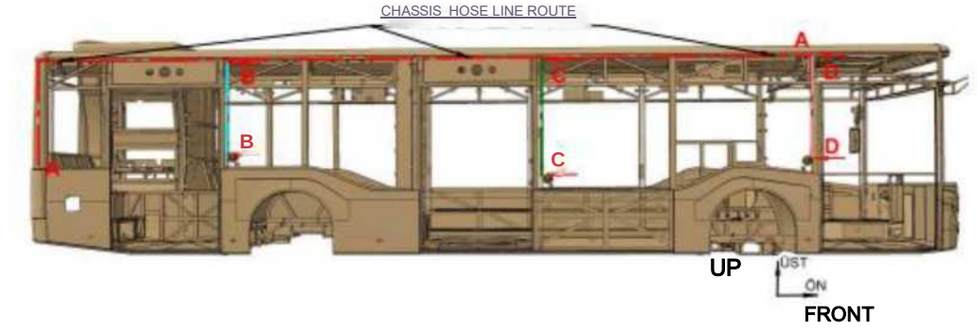


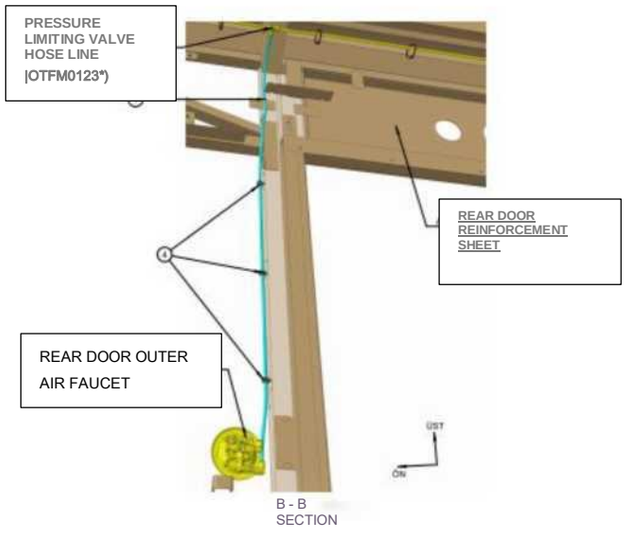




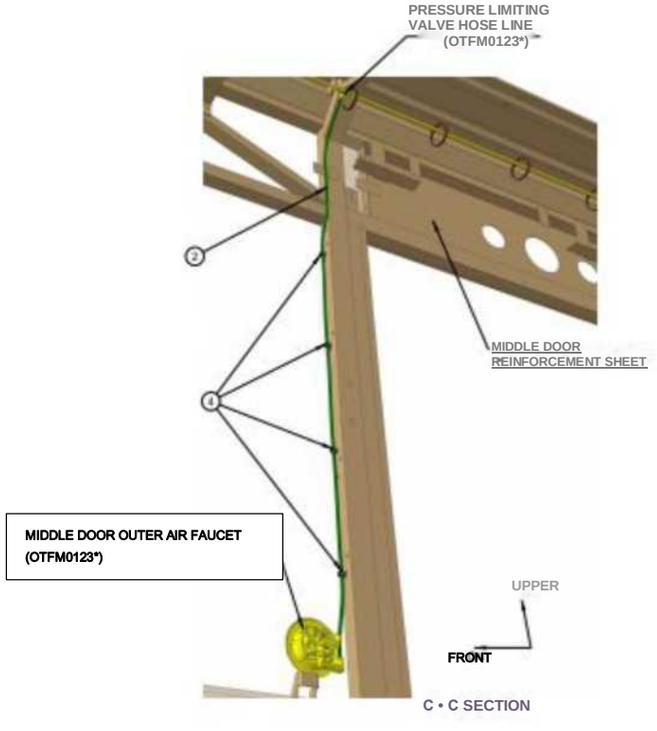
LEAFLET POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	942 - 240	308232335*	HOSE .PNO	1
2	B42 -214	3OK23211D'	HOSE . PNO	1
3	B42-Ö75	3B70Sa*6B-	CONNECTOR , T BX8X3	1
4	M2-11B	509707030'	FL.STRIP CLAMP - 230	15

DRAIN FAUCET TRIM HOSE LINE INSTALLATION

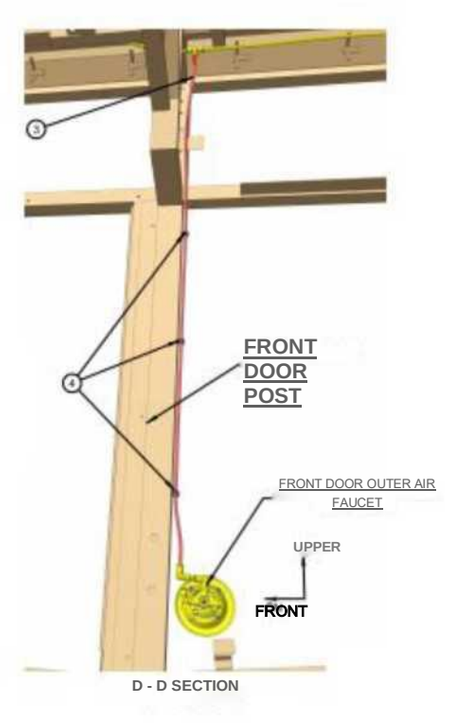




B - B SECTION



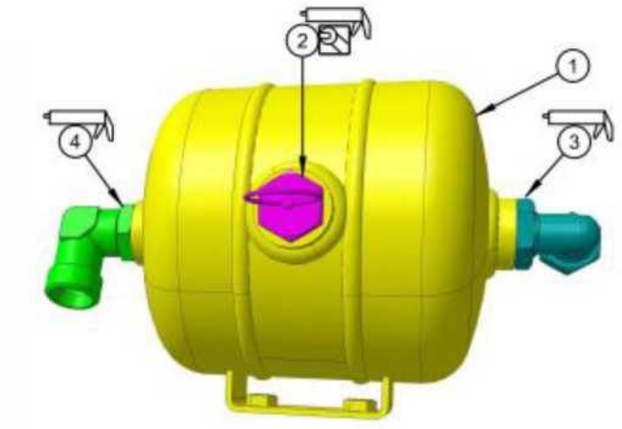
C • C SECTION



D - D SECTION

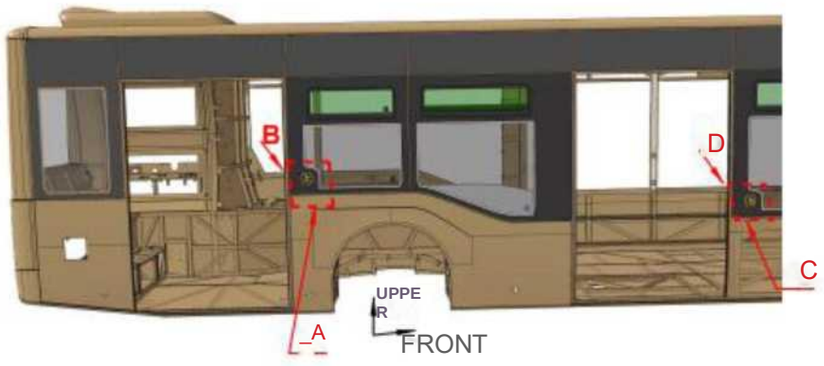
LEAFLET POSE	GROUP-POSE	PART NO	COMPONENT'S NAME	NUMBER
1	342 - 268	300232135'	HOSE . PNO	1
2	0*2 - 255	3DS23216S'	HOSE . PNO	1
3	542 - 253	306232140'	HOSE . PNO	1
4	042 - 088	357020852*	CLIP SINGLE, 8	1Û

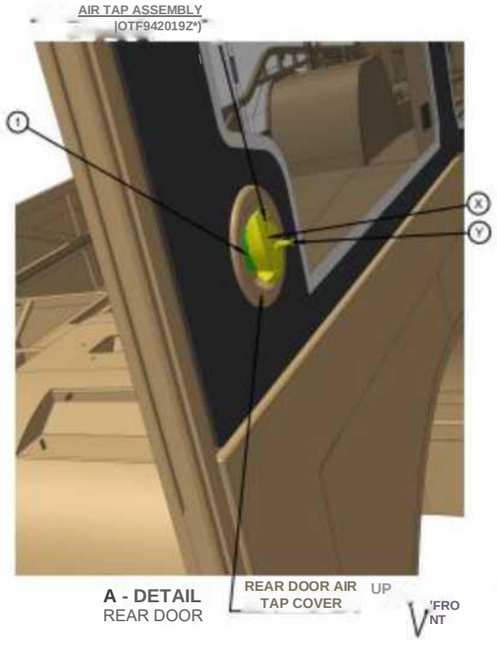
3 LITER AIR TANK ASSEMBLY

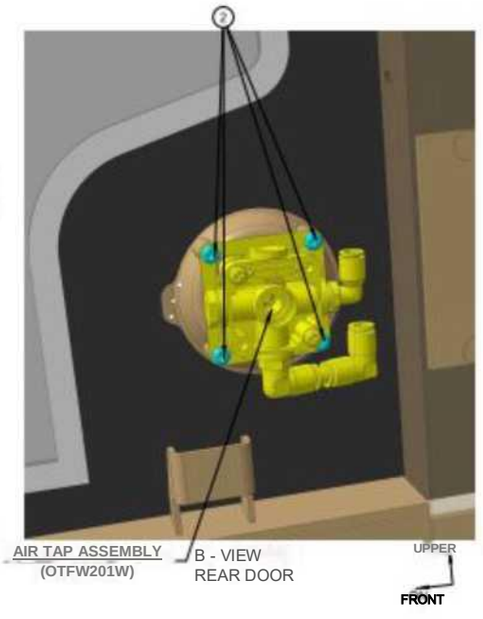


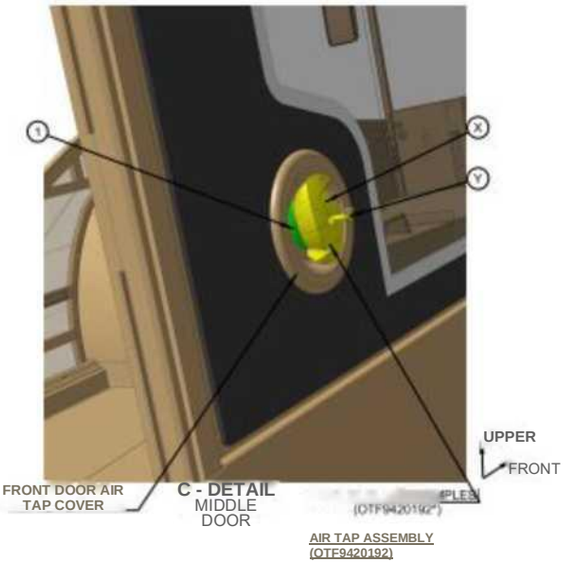
LEAFLET POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	942 - 023	387021686*	TANK, HAVA 3 LT	1
2	942 - 032	377779733*	EVACUATION . DRAWING TYPE	1
3	942 - 104	377773482*	PIPE COUPLING . ELBOW M22 x T 16	1
4	942 - 190	387043030*	PIPE COUPLING . ELBOW M22 X T 20	1

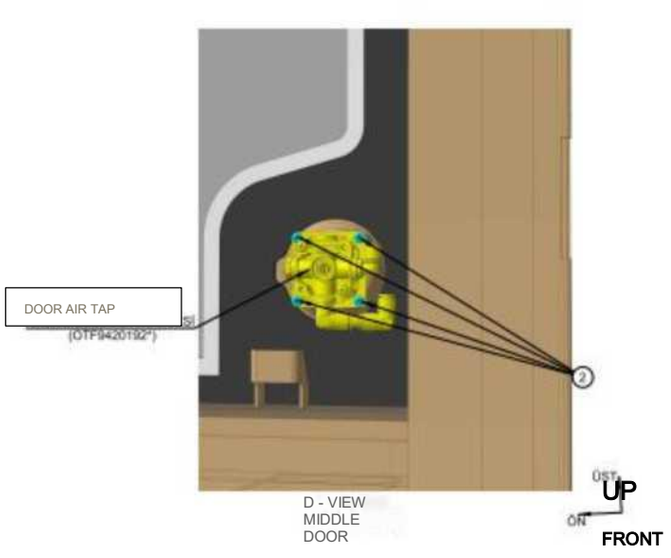
REAR AND MIDDLE DOOR AIR COVER INSTALLATION







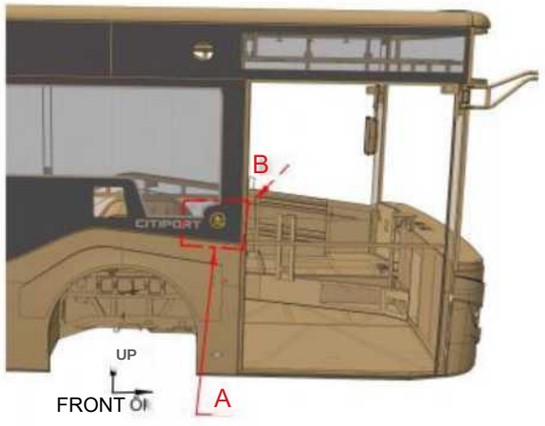


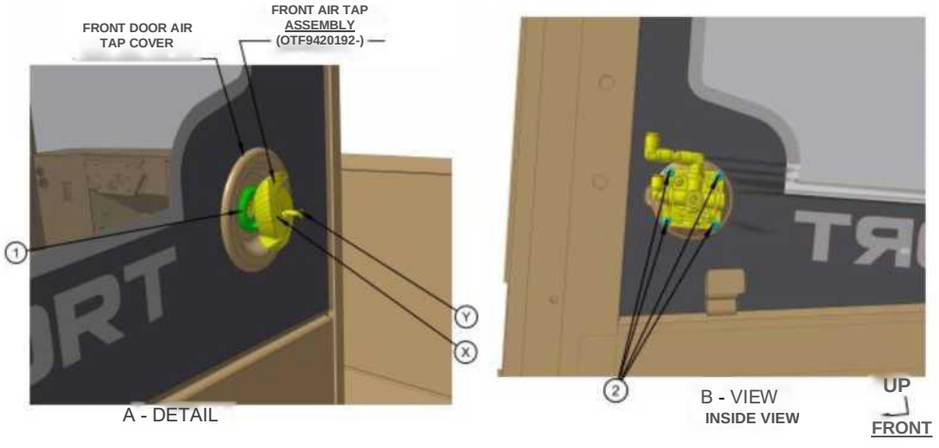


® TWIST HANDLE NO X AND SCREW NO ARE COMBINED WITH THE DOOR AIR DRAIN COVER

LEAFLET POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	942 - 124	3015005104-	SCREW M5X10 DİN 7986	8
2	942 -137	387018386	GASKET EMERGENCY SWITCH TAP	2

FRONT DOOR OUTER AIR TAP INSTALLATION

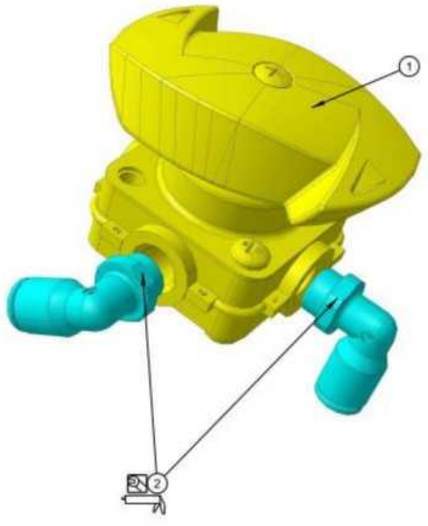


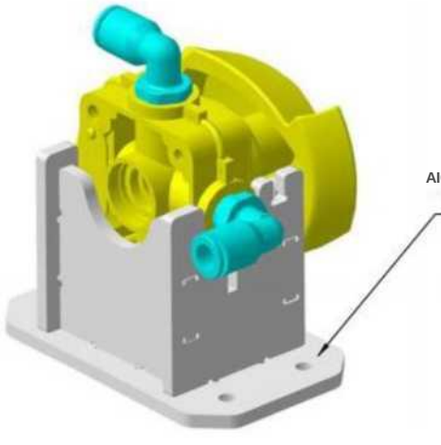


TWIST HANDLE NO X AND SCREW NO ARE COMBINED WITH THE DOOR AIR DRAIN COVER.

LEAFLET POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	942 - 124	3015405104*	SCREW M5x10 DİN 79886	4
2	942 - 137	397010386*	GASKET. EMERGENCY OUTLET TAP	2

FRONT, MIDDLE AND REAR INSIDE DOOR TAP PREPARATION PROCESS

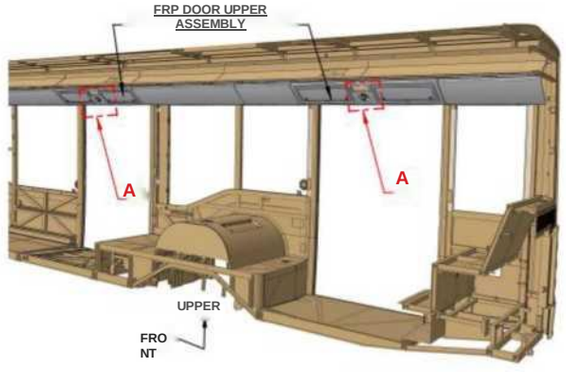


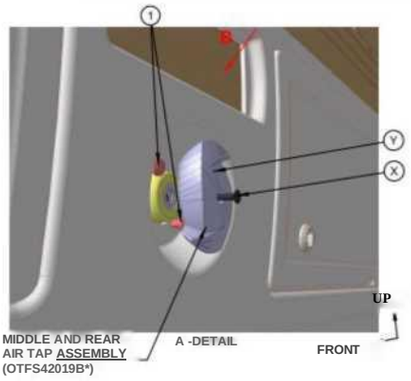


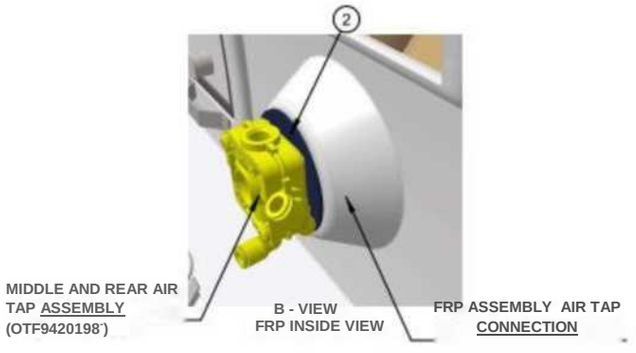
BRUSH TO O-RINGS BEFORE CONNECTING THE FITTING AND ELBOW CONNECTIONS SUGGESTED GREASE: BP ENERGREASE LC2 (or EQUIVALENT)

LEAFLET POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	942/021	38703D249*	TAP. WITHOUT FOUR CORNER SWITCH	3
2	942/084	387048886*	PIPE COUPLING , M12X1.6 T8	6

MIDDLE AND REAR DOOR INTERIOR AIR FAUCETS INSTALLATION



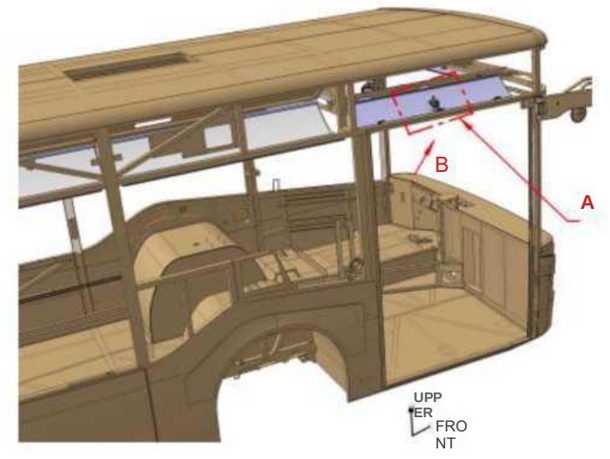


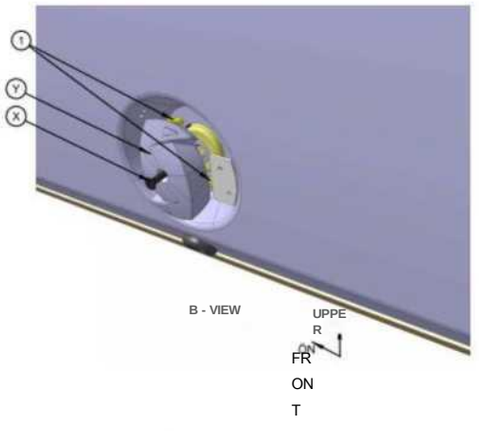


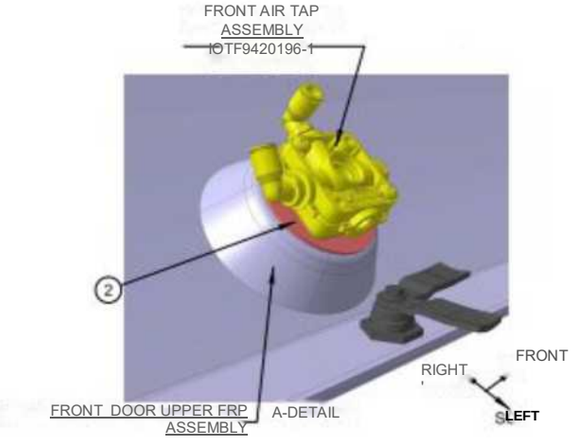
X POSE SCREW AND Y POSE SWIVEL ARM COMES WITH AIR TAP ASSEMBLY.

LEAFLET POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	942 - 123	301500615*	SCREW M 6X15 DİN 7936	4
2	942 - 043	387003217[1]	INTERCONNECTION PART TAP	2

FRONT DOOR INSIDE AIR TAP ASSEMBLY



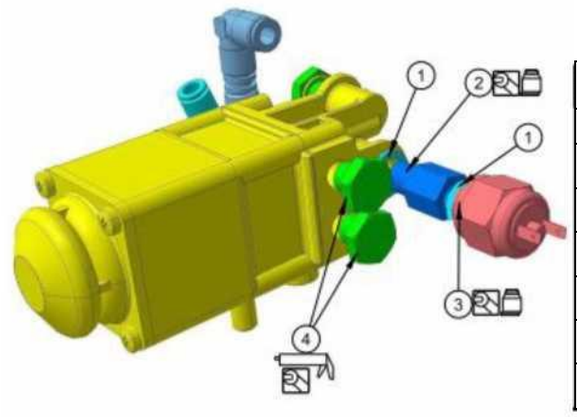




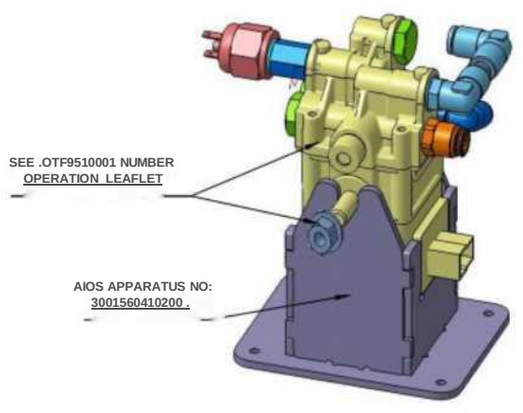
X POSE SCREW AND Y POSE SWIVEL ARM COMES WITH AIR TAP ASSEMBLY.

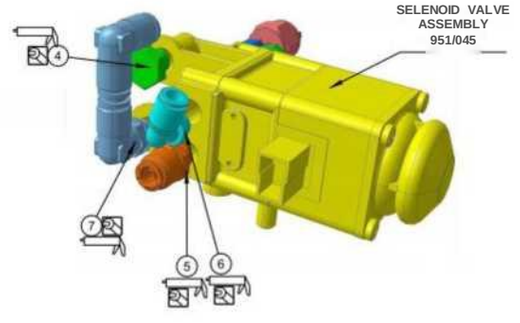
LEAFLET POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	942 - 123	301500615*	SCREW M 6X15 DİN 7986	2
2	942 - 043	337003217[1]	INTERCONNECTION PART TAP	1

FRONT DOOR MECHANISMS ELENOID VALVE PREPARATION



TORQUE ANTEDI (Nm)			
POSE	Std.	**Mln.**	**Max.**
2	17,5	16,8	18,2
3	17,5	16,8	18,2
4	24.5	23.5	25.5
5	11	10	12
6	11	10	12
7	11	10	12



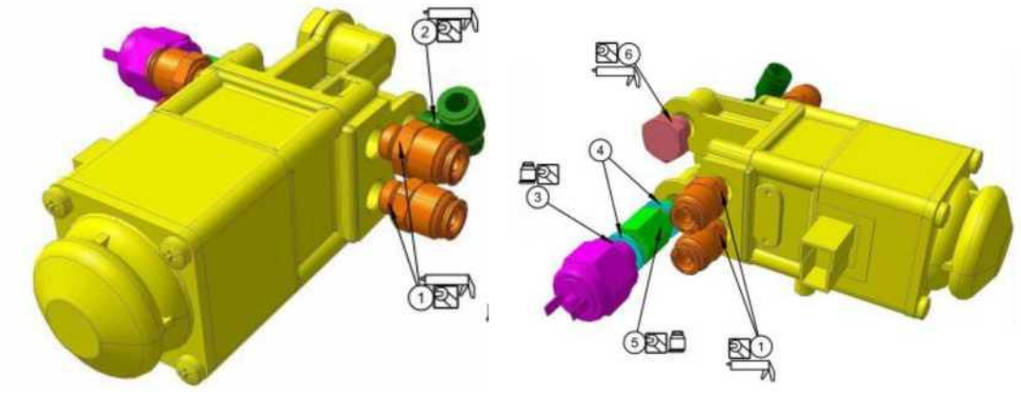


BEFORE MAKING PIPE COUPLING AND ELBOW CONNECTIONS, GREASE THE O-RINGS AROUND A THIN LAYER.
RECOMMENDED GREASE: BP ENERGREASE LC2 (or Equivalent)

RECOMMENDED ADHESIVE: LOCTITE 542 (Or EQUIVALENT)

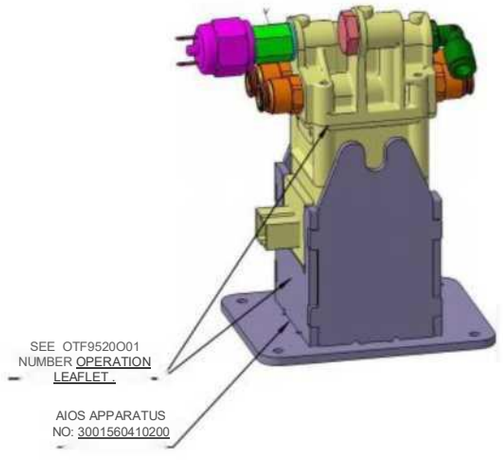
LEAFLET POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	642 - 139	3040100120*	WASHER. ALUMINUM 12x18x1	2
2	942 -087	377776704*	ADAPTER, MUSIR CONNECTION	1
3	942 -038	377778221*	MUSIR, PRESSURE 3 BAR	1
4	942 -083	377773546*	STOPPER, M12X1.5 ORING	3
5	942 - 082	387048405*	PIPE COUPLING , FLAT M12-T8	1
6	942 - 084	387048886*	PIPE COUPLING . M12X1.5T8	1
7	942 -085	387058999*	CONNECTOR, ELBOW 8X8	1

REAR AND MIDDLE DOOR MECHANISM SOLENOID VALVE ASSEMBLY



BEFORE MAKING PIPE COUPLING AND ELBOW CONNECTIONS, GREASE THE O-RINGS AROUND A THIN LAYER.
RECOMMENDED GREASE: BP ENERGREASE LC2 (or Equivalent)

RECOMMENDED ADHESIVE: LOCTITE 542 (Or EQUIVALENT)

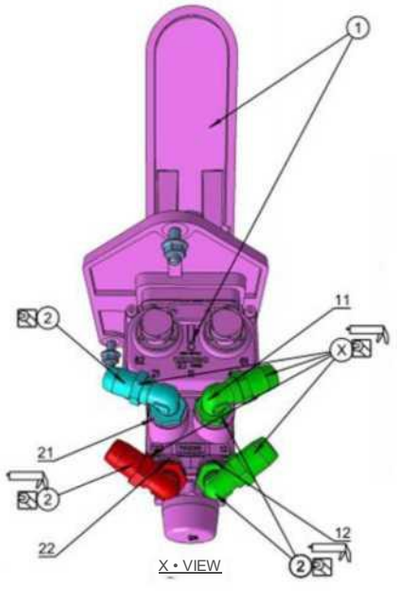


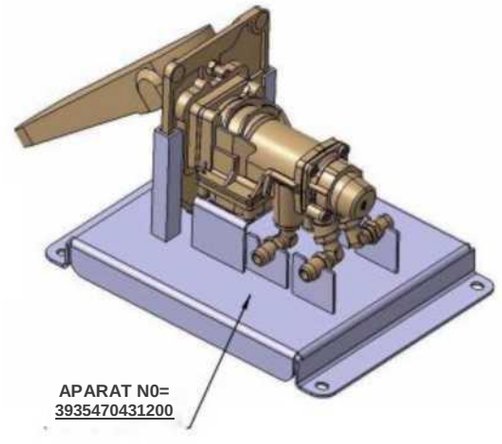
TORQUE ANTEDI (Nm)			
POSE	314	Mia	Max.
1	11	10	12
2	11	10	12
3	17.5	16.8	18,2
5	17.5	16,8	18.2
6	24.5	23.5	25.5

LEAFLET POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	942 - 062	387046405*	PIPE COUPLING , FLAT M12-T8	4
2	942 -084	387048886'	PIPE COUPLING , M12X1 .6 T8	1
3	942 - 038	377778221*	MUSIR. PRESSURE 3 BAR	1
4	942 - 1 39	304010012*	WASHER. ALUMINUM 12x18x1	2
5	942 - 087	377776704*	ADAPTER, MUSIR CONNECTION	1
6	942 - 083	377773546*	STOPPER, M 12x1.5 ORING	1

EBS FOOT BRAKE VALVE PREPARATION





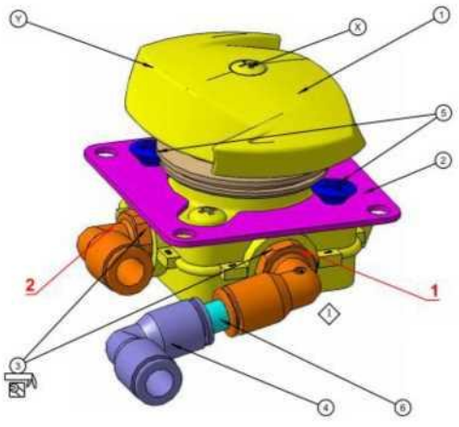


TORQUE ANTEDI		(N	m)
POSE	Sld.	Min.	Max.
2	35	33,5	36,4
X	24	23	25

BEFORE MAKING PIPE COUPLING AND ELBOW CONNECTIONS, GREASE THE O-RINGS AROUND A THIN LAYER WITH NO 12 BRUSH.
RECOMMENDED GREASE: BP ENERGREASE LC2 (or Equivalent)

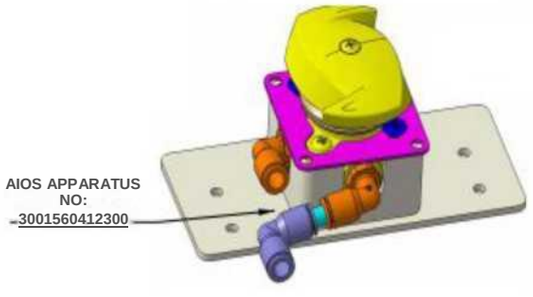
LEAFLET POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	942 - 008	387036373*	VALVE. BRAKE	1
2	942 - 110	377777221'	P.I.R, D.ELBOW, M16-T10	4

FRONT DOOR OUTER AIR TAP ASSEMBLY PREPARATION



BEFORE MAKING PIPE COUPLING AND ELBOW CONNECTIONS, GREASE THE O-RINGS AROUND A THIN LAYER WITH NO 12 BRUSH.
RECOMMENDED GREASE: BP ENERGREASE LC2 (or Equivalent)

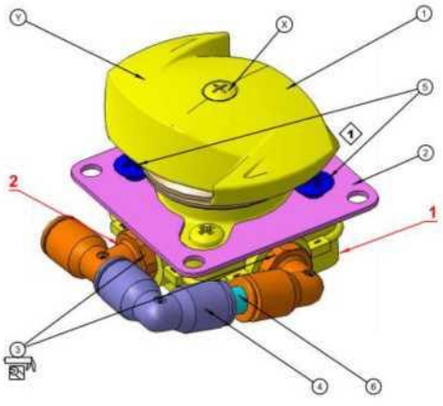




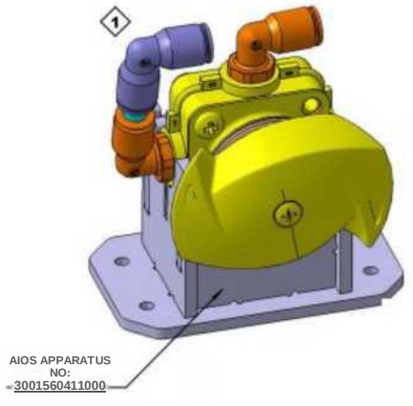
X NUMBER SCREW IS REMOVED AND (Y) NUMBER ROTARY HEAD IS REMOVED. AFTER THE 5 NUMBER CONNECTION SHEET IS INSTALLED, IT IS INSTALLED AGAIN.

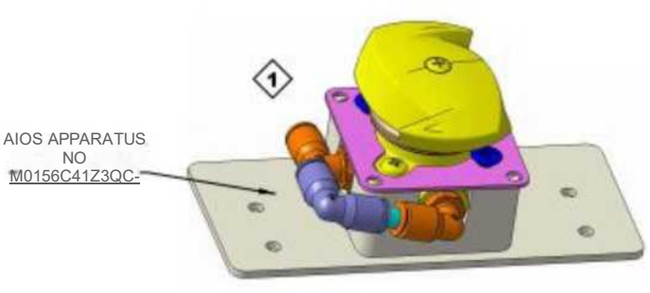
LEAFLET POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	942 - 021	387030249-	TAP. WITHOUT FOUR CORNER SWITCH	1
2	942 - 049	387018885*	PLATE, AIR TAP, CONNECTION	1
3	942 - 064	387048888*	PIPE COUPLING , M1 2X1,5 T8	2
4	942 -085	387058999*	CONNECTOR. ELBOW 8X8	1
5	942 - 125	3015406208*	SCREW M6	2
6	942 - 354	387052105*	ADAPTER, EXTENSION 8 - 8	1

MIDDLE, REAR DOOR OUTER AIR TAP ASSEMBLY PREPARATION



X NUMBER SCREW IS REMOVED AND (Y) NUMBER ROTARY HEAD IS REMOVED. AFTER THE 5 NUMBER CONNECTION SHEET IS INSTALLED, IT IS INSTALLED AGAIN.



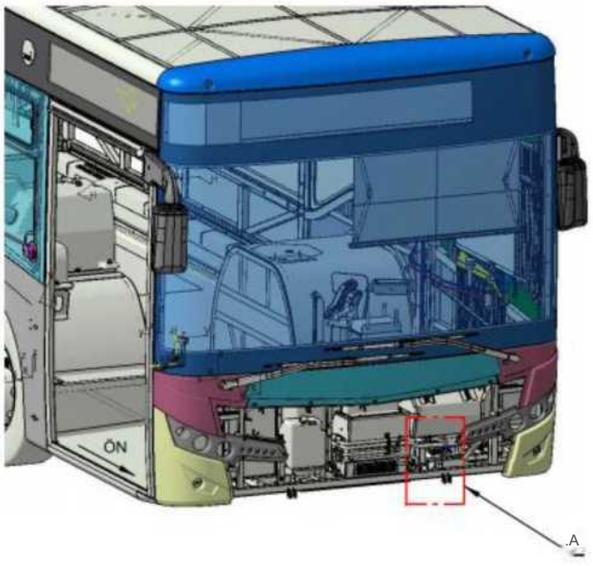


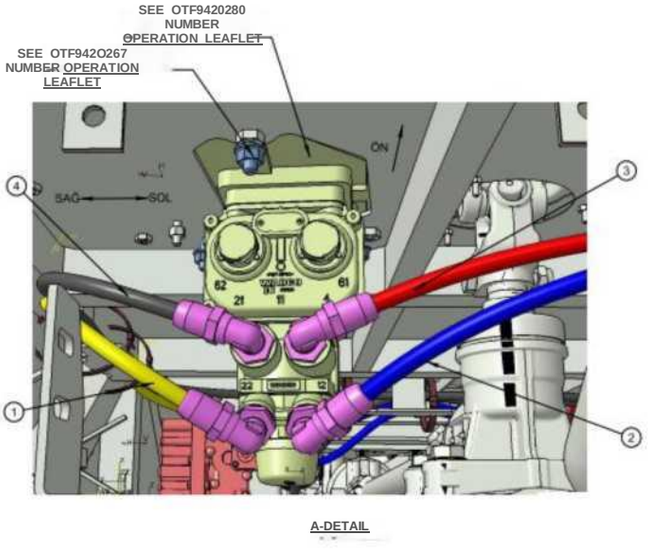
BEFORE MAKING PIPE COUPLING AND ELBOW CONNECTIONS, GREASE THE O-RINGS AROUND A THIN LAYER WITH NO 12 BRUSH.

RECOMMENDED GREASE: BP ENERGREASE LC2 (or Equivalent)

LEAFLET POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	942-021	387030249*	TAP. WITHOUT FOUR CORNER SWITCH	1
2	942 - 049	387018385*	SAC. AIR TAP. CONNECTION	1
3	942 - 084	387048886*	PIPE COUPLING , M12X1,5 T8	1
4	942 - 066	387056999*	CONNECTOR , ELBOW 6X8	1
5	942 - 125	3015406208*	SCREW M6	2
6	942 - 354	387052105*	ADAPTER, EXTENSION 8 - 8	1

BRAKE PEDAL HOSE INSTALLATION





A-DETAIL

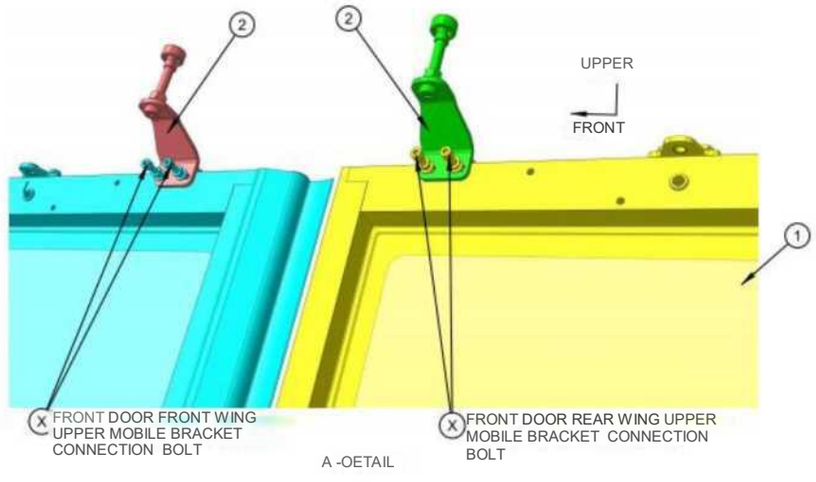
LEAFLET POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	942 - 220	3084441200*	HOSE . PNO	1
2	942 - 227	3083445900*	HOSE . PNO	1
3	942 - 22 8	3870363430*	HOSE , PNO	1
4	942 - 229	3870363280*	HOSE , PNO	1

RIGHT FRONT DOOR CARCASS INSTALLATION

FRONT DOOR WINGS FRONT PREPARATION

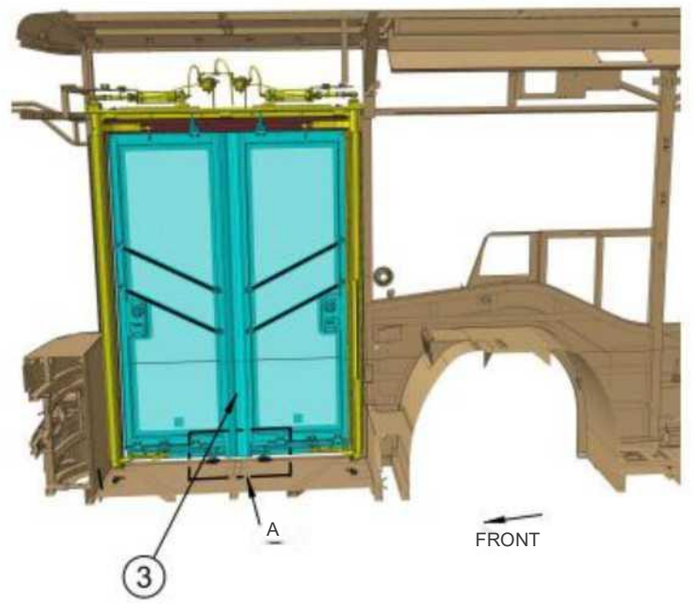


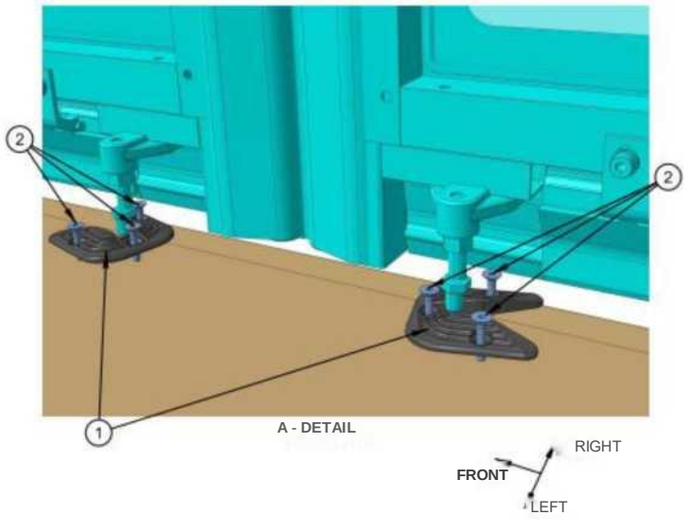
NOTE:
FRONT DOOR AND REAR WING MOBILE BRACKET INSTALLATION REMOVE BEFORE CONNECTION.
Y AND Z BRACKETS ARE THE PARTS OF DOOR ASSEMBLY.



LEAFLET POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER	ADDITIONAL INFO
1	949 - 002	387630969*	DOOR TOOL. FRONT AND MIDDLE	1	CITIPORT 9L AT E6C
1	949 - 002	387625343*	CITIPORT DOOR TOOL (SWTC.KİLİT)	1	CITIPORT AT E6-C CITIPORT CNG AT E6 CITIPORT S A/T E6C
2	949 - 700	387041122*	BRACKET ASSEMBLY , UPPER MOBILE	2	

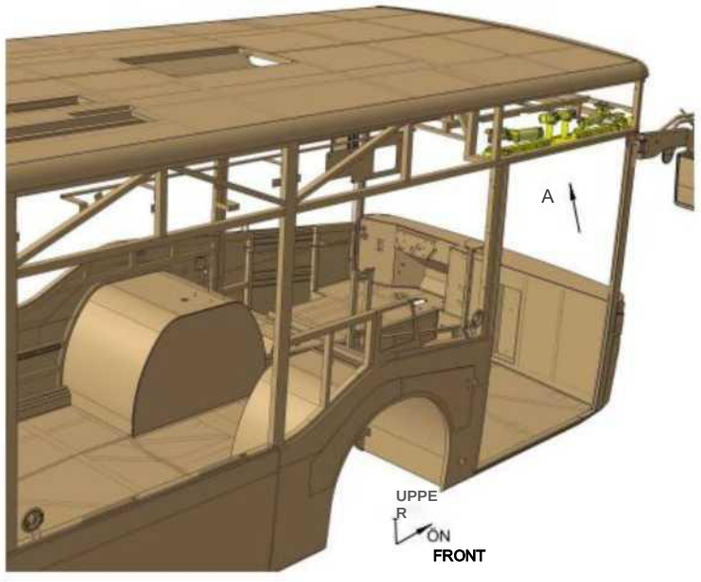
FRONT DOOR CENTERING BED ASSEMBLY

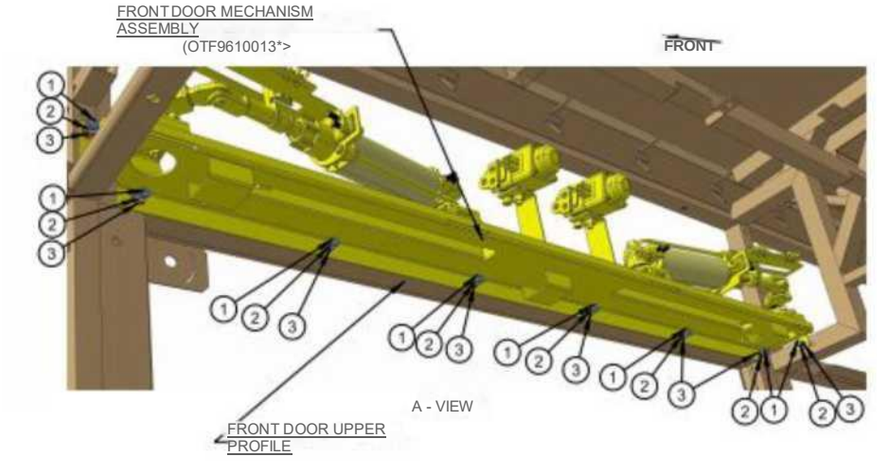




LEAFLET POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	949-013	387043164*	CENTERING BED ASSEMBLY	2
2	949-014	301700630*	SCREW LOWER CORNER PITTED	6
3	949 - 002	3B748B14B*	DOOR TOOL. FRONT, MIDDLE AND REAR	1 TK

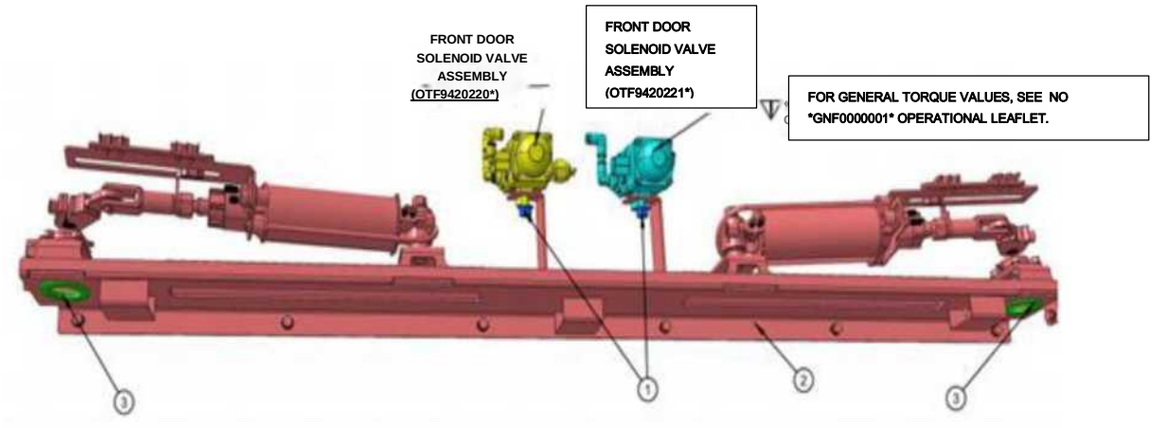
FRONT DOOR MECHANISM VEHICLE INSTALLATION





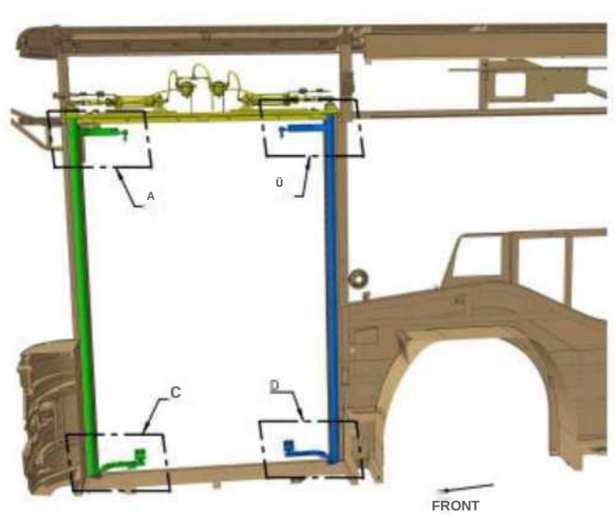
LEAFLET POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	951 - 002	3000108202*	BOLT . AKB M8X 1.2 5X20, THICK D. DIN933	8
2	951 - 003	3010100082*	WASHER , SPRINGY D=8 DİN 127	8
3	951 - 005	3010000082*	WASHER , FLAT D=8 DİN 125	8

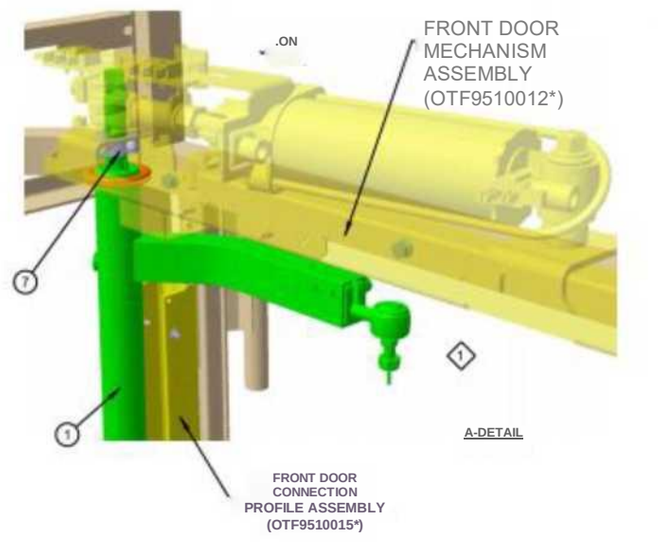
FRONT DOOR MECHANISM ASSEMBLY PREPARATION

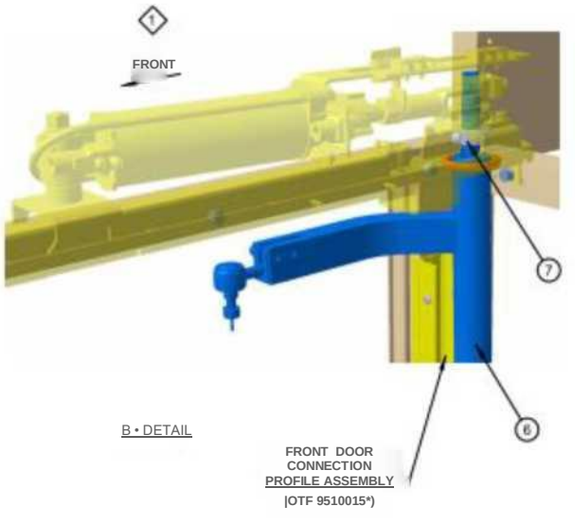


LEAF POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	951 - 046	3005800101*	NUT . FLN&TR M10X1.5, THICK D. DİN 6923	2
2	951 - 001	387038204*	PISTON MECHANISM GR.ALL, FRONT DOOR	1
3	951 -035	387027740*	GROMMET	2

FRONT DOOR MECHANISM FRONT AND REAR ROTATING HANDLE INSTALLATION




.ON
FRONT DOOR MECHANISM ASSEMBLY (OTF9510012*)
7
1
1
A-DETAIL
FRONT DOOR CONNECTION PROFILE ASSEMBLY (OTF9510015*)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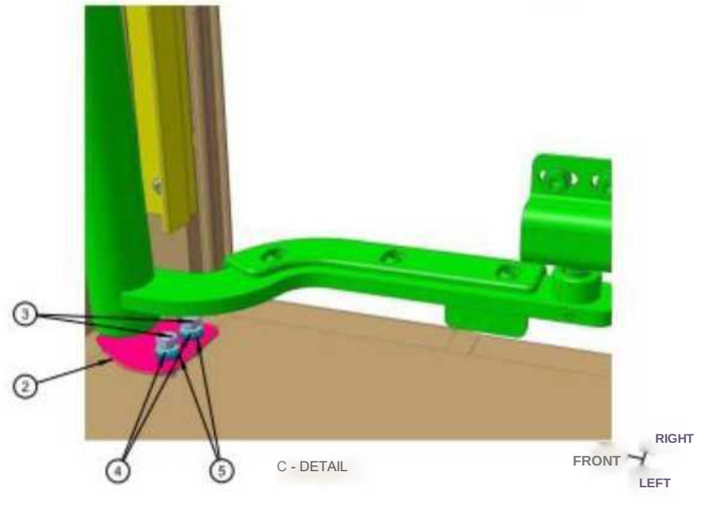
FRONT
7
6
B • DETAIL
FRONT DOOR CONNECTION PROFILE ASSEMBLY
|OTF 9510015*)


3
2
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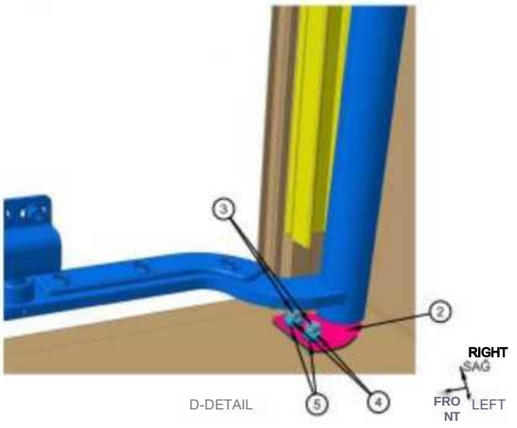
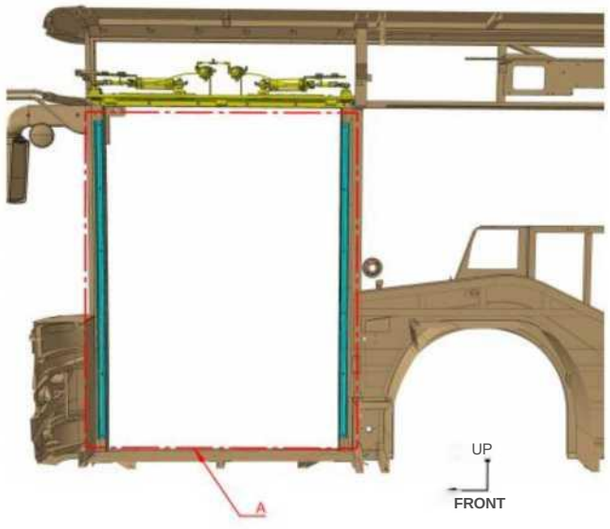
5
C - DETAIL
FRONT
RIGHT
LEFT



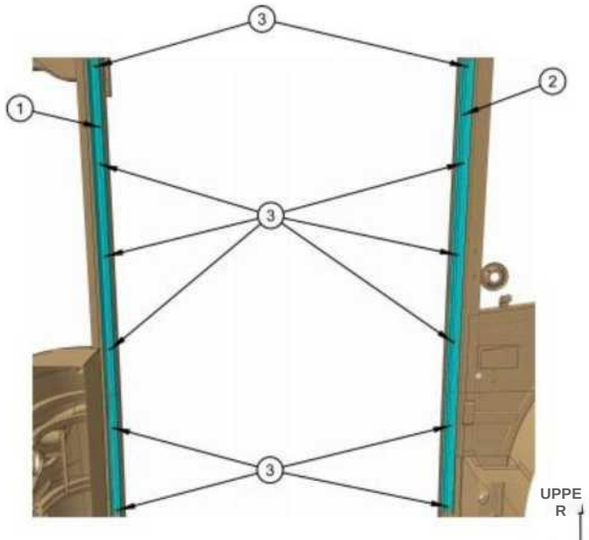


LEAFLET POSE	GROUP-POSE	PART NO	COMPONENT'S NAME	NUMBER
1	951 - 004	387060885'	ROTATING HANDLE ASSEMBLY FRONT	1
2	951 -015	367033220'	FOOD BRACKET ASSEMBLY ROTATING HANDLE LOWER	2
3	951 -016	3000108304*	BOLT , AKB M BX 1.25X30. THICK D. DİN93S	4
4	951 - 003	3010100088	WASHER , SPRINGY D-8 DIN 127	4
5	951-005	3010000086	WASHER , FLAT D=8 DİN 125	4
6	951 - 006	387054622	ROTATING HANDLE ASSEMBLY . DOOR REAR POLE	1
7	951-012	367054513'	KESTAMID, HALF-MOON ASSEMBLY	2

FRONT DOOR CONNECTION PROFILES INSTALLATION



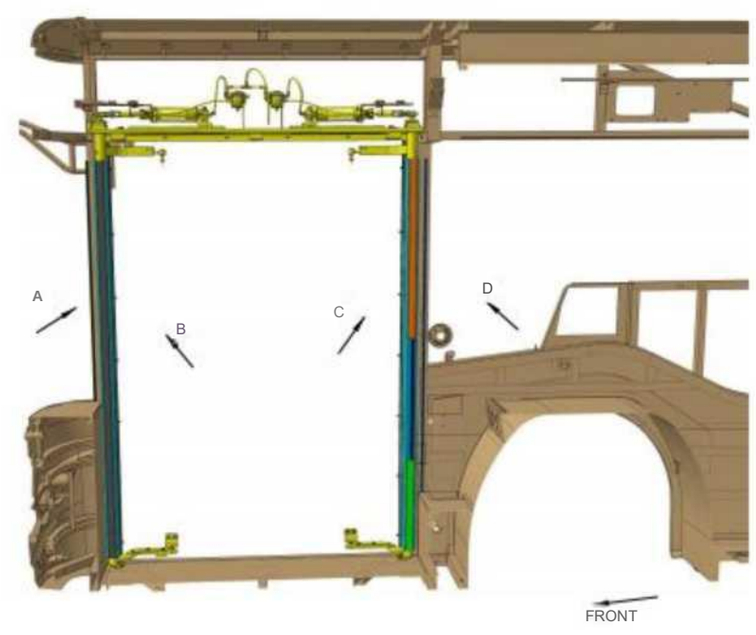
LEFT SIDE SECTION VIEW

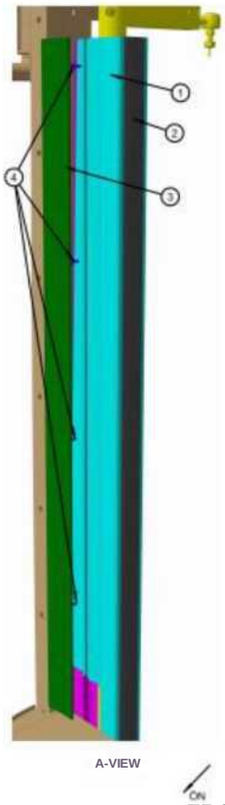


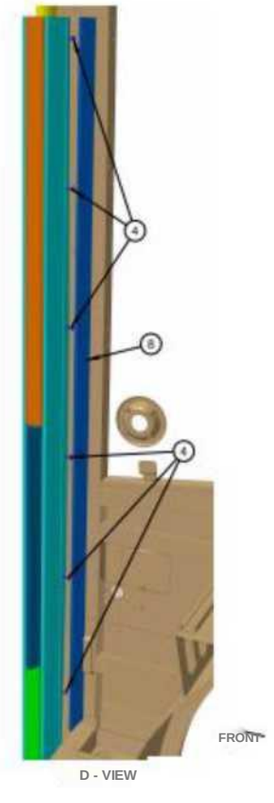
A - DETAIL

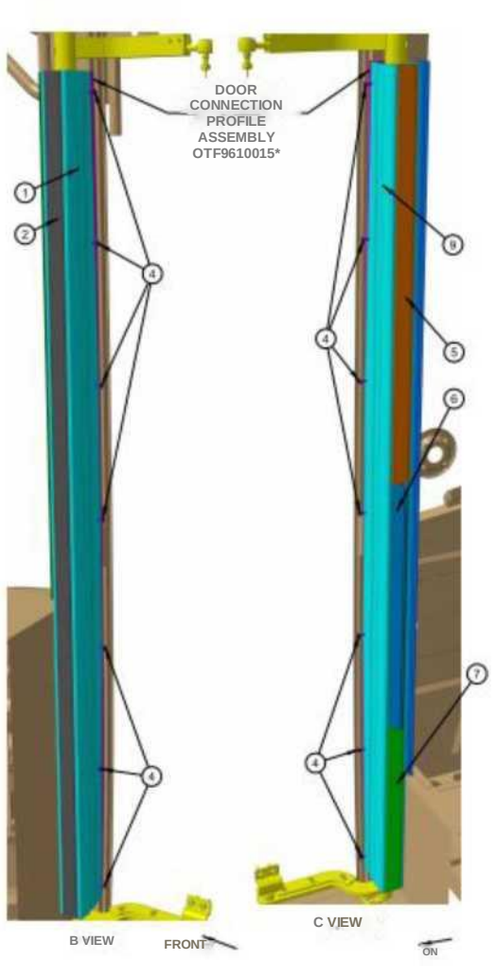
LEAFLET POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	951 -036	387035099*	CONNECTION PROFILE	1
2	951-037	387035096*	CONNECTION PROFILE	1
3	951-041	301894816*	WASHER SHEET SCREW SCREW 4.8X16	12

FRONT DOOR MECHANISMFRONT AND REAR CLOSING PROFILES INSTALLATION



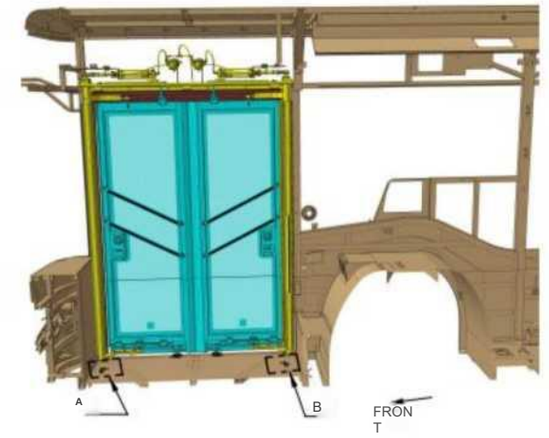


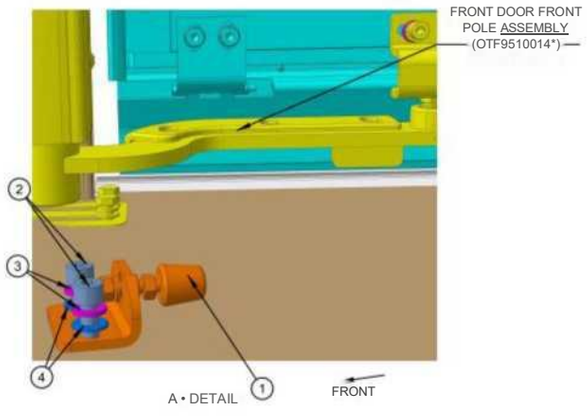


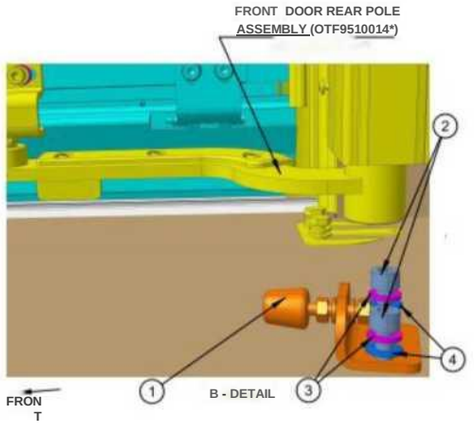


LEAFLET POSE	GROUP-POSE	PART NO	COMPONENT'S NAME	NUMBER
1	951 - 042	397088954'	PILLAR CLOSING PROFILE	1
2	951 - 048	387046936'	FRONT DOOR PROFILE EPDM RUBBER	1
3	951 - 043	337038653"	TIRE PROFILE	1
4	951 –041	301394816'	ROND.PLATE SCREW 4.SX16	24
5	951 - 049	337046935'	FRONT DOOR PROFILE. EPDM RUBBER	1
6	951 - 040	387046602'	PROFILE SAW GLASS SLOT	1
7	961 - 047	387046934'	FRONT DOOR PROFILE. EPDM RUBBER	1
e	951 - 038	357089412'	TIRE PROFILE	1
9	961 - 039	38703 6092'	Dİ PEK CLOSING PROFILE	1

FRONT DOOR LOWER DOLLY ALL INSTALLATION

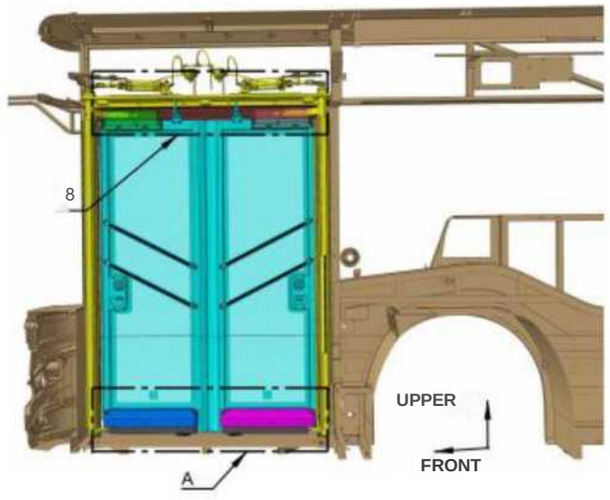


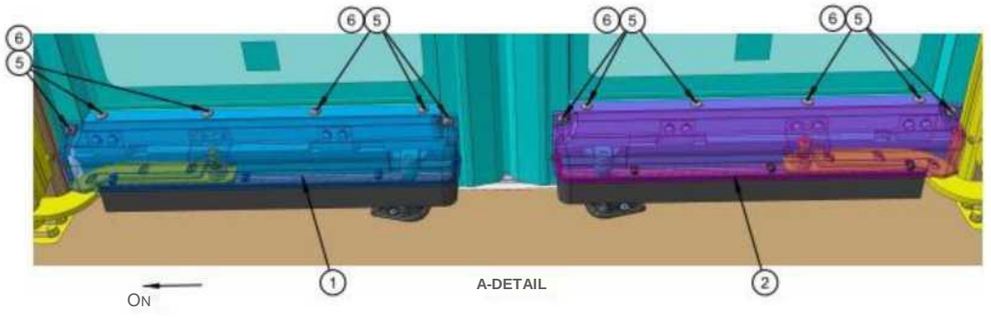


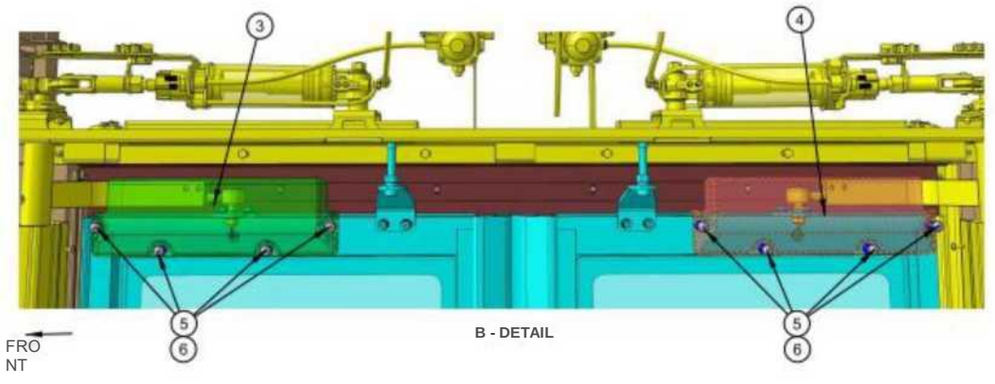


LEAFLET POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	951 -025	337023466*	DOLLY ALL , FRONT DOOR LOWER ELBOW	2
2	951-029	3090908303*	BOLT SLB M8X30, THICK D. DIN912	4
3	951 - 003	3010100082*	WASHER , SPRINGY D=8 DİN 127	4
4	951 - 005	3010000082*	WASHER , FLAT D=8 DIN 125	4

FRONT DOOR CLOSE COVERS INSTALLATION

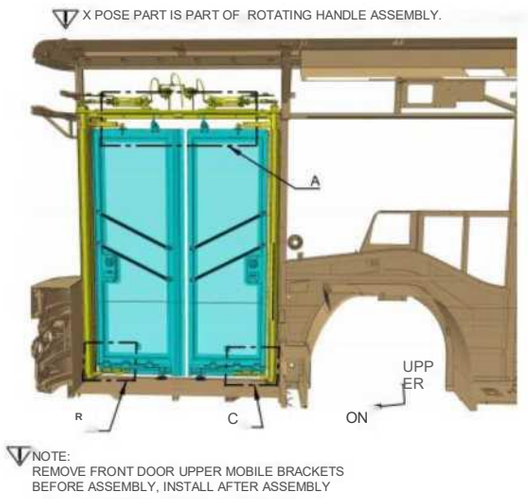


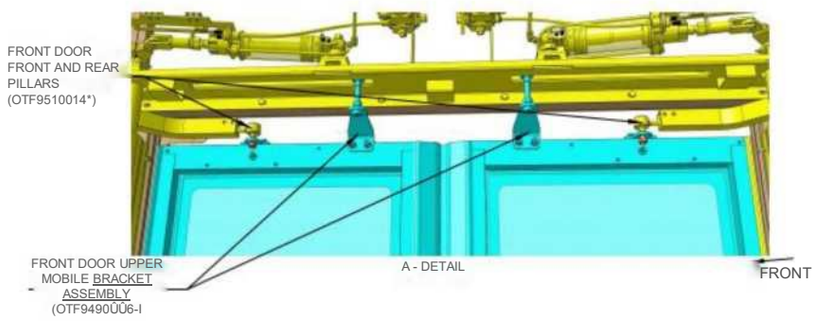


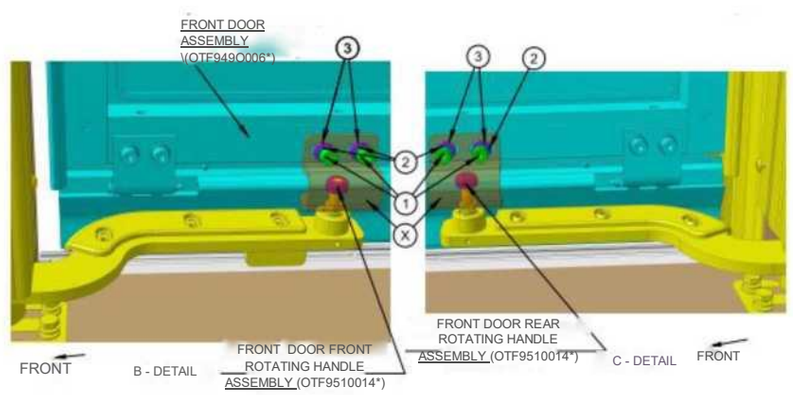


LEAFLET POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	951 - 019	387038214*	CLOSE ASSEMBLY . FRONT DOOR ALI	1
2	951 - 024	387038217*	CLOSE ASSEMBLY . REAR WING LOWER	1
3	951 - 023	387025004*	CLOSE ASSEMBLY . FRONT DOOR UPPER	1
4	951 - 020	387025006*	CLOSE ASSEMBLY . FRONT DOOR UPPER LEFT	1
5	951 - 034	387024992*	BOLT . PLASTIC, BLACK	20
6	951 - 033	387024991*	ANCHOR. PLASTIC. BLACK	20

FRONT DOOR WINGS MOUNTING

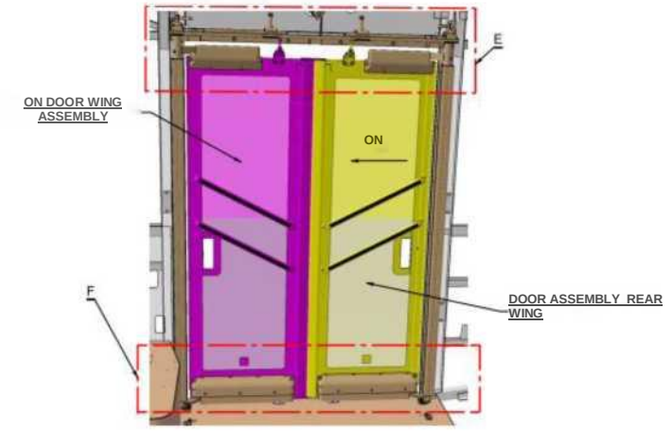


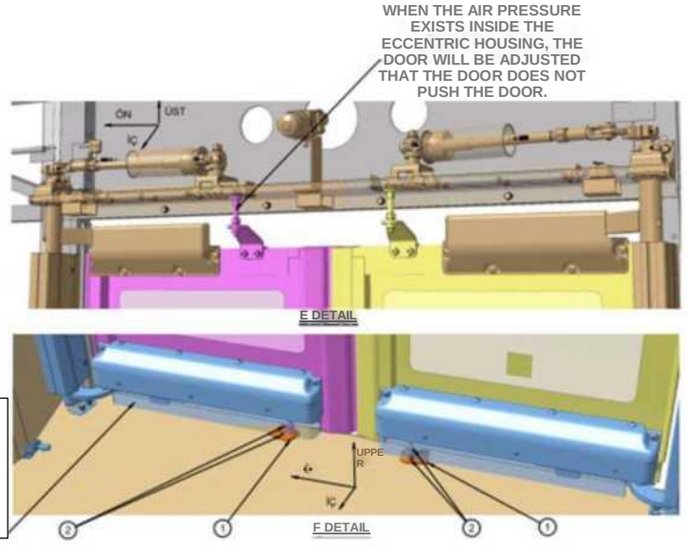




LEAFLET POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	951 - 029	3000908303"	BOLT . SLB M 8X30, THICK D. DIN912	4
2	951 - 003	3010100082*	WASHER , SPRINGY 0=8 DİN 127	4
3	951 - 005	3010000082*	WASHER , FLAT D=B DİN 125	4

REAR DOOR ALL ASSEMBLY





THE RUBBER HEMLINE PART WILL BE ADJUSTED TO THE SCALE TO PRESS THE OILCLOTH SWEETLY ALONG THE ENTIRE SIDE

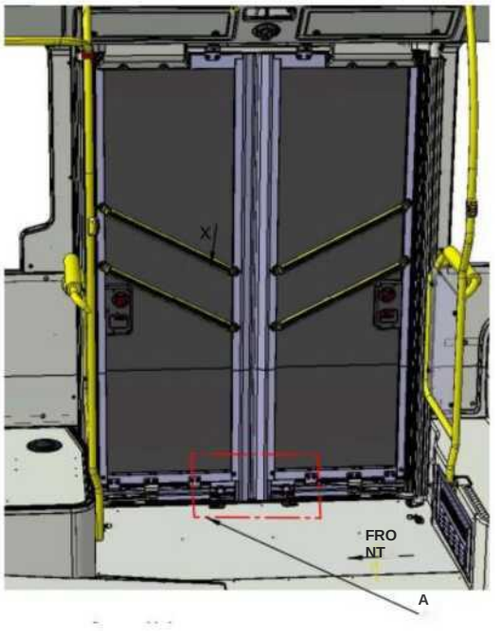
PISTON MECHANISM GROUP SLOT HOLES WILL BE INSTALLED BY CONSIDERING THE MIDDLE AXES.

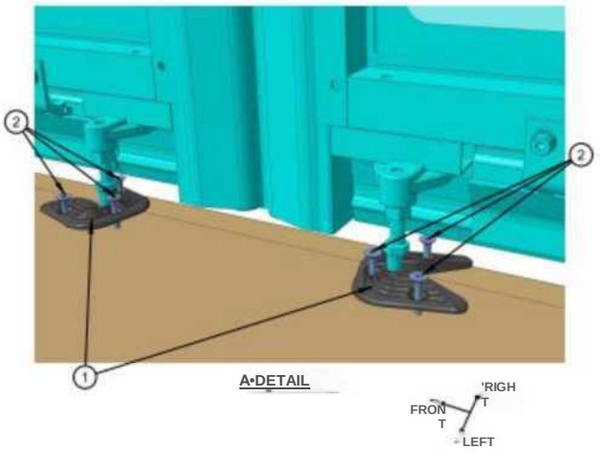
ROTATING HANDLE LOWER MECHANISM; IT WILL BE FITTED UNDER THE ROTATING ARM TO THE BED IN THE UPPER MECHANISM GROUP AND THE SIZES GIVEN WITH THE CONNECTION ELEMENTS ARE CONSIDERED TO BE CONNECTED TO THE SIDE PANEL.

SIZES GIVEN VALID WITH AIR AND DOORS CLOSED

LEAFLET POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	950-013	307343164*	CENTERING BED ALL	2
2	950-014	3017006301	SCREW LOWER CORNER PITTED	8

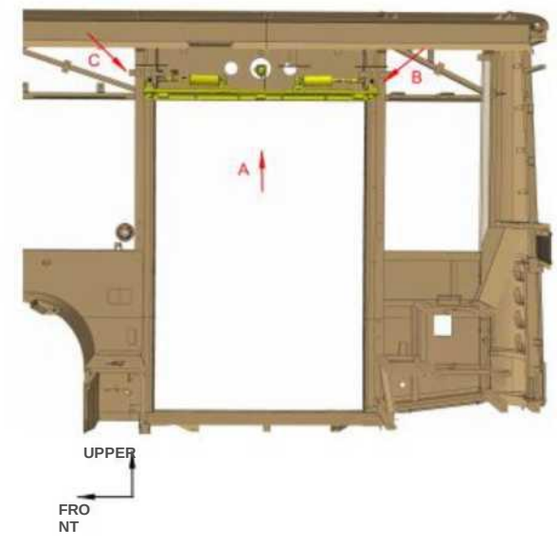
REAR DOOR CENTERING BED ALL ASSEMBLY

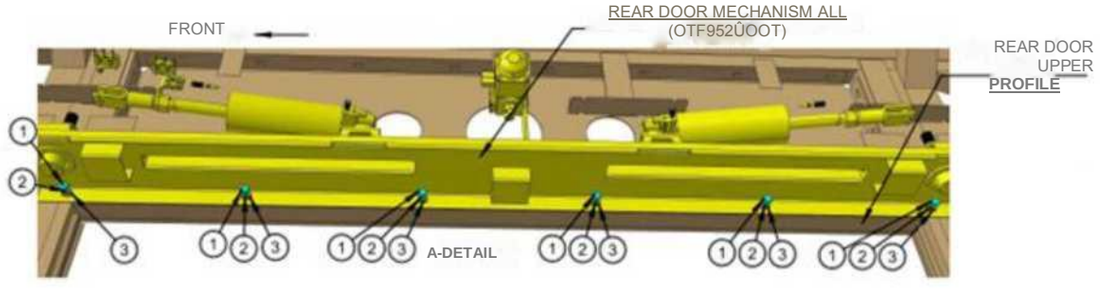


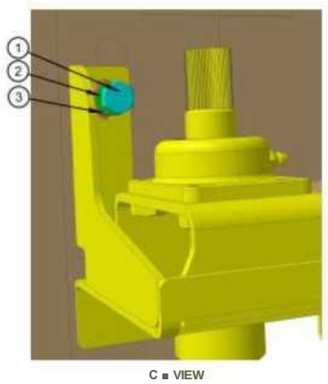


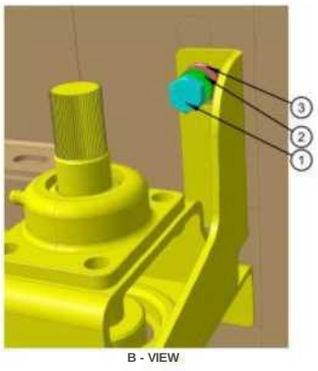
LEAFLET POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	950- 013	387043164*	CENTERING BED ASSEMBLY	2
2	950 - 014	3017006301*	SCREW LOWER CORNER PITTED	6

REAR DOOR MECHANISM VEHICLE INSTALLATION



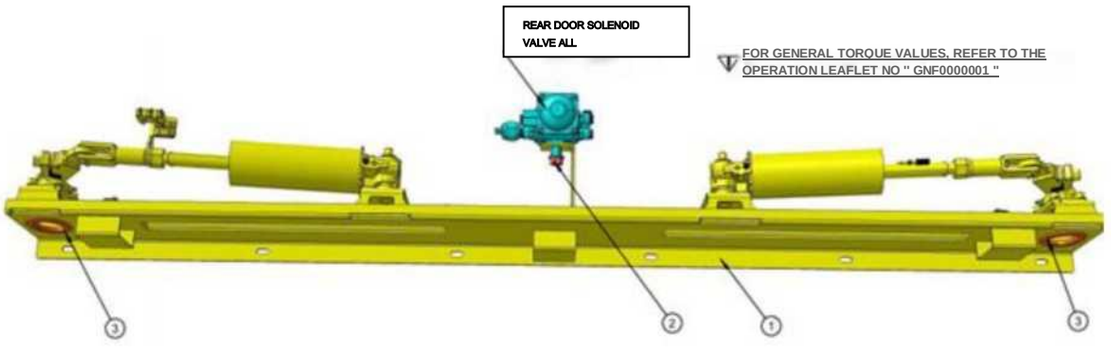



C ■ VIEW


B - VIEW

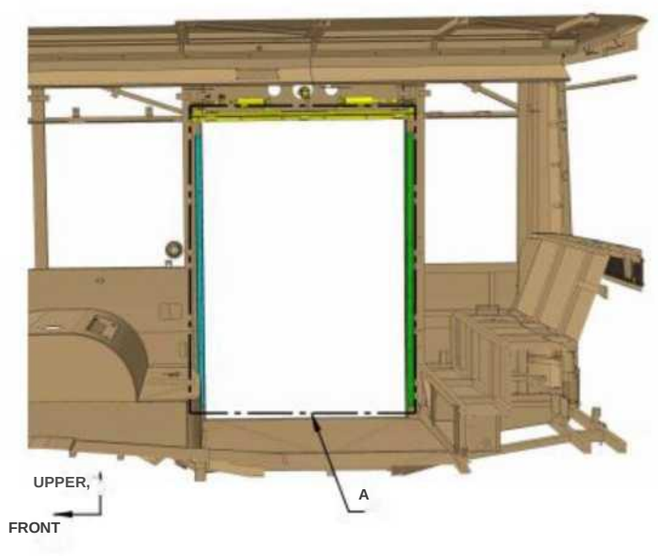
LEAFLET POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	952 - 002	3000108204*	BOLT . AKB M8X1.25X20. THICK D. DIN933	a
2	952 - 003	3010100086*	WASHER , SPRINGY D=8 DİN 127	a
3	952/005	3010000086*	WASHER , FLAT D=8 DİN 125	B

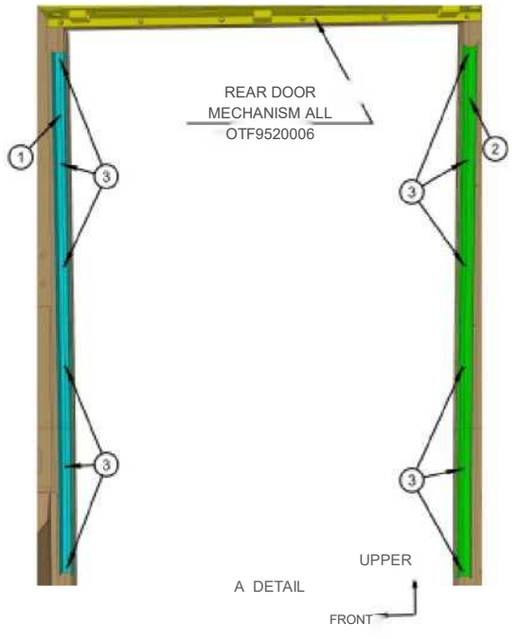
REAR DOOR MECHANISM PREPARATION



LEAF POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	952 - 001	387030210*	PISTON MECHANISM GR.ALL, MIDDLE REAR DOOR	1
2	952 - 046	3005800101*	NUT , FLN&TR M10X1.5, THICK D. DIN 6S23	1
3	952 -035	387027740*	GROMMET	2

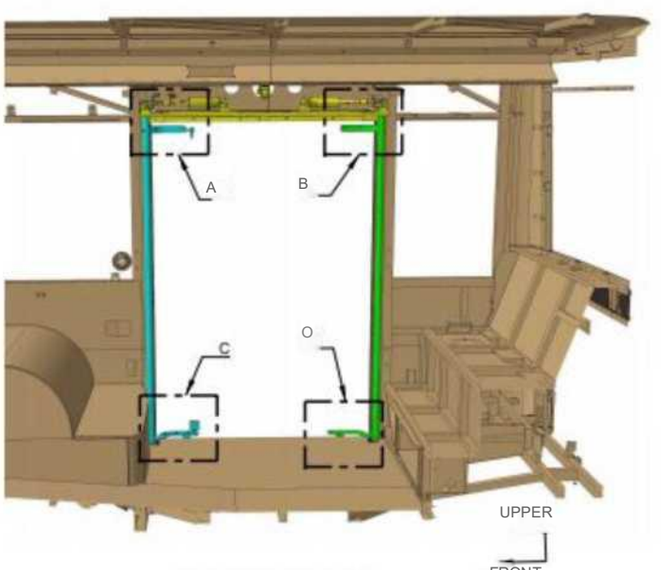
REAR DOOR CONNECTION PROFILE INSTALLATION



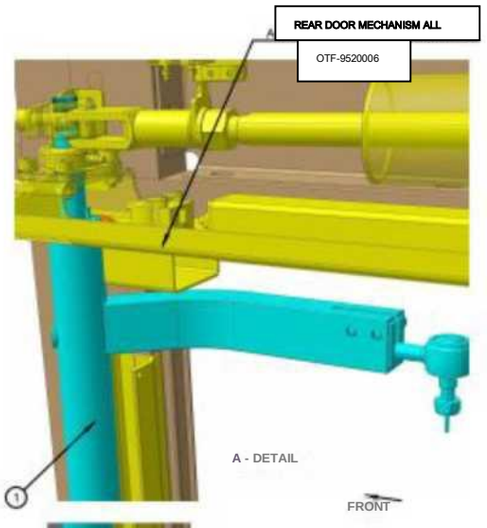


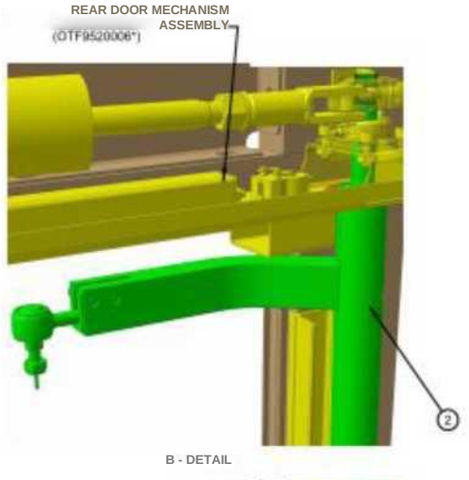
LEAFLET POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	**952 - 036**	**387035099"**	**CONNECTION PROFILE**	**1**
2	952 -037	387035996*	**CONNECTION PROFILE**	1
3	952 - 041	301894616*	WASHER SHEET SCREW 4.8X1 6	12

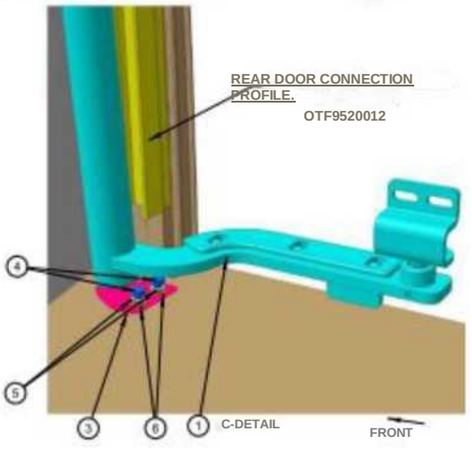
REAR DOOR ROTATING HANDLE ALL INSTALLATION

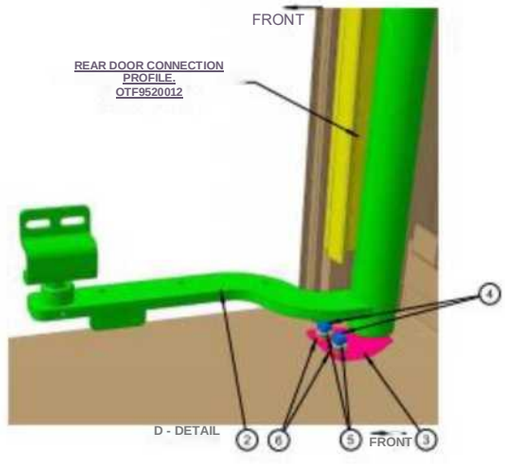


LEFT SIDE SECTION VIEW





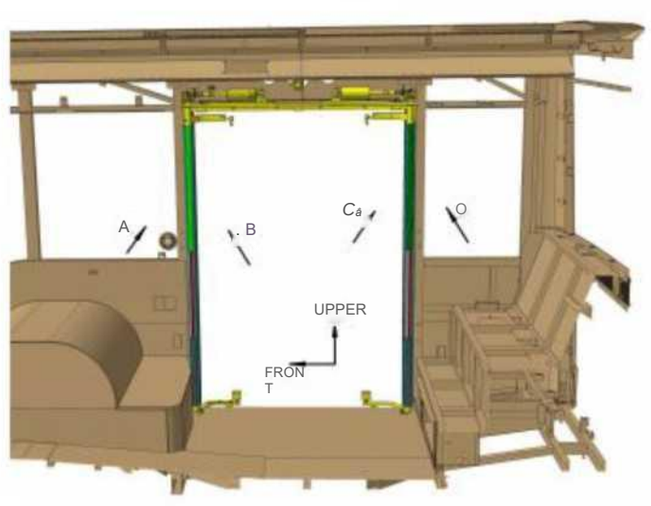


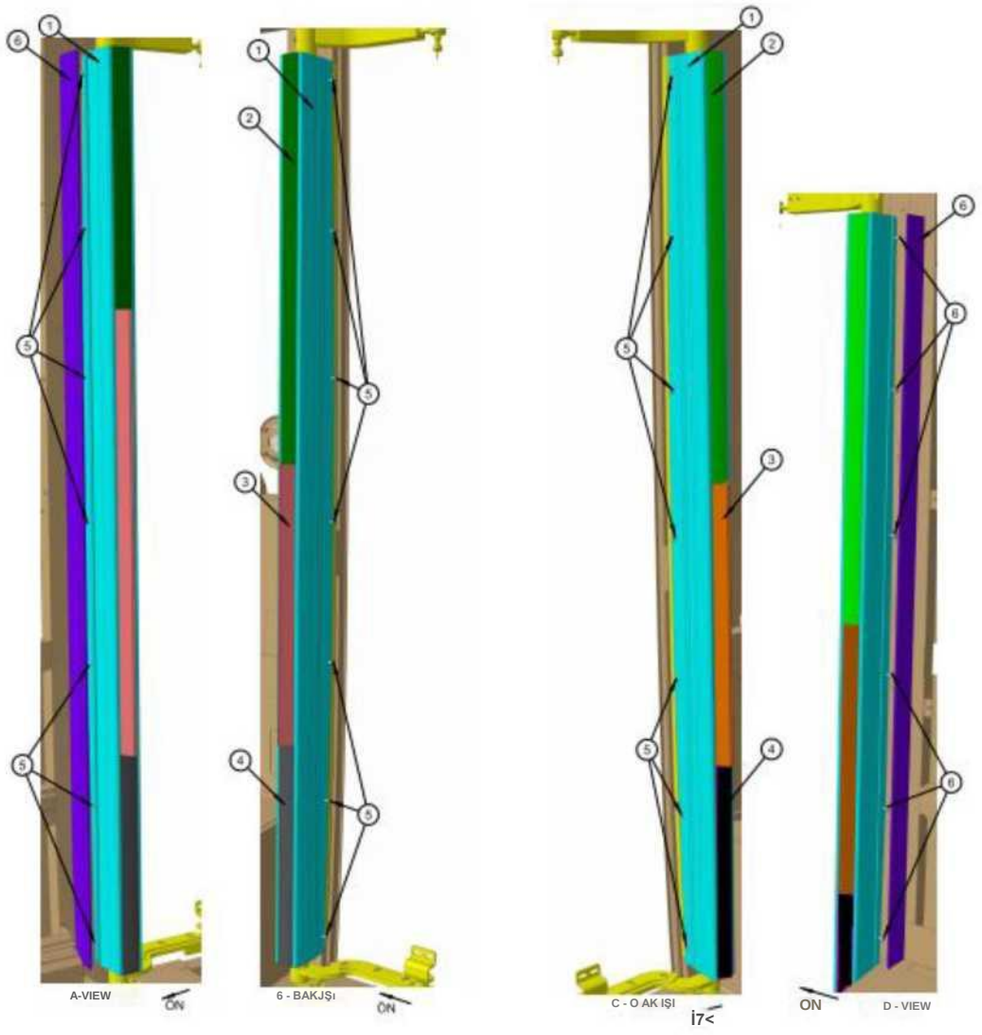




LEAFLET POSE	GROUP-POSE	PART NO	COMPONENT'S NAME	NUMBER	ADDITIONAL INFO
1	952 -004	387060486*	ROTATING HANDLE ALL . DOOR FRONT POLE	1	
1	952 -004	387060836*	ROTATING HANDLE ALL . DOOR FRONT POLE	1	CITIPORT CNG
2	952 -006	3876O1725*	ROTATING HANDLE ALL DOOR REAR POLE	1	CITIPORT CNG
2	952 - 006	387601725*	ROTATING HANDLE ALL DOOR REAR POLE	1	
3	952-015	387036220*	FOOD BRACKET ASSEMBLY , ROTATING HANDLE LOWER	2	
4	952-016	3000108302*	BOLT AKB M8X1.25X30 THICK. DIH933	4	
5	952-017	3010000082"	WASHER . FLAT D=8 DİN 126	4	
6	952 -018	3010100082	WASHER . SPRINGY D=8 DİN 127	4	

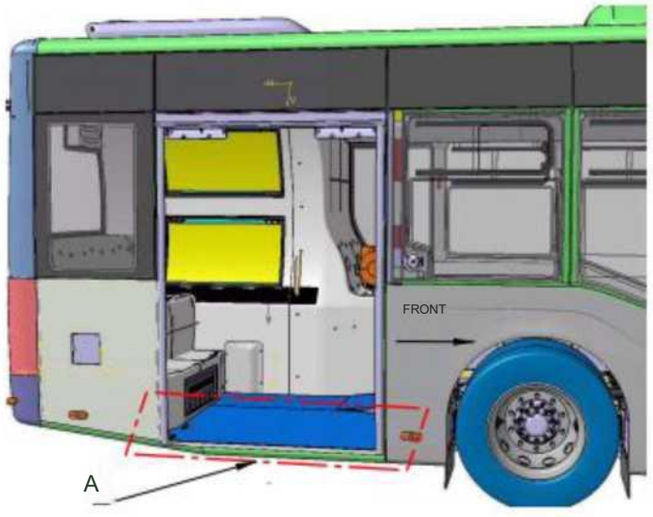
REAR DOOR CLOSE PROFILE INSTALLATION

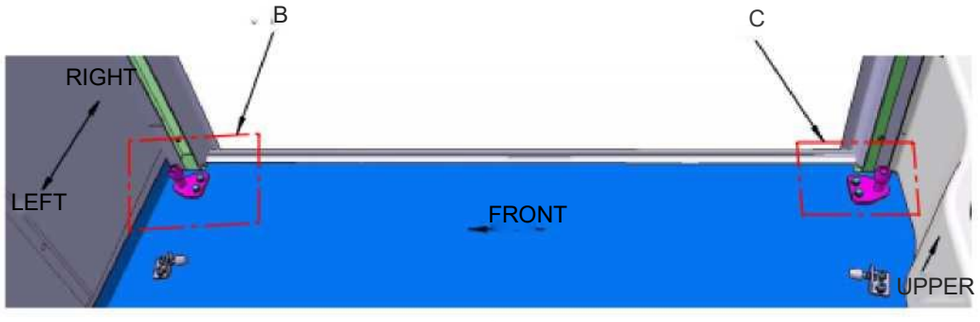




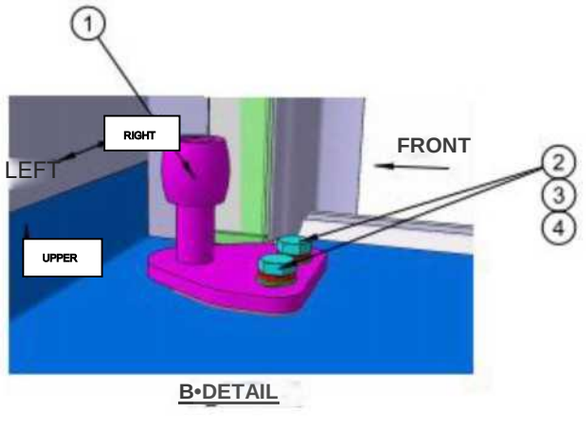
LEAFLET POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	952 - 039	387035092'	PILLAR CLOSE **PROFILE**	2
2	952 - 047	387046721*	DOOR PROFILE UPPER. EPDM RUBBER	2
3	952 - 040	387046692"	PROFILE, VEILING GLASS RECESS	2
4	952 - 048	337046720*	DOOR PROFILE, **EPDM** RUBBER	2
5	952 - 041	301894818	WASH SHEET SCREW **4.8X16**	27
6	952 - 038	387039412*	TIRE PROFILE	2

REAR DOOR ROTATING HANDLE LOWER FOOD BRACKET INSTALLATION

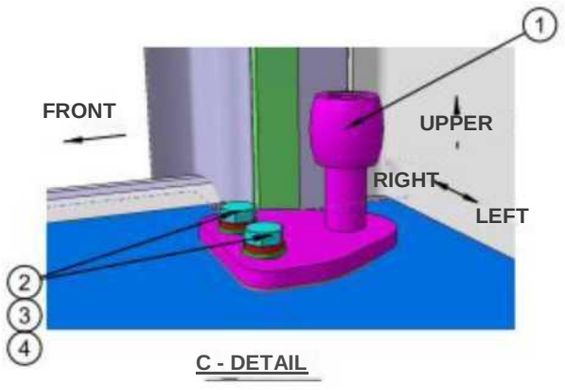




A - DETAIL
VEHICLE INSIDE VIEW



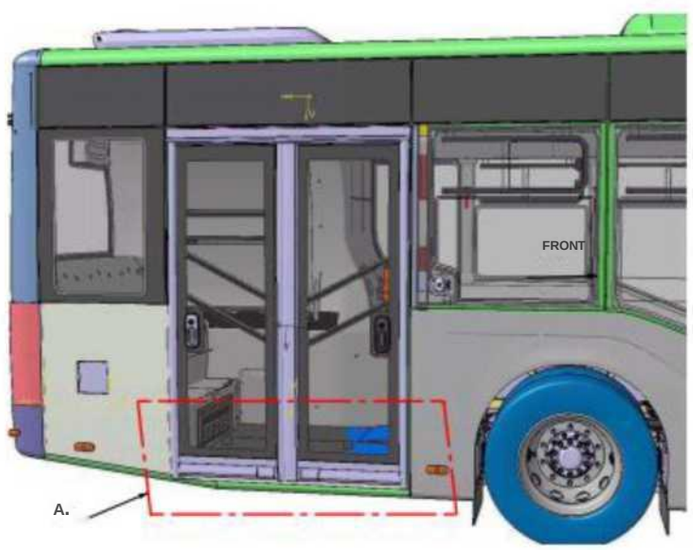
B•DETAIL

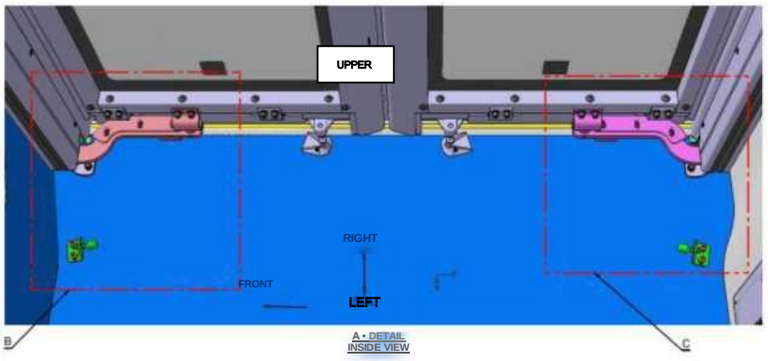


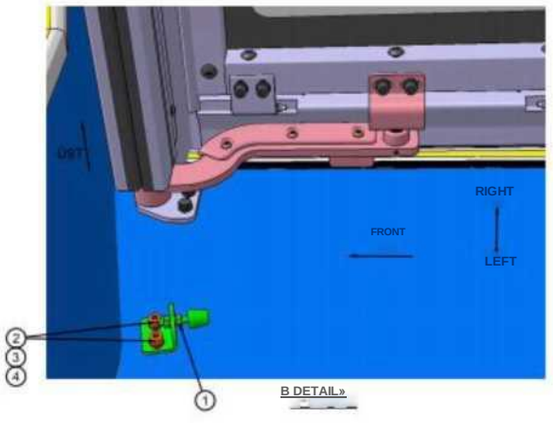
C - DETAIL

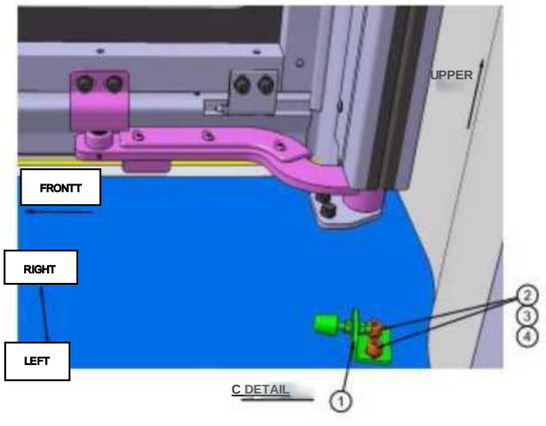
LEAFLET POSE	GROUP-POSE	PART NO	COMPONENT'S NAME	NUMBER
1	952-015	387038220*	BRACKET ALL , ROTATING HANDLE LOWER	2
2	952-016	3000108302*	BOLT , AKE M8X1.25X30, THICK D. DIN933	4
3	952 - 005	3010000086*	WASHER , FLAT D-8 DİN 125	4
4	952 - 003	3010100086*	WASHER , SPRINGY D=8 DIN 127	4

REAR DOOR SUPPORT INSTALLATION



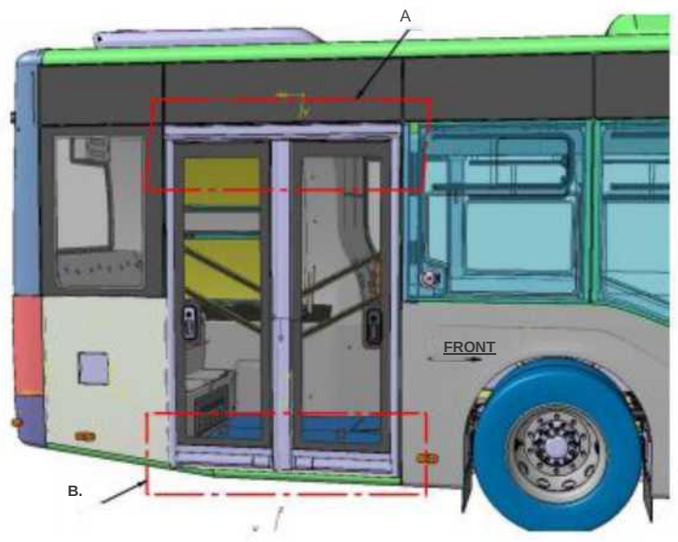


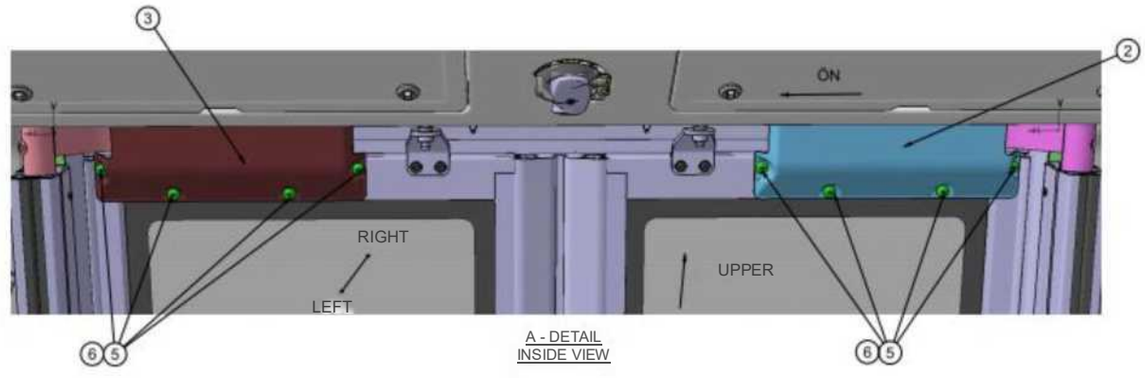




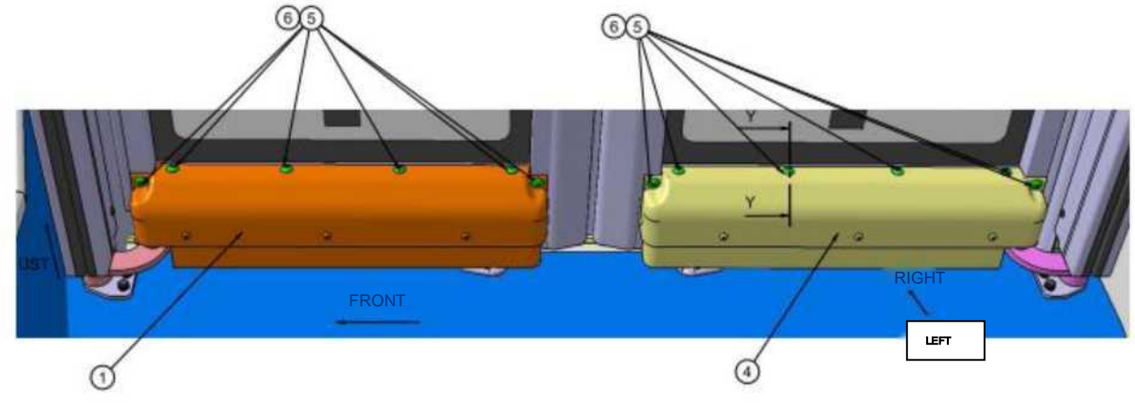
LEAFLET POSE	GROUP-POSE	PART NO	COMPONENT'S NAME	NUMBER
1	952 - 025	387023485*	DOLLY ALL . FRONT DOOR LOWER ELBOW	2
2	952 - 027	3010100088*	WASHER . SPRINGY D-İ DİN 127	4
3	952 - 028	3010000086'	WASHER , FLAT D=B DİN 125	4
4	952 - 029	3000908303	BOLT . ŞL . B. M8X30 DİN 912	4

REAR DOOR ASSEMBLY ABS CLOSE INSTALLATION

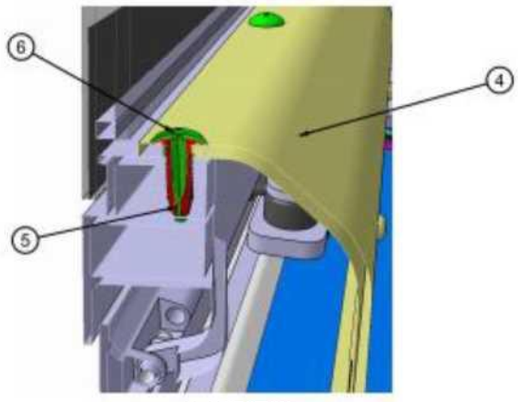




A - DETAIL
INSIDE VIEW



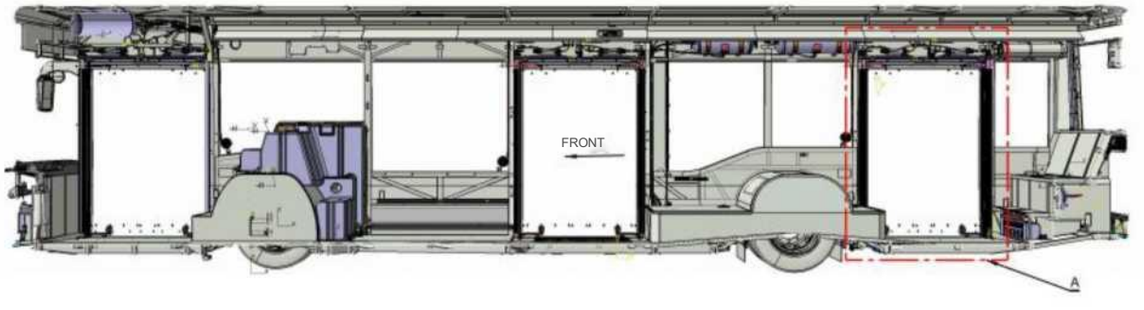
B - DETAIL
INSIDE VIEW

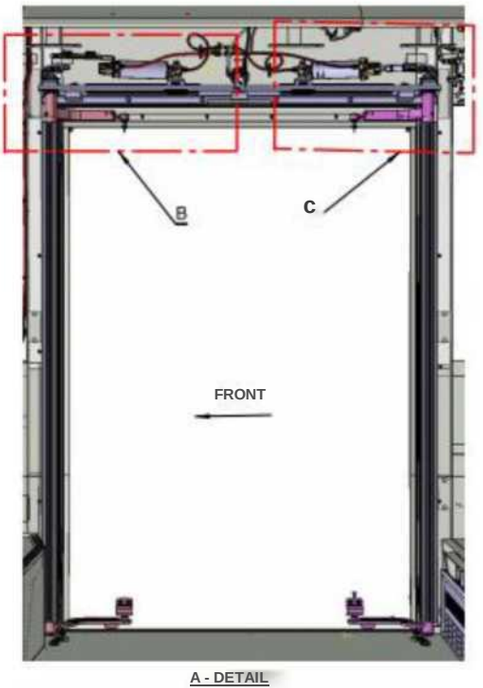


Y - Y SECTION

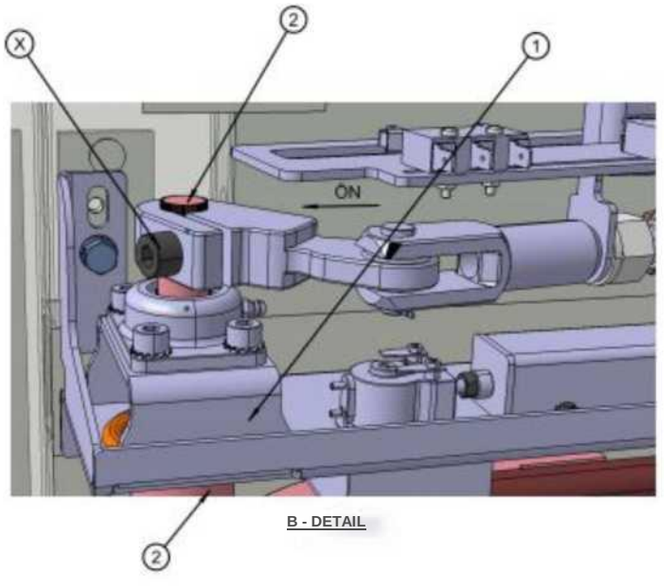
LEAFLET POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	952 -019	367038214*	CLOSE ASSEMBLY , FRONT DOOR LOWER	1
2	952 - 020	307025000*	CLOSE ALL E. FRONT DOOR UPPER LEFT	1
3	952 - 023	307025004'	CLOSE ASSEMBLY . FRONT DOOR UPPER	1
4	952 - 024	387038217"	CLOSE ASSEMBLY . REAR WING LOWER	1
5	952 - 033	387024991*	ANCHOR	20
6	952 - 034	307024902*	BOLT PLASTIC. BLACK	20

DOOR ROTATING HANDLE PISTONS INSTALLATION

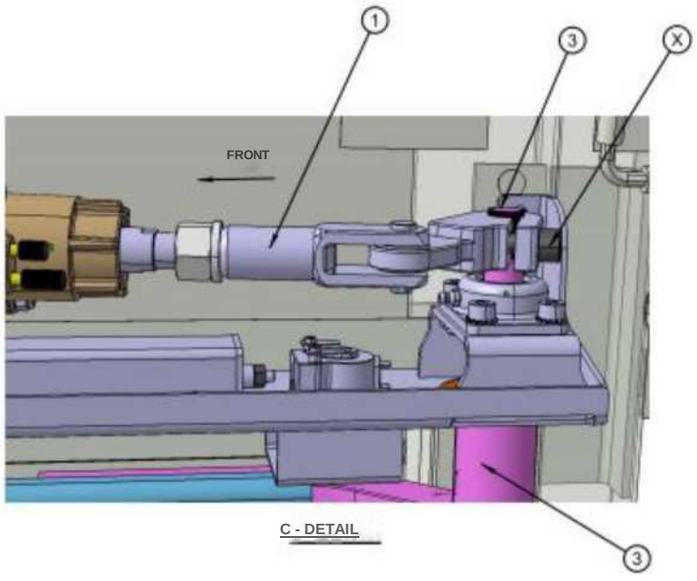




A - DETAIL

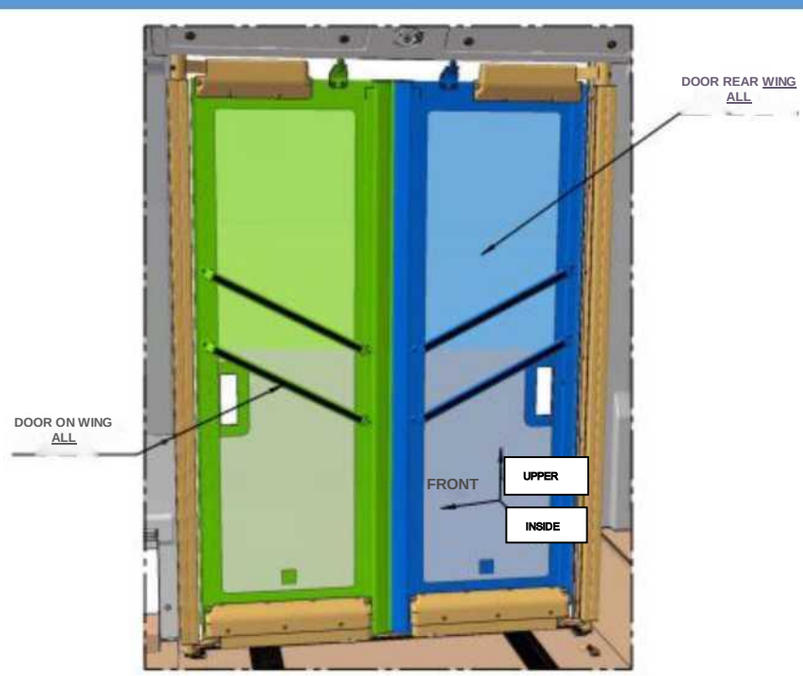


B - DETAIL



LEAFLET POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER	ADDITIONAL INFO
1	952-001	397038210*	PİSTON, MECHANISM GR. ALL. MIDDLE_REAR KAP	1	
2	952-004	387060886'	ROTATING HANDLE ASSEMBLY , DOOR FRONT POLE	1	CITIPORT CNG
2	952 - 004	397038104'	ROTATING HANDLE ASSEMBLY , DOOR FRONT POLE	1	
3	952 - 006	387501725*	ROTATING HANDLE ASSEMBLY , DOOR REAR POLE	1	CITIPORT CNG
3	952 -006	387038301"	ROTATING HANDLE ASSEMBLY , DOOR REAR POLE	1	

MIDDLE DOOR ALL ASSEMBLY

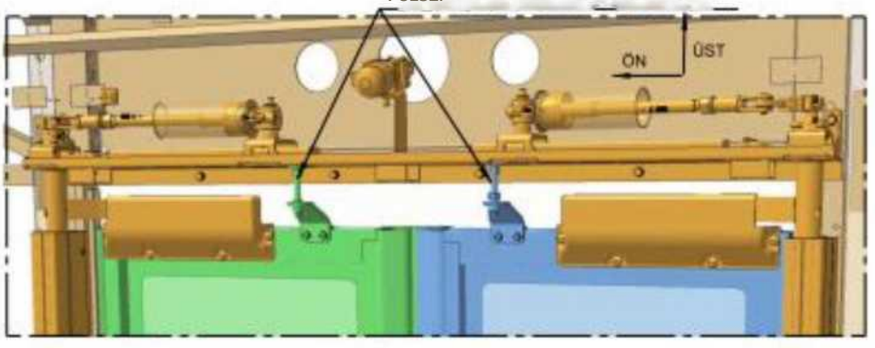


THE MIDDLE AXES OF THE PISTON MECHANISM GROUP WILL BE INSTALLED BY CONSIDERING THE SLOT HOLES.

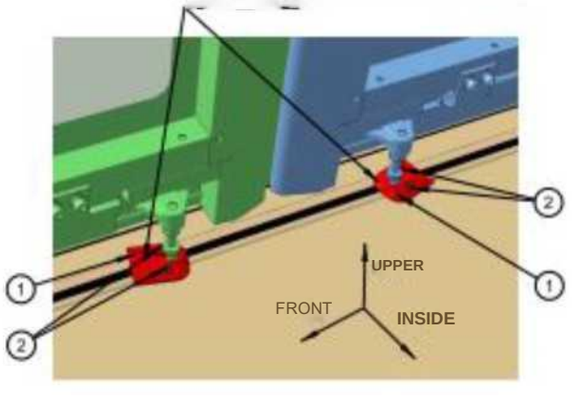
THE ROTATING HANDLE BOTTOM MECHANISM IS FITTING UNDER THE ROTATING HANDLE, THROUGH THE BED IN THE UPPER MECHANISM GROUP AND ATTACHING THE DISTANCE BUSH TO THE BACK OF THE LOWER BED, THERE IS THE DISTANCE BUSHING THAT ARE ATTACHED WITH THE SIZE CONNECTION ELEMENTS.

.THE SIZES GIVEN ARE VALID WITH AIR AND WITH THE DOORS CLOSED.

WHEN THE AIR PRESSURE EXISTS INSIDE THE ECCENTRIC HOUSING, THE DOOR WILL BE ADJUSTED THAT THE DOOR DOES NOT PULSE.

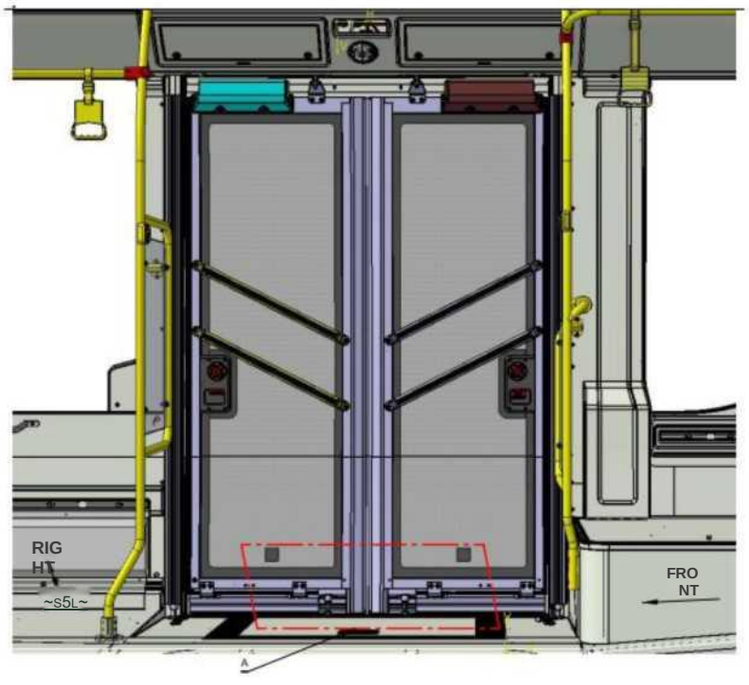


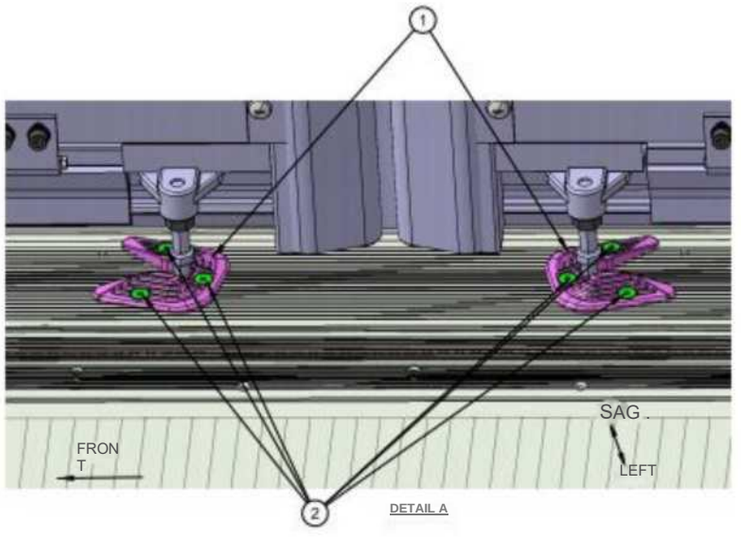
THE CHESTAMITE BOTTOM BEARINGS WILL BE DRILLED AND INSTALLED AFTER ADJUSTING THE DOOR PARALLEL TO THE THRESHOLD PROFILE.



LEAFLET POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	964-013	387043164	CENTERED BED ALL	2
2	964-014	3017006163	SCREW LOWER CORNER CUTTING(M6X16)	6

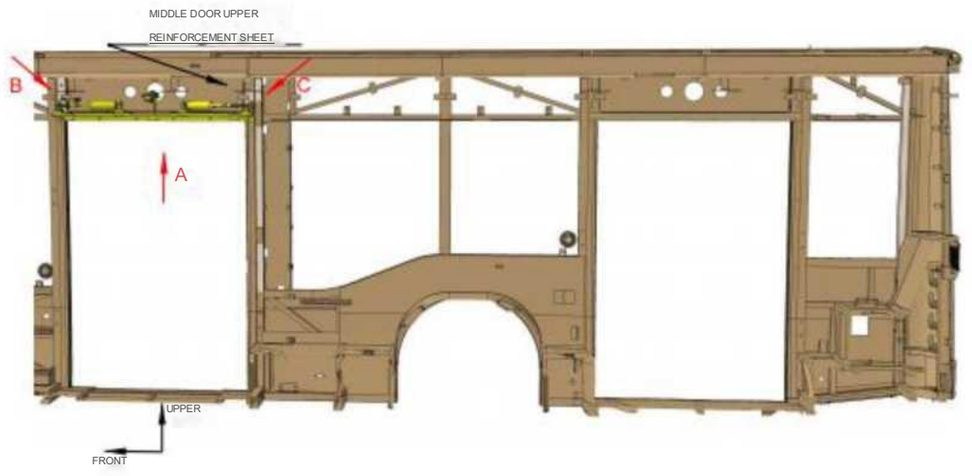
MIDDLE DOOR CENTERING BED ALL ASSEMBLY

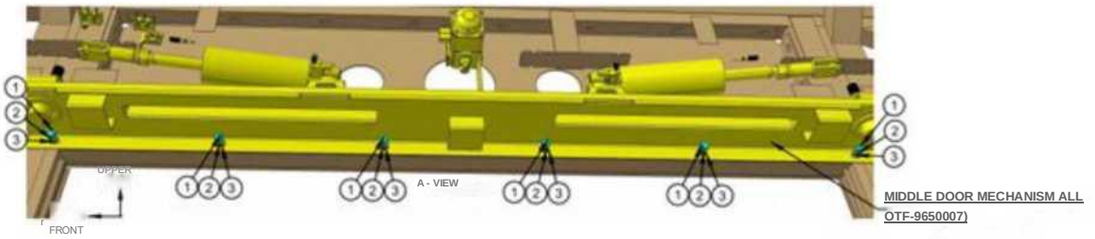


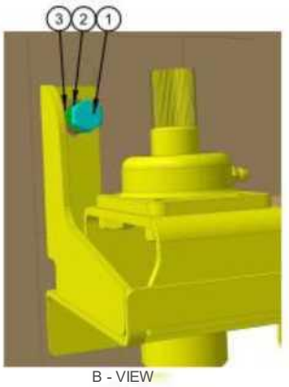


LEAFLET POSE	GROUP-POSE	PART NO	COMPONENT'S NAME	NUMBER
1	964-013	387043164*	CENTERING BED ASSEMBLY	2
2	964 - 014	3017006163*	SCREW LOWER CORNER CUTTING(M6x16)	6

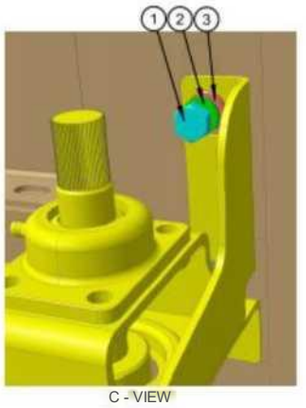
MIDDLE DOOR MECHANISM VEHICLE INSTALLATION







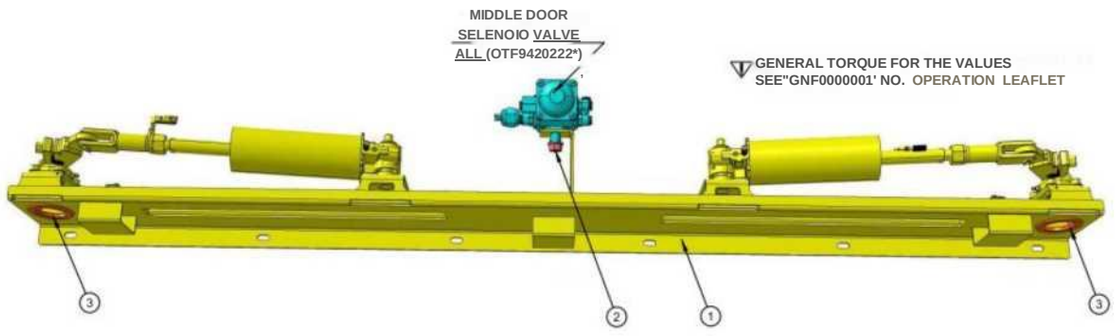
B - VIEW



C - VIEW

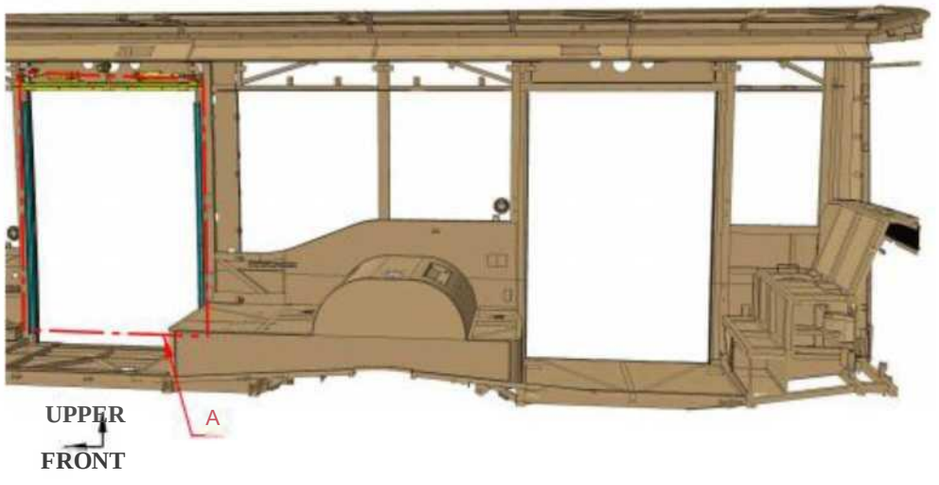
LEAFLET POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	965-002	3000108204*	BOLT . AKB M8X1.25X22. THICK D. DIN933	8
2	965 - 003	3010100080*	WASHER , SPRINGY D=8 DİN 127	8
3	965 - 005	3010000086*	WASHER , FLAT D=8 DİN 125	8

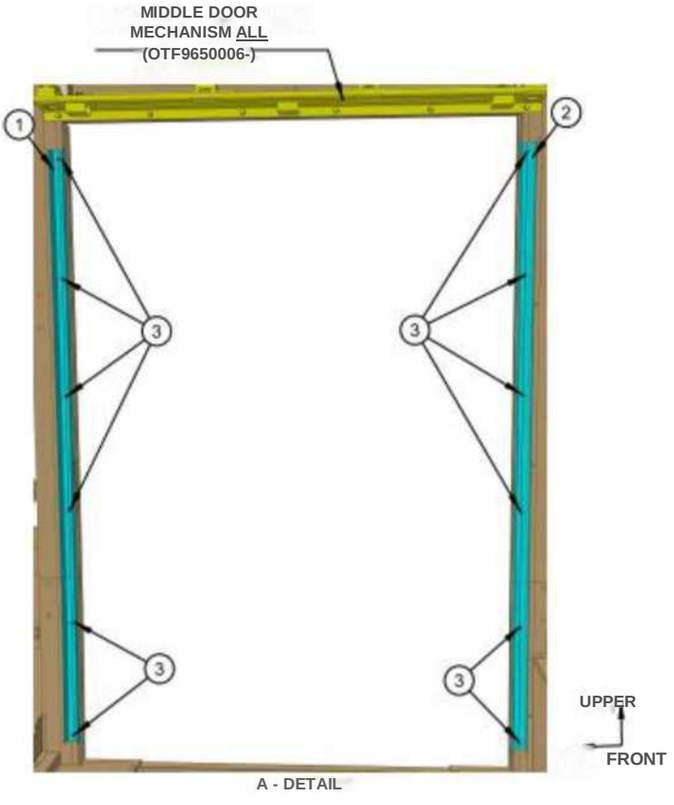
MIDDLE DOOR MECHANISM ASSEMBLY PREPARATION



LEAF POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	965 - 001	387030210*	PISTON MECHANISM GR.ALL, MIDDLE_REAR DOOR	1
2	951 - 046	3005800106*	NUT , FLN&TR M10X1. 5, THICK D. DİN 692	1
3	965 -035	387027740*	GROMMET	2

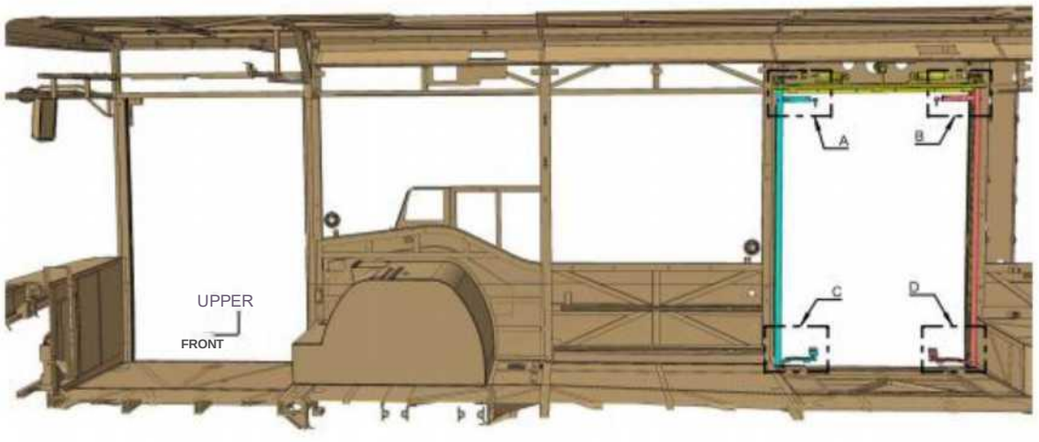
MIDDLE DOOR CONNECTION PROFILE INSTALLATION

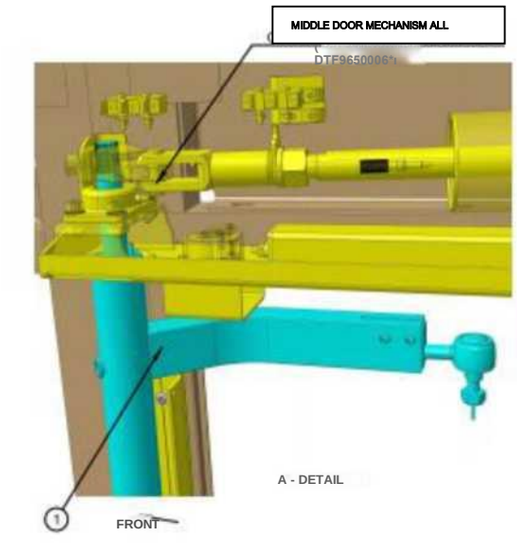




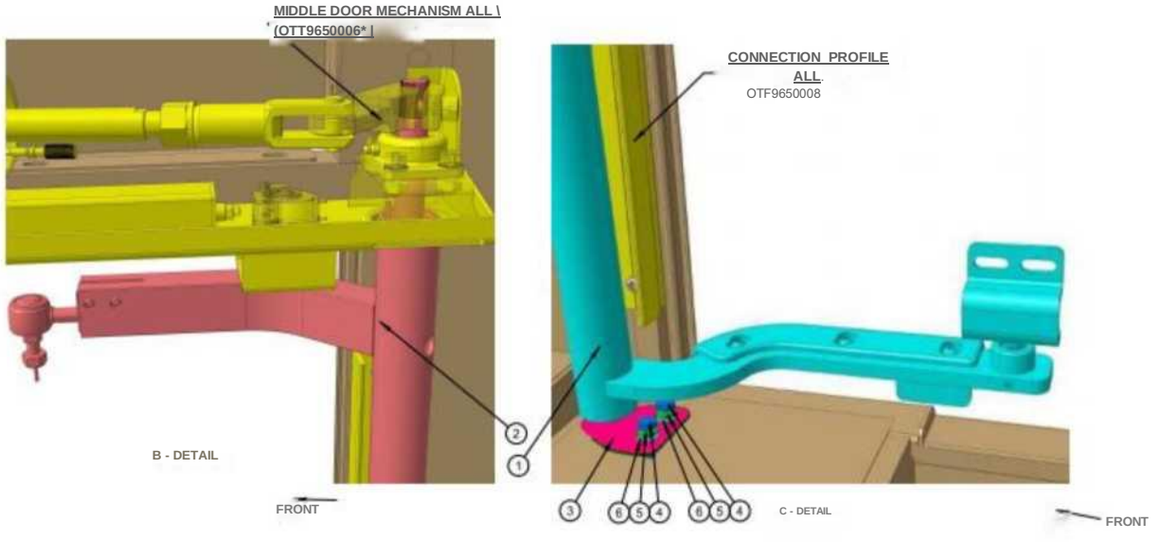
LEAFLET POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	965 - 036	387035099*	CONNECTION PROFILE	1
2	965 - 037	337035096*	CONNECTION PROFILE	1
3	965 -041	3018943163*	WASHER.SHEET SCREW 4.8X1 S	12

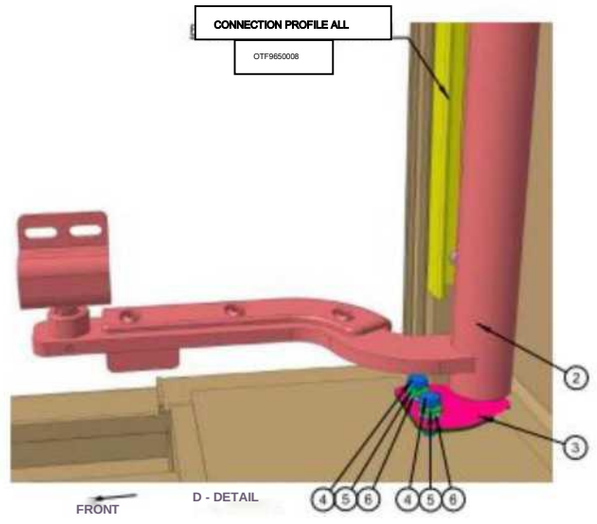
MIDDLE DOOR ROTATING HANDLE ASSEMBLY INSTALLATION





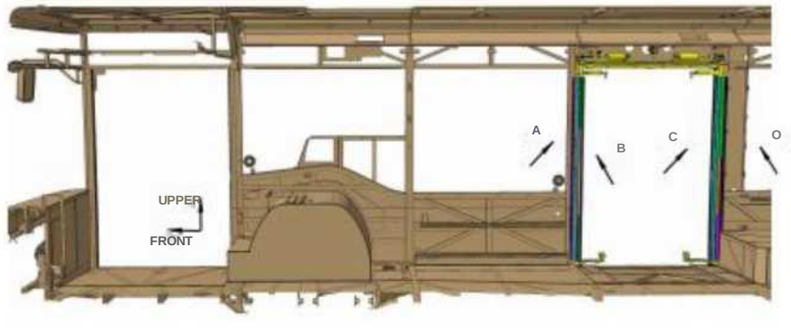


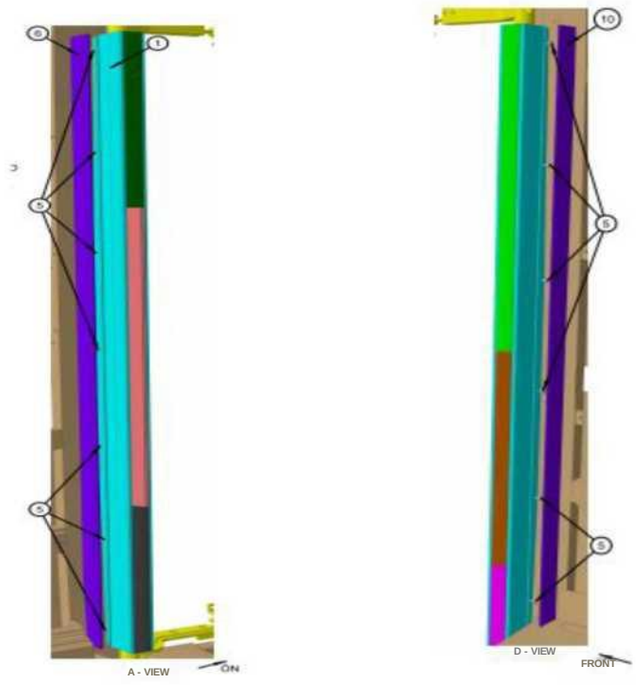


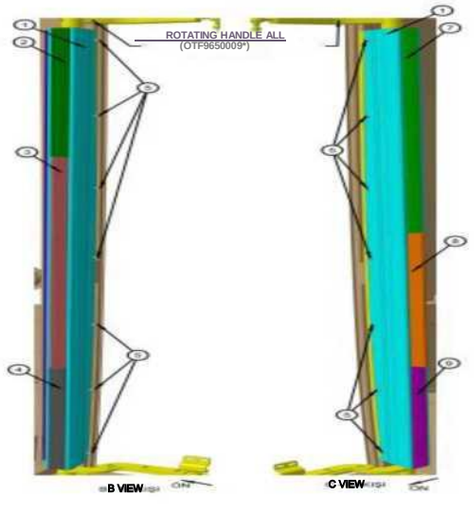


LEAFLET POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	965-004	387038194*'	ROTATING HANDLE ALL DOOR FRONT POLE	1
2	965 - 006	387038201*	ROTATING HANDLE ALL . DOOR REAR POLE	1
3	966- 015	387036220-	FOOT BRACKET ALL ROTATING HANDLE LOWER	2
4	966- 016	3000108302*	BOLT , AKB' M8X 1.25X30 THICK D. DIN933	4
5	966-003	3010100035'	WASHER . SPRINGY D=B DİN 127	4
6	966-005	3010000086	WASHER , FLAT D*6 DİN 125	4

MIDDLE DOOR MECHANISM CLOSE PROFILES INSTALLATION

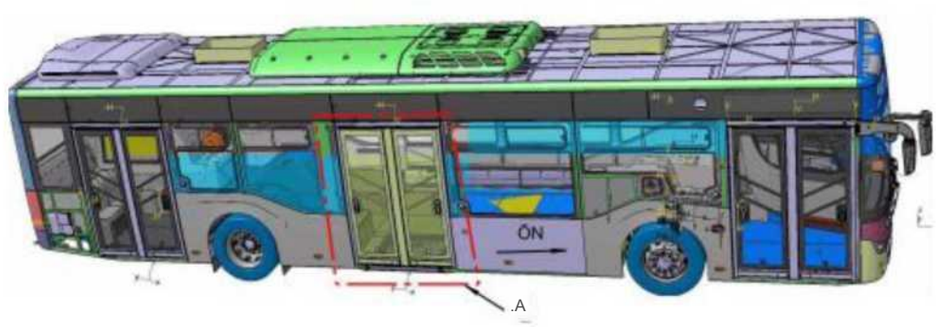


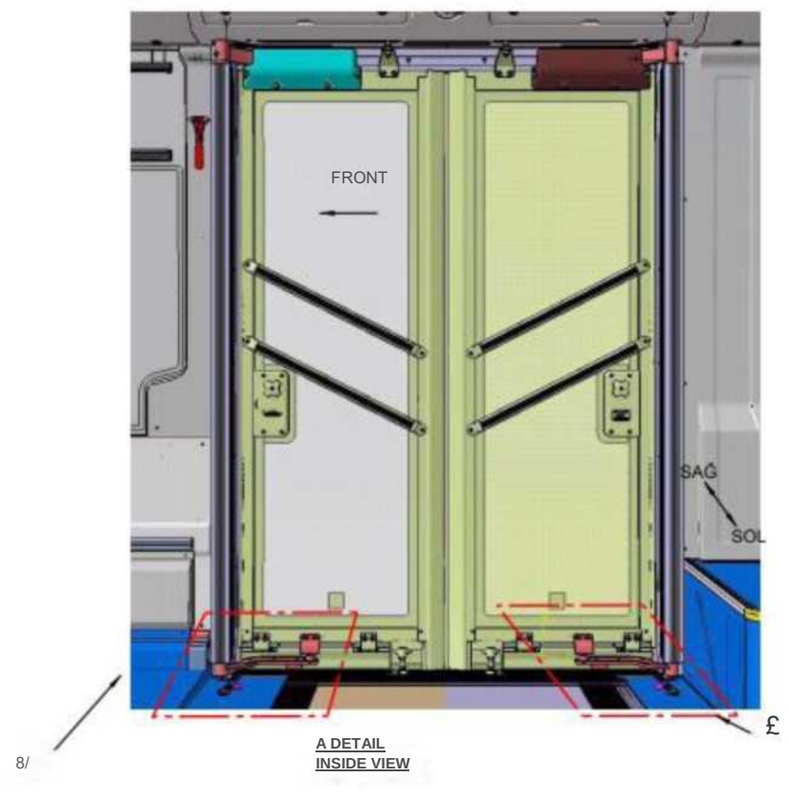




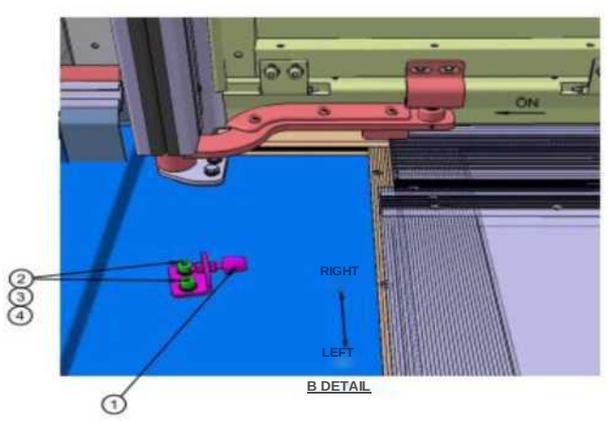
LEAF POSE	GROUP-POSE	PART NO	COMPONENT'S NAME	NUMBER
1	965 - 039	387035092'	PILLAR. CLOSE PROFILE	a
2	965 - 050	387046723*	DOOR PROFILE UPPER RIGHT EPDM RUBBER	1
3	965 - 040	387046694"	PROFILE SAW GLASS SLOT LONG	1
4	965 -051	387046722*	DOOR PROFILE RIGHT EPDM RUBBER	1
5	965 _ 041	3018948163'	WASHER SHEET HOUSING . 4.8X16	27
6	965 - 038	387035093*	TIRE. PROFILE	1
7	965 - 048	387046721 *	DOOR PROFILE UPPER, EPDM RUBBER	1
8	965 - 047	387046692'	PROFILE SAW GLASS SLOT	1
9	965 - 047	387040720*	DOOR PROFILE. EPDM RUBBER	1
10	-965 - 042	387039412*	TIRE. PROFILE	1

MIDDLE DOOR STRAPS INSTALLATION

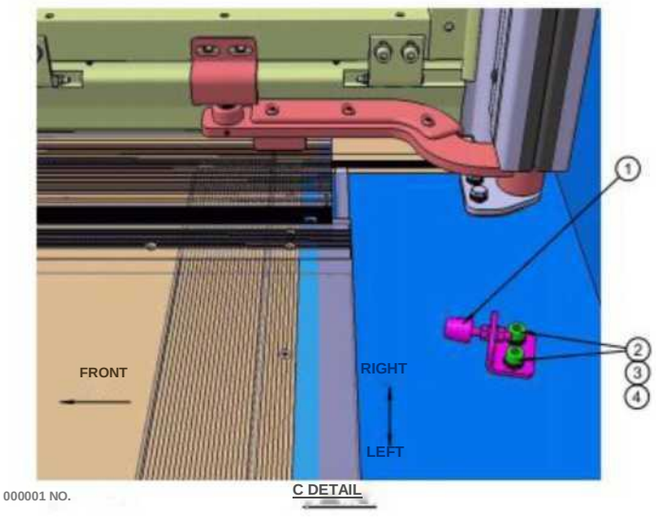




A DETAIL
INSIDE VIEW



B DETAIL

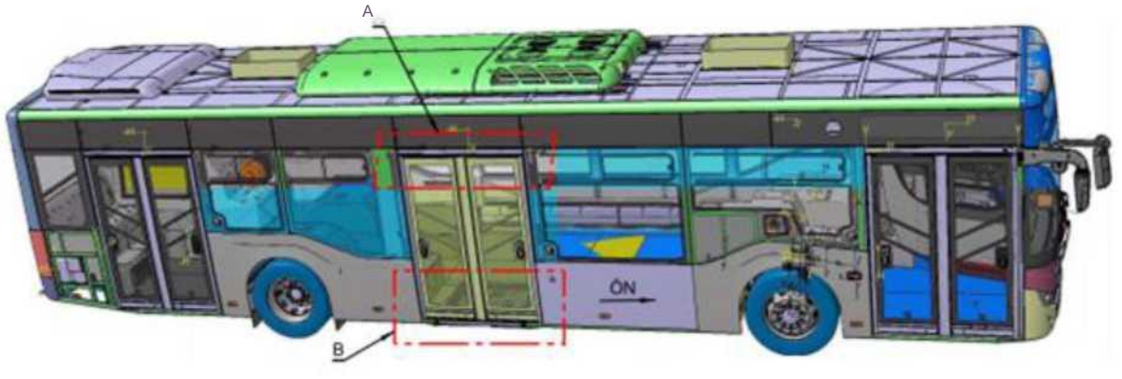


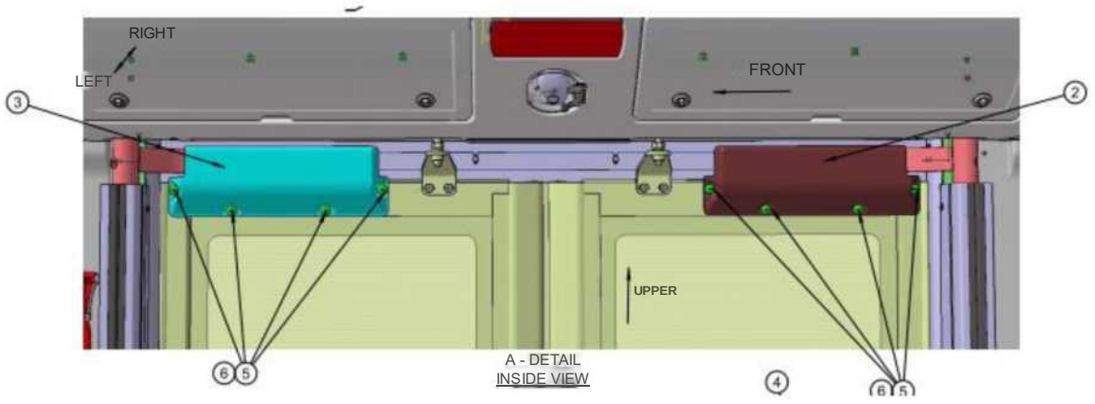
000001 NO.

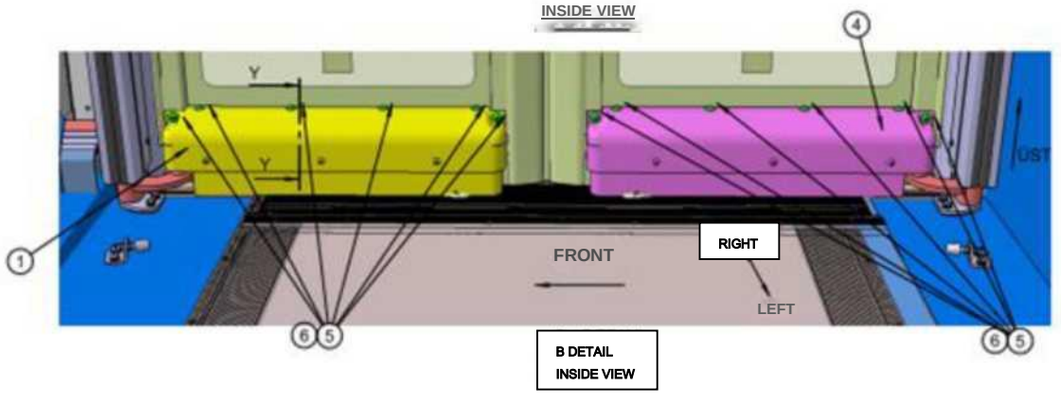
C DETAIL

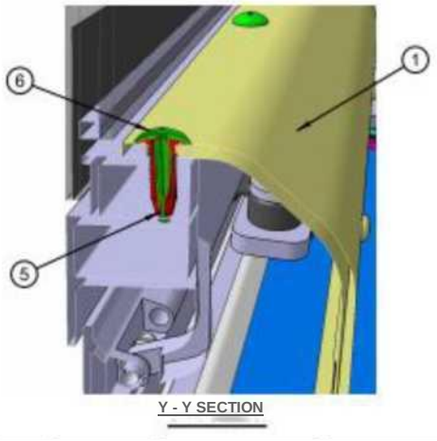
LEAFLET POSE	OROUP-POSE	PART NO	COMPONENT'S NAME	NUMBER
1	965 - 023	357023407*	DOLLY ALL **MIDDLE-REAR** DOOR LOWER ELBOW	2
2	965 - 003	3010100088	**WASHER , SPRINGY D=8 DİN** 127	4
3	965 - 005	3010000088*	WASHER , FLAT D=8 **DİN** 125	4
4	965 - 029	3000908303*	**BOLT SLB M8X30, THICK D. DIN012**	4

MIDDLE DOOR ASSEMBLY ABS CLOSE INSTALLATION



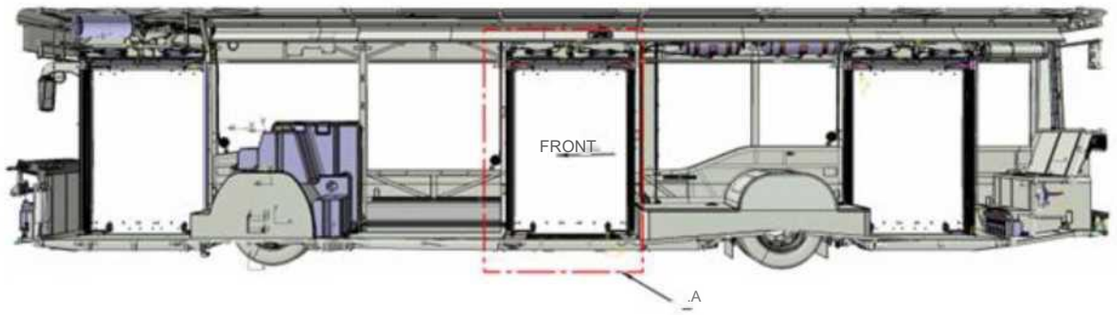


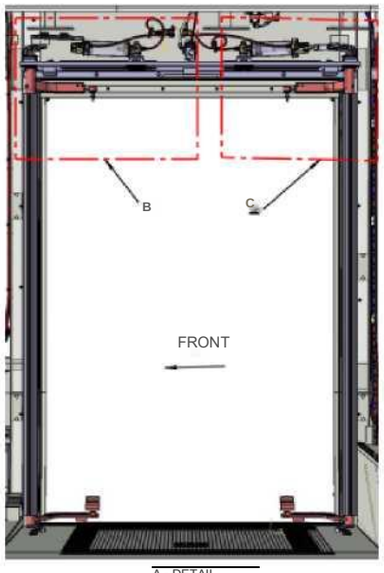




LEAFLET POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	W5-019	387030214'	CLOSE ALL , FRONT DOOR LOWER	1
2	965-020	397026000*	CLOSE ALL. FRONT DOOR UPPER LEFT	1
3	9S5-023	307025004*	CLOSE ALL , FRONT DOOR UPPER	1
4	965 - 024	387038217'	CLOSE ALL . REAR WING LOWER	1
5	985-033	387024991"	ANCHOR. PLASTIC, BLACK	20
6	006-034	387024992'	BOLT . PLASTIC. BLACK	20

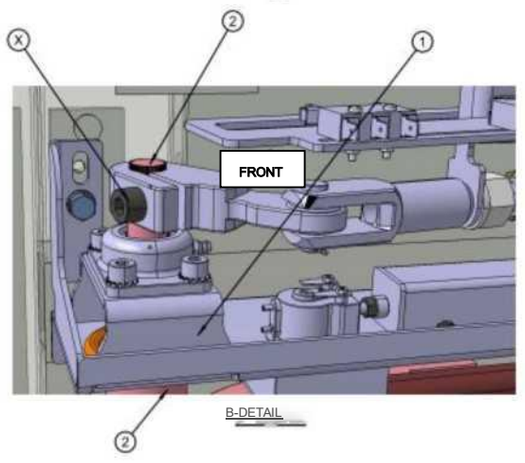
ASSEMBLY OF DOOR SWIVEL HANDLE ON PISTONS



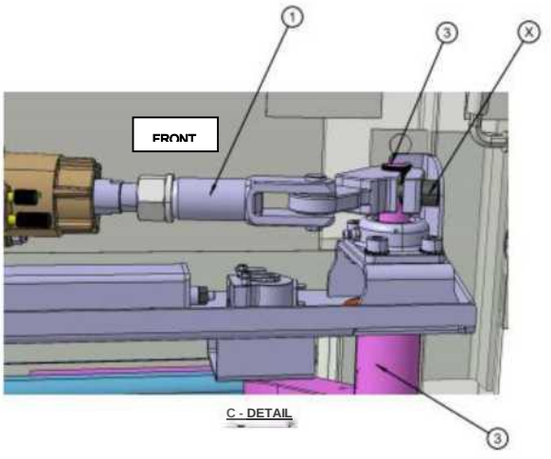


A - DETAIL

LEAFLET POSE	GROUP POSE	PART NO	COMPONENT'S NAME	NUMBER
1	965-001	367036210'	PISTON MECHANISM GR. ALL, MIDDLE / REAR DOOR	1
2	965 - 904	387060886-	ROTATING HANDLE ASSEMBLY , DOOR FRONT POLE	1
3	985 - 006	387601725-	ROTATING HANDLE ASSEMBLY . DOOR REAR POLE	1

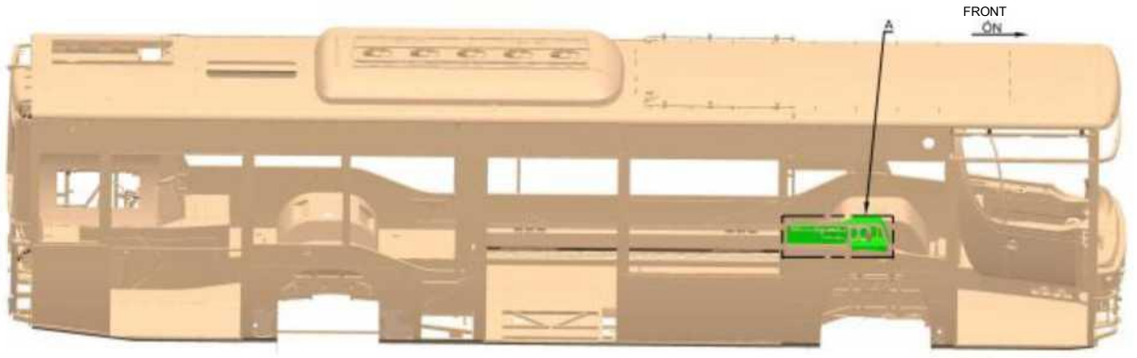


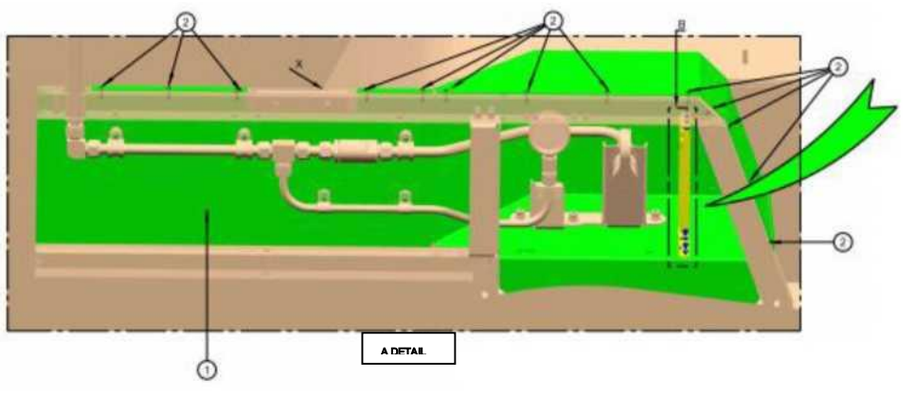
B-DETAIL

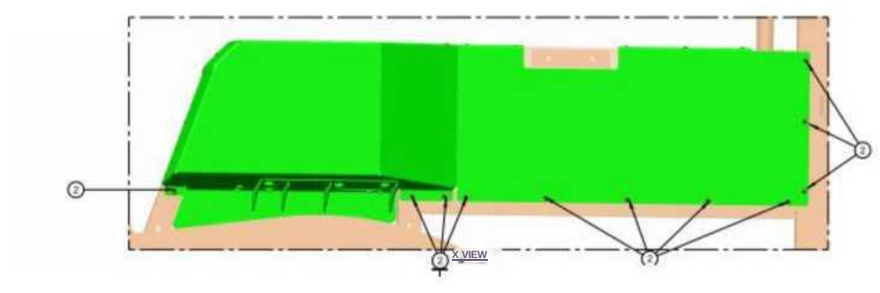


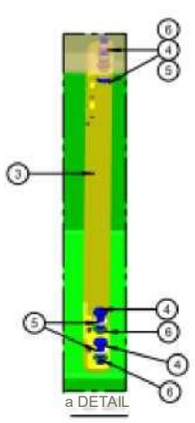
C - DETAIL

FUEL FILLING COVER VE HINGE CONNECTION INSTALLATION



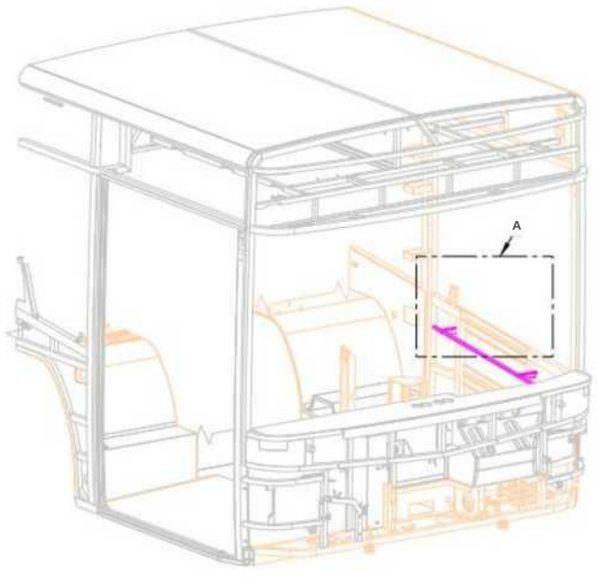




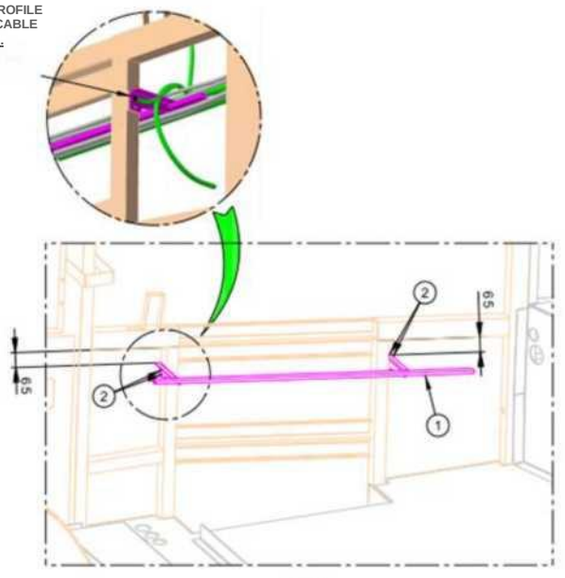


LEAFLET POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	956 - 003	307044219	FILLING NOZZLE BOX ASSEMBLY	1
2	956 - 031	3017942194'	SCREW. LENTIL FLARE HEAD 4.2	24
3	956 - 003	387044469'	BRACKET . HINGE CONNECTION	1
4	956 - 032	3000105164'	BOLT , AKB M5X0.8X16, THICK D. DIN933	4
5	956 - 034	3010100054*	WASHER , SPRINGY 05 DİN 127	4
6	956-033	301000054'	WASHER , FLAT D=5 DİNİ 26	4

MONTAGE HOLDER PROFILE INSTALLATION



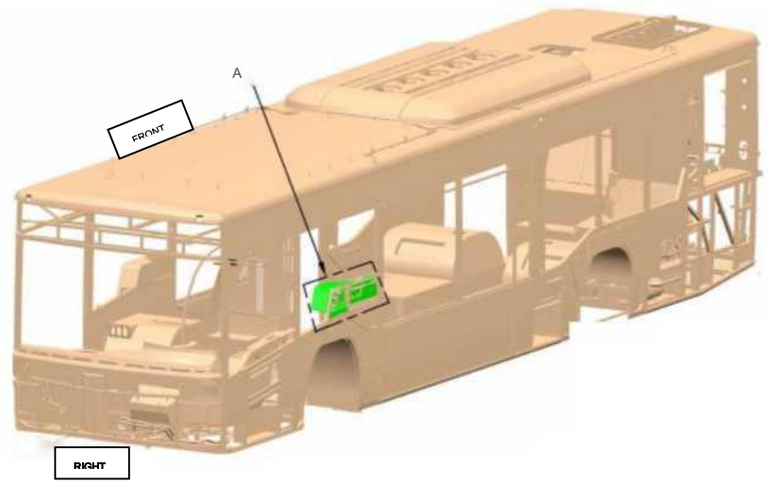
WHEN THE INSTALATION HOLDER PROFILE IS INSTALLED. CHASSIS EARTHING CABLE INSTALLATION WILL ALSO BE MADE.

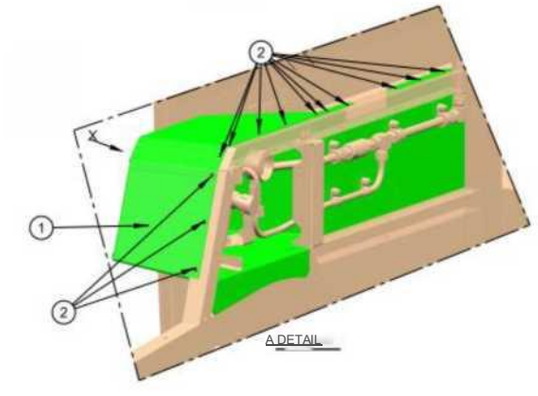


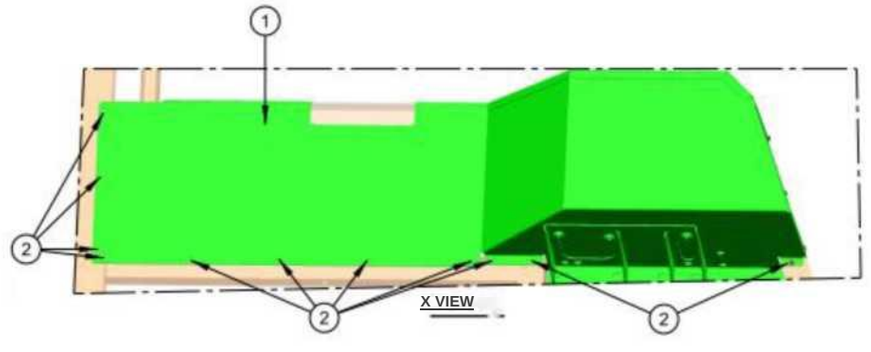
A DETAIL

LEAFLET POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	957 - 006	387040344*	PROFILE, INSTALATION HOLDER	1
2	957-013	3001206166	BOLT , FLN M6X1X16, THICK D. DIN6921	4

FUEL FILLING CAP ASSEMBLY

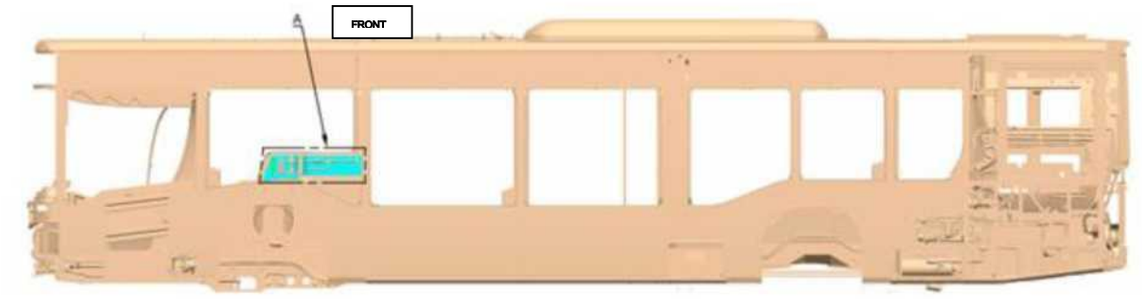


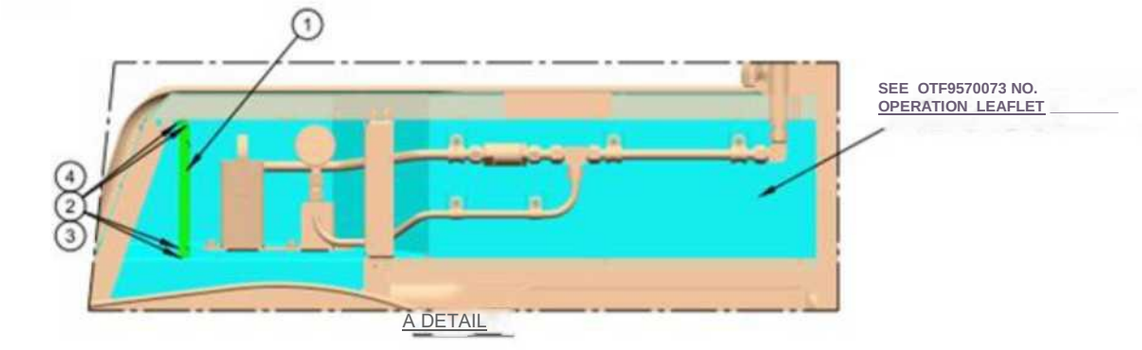




LEAFLET POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	957-010	387044233*	FILLING NOZZLE BOX ASSEMBLY	1
2	957 - 021	3017942194*	SCREW. LENTIL TOWEL HEAD 4.2	24

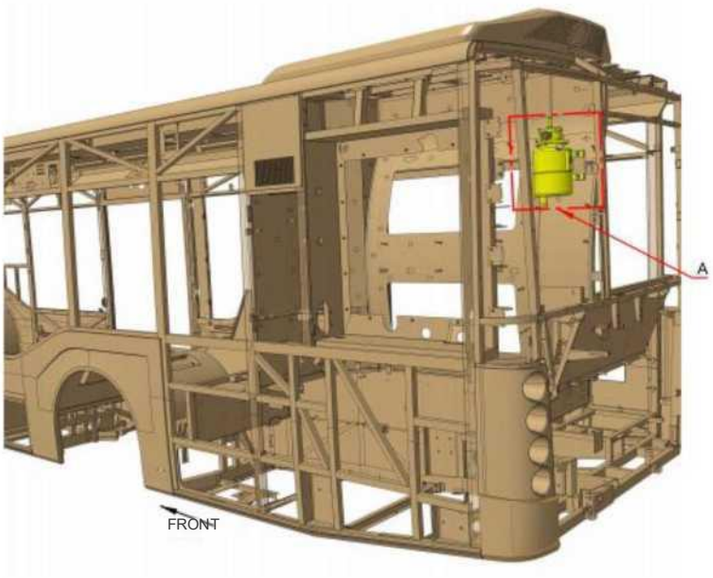
FUEL FILLING CAP HINGE ASSEMBLY

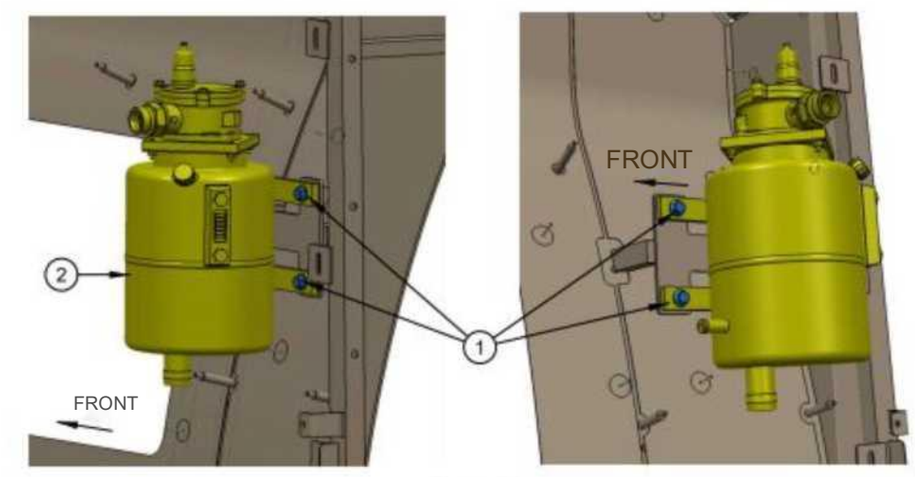




LEAFLET POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	957 - 007	387044563*	BRACKET . HINGE CONNECTION	1
2		3000105164*	BOLT . AKB M5X0.BX16, THICK D. DIN933	4
3		3010100054*	WASHER , SPRINGY D=5 DİN 127	4
4		3010000054*	WASHER , FLAT D=5 DIN125	4

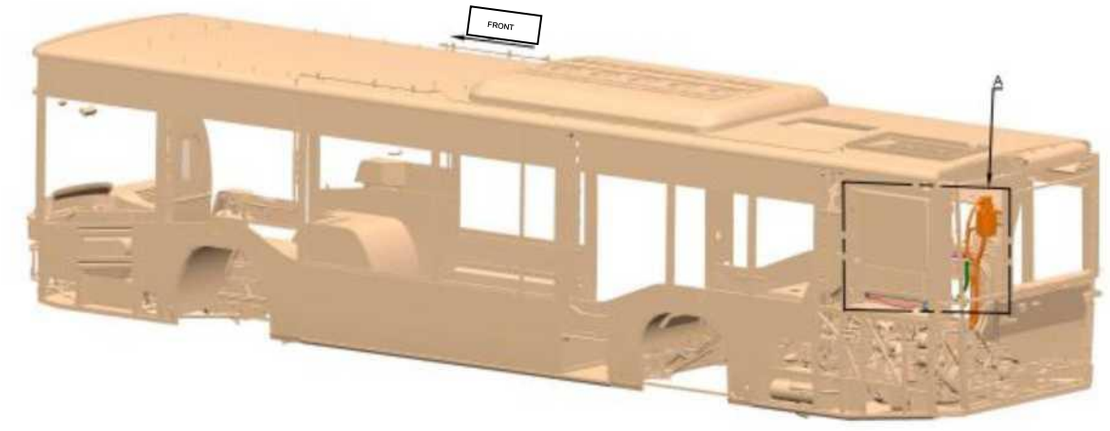
FAN DRIVE SYSTEM INSTALLATION

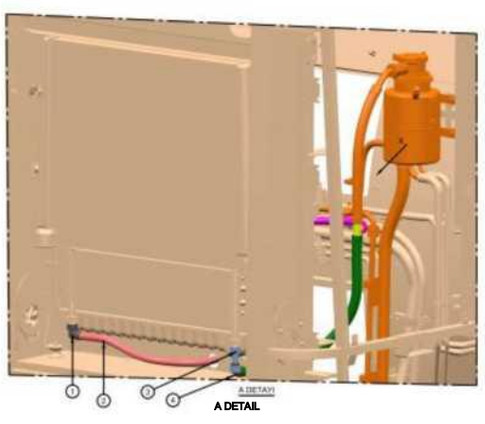


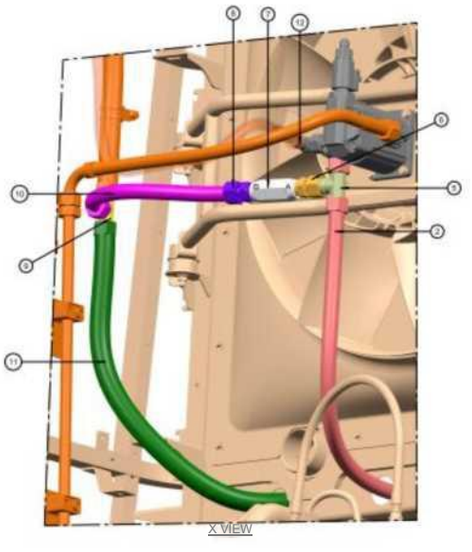


A DETAIL

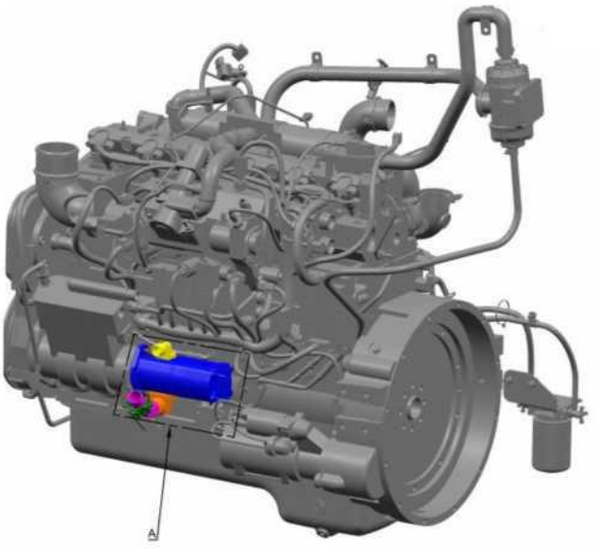
LEAFLET POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER	ADDITIONAL INFO
1	966 - 004	3001410306*	BOLT , FLN M10X1.25X30, THİN D. DIN6921	4	
1	969 - 046	3001410304*	BOLT , FLN M10X1.25X30, THİN D. DIN6921	4	CITIPORT CNG
2	969 - 001	384311995*	HYDRAULIC TANK	1	CITIPORT CNG
2	969 - 001	387056163*	TANK KMPL, OIL, 8LT	1	

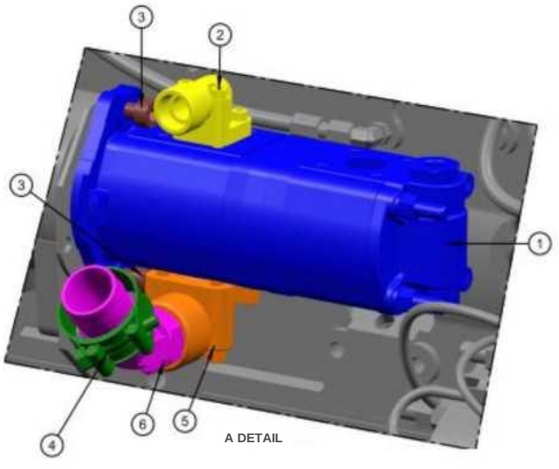






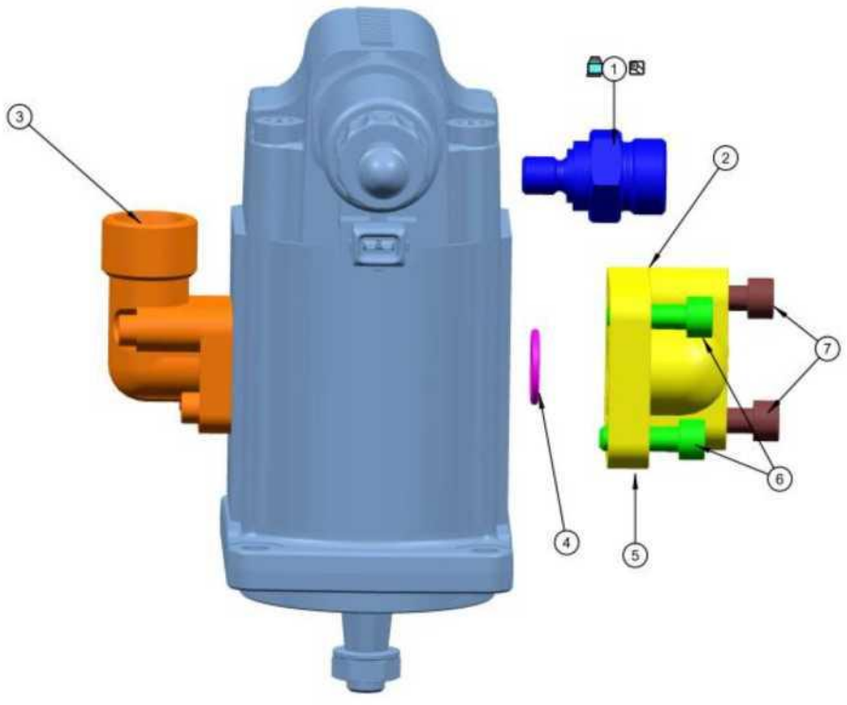
LEAF POSE	GROUP-POSE	PART NO	COMPONENT'S NAME	NUMBER
1	969 - 047	387057305-	HOSE KMP HYDRAULIC	11
2	969 - 050	387057297*	HOSE . INPUT, COOLER, OIL	1
3	969 - 047	307044006*	PIPE , RADIATOR INPUT	1
4	969 -047	387033785-	ELBOW. HOSE KMPL, TANK. TURN.	11
5	969 - 047	307033521*	PIPE COUPLING . Ø20. T. RADIATOR OUTLET	1
6	969 - 047	**387033525**	PIPE COUPLING . 3/4", REVERSE, PEFLEXLI. RADIATOR	1
7	969 - 047	387033523	CHECK VALVE LINE TYPE	1
8	969 - 047	387033626*	PIPE COUPLING . 3/4. REVERSE PEFLEXLI RADIATOR	11
9	969 - 047	387033521**	PIPE COUPLING . Ø20 T, RADIATOR OUTLET	1
10	969 - 048	387067304*	HOSE . CONNECTION	1
11	969 - 049	387057298*	HOSE . OUTLET, COOLER. OIL	1
12	969 - 025	3870581000*	WASHER COPPER. M14. HOSE KMPL SLIP LINE	1





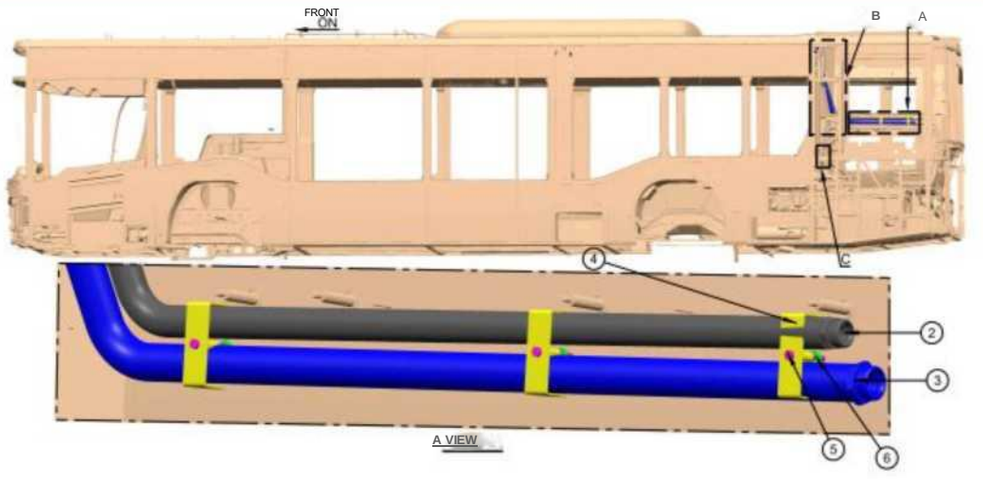
LEAFLET POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	969 - 023	387704376*	PUMP, HYDRAULIC, R918PT2737	1
2	969 - 063	387056153*	ADAPTER. PRESSURE LINE, HYDRAULIC	1
3	969 - 029	3000910304*	BOLT , SLB M10X30, THICK D. DIN912	2
4	939 - 008	3871000230*	**CLAMP , Ø49-53**	1
5	969 - 006	387056243*	ADAPTER, EXTRACTION	1
6	969 - 005	387056169*	PIPE COUPLING . 45 DEGREES , HYDRAULIC	1

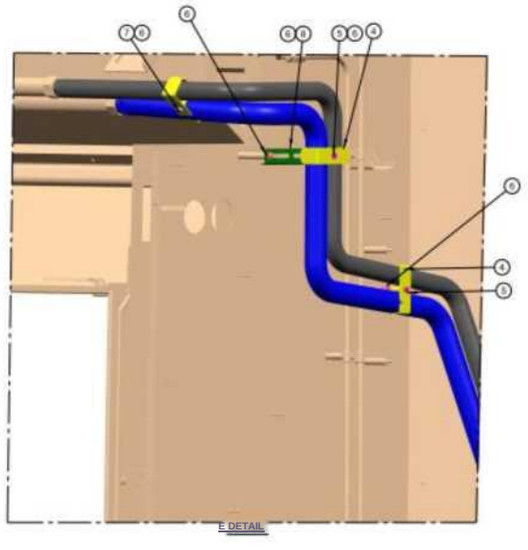
HYDRAULIC FAN ENGINE ASSEMBLY FRONT PREPARATION

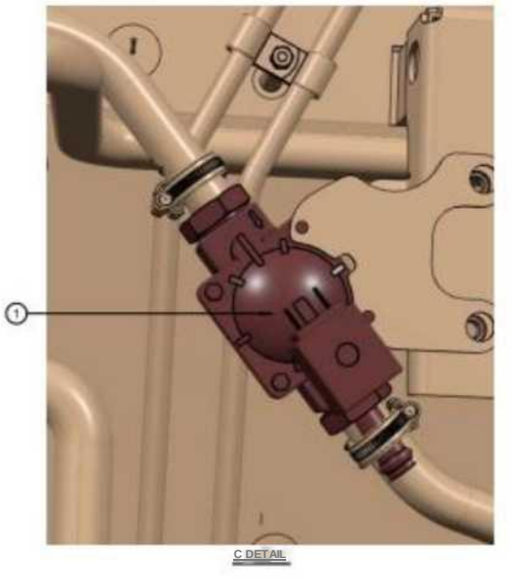


LEAFLET POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	969-018	367704377*	PIPE COUPLING , SLIP LINE. HYDRAULIC	1
2	969 - 072	384312583*	ADAPTER, HYDRAULIC	1
3	969 - 063	387058153*	ADAPTER, PRESSURE LINE. HYDRAULIC	1
4	969-019	387056159*	O-RING, ø19X2,5, HOSE KMPL, PRESSURE HAT	1
5	969 - 072	384312583*	ADAPTER, HYDRAULIC	1
6	969 - 076	3000908254*	BOLT SLB M8X25, THICK D. DIN912	2
7	969 - 075	3000908456*	BOLT SLB LI8X45, THICK D. DIN912	

ENGINE ROOM AIR CONDITIONING HOSES INSTALLATION



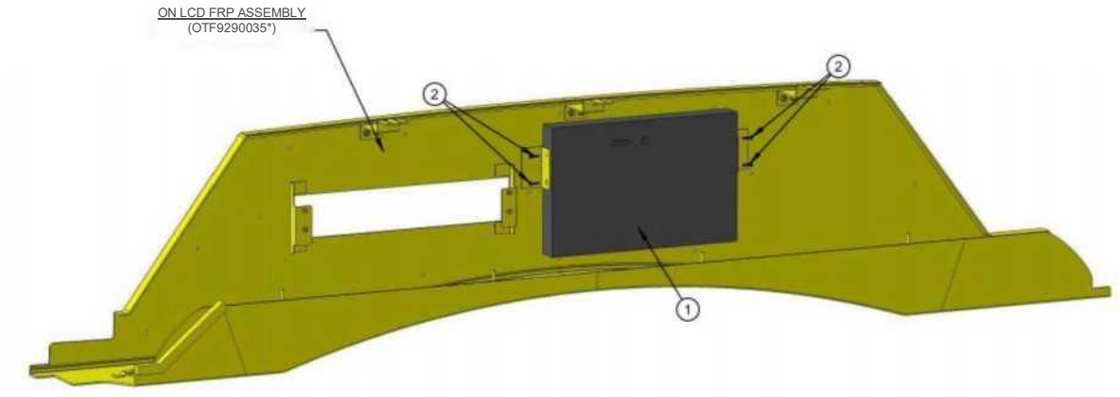




LEAFLET POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	972 - *024*	387039052'	VALVE. SOLENOID HEATED AIR CONDITIONING	1
2	972 -011	**357309514'**	**PIPE, LOW PRESSURE 1**	11
3	972 -013	387809515	**PIPE, LOW PRESSURE 1**	1
4	**972 - 014**	**387035979**	**BRACKET . AIR CONDITIONING**	6
5	972 - 973	3000106554*	BOLT . AKB **M6X1X55, THICK D.** DIN9S3	B
6	972 - 974	3005800068*	NUT . FLNSTR M5X1 THICK D. DIN3023	B
7	972 - 031	3000303454*	**BOLT , AKB M5K1X45 İTHICK D. DIN931**	1
8	972 - 97S	397030912*	**BRACKET**	1

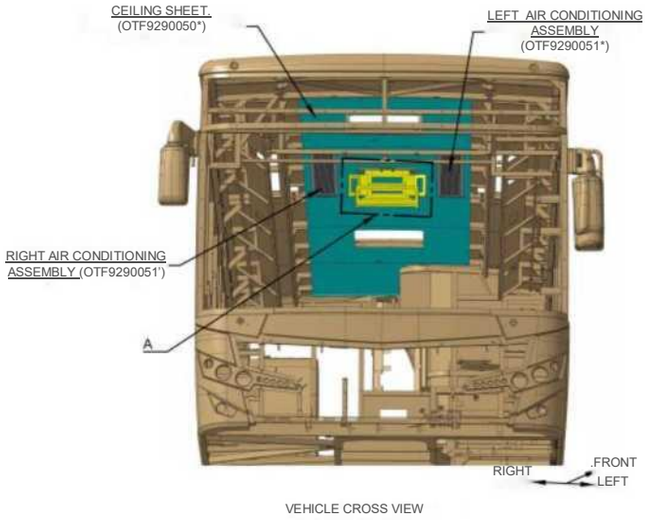
TV, VIDEO AND MICROPHONE INSTALLATION

19” LCD INSTALLATION

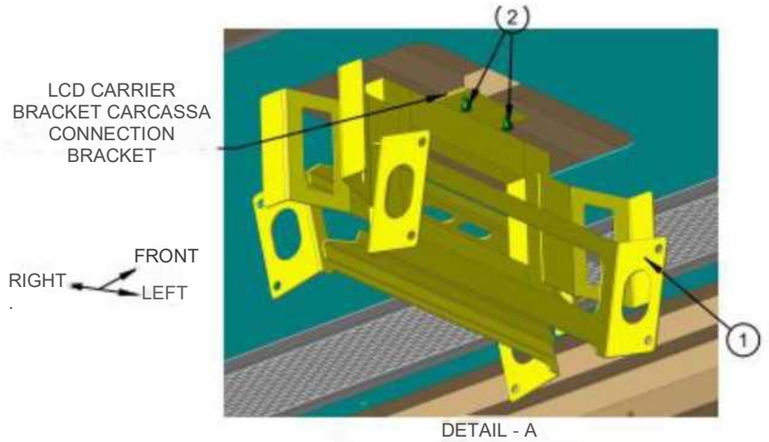


LEAFLE TET POSE	GROUP/POSE	PART NO	COMPONENT’S NAME	NUMBER
1	973 -028	387723937*	LCD, JMIE 19"	1
2	973 -008	301500520*	SCREW NI5X2O DİN 7986	4

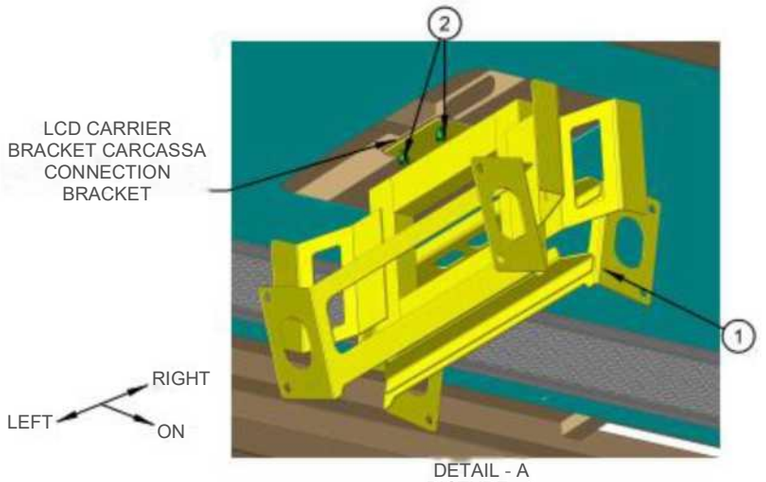
LCD CARRIER BRACKET TO VEHICLE INSTALLATION



VEHICLE CROSS VIEW



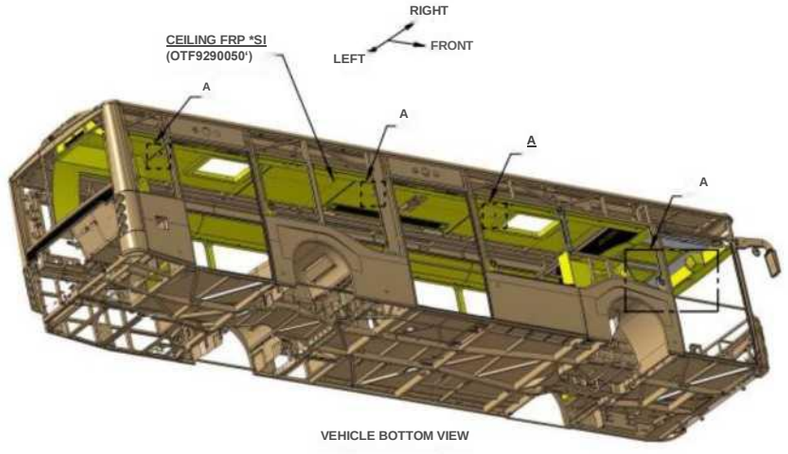
DETAIL - A
PICTURE - 1



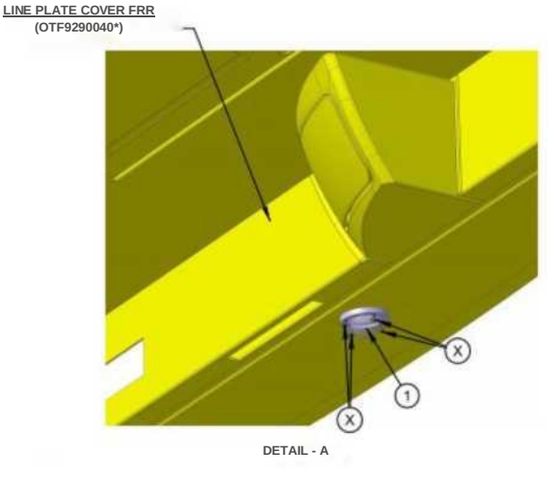
DETAIL - A
PICTURE - 2

LEAFLET POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	973 - 001	387046783*	BRACKET LCD CARRIER	1
2	973 -017	3000908203*	BOLT SLB 8X20, THICK D. DIN912	4

CCTV GLASSERA INSTALLATION



VEHICLE BOTTOM VIEW



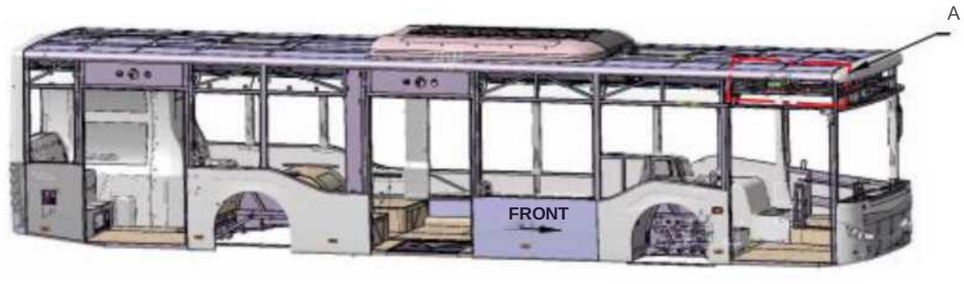
DETAIL - A

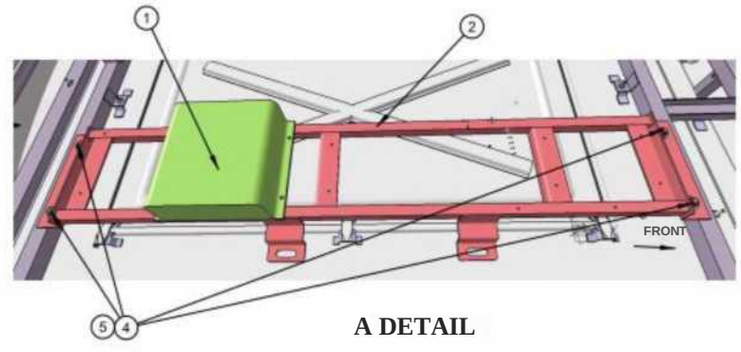
NOTE: THE SCREWS SHOWN BY X ARE COMING WITH THE CCTV GLASSERA ASSEMBLY.

NOTE: EVERY CCTV GLASSERA ASSEMBLY IS INSTALLED WITH 4 NUMBER SCREW.

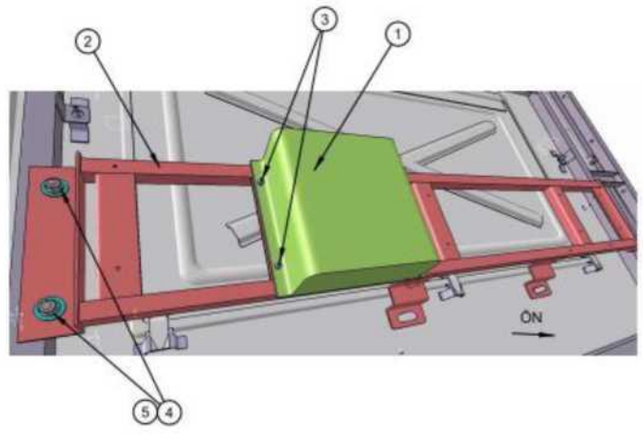
LEAFLET POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	973/005	387025839*	GLASSERA. CCTV	5

CARCASS PC CONNECTION VE DVR INSTALLATION



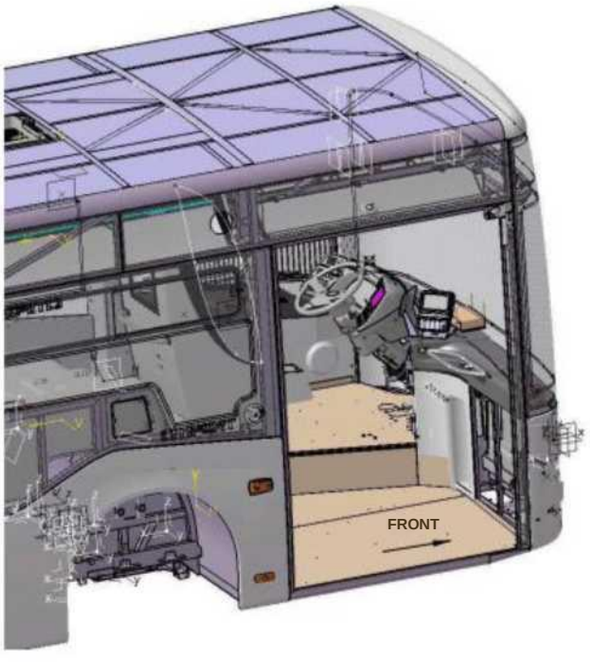


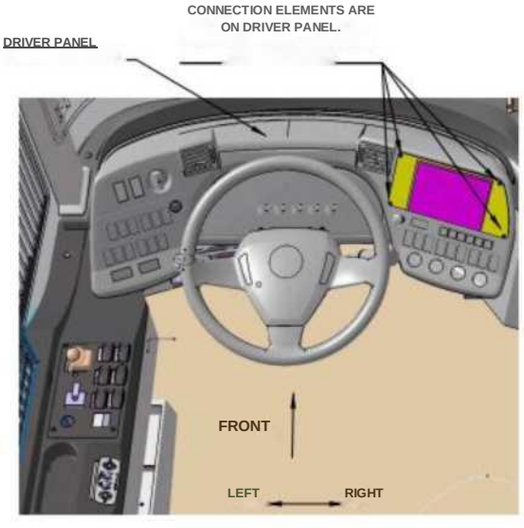
A DETAIL

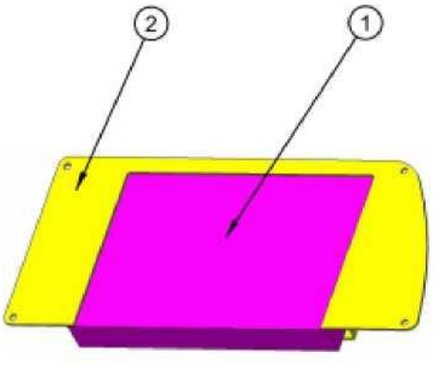


LEAFLET POSE	GROUP-POSE	PART NO	COMPONENT'S NAME	NUMBER
1	373 - 006	387038944*	DVR. MOBIL 8 DEVICE	1
2	373 - 007	387035553'	CARCASS. PC CONNECTION	1
3	973 - 006	3015005201*	SCREW M5X20 DİN 7986	2
4	973 - 010	3011100082*	WASHER . FLAT D=8 DİN 9021	4
5	973 - 011	3005800082*	NUT , FLN&TR M8X1.25, THICK D. DİN 6923	4

LCD MONITOR AND TORPEDO UPPER LCD INSTALLATION



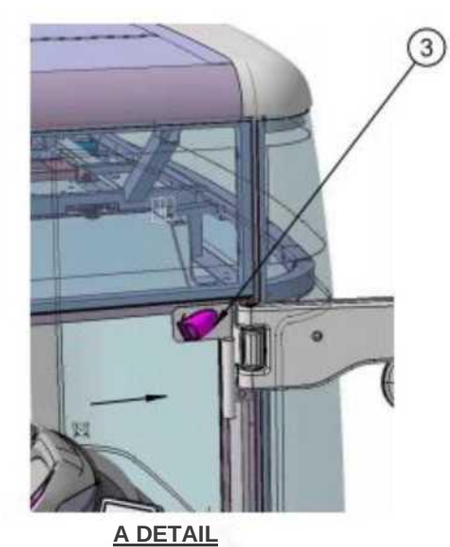




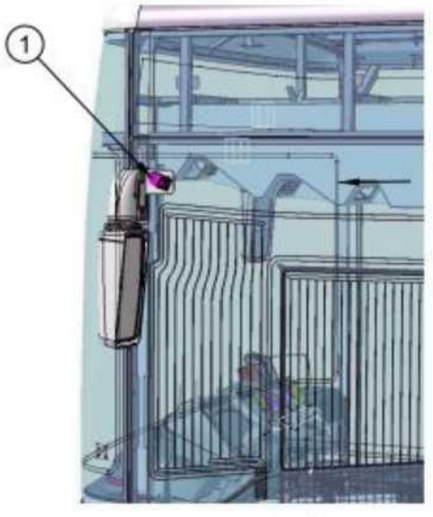
LEAFLET POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	973 - 022	387050911'	MONITOR 4 CHANNELS, BACK VIEW SCREEN, 7 "	1
2	973 - 023	307039001*	BRACKET . LCD TORPEDO UPPER	1

ENCLOSURE GLASSERA AND BACK VIEW GLASSERA INSTALLATION

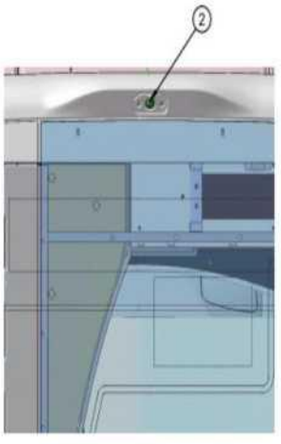




A DETAIL

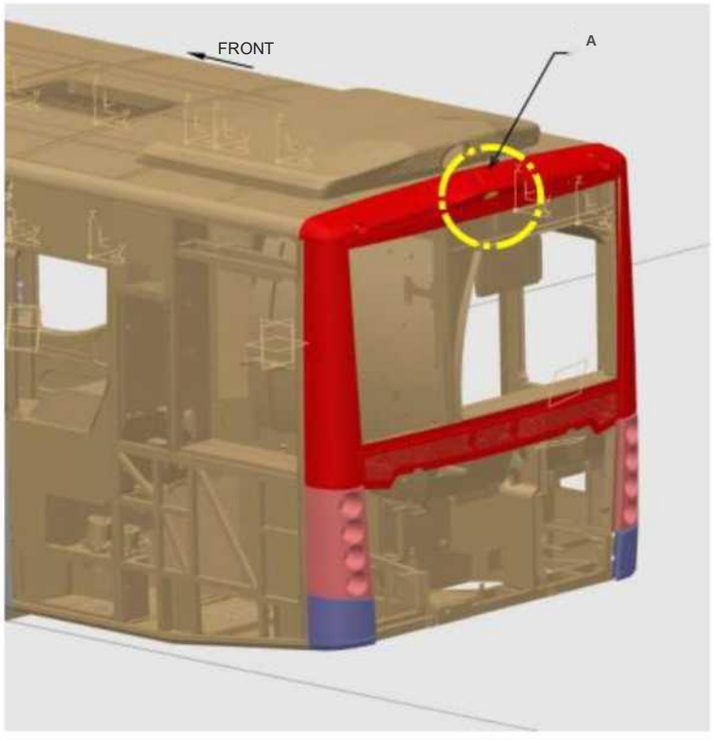


X VIEW



Y VIEW
VEHICLE REAR VIEW

LEAFLET POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	973-013	387038348-	GLASSERA ALL ENCLOSED	1
2	973-016	387050615'	BACK VIEW GLASSERA NTSC	1
3	973-067	387522345'	GLASSERA ALL ENCLOSED .RIGHT	1



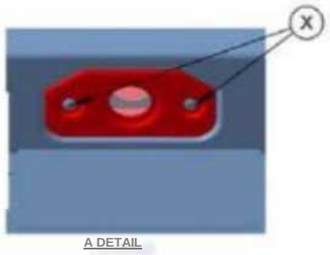


PICTURE-C



PICTURE-O





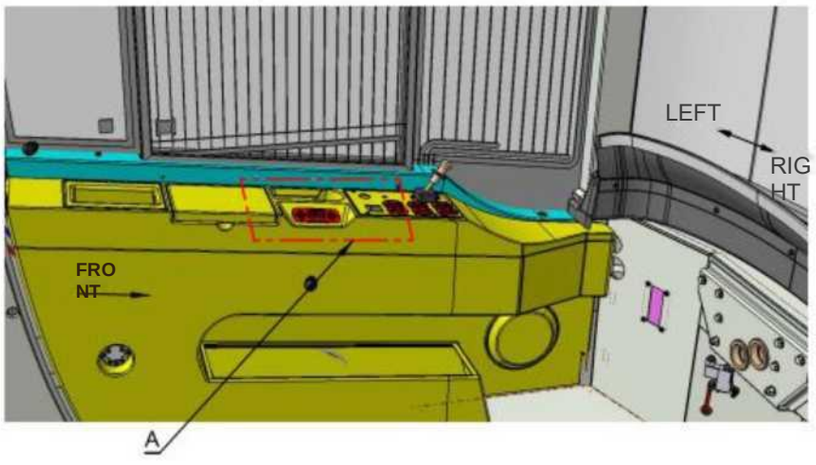
A DETAIL

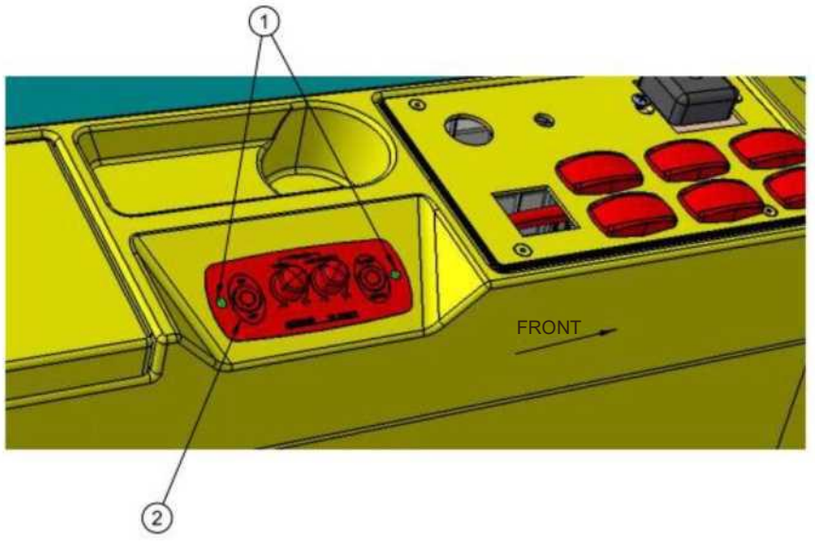
PICTURE B



LEAFLET POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	973-016	387050615*	BACK VIEW GLASSERA NTSC	1
1	973 - 020	387050615*	BACK VIEW GLASSERA NTSC	1
1	973 - 030	387025772*	BACK VIEW GLASSERA	1
1	973-016	387491741*	GLASSERA. BACK VIEW, PAL	1

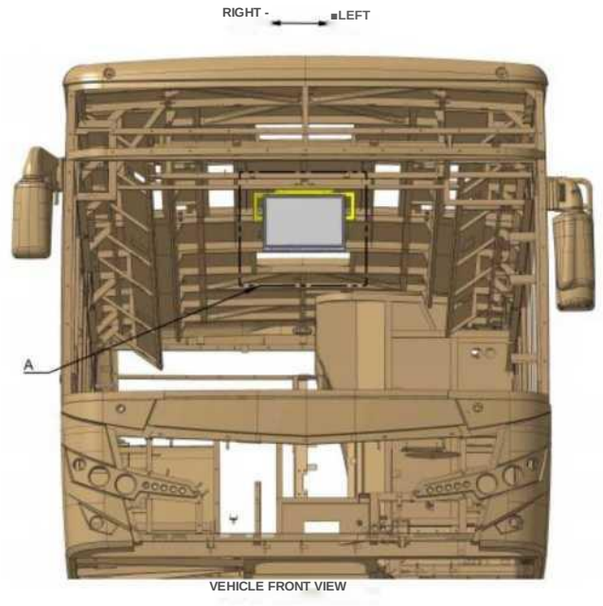
DRIVER CONSOLE ANFI INSTALLATION



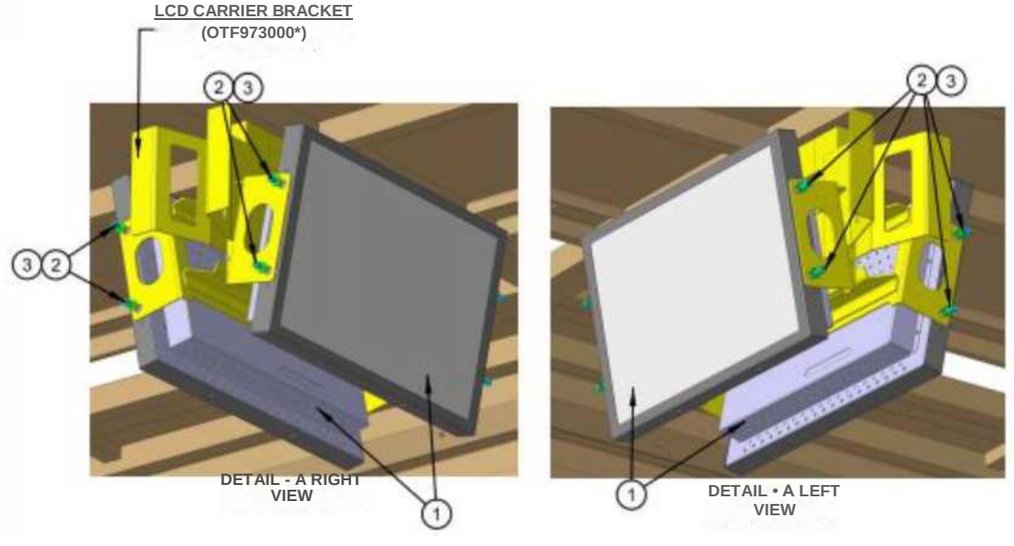


LEAFLET POSE	GRUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	973 / 003	3018135193*	SCREW	2
2	9731025	38705428S*	AMPLIFIER. 24V	1

LCD TOCHI 190WAS4 INFORMATION DISPLAY VEHICLE MOUNTING.



VEHICLE FRONT VIEW

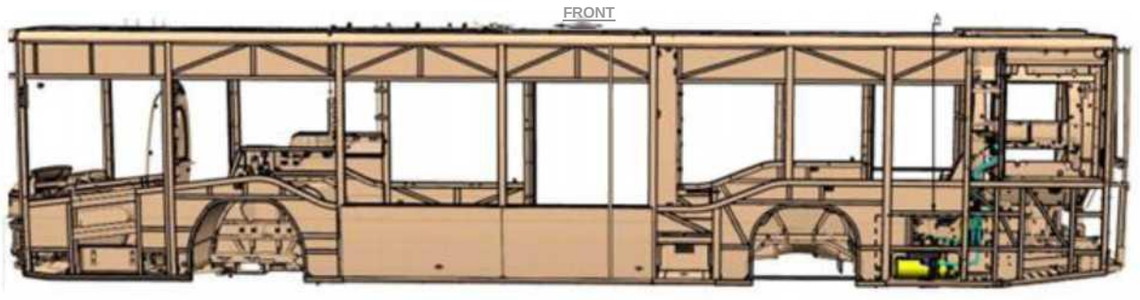


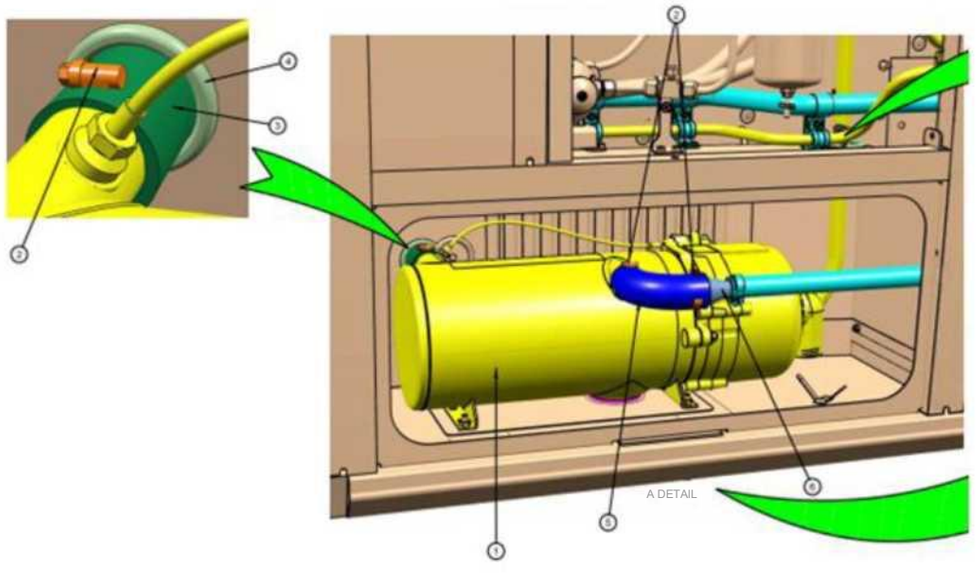
DETAIL - A RIGHT VIEW

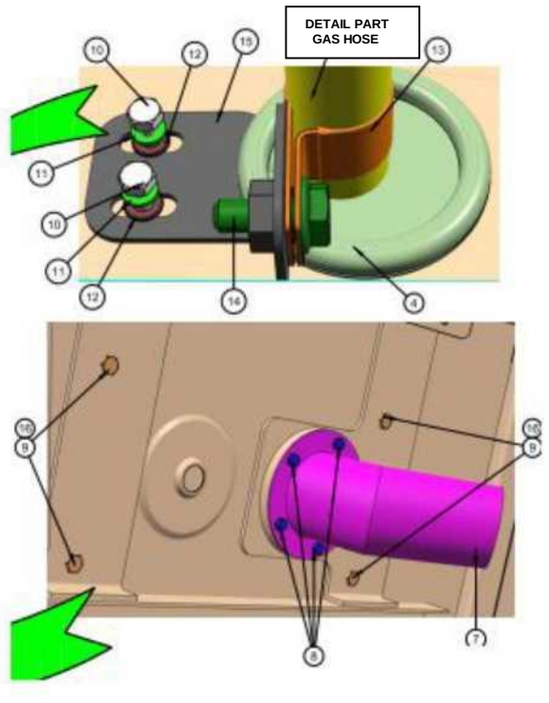
DETAIL • A LEFT VIEW

LEAFLE TET *POSE*	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	973-012	387046787*	LCD TOCHI,190WAS4 INFORMATION DISPLAY	2
2	973 -060	3000906123*	BOLT SLB M6X12, THICK D. DIN912	8
3	973 -061	3011200061*	WASHER , FLAT D=6	8

FRONT HEATER INSTALLATION

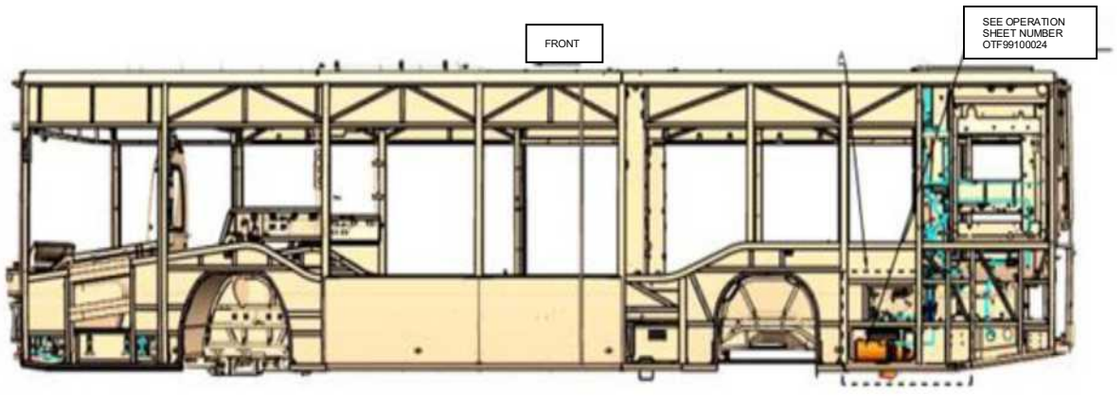


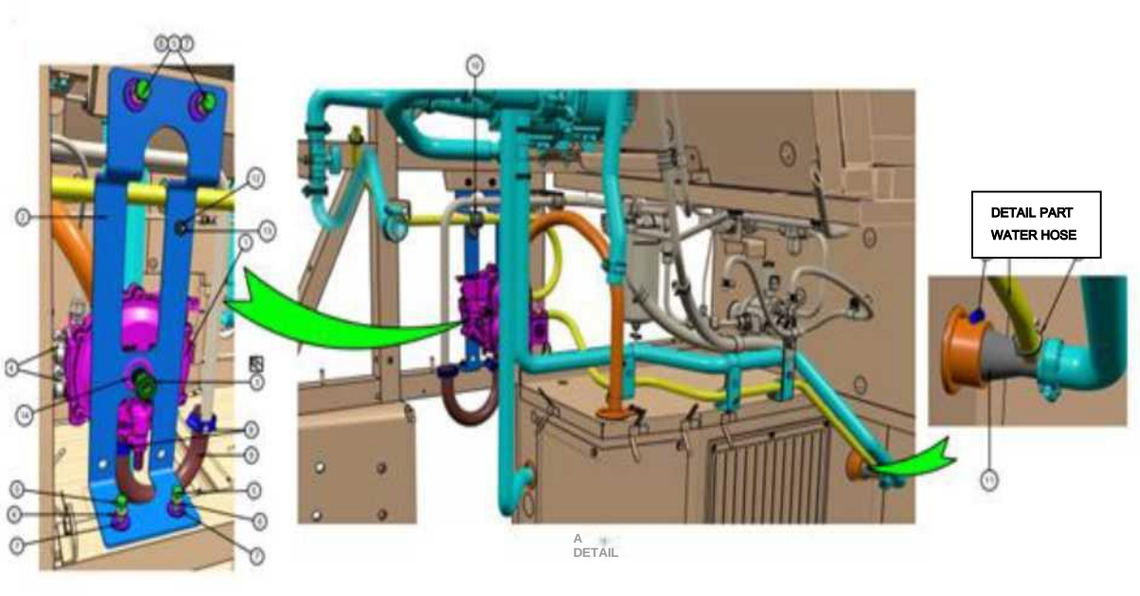




LEAFLE TLE POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	991 - 024	387596222'	FRONT HEATER CITIPORT CNG	1
2	991 - 011	305403550	CLAMP . SCREW B12. SPRINGY , Ø35 55, DIN3	3
3	991 - 005	387038395*	HOSE . Ø38$	1
4	991 - 010	337019407*	GROMMET AIR CONDITIONING GAS HOSE	2
5	991 - 004	38703705*	HOSE ELBOW	1
6	991 - 001	387055079*	ADAPTER	1
7	991 - 002	387542904'	EXHAUPPER ASSEMBLY	1
8	991 - 034	3000108124	BOLT . AKB M6X1X12 THICK D. DIN95J	4
9	991 - 016	3000108204*	BOLT . AKE M8X1.25X22. THICK D. DIN935	4
10	991 - 029	3000105124"	BOLT . AKB M5X0.8X12, THICK D. DIN951	2
11	991 - 022	3010100054*	WASHER , SPRINGY D=5 D|N 127	2
12	991 -014	3010000054*	WASHER . FLAT D=6 DIN125	2
13	991 - 035	3870141520*	CLIP. SHEET	1
14	991 - 033	3001208260	BOLT FLNM8X1.2SX20 THICK D. DIN6921	1
15	991 - 008	387664138*	BRACKET ASSEMBLY	1
16	991 - 021	301000084'	WASHER . FLAT 0-8 DİN 125	4

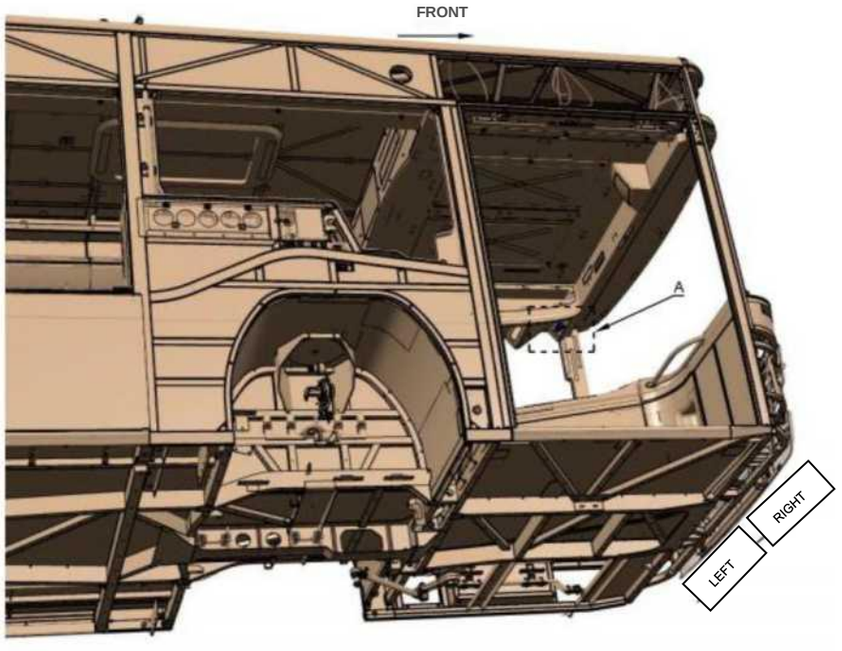
FRONT HEATER REGULATOR INSTALLATION

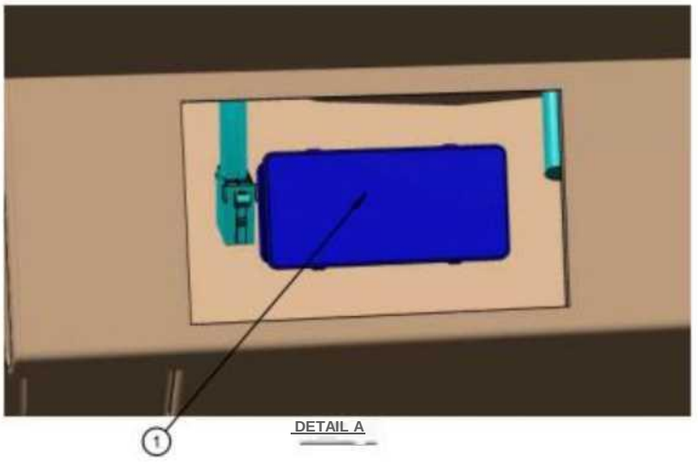




LEAF POSE	GROUP-POSE	PART NO	COMPONENT'S NAME	NUMBER
1	901 - 024	337596222'	FRONT HEATER CITIPOR CNG	1
2	991 - 009	387672180'	BRACKET , CNG REGULATOR	1
3	991 - 038	3005000124*	NUT AKB M12X1.75. THICK D. DIN934	1
4	991 - 057	3054012220*	CLAMP SCREW B12. SPRINGY . Ø12 22, DİN	3
5	991 - 023	3000106164*	BOLT AKBM6X1X16 THICK D. DİN933	4
6	991 - 012	3010100064*	WASHER , SPRINGY D=6 DİN 127	4
7	991 - 015	30111100064'	WASHER , FLAT D-6 DİN 0021	4
8	991 - 045	3054015270'	CLAMP , SCREW Ø12. SPRINGY . Ø16 27. DIN3	2
9	991 - 047	387939739'	HOSE . CNG GAS	1
10	991 - 044	387040281'	CLIP , Ø16 M8	1
11	991 - 007	387933683'	PIPE. ADAPTER	1
12	991 - 036	3005000064*	NUT AKB M6X1. THICK D. DIN934	1
13	991 - 032	3001206188*	BOLT FLN M6X1X16 THICK D. DİN6921	1
14	991 - 046	3873487550*	M10 SPRINGY 8.6 WHITE WASHER	1
15	991 - 011	30548355501*	CLAMP SCREW B12. SPRINGY . Ø35 66. DIN3	1

FRONT HEATER CONTROLLER INSTALLATION

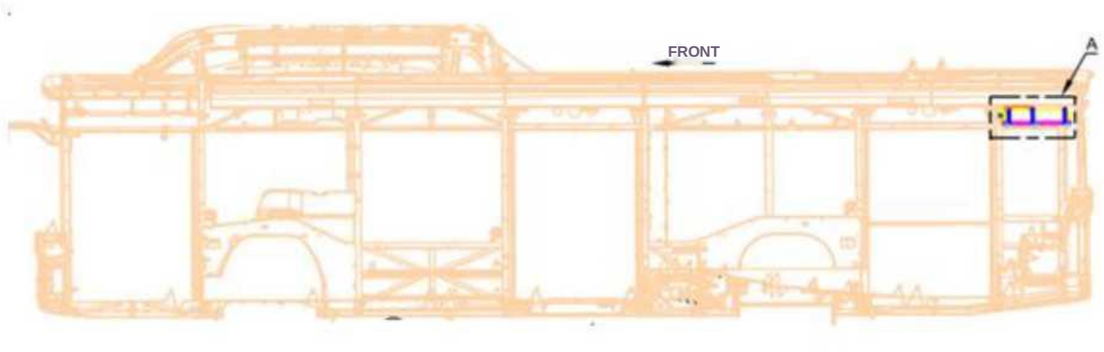


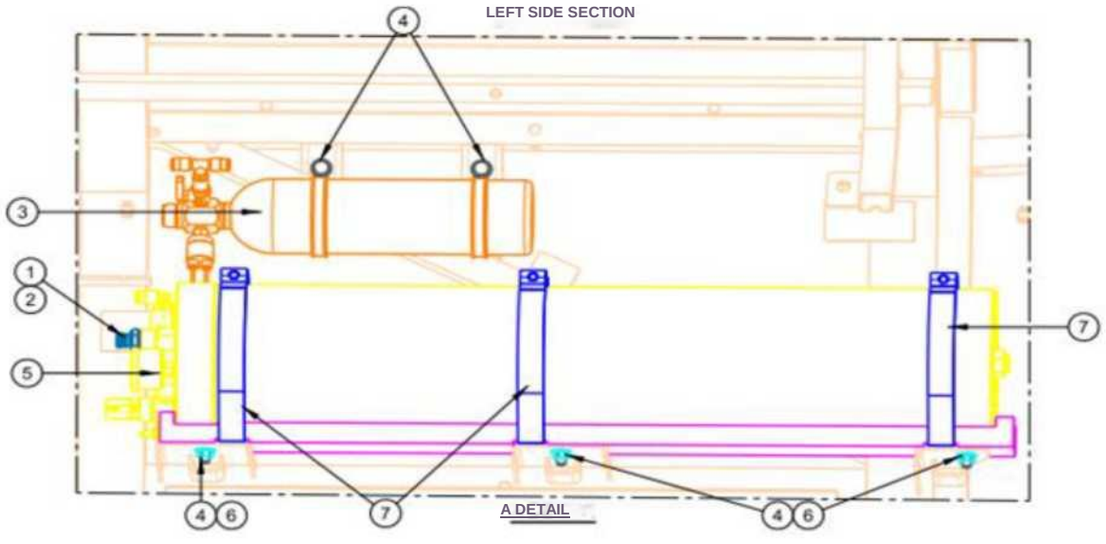


LEAFLET POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	991 - 039	387609974*	**REMOTE, PANEL**	1

FIRE EXTINGUISHING SYSTEM

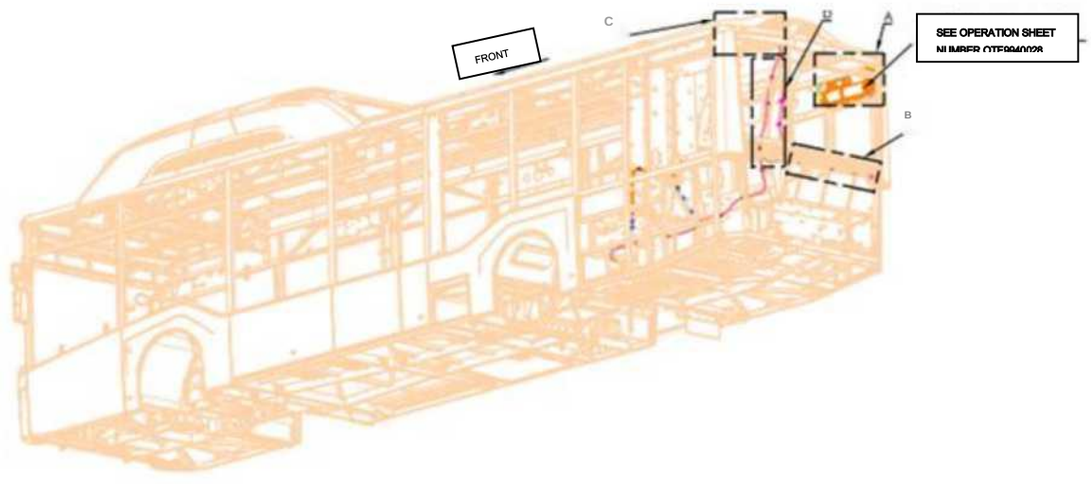
FIRE EXTINGUISHING TUBE INSTALLATION

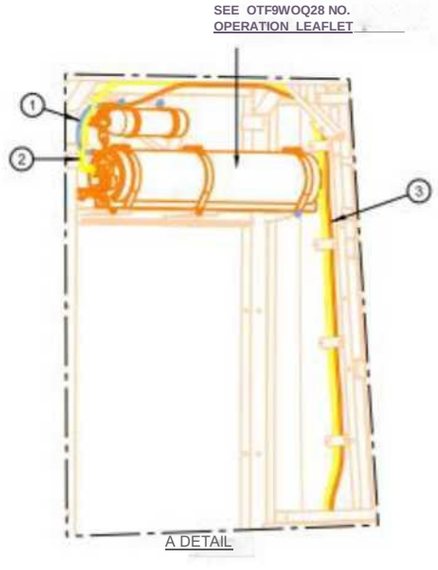




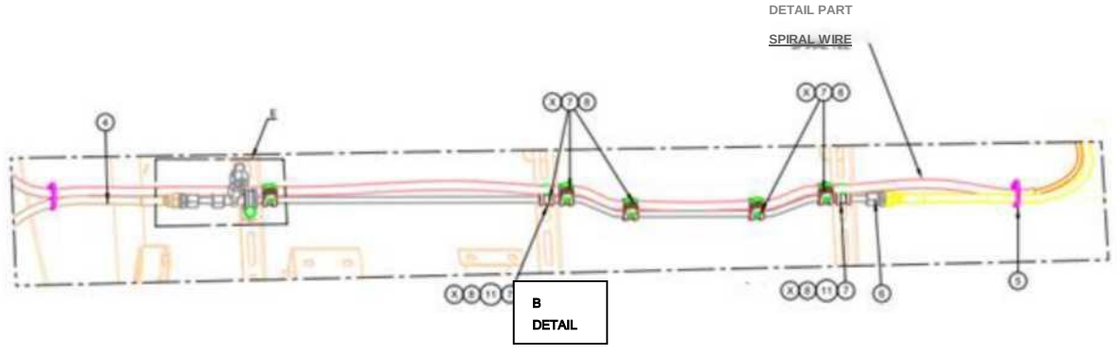
LEAFLET POSE	GROUP-POSE	PART NO	COMPONENT'S NAME	NUMBER
1	994 - 036	387036585*	NIPEL, 1/4" (4607)	1
2	994 - 035	3870365840*	WASHER , SEALED STEEL 1/4 (5606)	1
3	994 - 038	387039871*	TANK, NITROGEN 24 BAR (1656 00 24)	1
4	994 - 017	3001208206*	BOLT , FLN M8X1.25X20, THICK D. DİN6921	5
5	994 -027	387039827*	TANK, WATER FIRE (1072-02-020)	1
6	994 - 016	3005800086"	NUT , FLN&TR M8X1.25, THICK D. IDIN6923	3
7	994 - 029	3870365780*	CLAMP . WATER TANK (5105)	3
8	994 - 028	387039828*	BRACKET , WATER TANK 7,5 L (2405)	1

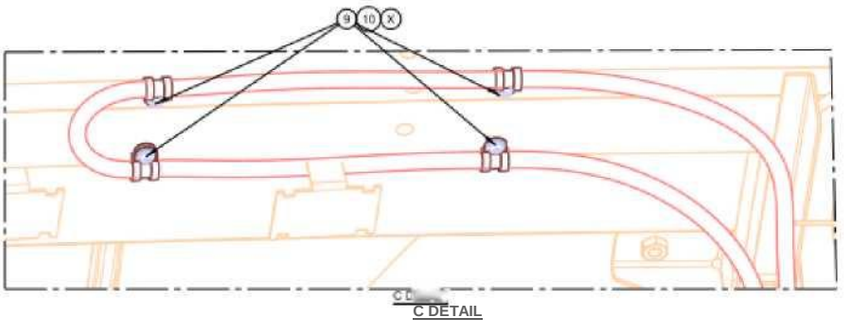
FIRE EXTINGUISHING HOSES INSTALLATION



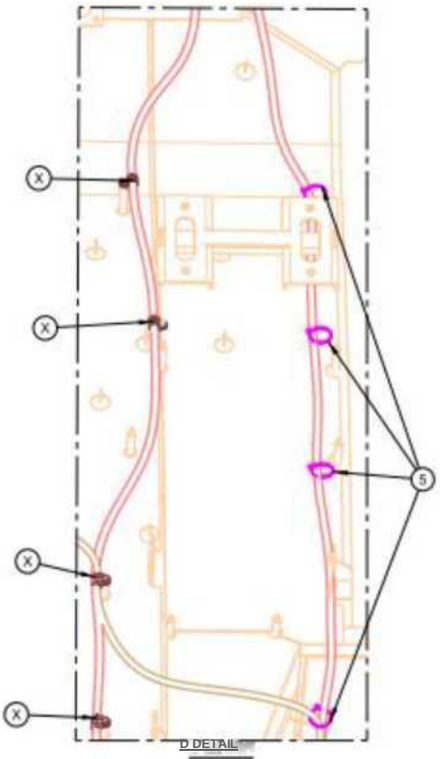


A DETAIL

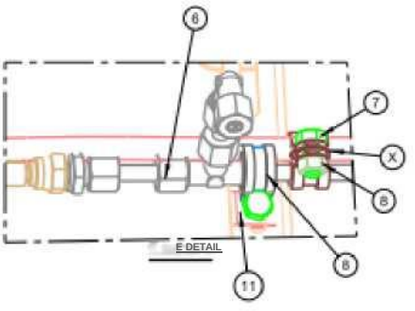




C DETAIL

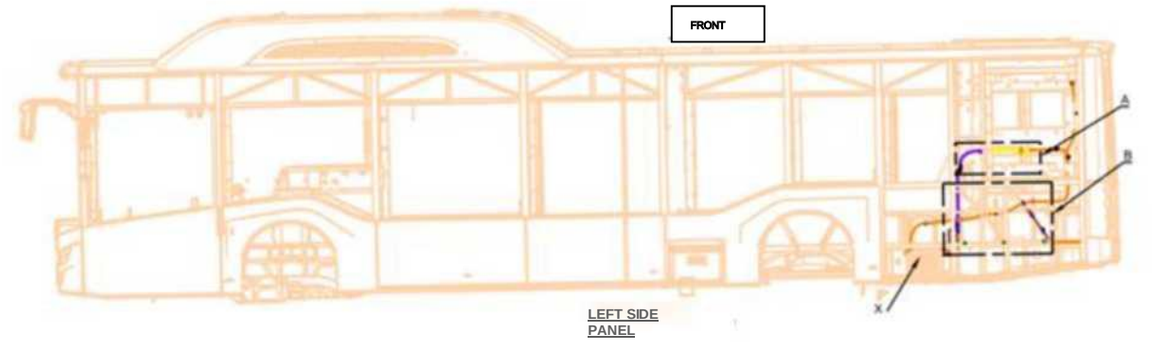


D DETAIL

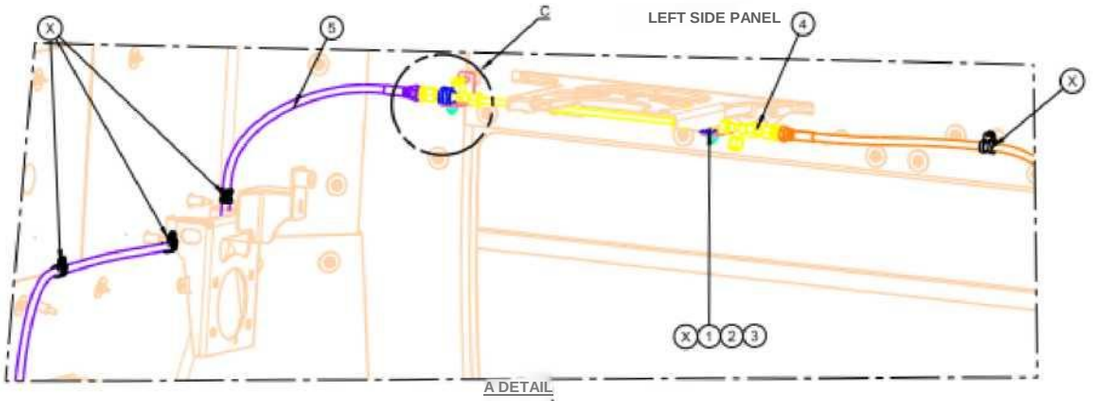


E DETAIL

LEAFLET POSE	GROUP-POSE	PART . NO	COMPONENT'S NAME	NUMBER
1	994 - 035	387039850*	HOSE , PERCEPTION (40380)	1
2	994 - 030	387039829'	HOSE . HYDRAULIC (4127)	1
3	994 - 034	387039851*	HOSE , FIRE PERCEPTION 3,8- 12500 MM	1
4	994 - 031	387039830'	HOSE , HP 1.25 M-FLAT (4118-1)	1
5	994 - 015	3777714370*	PLASTIC. CLAMP . EB. 03. 203_3 6-15OMM	7
6	994 - 025	307039859'	PIPE ASSEMBLY, EXTINGUISHING FIRE. ENGINE REAR	1
7	994 - 019	3000108166'	BOLT . AK0 MBX1.25X18 THICK D. DIN933	8
8	994 - 022	3005000006*	NUT . AKB M8X1.2.5, THICK D. DIN934	8
9	994 - 021	3370047720'	SELF TAPPING SCREW M4. 8 X 19 DİN 7504, YSB	4
10	994 - 020	3010000053*	WASHER , FLAT D=5 DIN125	4
11	994 - 015	3670356810*	CLIP	3

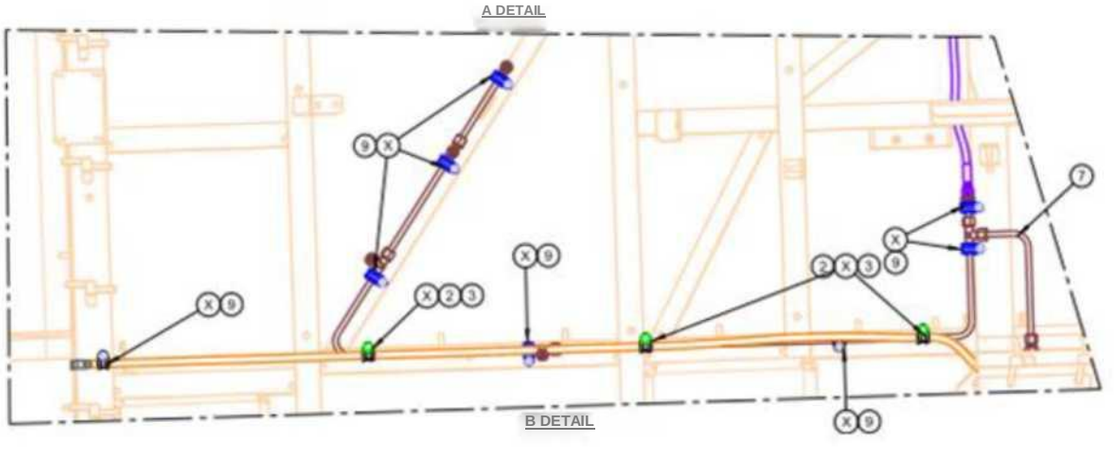


LEFT SIDE PANEL

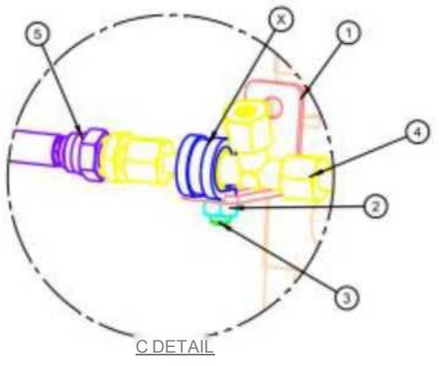


A DETAIL

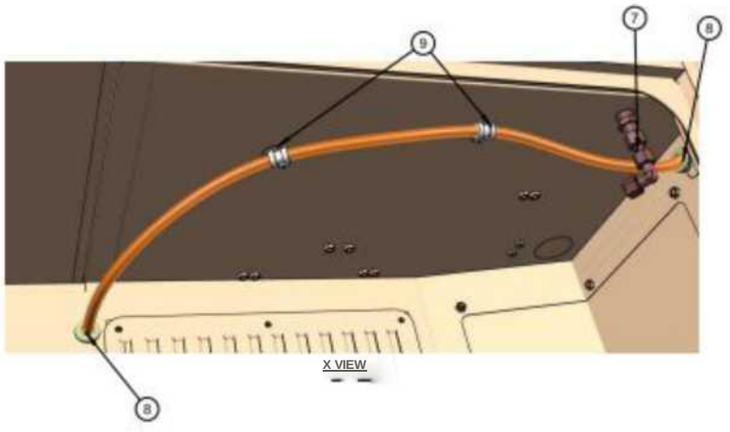
A DETAIL



B DETAIL



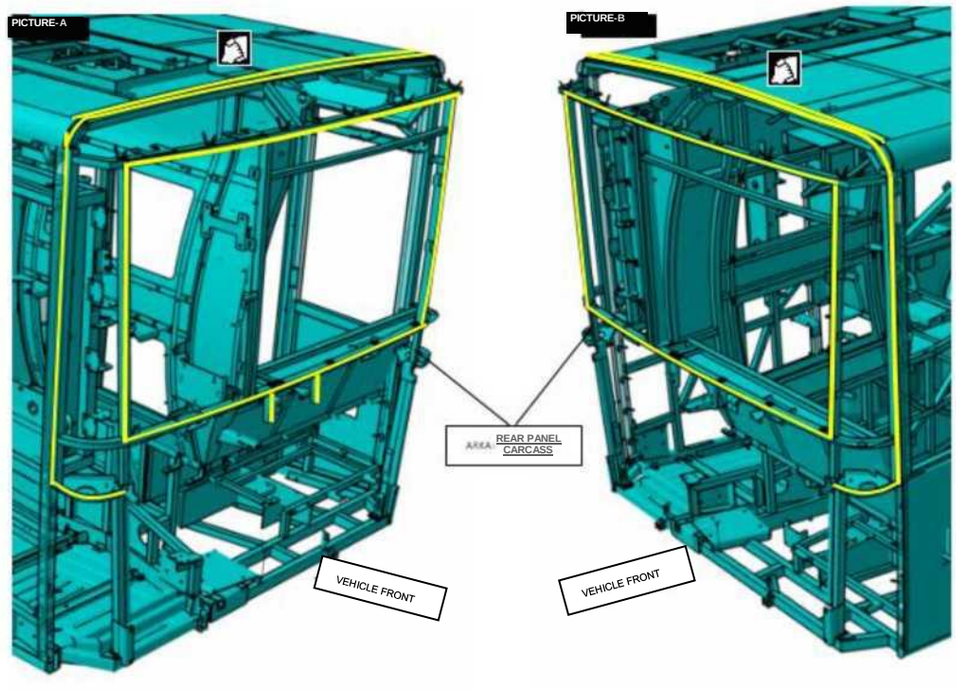
C DETAIL



LEAFLET POSE	GROUP/POSE	PART NO	COMPONENT'S NAME	NUMBER
1	994-013	387039862‘	BRACKET FIRE EXTINGUISHING	2
2	994-002	3005000086’	NUT AKB MBX1.25 THICK D. DIM934	5
3	994-019	3000108166'	BOLT , AKB MBX1.25X19. THICK D DIN933	5
4	994-026	387039860*	PIPE ALL FIRE EXTINGUISHING. ENGINE RIGHT	1
5	994-032	387039831*	HOSE , HP 2 M-FLAT (4111)	1
6	994-020	3010000053	WASHER , FLAT 0-5 DIN125	9
7	994-024	387039861'	PIPE ASSEMBLY, FIRE EXTINGUISHING ENGINE LEFT	1
8	994-014	388883158*	GROMMET	2
9	994 - 021	3870047720	SELF TAPPING SCREW M4 8X19 DİN 7604, YSB	9

REAR MASK INSTALLATION

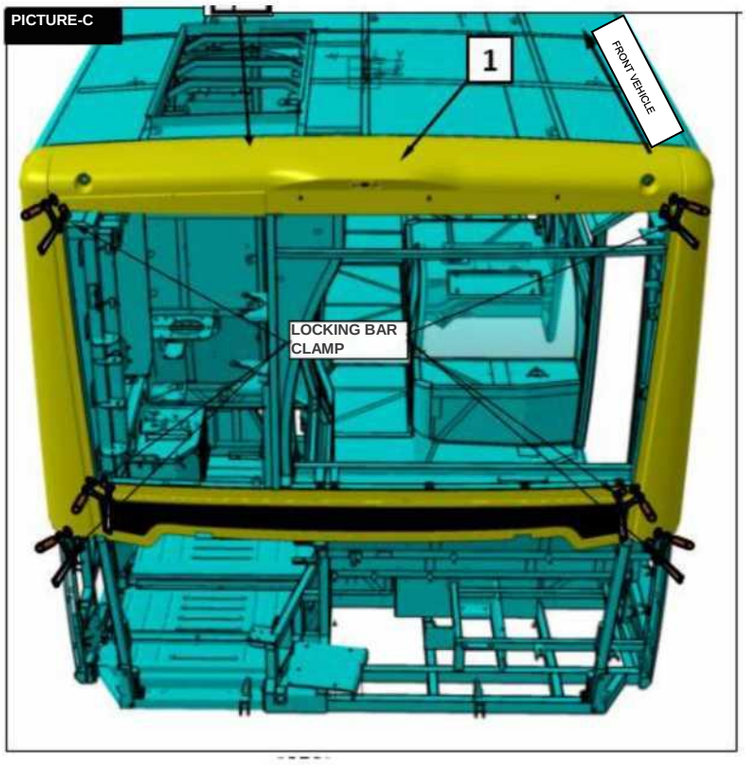
VEHICLE PREPARATION FOR REAR MASK INSTALLATION

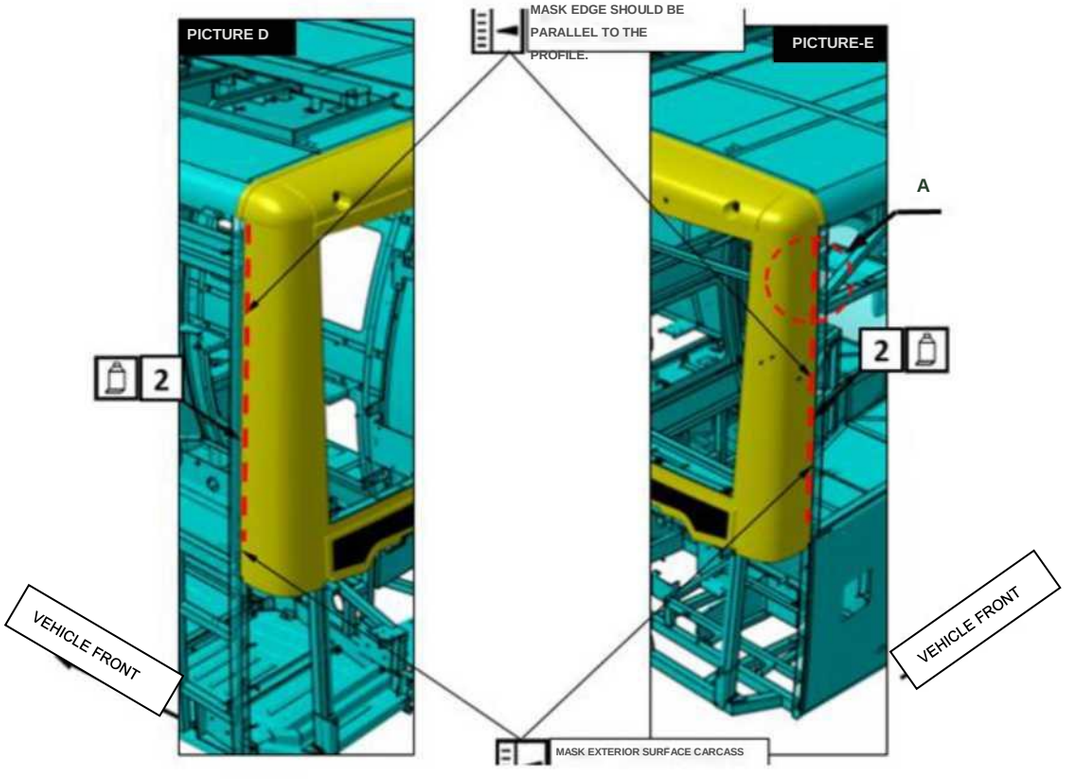


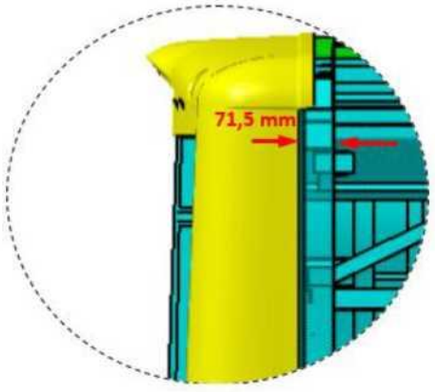
NO	JOB DESCRIPTION	CRITICAL POINT	EQUIPPMENT APPARAT
1	CLEAN SURFACES WITH YELLOW COLOR IN PICTURE-A USING ACTIVATOR.	1. RELATED INSTRUCTIONS; MOVE BY T-OU-212. 2- DO NOT MOVE THE PRIMER APPLICATION OUTSIDE THE ADHESION AREA .	
II	APPLY PRIMER TO SURFACES WITH YELLOW COLOR IN PICTURE-A		
III	ADHES A PAPER TAPE TO THE FINISH OF THE MARKED BONDING SURFACES TO PROTECT MASTIC OVERFLOW.		

NQ	GROUP/POSE	PART NO	COMPONENT'S NAME	QUANTITY
2	940/240	387021396*	PRIMER,SIKA 206G+P GLASS/UET.	1
1	940/090	387016452*	CLEANER, SIKA ACTIVATOR.-	1

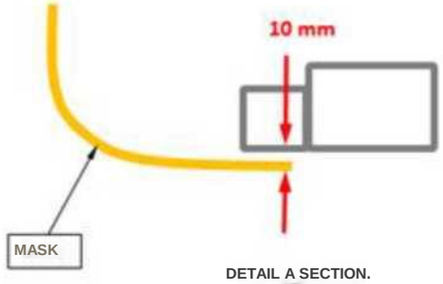
REAR MASK VEHICLE INSTALLATION







DETAIL A



DETAIL A SECTION.

PICTURE E



CITIPORT REAR MASK TEMPLATE 3935600410100.

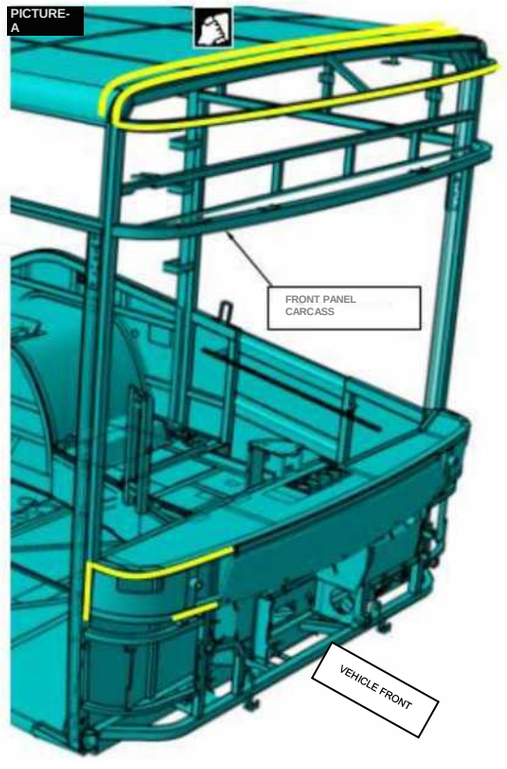
NO	JOB DESCRIPTION	CRITICAL POINT	EQUIPMENT APPARAT
II	PLACES IT IN 1 POSE PART AS SHOWN IN PICTURE-C		
III	TIGHTEN THE LOCKING BAR CLAMP AT THE SPECIFIED POINTS IN PICTURE C.	TIGHTENING PROCESS WILL BE DONE UNTIL THE MASK WEDGE CONTACT. LOCKING BAR IN THE BOTTOM CORNER IS TO ADJUPPER THE PARALLELING OF THE SIDE EDGE OF THE CLAMP MASK.	
IV	DJUPPER THE CARCASS PARALLEL WITH THE EDGE OF THE MASK AS SPECIFIED IN PICTURE D AND PICTURE.		
V	ADJUPPER THE PICTURE D AND THE PICTURE E AS DESCRIBED BY THE SIDE OF THE MASK TO 10 MM OF THE FRAME. SUPPORT REQUIRED REGIONS WITH SUITABLE THICKNESS WEDGE.	SHOULD NOT BE MOVED OUTSIDE OF WEDGE.	
VI	PICTURE D AND PICTURE-E ARE FILLED BY APPLYING MASTIC TO THE REGIONS MARKED WITH RED CUT.		MASTIC MIXTURE AND APPLICATION PUMP 3332
VII	CHECK THE FORM OF THE COVER UPPER ZONE WITH YOUR TEMPLATE AS SHOWN IN THE PICTURE .	AKE CARE OF THE ACCURACY OF THE FORM TO AVOID PROBLEMS IN COVER COMPATIBILITY.	CITIPORT REAR MASK TEMPLATE 0410100.

NO	GROUP/POSE	PART NO	COMPONENT'S NAME	QUANTITY
4	921/016	388884448*	WEDGE; GLASS MOUNTING	10
3	936/067	387018138*	WEDGE; GLASS MOUNTING	20
2	940/250	387031749*	MASTIC, SIKAFLEX 260N (27,6	1
1	**936/015**	387043264*	MASK, REAR	1

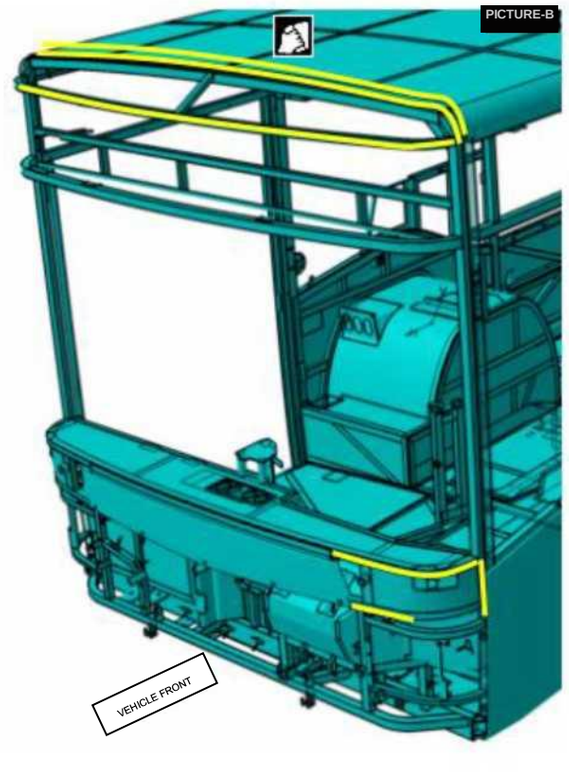
FRONT MASK INSTALLATION

PREPARING FOR FRONT MASK VEHICLE INSTALLATION.

PICTURE-A



PICTURE-B

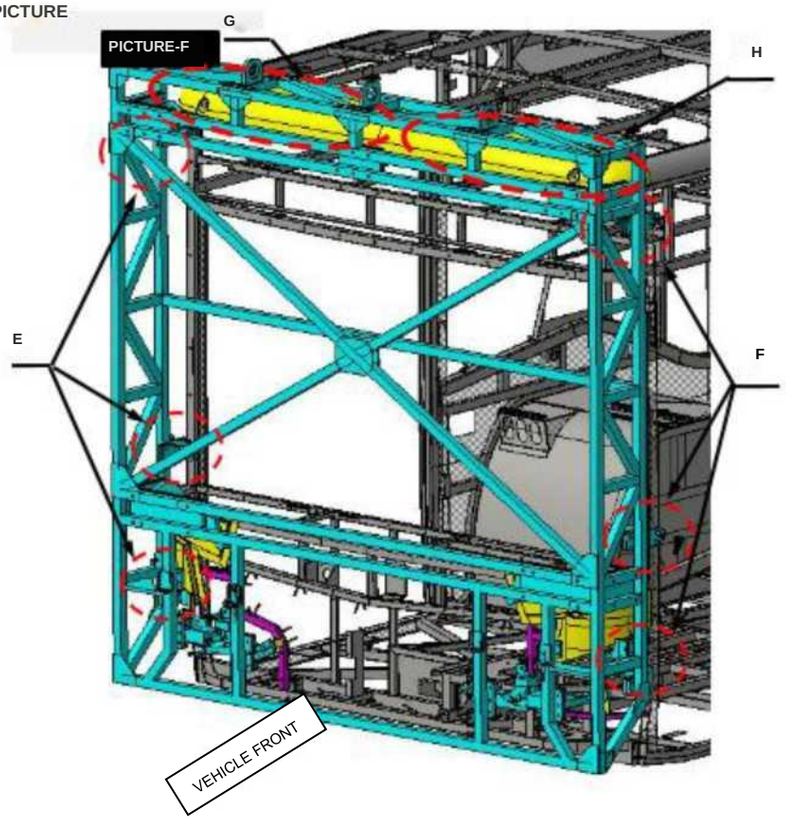


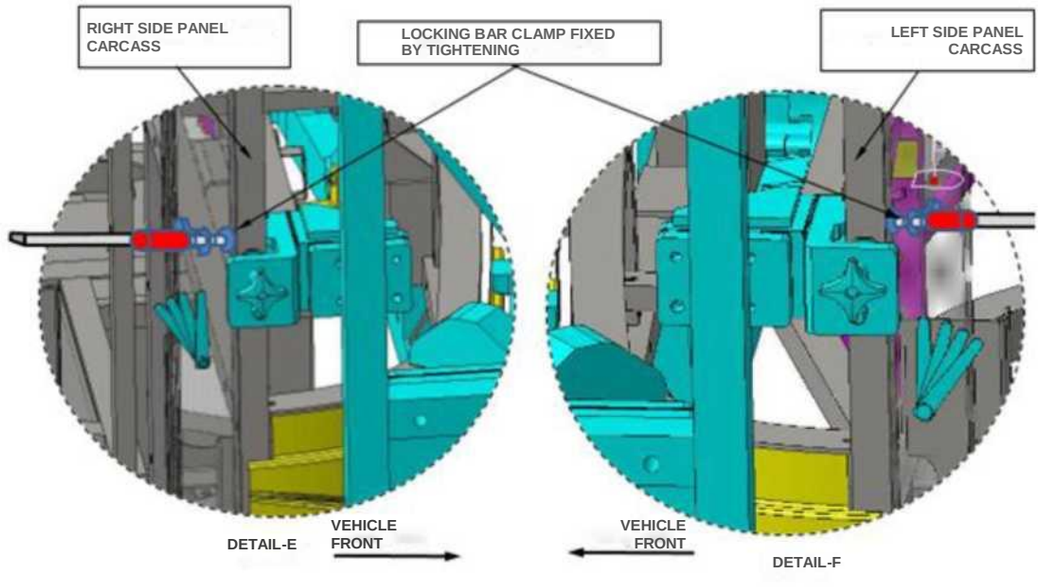
NO	JOB DESCRIPTION	CRITICAL POINT
1	CLEAN SURFACES DESCRIBED WITH YELLOW IN PICTURE-A USING ACTIVATOR	1- RELATED INSTRUCTIONS; MOVE BY T-OU-213E . 2- DO NOT MOVE THE PRIMER APPLICATION OUTSIDE THE ADHESION AREA .
II	APPLY PRIMER TO SURFACES WITH YELLOW COLOR IN PICTURE-A.	
III	DHES A PAPER TAPE TO THE FINISH OF THE MARKED BONDING SURFACES TO PROTECT MASTIC OVERFLOW	

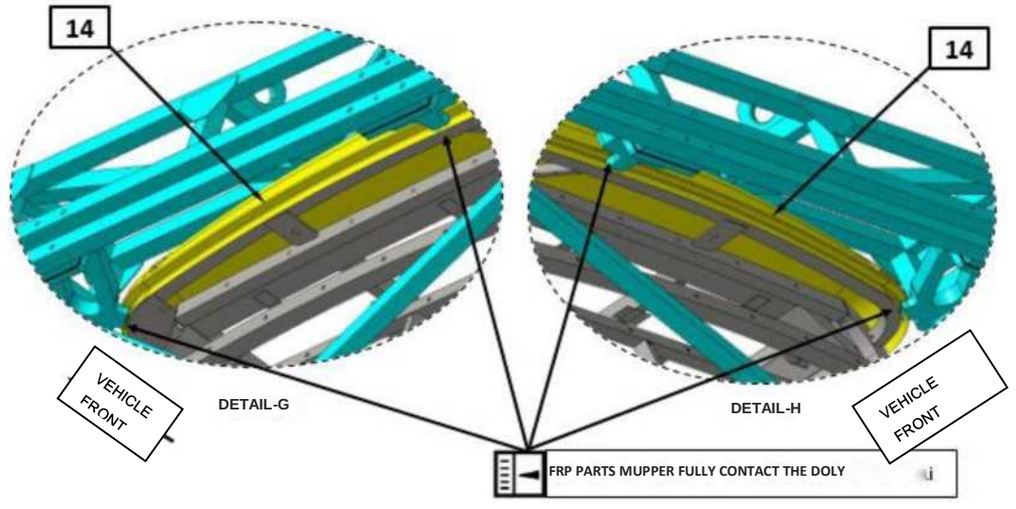
NO	GROUP/POSE	PART NO	COMPONENT'S NAME	QUANTITY
2	940/240	387021396*	PRIMER.SIKA 206G+P GLASS/MET.	1
1	940/090	387016452*	CLEANER, SIKA ACTIVATOR.-	1

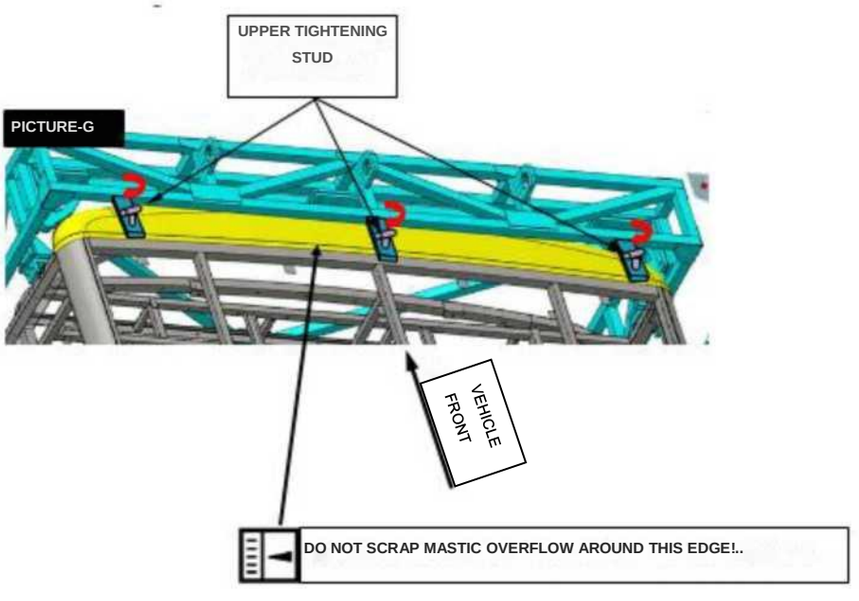
FRONT MASK TOOL INSTALLATION

PICTURE






14
14
VEHICLE FRONT
DETAIL-G
DETAIL-H
VEHICLE FRONT
FRP PARTS MUPPER FULLY CONTACT THE DOLY


UPPER TIGHTENING STUD
PICTURE-G
VEHICLE FRONT
DO NOT SCRAP MASTIC OVERFLOW AROUND THIS EDGE!..

NO	JOB DESCRIPTION	CRITICAL POINT	EQUIPMENT APPARAT
Xİ	KEEP THE APPARATUS FULLY CONTACT WITH THE SIDE FRAME BY TORING THE BODIES SHOWN IN DETAIL-E AND DETAIL-F	 1- ACCORDING TO RELATED INSTRUCTION T-OU-213 - MOVE. 2- MOVING THE MASTIC APPLIC OUT OF THE ADHESION AREA 3- REGIONS WITH MASTIC OVERFLOW SHOULD BE MASKED WITH PAPER TAPE.	1. FRONT MASK GROUP MOUNTING APPARAT 342020329200. 2-LOCKING BAR CLAMP
Xİİ	DETAIL-G AND DETAIL-H ENSURE THAT THE 14-POSITION PIECE IS FULLY CONTACT THE REARS AS SHOWN		
XII	COMPLETE THE FIXING OF 14 POSE PARTS BY TIGHTENING THE TOP TIGHTENING LEGS AS SHOWN IN PICTURE G.		
XII	LEAN MASTIC OVERFLOW WITH CARTON AND LEVEL THE REQUIRED ZONES WITH POTATOES		

NQ	GROUP/POSE	PART NO	COMPONENT'S NAME	QUANTITY
14	936/010	3S70326SQ101	CEILING, FRONT	1

Kurum/Şirket İçi / Internal Only

CORROSION TREATMENT PROCEDURES

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1. PREFACE

Purpose of this document	This document has been prepared to describe the processes. and treatment methods for corrosion in vehicles.
technical competence	The information and explanations given in this booklet are intended to be understood by users with sufficient technical competence, experience and ability. In addition to the definition and safety information in this booklet, all national and international occupational health and safety regulations and directives must be followed.
processes	The processes described in this booklet, such as painting, patching, grinding, sanding, may differ depending on environmental conditions. Additional actions according to vehicle type and damage type
Consumables	In this booklet, primer, paint, etc. Some consumables are indicated by their brand or codes. To use such consumables other than the specified consumables, please contact Anadolu ISUZU International Customer Services.

2. MEASURES

personal responsibility	Even with the safest tools and processes, situations can occur during operation that pose a health or safety hazard to technicians or third parties unless clear operation, service, maintenance, and other informative instructions are posted to ensure proper operation and use. as well as by education and training personnel. Additional important factors are the location of the equipment and environmental conditions.
Check Consumables	Check storage conditions and expiration dates of consumables (thinner, solvents, primers, paints, etc.) before use. Some consumables can cause damage to the vehicle body due to storage conditions and other factors.
Control Tools	Check tools and other equipment before use. Damaged or unsuitable tools can cause safety or health problems.
Control Tools	Some operations described in this booklet require special safety equipment and accessories. Please use the appropriate type of safety equipment and accessories according to the procedure described.

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2.1 SAFETY EQUIPMENT AND ACCESSORIES

Make sure technicians don't wear their hair long and loose or wear loose clothing or jewelry including rings, all of which pose a safety hazard as such objects are likely to be attracted to or caught in tools.

2.1.1 STANDARD ACCESSORIES

Standard safety equipment should be used for all operations.

safety shoes



With the thick sole and metal protective sheet in front, the safety shoes protect your feet from any impact.

Safety glasses



Safety glasses, sanding, painting, cleaning, etc. Protects your eyes against dust and small particles during operations. Also thinner, primer, etc. Used to protect eyes against vapors of chemical consumables.

Ear Protectors



High noise level during some operations such as grinding, cleaning, priming can cause permanent sound damage. Use ear protectors to prevent damage.

2.1.2 SAFETY EQUIPMENT AND ACCESSORIES FOR SANDING



During the sanding process, in addition to the standard accessories mentioned above, some equipment must be used.

Pretection Masks



Sanding causes small particles to become suspended in the air that can be easily inhaled. Use paper masks to avoid inhaling small particles.



CAUTION

The masks used in the sanding process must comply with the EN149:2001 FFP2 standard.

safety gloves



Use protective gloves to protect your hands when lifting - transferring parts using tools.

2.1.3 SAFETY EQUIPMENT AND ACCESSORIES FOR THE PAINTING PROCESS



In addition to the standard accessories mentioned above, some additional equipment must be used during the painting process.

gas masks



Filtered gas masks block small particles of paint suspended in the air and prevent these particles from being inhaled.

Solvent Resistant Gloves



Some organic solvents used for painting and priming can cause serious damage to your skin.

CAUTION

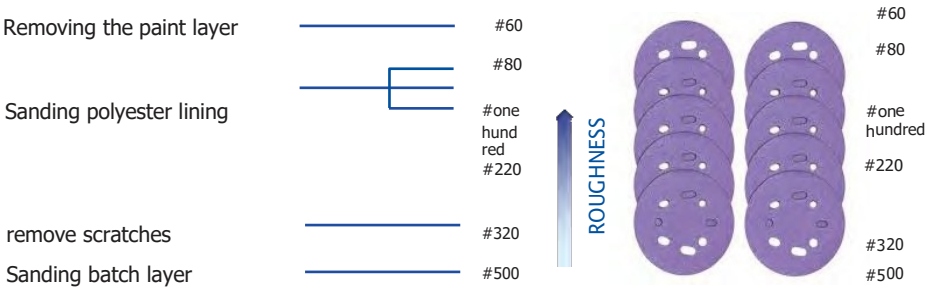
Gas masks have filters. After a while, these filters become clogged and can no longer be used. Change filters as needed.

3. PROCEDURES

This procedure is used to remove paint, primer, bulk layers from surfaces and to prepare the surface for new applications. Sanding is done by hand, with an air gun or vacuum sander. There are two types, dry sanding and wet sanding, according to the application method.

Sanding steps are indicated by paper numbers. It is extremely important to use the appropriate number of papers according to the application.

3.1.1 CHOOSING THE RIGHT PAPER



The roughness of the sandpaper decreases inversely with the number of papers to be used. The lower the paper count, the higher the roughness.

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3.1.2 REMOVING THE PAINT LAYER

Use #80 paper to remove the old paint layer from the part surface.

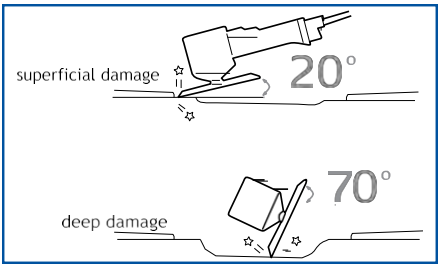


To be careful!

1. Turn on the sander after touching the surface. Always apply even pressure to the surface to avoid deep scratches on the surface.

2. DO NOT leave the sander on the same area for long periods of time to avoid overheating the surface.

3. Use both hands when using the sander.



3.1.3 WEAR LAYER LIMITS

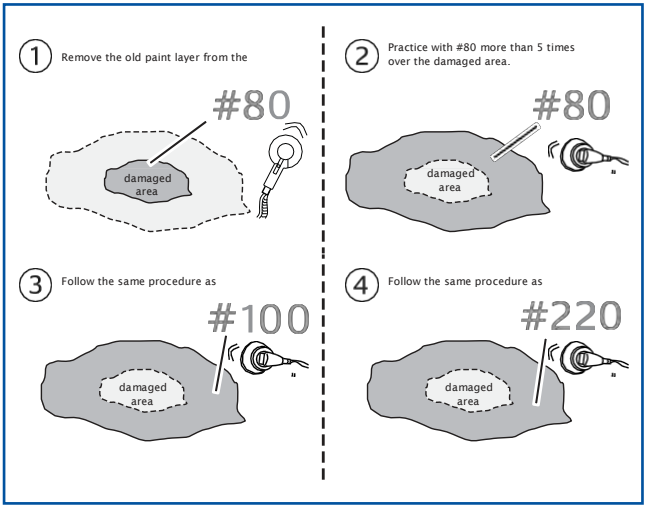
NS Visible paint layers are avoided, surfaces are lapped.



Use the vacuum sander in three steps. use #80, #100,
220 in paper order.

x5

Perform the lapping procedure on 5 times the damaged area.



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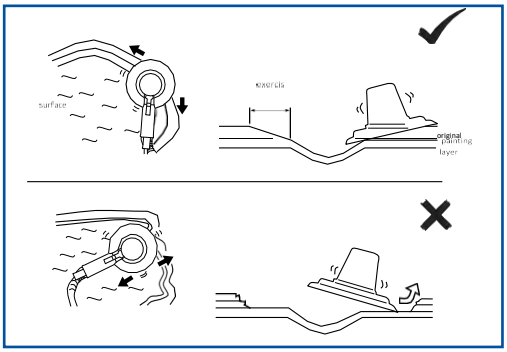
3.1.3 WEAR LAYER LIMITS

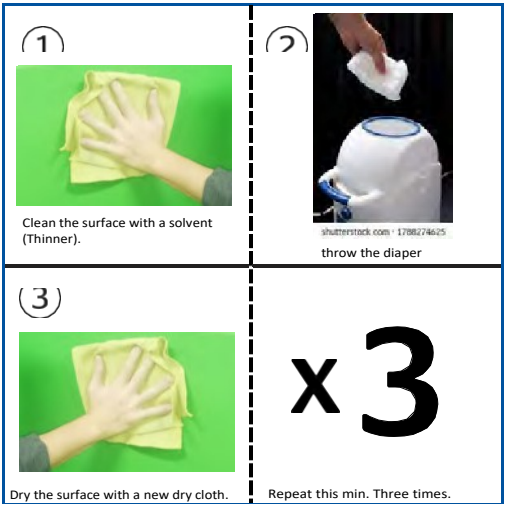
Use a sander in circular motions at layer boundaries.



3.1.4 CLEANING SURFACES

3.2 SANDING

1. **Clean the surface with a solvent until no dirt or particles remain.**
2. **Dry the surface immediately with a new dry cloth.**
3. **Use new clothes each time or remove the inside of the fabric each time.**



3.1.5 MASKING

Protect areas of the vehicle (which should not be painted, sanded, primed or plastered) using a masking paper and masking tape.

Regarding the staining procedure, there are two types of masking;

1. **Masking for grouping**
2. **Masking for part painting**



3.1.5 MASKING

3.1.5.1 MASKING FOR SHIRTING

This masking procedure is used before stacking.

Reverse masking should be applied to avoid the lining effect at the borders.

Reverse masking is accomplished by gluing the top side of the masking paper and turning the bottom side towards the vehicle.

Thus, the primer effect between the paint and primer layers is eliminated.



3.1.5.2 MASKING FOR PAINTING

Mask the entire surface to be painted.

CAUTION

Check and make sure that the masking tape used for masking does not damage the vehicle surface.



3.2 USING AN AIR GUN

Use air guns to clean surfaces of dust and small particles.

Compressed air helps blow particles from surfaces.



CAUTION

Check the system pressure before using the air gun. Make sure it's the minimum system pressure is 5 bar.

3.3 USE OF PAINT - PRIMER - WAX GUN

They use compressed air to atomize the paint, primer and lacquer. Depending on the application, two types can be used, with a top-loading hopper and a bottom-loading hopper, depending on the type of application.

CAUTION

Paint, primer and polish guns use compressed air. Check system pressure before starting.



3.3 USING INFRARED HEATERS

Infrared heaters can be used to dry areas locally.

When using infrared heaters, DO NOT leave them on surfaces that will be constantly contaminated. It may cause the surfaces to overheat.

The distance between the heater and the surface to be dried is important. Consult the heater's user manual for such technical information before use.

CAUTION

DO NOT stand in front of heaters.



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4. CORROSION & PREVENTIVE METHODS

What is corrosion?

Corrosion is a state of deterioration in metals (steel, copper, zinc, aluminum and their compounds) caused by oxidation or chemical action.

Observation

- **Red rust on steel parts,**
- **White spotting on zinc parts,**
- **White spotting on Dacromet/Geomet coated parts,**
- **Green rust on copper parts,**
- **White spotting on aluminum parts.**

Corrosion Causes

1 User Errors

Non-compliance with the rules those specified in the user, workshop warranty and service manuals may cause corrosion.

- **Failure to intervene in time to scratches on the painted parts of the vehicle,**
- **Failure to follow preventive maintenance procedures**
- **Failure to comply with preventive actions before the winter season**

2 environmental factors

Environmental and geographical factors determine the corrosion factors.

- **Hot and humid areas (e.g. by the sea)**
- **Cold and snowy areas (road de-icing)**
- **Cold and rainy regions**
- **Industrial zones**
- **Additional applications for paving public roads (solid or liquid salt)**

Corrosion Zones

Anti-corrosion methods can be applied to three main areas on the vehicle;

A ZONE A
Engine Compartment

B ZONE B
Chasis (including luggage comp.)

C ZONE C
Side pannel, and the rest of the vehicle



A ZONE A B ZONE B C ZONE C

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5.1 ENGINE AND COATINGS

If any corrosion is observed on the engine or coatings;

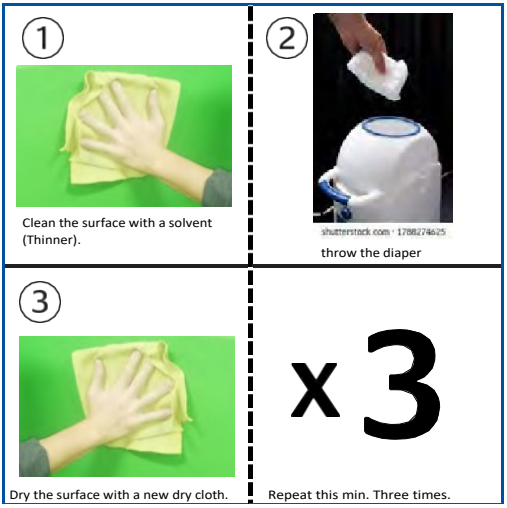


1. Scrub the corroded area with a wire brush.

> **CAUTION**
> Brush the worn area until the uncoated metal surface is visible.
> Poorly brushed surfaces can cause paint deterioration and re-corrosion.

2. To clean the engine, clean the brushed area with gasoline or any suitable spray material.

> **CAUTION**
> Take necessary precautions to avoid the risk of fire when working with any solvent.



> **CAUTION**
> Mask off necessary areas before applying the primer.

3. Apply heat resistant paint approved by the engine manufacturer.

> **CAUTION**
> Wait at least 45 minutes after applying primer to the surfaces.

4. Paint the zones with a suitable color code (according to engine type and model)

5.2 TUBES AND BRACKETS

If any corrosion is observed on the pipes or brackets in the engine compartment;

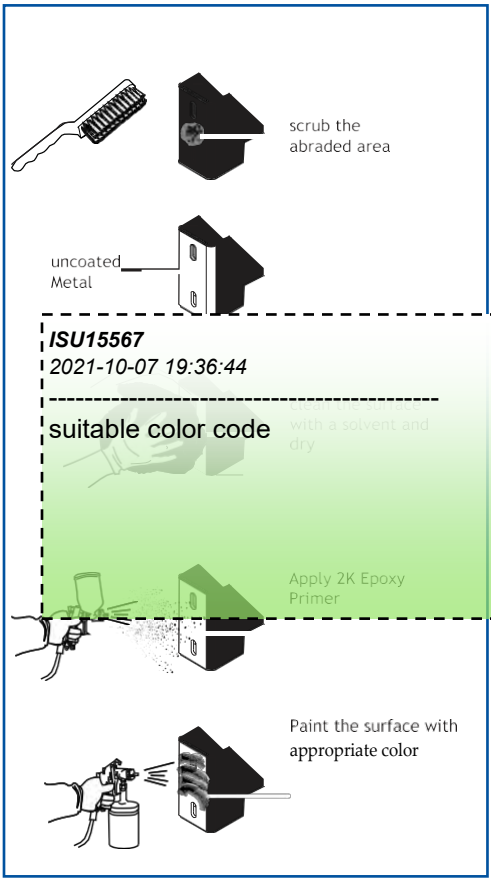


1. **Scrub the corroded area with a wire brush.**

2. **Clean the brushed area with a solvent or thinner and dry with a dry cloth.**

3. **Apply 2K Epoxy Primer to cleaned and dried areas.**

4. **Paint the zones with appropriate color code**

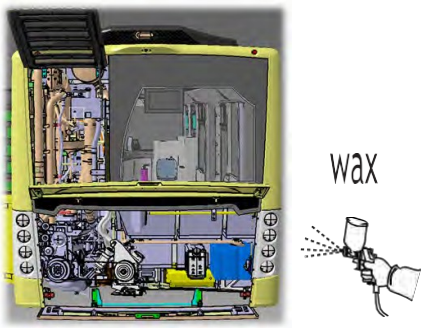


> **CAUTION**
>
> Use heat resistant coating materials for parts close to hot lines.

5.3 ENGINE SECTION SHINING APPLICATION

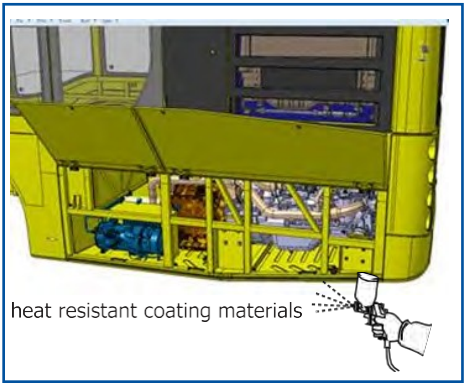
All metal parts in the engine compartment (including copper pipes and A/C compressor etc.) can be polished with Anti-Corrosion Material as shown.

Yellow and red dots may appear in the exhaust line due to high temperature. These stains should not be considered as corrosion.



CAUTION

Do not apply any chemical protection method if any corrosion is observed in the exhaust line or turbo line in the engine compartment.
The exhaust line gets hot while the engine is running. Any chemical applied to the exhaust line for protection can cause a fire.
If any holes or leaks appear on it exhaust line, please replace the line elements with the original ones.

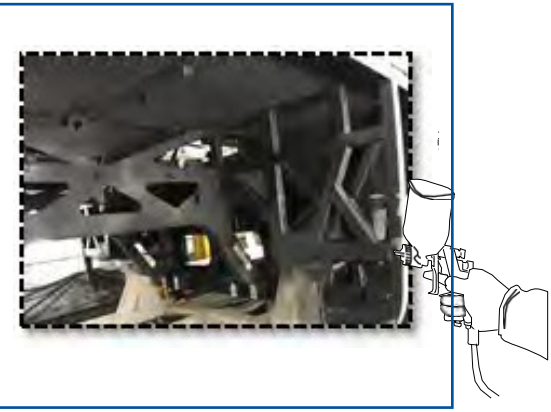


CAUTION

Use heat resistant coating materials for parts close to hot lines.

6. CHASSIS METHOD (ZONE B)

6.1 CHASSIS PROFILES

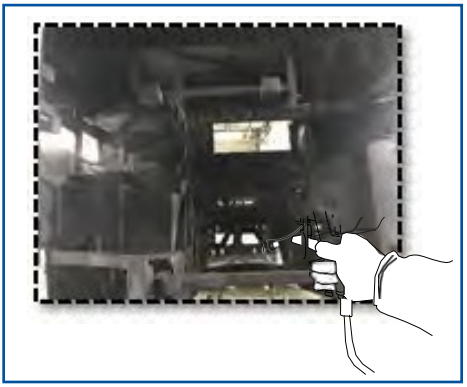


1. **Scrub the corroded area with a wire brush.**
2. **Clean the brushed area with a solvent or thinner and dry with a dry cloth.**
3. **Apply epoxy primer to cleaned and dried areas.**
4. **To wait 12 hours for primed surfaces to dry.**
5. **Apply Efcoat WE439A1 Anti-Corrosion Material.**

6. CHASSIS METHOD (ZONE B)

6.2 SCREW WAX APPLICATION

All metal parts in the engine compartment (including heating copper pipes and A/C compressor, Exhaust muffler bracket, etc.) can be polished with Efcoat WE439A1 Anti-Corrosion Material as shown.

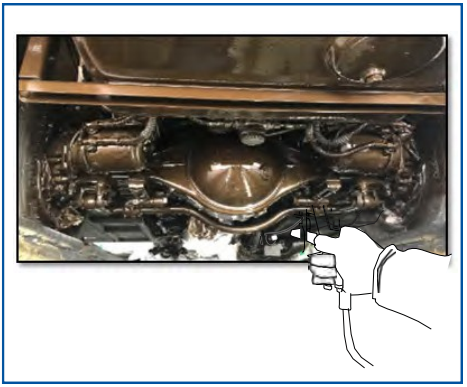


CAUTION

Receive necessary fire precautions during the operation of the muffler line, screws and heating system

6.3 BODY BODY COATING

1. **Scrub the corroded area with a wire brush.**



2. **Clean the brushed area with a solvent or thinner and dry with a dry cloth.**

3. **Apply epoxy primer to cleaned and dried areas.**



4. **To wait 12 hours for primed surfaces to dry.**

5. **Apply underbody coating (HENKEL MS 9320).**



CAUTION

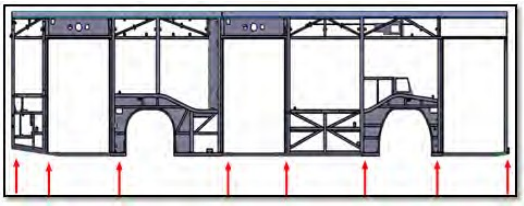
- DO NOT use any heat source to dry the underbody epoxy primer.

- NS avoid any cooling problems, differential coating thickness should be 300-350 microns.

6. CHASSIS METHOD (ZONE B)

6.4 PROFILE WAX APPLICATION

Can be waxed with the inside of the profiles with Anti-Corrosion Material.

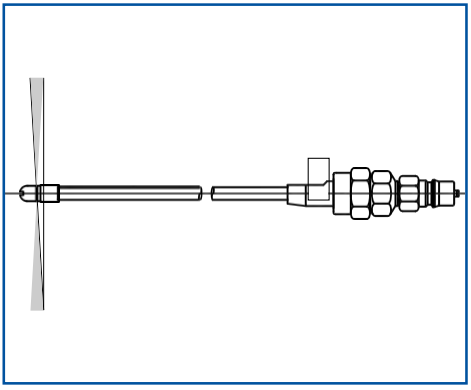


1. **Clean the underbody using a high pressure washer**
2. **Dry the lower body**
3. **Apply Anti-corrosion material to the wax holes. Polish should be applied to all holes in the lower body. Wax holes are 8 mm.**



4. **To wait 20 minutes.**
5. **Remove excess residue from the wax holes with a clean cloth.**

A bidirectional stick should be used for wax application.



CAUTION

Take necessary precautions while working under the body

If any corrosion is observed on the surface luggage compartments and profiles;



1. **Scrub the corroded area with a wire brush.**

2. **Clean the brushed area with a solvent or thinner and dry with a dry cloth.**



3. **Apply 2K Epoxy Primer to cleaned and dried areas.**

4. **Wait at least 45 minutes to ensure surfaces are thoroughly dry. In addition, infrared heaters can be used for drying.**

! CAUTION

If the corroded area is close to electrical-electronic equipment (switch panel, relay panel, batteries, any cable, etc.), DO NOT use external heat sources such as infrared heaters to dry the painted areas before insulating (thermal) these equipment.



! CAUTION

After brushing, cleaning and priming, apply coarse paint to the interior areas of the luggage compartments.

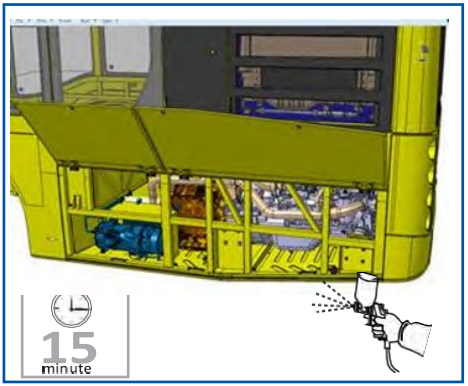
If any corrosion is observed on the side panels;



1. **Mask the areas you want to protect using reverse masking methods.**

2. **Scrub the corroded area with a wire brush.**

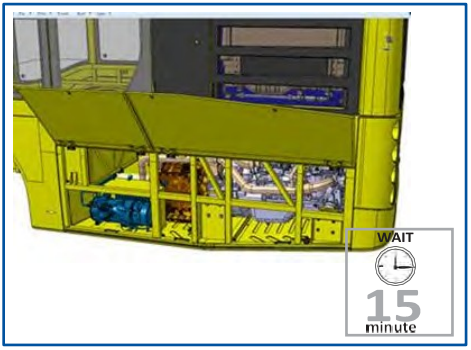
3. **Use compressed air to clean the surface.**



4. **Clean the brushed area with a solvent or thinner and dry with a dry cloth.**

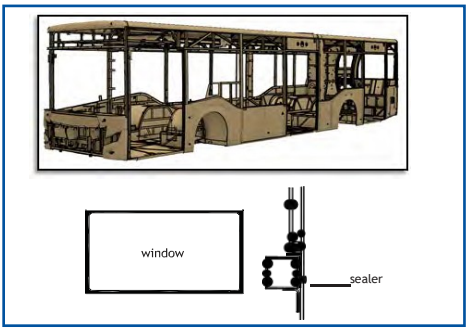
5. **Apply 2K epoxy primer to cleaned and dried areas**

6. **Wait at least 45 minutes to ensure surfaces are thoroughly dry. In addition, infrared heaters can be used for drying.**



7.2 PROCEDURE FOR WINDOW SIDE CORROSIONS

If any corrosion is observed on the window side;



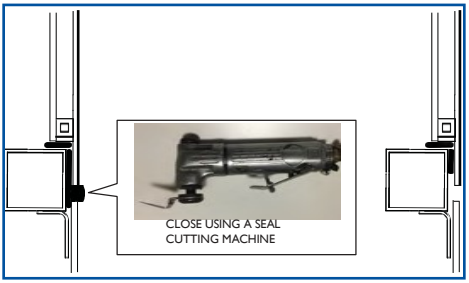
1. **Remove the sealant from the worn area.**

2. **Scrub the corroded area with a wire brush.**

3. **Clean the brushed area with a solvent or thinner and dry with a dry cloth.**

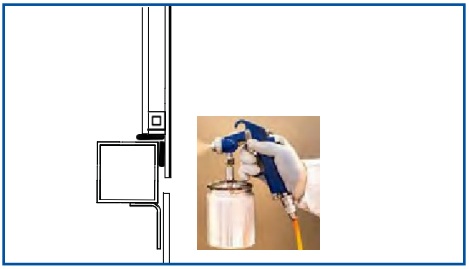
4. **Mask the necessary areas.**

5. **Apply 2K Epoxy Primer to cleaned and dried areas. Wait at least 12 hours or use an infrared heater to dry the area.**





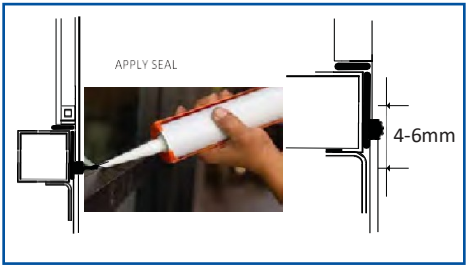
6. **Paint the treated area with 2K black paint using spray paint.**



7. **Wait at least 45 minutes to ensure surfaces are thoroughly dry.**

8. **Apply sealant to the gap between the side** panel and window profile.

   Terostat 8599 should be used for this process.



CAUTION

Use the adhesive (sealant) only in a well-ventilated area. The adhesive is stable, do not swallow or do not breathe, keep away from eyes and skin, may cause injury.

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8. MAINTENANCE PROCEDURE

Every vehicle should be checked every 6 months. If the vehicle is not checked, it will be out of warranty. If there is damage to the vehicle, it must be repaired to avoid corrosion problems.

CAUTION

Internal profiles should be checked annually, if wax has been removed, polishing[one]must be applied to the required structure of the hull with service approval.

CAUTION

It is recommended to wash the vehicle at least once a week and to wash the underbody with low pressure water at least once a month in order to prevent the contamination from damaging the chemicals. High pressure water causes wear on the underbody lining.
If any signs of corrosion are confirmed, should be rescheduled without delay.

CAUTION

In winter, peeling and shedding should be checked 3 times on the underbody coating. Before the start of the winter season, at the end of January (when the high winter season is at the end of October), at the end of the winter season If there is wear, the coating[2nd] should be renewed where necessary

1: Candle: EFCOAT WH 492 A1
2: Underbody Coating HENKEL MS9320

CAUTION

Vehicle should be check in 3 times a year.
1st: Automn maintenance should be done in October
2nd: Winter maintenance should be done in January
3rd: Spring maintenance should be done in April

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8.1 AUTOMN MAINTENANCE LİST (YEAR 1)

Service/Dealer Signature

Maintenance Date:

Kilometer

Registration plate :

Repair Maintenance Service (Workshop)

	Maintenance	explanation
☐	Wash Undebody and Check Coating	The lower body should be washed with low pressure water. It should be checked whether there is peeling and peeling on the underbody coating, If there is wear, the coating[one] should be renewed where necessary.
☐	Check Engine Room	The engine room should be checked for any traces of corrosion and if there is any damage, the damage should be repaired.
☐	Check Zone-B	The undersides (Zone B) should be checked for any signs of corrosion and any damage (due to rock impact, etc.) should be repaired.
☐	Check external moving parts and brackets	Exterior moving parts should be cleaned and lubricated (e.g. Bumper hinges, Door mechanism, Door locks, Wiper mechanism, Front lighting brackets, Side mirror, Door handles, Rear doors suspension, Rear light brackets, Exhaust cap screws and nuts, Radiator cap).
☐	Check hatches and doors	Covers and doors should be checked for signs of corrosion and any damage should be repaired.
☐	Check inside the building profiles	Internal profiles should be checked, if wax or rusting is observed, wax work[2nd] should be applied to the necessary structure of the body.
☐	Check Vehicle Paint	Paint control should be done. If there are any scratches and paint damage, the paint of the damaged area should be renewed.

1: Candle: EFCOAT WH 492 A1
2: Underbody Coating HENKEL MS9320

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8.2 WINTER MAINTENANCE LİST (YEAR 1)

Service/Dealer Signature

Maintenance Date:

Kilometer

Registration plate :

Repair Maintenance Service (Workshop)

	Maintenance	explanation
☐	Wash Undebody and Check Coating	The lower body should be washed with low pressure water. It should be checked whether there is peeling and peeling on the underbody coating, If there is wear, the coating[one] should be renewed where necessary.
☐	Check Vehicle Paint	Paint control should be done. If there are any scratches and paint damage, the paint of the damaged area should be renewed.

1: Coating: Dinitrol 3641 A 80 - AB-01-027Y - Wide min 300 µ

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8.3 SPRING MAINTENANCE LİST (YEAR 1)

Service/Dealer Signature

Maintenance Date:

Kilometer

Registration plate :

Repair Maintenance Service (Workshop)

	Maintenance	explanation
☐	Wash Undebody and Check Coating	The lower body should be washed with low pressure water. It should be checked whether there is peeling and peeling on the underbody coating, If there is wear, the coating[one] should be renewed where necessary.
☐	Check Engine Room	The engine room should be checked for any traces of corrosion and if there is any damage, the damage should be repaired.
☐	Check Zone-B	The undersides (Zone B) should be checked for any signs of corrosion and any damage (due to rock impact, etc.) should be repaired.
☐	Check external moving parts and brackets	Exterior moving parts should be cleaned and lubricated (e.g. Bumper hinges, Door mechanism, Door locks, Wiper mechanism, Front lighting brackets, Side mirror, Door handles, Rear doors suspension, Rear light brackets, Exhaust cap screws and nuts, Radiator cap).
☐	Check hatches and doors	Covers and doors should be checked for signs of corrosion and any damage should be repaired.
☐	Check inside the building profiles	Internal profiles should be checked, if wax or rusting is observed, wax work[2nd] should be applied to the necessary structure of the body.
☐	Check Vehicle Paint	Paint control should be done. If there are any scratches and paint damage, the paint of the damaged area should be renewed.

1: Candle: EFCOAT WH 492 A1
2: Underbody Coating HENKEL MS9320

8.4 AUTOMN MAINTENANCE LİST (YEAR 2)

Service/Dealer Signature

Maintenance Date:

Kilometer

Registration plate :

Repair Maintenance Service (Workshop)

	Maintenance	explanation
☐	Wash Undebody and Check Coating	The lower body should be washed with low pressure water. It should be checked whether there is peeling and peeling on the underbody coating, If there is wear, the coating[one] should be renewed where necessary.
☐	Check Engine Room	The engine room should be checked for any traces of corrosion and if there is any damage, the damage should be repaired.
☐	Check Zone-B	The undersides (Zone B) should be checked for any signs of corrosion and any damage (due to rock impact, etc.) should be repaired.
☐	Check external moving parts and brackets	Exterior moving parts should be cleaned and lubricated (e.g. Bumper hinges, Door mechanism, Door locks, Wiper mechanism, Front lighting brackets, Side mirror, Door handles, Rear doors suspension, Rear light brackets, Exhaust cap screws and nuts, Radiator cap).
☐	Check hatches and doors	Covers and doors should be checked for signs of corrosion and any damage should be repaired.
☐	Check inside the building profiles	Internal profiles should be checked, if wax or rusting is observed, wax work[2nd] should be applied to the necessary structure of the body.
☐	Check Vehicle Paint	Paint control should be done. If there are any scratches and paint damage, the paint of the damaged area should be renewed.

1: Candle: EFCOAT WH 492 A1
2: Underbody Coating HENKEL MS9320

8.5 WINTER MAINTENANCE LİST (YEAR 2)

Service/Dealer Signature

Maintenance Date:

Kilometer

Registration plate :

Repair Maintenance Service (Workshop)

	Maintenance	explanation
☐	Wash Undebody and Check Coating	The lower body should be washed with low pressure water. It should be checked whether there is peeling and peeling on the underbody coating, If there is wear, the coating[one] should be renewed where necessary.
☐	Check Vehicle Paint	Paint control should be done. If there are any scratches and paint damage, the paint of the damaged area should be renewed.

1: Coating: Dinitrol 3641 A 80 - AB-01-027Y - Wide min 300 µ

8.6 SPRING MAINTENANCE LİST (YEAR 2)

Service/Dealer Signature	Maintenance Date: Kilometer Registration plate : Repair Maintenance Service (Workshop)

	Maintenance	explanation
☐	Wash Undebody and Check Coating	The lower body should be washed with low pressure water. It should be checked whether there is peeling and peeling on the underbody coating, If there is wear, the coating[one] should be renewed where necessary.
☐	Check Engine Room	The engine room should be checked for any traces of corrosion and if there is any damage, the damage should be repaired.
☐	Check Zone-B	The undersides (Zone B) should be checked for any signs of corrosion and any damage (due to rock impact, etc.) should be repaired.
☐	Check external moving parts and brackets	Exterior moving parts should be cleaned and lubricated (e.g. Bumper hinges, Door mechanism, Door locks, Wiper mechanism, Front lighting brackets, Side mirror, Door handles, Rear doors suspension, Rear light brackets, Exhaust cap screws and nuts, Radiator cap).
☐	Check hatches and doors	Covers and doors should be checked for signs of corrosion and any damage should be repaired.
☐	Check inside the building profiles	Internal profiles should be checked, if wax or rusting is observed, wax work[2nd] should be applied to the necessary structure of the body.
☐	Check Vehicle Paint	Paint control should be done. If there are any scratches and paint damage, the paint of the damaged area should be renewed.

1: Candle: EFCOAT WH 492 A1
2: Underbody Coating HENKEL MS9320

8.7 AUTOMN MAINTENANCE LİST (YEAR 3)

Service/Dealer Signature

Maintenance Date:

Kilometer

Registration plate :

Repair Maintenance Service (Workshop)

	Maintenance	explanation
☐	Wash Undebody and Check Coating	The lower body should be washed with low pressure water. It should be checked whether there is peeling and peeling on the underbody coating, If there is wear, the coating[one] should be renewed where necessary.
☐	Check Engine Room	The engine room should be checked for any traces of corrosion and if there is any damage, the damage should be repaired.
☐	Check Zone-B	The undersides (Zone B) should be checked for any signs of corrosion and any damage (due to rock impact, etc.) should be repaired.
☐	Check external moving parts and brackets	Exterior moving parts should be cleaned and lubricated (e.g. Bumper hinges, Door mechanism, Door locks, Wiper mechanism, Front lighting brackets, Side mirror, Door handles, Rear doors suspension, Rear light brackets, Exhaust cap screws and nuts, Radiator cap).
☐	Check hatches and doors	Covers and doors should be checked for signs of corrosion and any damage should be repaired.
☐	Check inside the building profiles	Internal profiles should be checked, if wax or rusting is observed, wax work[2nd] should be applied to the necessary structure of the body.
☐	Check Vehicle Paint	Paint control should be done. If there are any scratches and paint damage, the paint of the damaged area should be renewed.

1: Candle: EFCOAT WH 492 A1
2: Underbody Coating HENKEL MS9320

Kurum/Şirket İçi / Internal Only

8.8 WINTER MAINTENANCE LİST (YEAR 3)

Service/Dealer Signature

Maintenance Date:

Kilometer

Registration plate :

Repair Maintenance Service (Workshop)

	Maintenance	explanation
☐	Wash Undebody and Check Coating	The lower body should be washed with low pressure water. It should be checked whether there is peeling and peeling on the underbody coating, If there is wear, the coating[one] should be renewed where necessary.
☐	Check Vehicle Paint	Paint control should be done. If there are any scratches and paint damage, the paint of the damaged area should be renewed.

1: Coating: Dinitrol 3641 A 80 - AB-01-027Y - Wide min 300 µ

Kurum/Şirket İçi / Internal Only

8.9 SPRING MAINTENANCE LİST (YEAR 3)

Service/Dealer Signature

Maintenance Date:

Kilometer

Registration plate :

Repair Maintenance Service (Workshop)

	Maintenance	explanation
☐	Wash Undebody and Check Coating	The lower body should be washed with low pressure water. It should be checked whether there is peeling and peeling on the underbody coating, If there is wear, the coating[one] should be renewed where necessary.
☐	Check Engine Room	The engine room should be checked for any traces of corrosion and if there is any damage, the damage should be repaired.
☐	Check Zone-B	The undersides (Zone B) should be checked for any signs of corrosion and any damage (due to rock impact, etc.) should be repaired.
☐	Check external moving parts and brackets	Exterior moving parts should be cleaned and lubricated (e.g. Bumper hinges, Door mechanism, Door locks, Wiper mechanism, Front lighting brackets, Side mirror, Door handles, Rear doors suspension, Rear light brackets, Exhaust cap screws and nuts, Radiator cap).
☐	Check hatches and doors	Covers and doors should be checked for signs of corrosion and any damage should be repaired.
☐	Check inside the building profiles	Internal profiles should be checked, if wax or rusting is observed, wax work[2nd] should be applied to the necessary structure of the body.
☐	Check Vehicle Paint	Paint control should be done. If there are any scratches and paint damage, the paint of the damaged area should be renewed.

1: Candle: EFCOAT WH 492 A1
2: Underbody Coating HENKEL MS9320

8.10 AUTOMN MAINTENANCE LİST (YEAR 4)

Service/Dealer Signature

Maintenance Date:

Kilometer

Registration plate :

Repair Maintenance Service (Workshop)

	Maintenance	explanation
☐	Wash Undebody and Check Coating	The lower body should be washed with low pressure water. It should be checked whether there is peeling and peeling on the underbody coating, If there is wear, the coating[one] should be renewed where necessary.
☐	Check Engine Room	The engine room should be checked for any traces of corrosion and if there is any damage, the damage should be repaired.
☐	Check Zone-B	The undersides (Zone B) should be checked for any signs of corrosion and any damage (due to rock impact, etc.) should be repaired.
☐	Check external moving parts and brackets	Exterior moving parts should be cleaned and lubricated (e.g. Bumper hinges, Door mechanism, Door locks, Wiper mechanism, Front lighting brackets, Side mirror, Door handles, Rear doors suspension, Rear light brackets, Exhaust cap screws and nuts, Radiator cap).
☐	Check hatches and doors	Covers and doors should be checked for signs of corrosion and any damage should be repaired.
☐	Check inside the building profiles	Internal profiles should be checked, if wax or rusting is observed, wax work[2nd] should be applied to the necessary structure of the body.
☐	Check Vehicle Paint	Paint control should be done. If there are any scratches and paint damage, the paint of the damaged area should be renewed.

1: Candle: EFCOAT WH 492 A1
2: Underbody Coating HENKEL MS9320

Kurum/Şirket İçi / Internal Only

8.11 WINTER MAINTENANCE LİST (YEAR 4)

Service/Dealer Signature

Maintenance Date:

Kilometer

Registration plate :

Repair Maintenance Service (Workshop)

	Maintenance	explanation
☐	Wash Undebody and Check Coating	The lower body should be washed with low pressure water. It should be checked whether there is peeling and peeling on the underbody coating, If there is wear, the coating[one] should be renewed where necessary.
☐	Check Vehicle Paint	Paint control should be done. If there are any scratches and paint damage, the paint of the damaged area should be renewed.

1: Coating: Dinitrol 3641 A 80 - AB-01-027Y - Wide min 300 µ

Kurum/Şirket İçi / Internal Only

8.12 SPRING MAINTENANCE LİST (YEAR 4)

Service/Dealer Signature

Maintenance Date:

Kilometer

Registration plate :

Repair Maintenance Service (Workshop)

	Maintenance	explanation
☐	Wash Undebody and Check Coating	The lower body should be washed with low pressure water. It should be checked whether there is peeling and peeling on the underbody coating, If there is wear, the coating[one] should be renewed where necessary.
☐	Check Engine Room	The engine room should be checked for any traces of corrosion and if there is any damage, the damage should be repaired.
☐	Check Zone-B	The undersides (Zone B) should be checked for any signs of corrosion and any damage (due to rock impact, etc.) should be repaired.
☐	Check external moving parts and brackets	Exterior moving parts should be cleaned and lubricated (e.g. Bumper hinges, Door mechanism, Door locks, Wiper mechanism, Front lighting brackets, Side mirror, Door handles, Rear doors suspension, Rear light brackets, Exhaust cap screws and nuts, Radiator cap).
☐	Check hatches and doors	Covers and doors should be checked for signs of corrosion and any damage should be repaired.
☐	Check inside the building profiles	Internal profiles should be checked, if wax or rusting is observed, wax work[2nd] should be applied to the necessary structure of the body.
☐	Check Vehicle Paint	Paint control should be done. If there are any scratches and paint damage, the paint of the damaged area should be renewed.

1: Candle: EFCOAT WH 492 A1
2: Underbody Coating HENKEL MS9320

8.13 AUTOMN MAINTENANCE LİST (YEAR 5)

Service/Dealer Signature

Maintenance Date:

Kilometer

Registration plate :

Repair Maintenance Service (Workshop)

	Maintenance	explanation
☐	Wash Undebody and Check Coating	The lower body should be washed with low pressure water. It should be checked whether there is peeling and peeling on the underbody coating, If there is wear, the coating[one] should be renewed where necessary.
☐	Check Engine Room	The engine room should be checked for any traces of corrosion and if there is any damage, the damage should be repaired.
☐	Check Zone-B	The undersides (Zone B) should be checked for any signs of corrosion and any damage (due to rock impact, etc.) should be repaired.
☐	Check external moving parts and brackets	Exterior moving parts should be cleaned and lubricated (e.g. Bumper hinges, Door mechanism, Door locks, Wiper mechanism, Front lighting brackets, Side mirror, Door handles, Rear doors suspension, Rear light brackets, Exhaust cap screws and nuts, Radiator cap).
☐	Check hatches and doors	Covers and doors should be checked for signs of corrosion and any damage should be repaired.
☐	Check inside the building profiles	Internal profiles should be checked, if wax or rusting is observed, wax work[2nd] should be applied to the necessary structure of the body.
☐	Check Vehicle Paint	Paint control should be done. If there are any scratches and paint damage, the paint of the damaged area should be renewed.

1: Candle: EFCOAT WH 492 A1
2: Underbody Coating HENKEL MS9320

Kurum/Şirket İçi / Internal Only

8.14 WINTER MAINTENANCE LİST (YEAR 5)

Service/Dealer Signature

Maintenance Date:

Kilometer

Registration plate :

Repair Maintenance Service (Workshop)

Maintenance	explanation
☐ Wash Undebody and Check Coating	The lower body should be washed with low pressure water. It should be checked whether there is peeling and peeling on the underbody coating, If there is wear, the coating[one] should be renewed where necessary.
☐ Check Vehicle Paint	Paint control should be done. If there are any scratches and paint damage, the paint of the damaged area should be renewed.

1: Coating: Dinitrol 3641 A 80 - AB-01-027Y - Wide min 300 µ

Kurum/Şirket İçi / Internal Only

8.15 SPRING MAINTENANCE LİST (YEAR 5)

Service/Dealer Signature

Maintenance Date:

Kilometer

Registration plate :

Repair Maintenance Service (Workshop)

	Maintenance	explanation
☐	Wash Undebody and Check Coating	The lower body should be washed with low pressure water. It should be checked whether there is peeling and peeling on the underbody coating, If there is wear, the coating[one] should be renewed where necessary.
☐	Check Engine Room	The engine room should be checked for any traces of corrosion and if there is any damage, the damage should be repaired.
☐	Check Zone-B	The undersides (Zone B) should be checked for any signs of corrosion and any damage (due to rock impact, etc.) should be repaired.
☐	Check external moving parts and brackets	Exterior moving parts should be cleaned and lubricated (e.g. Bumper hinges, Door mechanism, Door locks, Wiper mechanism, Front lighting brackets, Side mirror, Door handles, Rear doors suspension, Rear light brackets, Exhaust cap screws and nuts, Radiator cap).
☐	Check hatches and doors	Covers and doors should be checked for signs of corrosion and any damage should be repaired.
☐	Check inside the building profiles	Internal profiles should be checked, if wax or rusting is observed, wax work[2nd] should be applied to the necessary structure of the body.
☐	Check Vehicle Paint	Paint control should be done. If there are any scratches and paint damage, the paint of the damaged area should be renewed.

1: Candle: EFCOAT WH 492 A1
2: Underbody Coating HENKEL MS9320

8.16 AUTOMN MAINTENANCE LİST (YEAR 6)

Service/Dealer Signature

Maintenance Date:

Kilometer

Registration plate :

Repair Maintenance Service (Workshop)

	Maintenance	explanation
☐	Wash Undebody and Check Coating	The lower body should be washed with low pressure water. It should be checked whether there is peeling and peeling on the underbody coating, If there is wear, the coating[one] should be renewed where necessary.
☐	Check Engine Room	The engine room should be checked for any traces of corrosion and if there is any damage, the damage should be repaired.
☐	Check Zone-B	The undersides (Zone B) should be checked for any signs of corrosion and any damage (due to rock impact, etc.) should be repaired.
☐	Check external moving parts and brackets	Exterior moving parts should be cleaned and lubricated (e.g. Bumper hinges, Door mechanism, Door locks, Wiper mechanism, Front lighting brackets, Side mirror, Door handles, Rear doors suspension, Rear light brackets, Exhaust cap screws and nuts, Radiator cap).
☐	Check hatches and doors	Covers and doors should be checked for signs of corrosion and any damage should be repaired.
☐	Check inside the building profiles	Internal profiles should be checked, if wax or rusting is observed, wax work[2nd] should be applied to the necessary structure of the body.
☐	Check Vehicle Paint	Paint control should be done. If there are any scratches and paint damage, the paint of the damaged area should be renewed.

1: Candle: EFCOAT WH 492 A1
2: Underbody Coating HENKEL MS9320

Kurum/Şirket İçi / Internal Only

8.17 WINTER MAINTENANCE LİST (YEAR 6)

Service/Dealer Signature

Maintenance Date:

Kilometer

Registration plate :

Repair Maintenance Service (Workshop)

	Maintenance	explanation
☐	Wash Undebody and Check Coating	The lower body should be washed with low pressure water. It should be checked whether there is peeling and peeling on the underbody coating, If there is wear, the coating[one] should be renewed where necessary.
☐	Check Vehicle Paint	Paint control should be done. If there are any scratches and paint damage, the paint of the damaged area should be renewed.

1: Coating: Dinitrol 3641 A 80 - AB-01-027Y - Wide min 300 µ

Kurum/Şirket İçi / Internal Only

8.18 SPRING MAINTENANCE LİST (YEAR 6)

Service/Dealer Signature

Maintenance Date:

Kilometer

Registration plate :

Repair Maintenance Service (Workshop)

	Maintenance	explanation
☐	Wash Undebody and Check Coating	The lower body should be washed with low pressure water. It should be checked whether there is peeling and peeling on the underbody coating, If there is wear, the coating[one] should be renewed where necessary.
☐	Check Engine Room	The engine room should be checked for any traces of corrosion and if there is any damage, the damage should be repaired.
☐	Check Zone-B	The undersides (Zone B) should be checked for any signs of corrosion and any damage (due to rock impact, etc.) should be repaired.
☐	Check external moving parts and brackets	Exterior moving parts should be cleaned and lubricated (e.g. Bumper hinges, Door mechanism, Door locks, Wiper mechanism, Front lighting brackets, Side mirror, Door handles, Rear doors suspension, Rear light brackets, Exhaust cap screws and nuts, Radiator cap).
☐	Check hatches and doors	Covers and doors should be checked for signs of corrosion and any damage should be repaired.
☐	Check inside the building profiles	Internal profiles should be checked, if wax or rusting is observed, wax work[2nd] should be applied to the necessary structure of the body.
☐	Check Vehicle Paint	Paint control should be done. If there are any scratches and paint damage, the paint of the damaged area should be renewed.

1: Candle: EFCOAT WH 492 A1
2: Underbody Coating HENKEL MS9320

8.19 AUTOMN MAINTENANCE LİST (YEAR 7)

Service/Dealer Signature

Maintenance Date:

Kilometer

Registration plate :

Repair Maintenance Service (Workshop)

	Maintenance	explanation
☐	Wash Undebody and Check Coating	The lower body should be washed with low pressure water. It should be checked whether there is peeling and peeling on the underbody coating, If there is wear, the coating[one] should be renewed where necessary.
☐	Check Engine Room	The engine room should be checked for any traces of corrosion and if there is any damage, the damage should be repaired.
☐	Check Zone-B	The undersides (Zone B) should be checked for any signs of corrosion and any damage (due to rock impact, etc.) should be repaired.
☐	Check external moving parts and brackets	Exterior moving parts should be cleaned and lubricated (e.g. Bumper hinges, Door mechanism, Door locks, Wiper mechanism, Front lighting brackets, Side mirror, Door handles, Rear doors suspension, Rear light brackets, Exhaust cap screws and nuts, Radiator cap).
☐	Check hatches and doors	Covers and doors should be checked for signs of corrosion and any damage should be repaired.
☐	Check inside the building profiles	Internal profiles should be checked, if wax or rusting is observed, wax work[2nd] should be applied to the necessary structure of the body.
☐	Check Vehicle Paint	Paint control should be done. If there are any scratches and paint damage, the paint of the damaged area should be renewed.

1: Candle: EFCOAT WH 492 A1
2: Underbody Coating HENKEL MS9320

Kurum/Şirket İçi / Internal Only

8.20 WINTER MAINTENANCE LİST (YEAR 7)

Service/Dealer Signature

Maintenance Date:

Kilometer

Registration plate :

Repair Maintenance Service (Workshop)

	Maintenance	explanation
☐	Wash Undebody and Check Coating	The lower body should be washed with low pressure water. It should be checked whether there is peeling and peeling on the underbody coating, If there is wear, the coating[one] should be renewed where necessary.
☐	Check Vehicle Paint	Paint control should be done. If there are any scratches and paint damage, the paint of the damaged area should be renewed.

1: Coating: Dinitrol 3641 A 80 - AB-01-027Y - Wide min 300 µ

Kurum/Şirket İçi / Internal Only

8.21 SPRING MAINTENANCE LİST (YEAR 7)

Service/Dealer Signature

Maintenance Date:

Kilometer

Registration plate :

Repair Maintenance Service (Workshop)

	Maintenance	explanation
☐	Wash Undebody and Check Coating	The lower body should be washed with low pressure water. It should be checked whether there is peeling and peeling on the underbody coating, If there is wear, the coating[one] should be renewed where necessary.
☐	Check Engine Room	The engine room should be checked for any traces of corrosion and if there is any damage, the damage should be repaired.
☐	Check Zone-B	The undersides (Zone B) should be checked for any signs of corrosion and any damage (due to rock impact, etc.) should be repaired.
☐	Check external moving parts and brackets	Exterior moving parts should be cleaned and lubricated (e.g. Bumper hinges, Door mechanism, Door locks, Wiper mechanism, Front lighting brackets, Side mirror, Door handles, Rear doors suspension, Rear light brackets, Exhaust cap screws and nuts, Radiator cap).
☐	Check hatches and doors	Covers and doors should be checked for signs of corrosion and any damage should be repaired.
☐	Check inside the building profiles	Internal profiles should be checked, if wax or rusting is observed, wax work[2nd] should be applied to the necessary structure of the body.
☐	Check Vehicle Paint	Paint control should be done. If there are any scratches and paint damage, the paint of the damaged area should be renewed.

1: Candle: EFCOAT WH 492 A1
2: Underbody Coating HENKEL MS9320

8.22 AUTOMN MAINTENANCE LİST (YEAR 8)

Service/Dealer Signature

Maintenance Date:

Kilometer

Registration plate :

Repair Maintenance Service (Workshop)

	Maintenance	explanation
☐	Wash Undebody and Check Coating	The lower body should be washed with low pressure water. It should be checked whether there is peeling and peeling on the underbody coating, If there is wear, the coating[one] should be renewed where necessary.
☐	Check Engine Room	The engine room should be checked for any traces of corrosion and if there is any damage, the damage should be repaired.
☐	Check Zone-B	The undersides (Zone B) should be checked for any signs of corrosion and any damage (due to rock impact, etc.) should be repaired.
☐	Check external moving parts and brackets	Exterior moving parts should be cleaned and lubricated (e.g. Bumper hinges, Door mechanism, Door locks, Wiper mechanism, Front lighting brackets, Side mirror, Door handles, Rear doors suspension, Rear light brackets, Exhaust cap screws and nuts, Radiator cap).
☐	Check hatches and doors	Covers and doors should be checked for signs of corrosion and any damage should be repaired.
☐	Check inside the building profiles	Internal profiles should be checked, if wax or rusting is observed, wax work[2nd] should be applied to the necessary structure of the body.
☐	Check Vehicle Paint	Paint control should be done. If there are any scratches and paint damage, the paint of the damaged area should be renewed.

1: Candle: EFCOAT WH 492 A1
2: Underbody Coating HENKEL MS9320

Kurum/Şirket İçi / Internal Only

8.23 WINTER MAINTENANCE LİST (YEAR 8)

Service/Dealer Signature

Maintenance Date:

Kilometer

Registration plate :

Repair Maintenance Service (Workshop)

	Maintenance	explanation
☐	Wash Undebody and Check Coating	The lower body should be washed with low pressure water. It should be checked whether there is peeling and peeling on the underbody coating, If there is wear, the coating[one] should be renewed where necessary.
☐	Check Vehicle Paint	Paint control should be done. If there are any scratches and paint damage, the paint of the damaged area should be renewed.

1: Coating: Dinitrol 3641 A 80 - AB-01-027Y - Wide min 300 µ

Kurum/Şirket İçi / Internal Only

8.24 SPRING MAINTENANCE LİST (YEAR 8)

Service/Dealer Signature

Maintenance Date:

Kilometer

Registration plate :

Repair Maintenance Service (Workshop)

	Maintenance	explanation
☐	Wash Undebody and Check Coating	The lower body should be washed with low pressure water. It should be checked whether there is peeling and peeling on the underbody coating, If there is wear, the coating[one] should be renewed where necessary.
☐	Check Engine Room	The engine room should be checked for any traces of corrosion and if there is any damage, the damage should be repaired.
☐	Check Zone-B	The undersides (Zone B) should be checked for any signs of corrosion and any damage (due to rock impact, etc.) should be repaired.
☐	Check external moving parts and brackets	Exterior moving parts should be cleaned and lubricated (e.g. Bumper hinges, Door mechanism, Door locks, Wiper mechanism, Front lighting brackets, Side mirror, Door handles, Rear doors suspension, Rear light brackets, Exhaust cap screws and nuts, Radiator cap).
☐	Check hatches and doors	Covers and doors should be checked for signs of corrosion and any damage should be repaired.
☐	Check inside the building profiles	Internal profiles should be checked, if wax or rusting is observed, wax work[2nd] should be applied to the necessary structure of the body.
☐	Check Vehicle Paint	Paint control should be done. If there are any scratches and paint damage, the paint of the damaged area should be renewed.

1: Candle: EFCOAT WH 492 A1
2: Underbody Coating HENKEL MS9320

8.25 AUTOMN MAINTENANCE LİST (YEAR 9)

Service/Dealer Signature

Maintenance Date:

Kilometer

Registration plate :

Repair Maintenance Service (Workshop)

	Maintenance	explanation
☐	Wash Undebody and Check Coating	The lower body should be washed with low pressure water. It should be checked whether there is peeling and peeling on the underbody coating, If there is wear, the coating[one] should be renewed where necessary.
☐	Check Engine Room	The engine room should be checked for any traces of corrosion and if there is any damage, the damage should be repaired.
☐	Check Zone-B	The undersides (Zone B) should be checked for any signs of corrosion and any damage (due to rock impact, etc.) should be repaired.
☐	Check external moving parts and brackets	Exterior moving parts should be cleaned and lubricated (e.g. Bumper hinges, Door mechanism, Door locks, Wiper mechanism, Front lighting brackets, Side mirror, Door handles, Rear doors suspension, Rear light brackets, Exhaust cap screws and nuts, Radiator cap).
☐	Check hatches and doors	Covers and doors should be checked for signs of corrosion and any damage should be repaired.
☐	Check inside the building profiles	Internal profiles should be checked, if wax or rusting is observed, wax work[2nd] should be applied to the necessary structure of the body.
☐	Check Vehicle Paint	Paint control should be done. If there are any scratches and paint damage, the paint of the damaged area should be renewed.

1: Candle: EFCOAT WH 492 A1
2: Underbody Coating HENKEL MS9320

8.26 WINTER MAINTENANCE LİST (YEAR 9)

Service/Dealer Signature

Maintenance Date:

Kilometer

Registration plate :

Repair Maintenance Service (Workshop)

	Maintenance	explanation
☐	Wash Undebody and Check Coating	The lower body should be washed with low pressure water. It should be checked whether there is peeling and peeling on the underbody coating, If there is wear, the coating[one] should be renewed where necessary.
☐	Check Vehicle Paint	Paint control should be done. If there are any scratches and paint damage, the paint of the damaged area should be renewed.

1: Coating: Dinitrol 3641 A 80 - AB-01-027Y - Wide min 300 µ

8.27 SPRING MAINTENANCE LİST (YEAR 9)

Service/Dealer Signature

Maintenance Date:

Kilometer

Registration plate :

Repair Maintenance Service (Workshop)

	Maintenance	explanation
☐	Wash Undebody and Check Coating	The lower body should be washed with low pressure water. It should be checked whether there is peeling and peeling on the underbody coating, If there is wear, the coating[one] should be renewed where necessary.
☐	Check Engine Room	The engine room should be checked for any traces of corrosion and if there is any damage, the damage should be repaired.
☐	Check Zone-B	The undersides (Zone B) should be checked for any signs of corrosion and any damage (due to rock impact, etc.) should be repaired.
☐	Check external moving parts and brackets	Exterior moving parts should be cleaned and lubricated (e.g. Bumper hinges, Door mechanism, Door locks, Wiper mechanism, Front lighting brackets, Side mirror, Door handles, Rear doors suspension, Rear light brackets, Exhaust cap screws and nuts, Radiator cap).
☐	Check hatches and doors	Covers and doors should be checked for signs of corrosion and any damage should be repaired.
☐	Check inside the building profiles	Internal profiles should be checked, if wax or rusting is observed, wax work[2nd] should be applied to the necessary structure of the body.
☐	Check Vehicle Paint	Paint control should be done. If there are any scratches and paint damage, the paint of the damaged area should be renewed.

1: Candle: EFCOAT WH 492 A1
2: Underbody Coating HENKEL MS9320

8.28 AUTOMN MAINTENANCE LİST (YEAR 10)

Service/Dealer Signature

Maintenance Date:

Kilometer

Registration plate :

Repair Maintenance Service (Workshop)

	Maintenance	explanation
☐	Wash Undebody and Check Coating	The lower body should be washed with low pressure water. It should be checked whether there is peeling and peeling on the underbody coating, If there is wear, the coating[one] should be renewed where necessary.
☐	Check Engine Room	The engine room should be checked for any traces of corrosion and if there is any damage, the damage should be repaired.
☐	Check Zone-B	The undersides (Zone B) should be checked for any signs of corrosion and any damage (due to rock impact, etc.) should be repaired.
☐	Check external moving parts and brackets	Exterior moving parts should be cleaned and lubricated (e.g. Bumper hinges, Door mechanism, Door locks, Wiper mechanism, Front lighting brackets, Side mirror, Door handles, Rear doors suspension, Rear light brackets, Exhaust cap screws and nuts, Radiator cap).
☐	Check hatches and doors	Covers and doors should be checked for signs of corrosion and any damage should be repaired.
☐	Check inside the building profiles	Internal profiles should be checked, if wax or rusting is observed, wax work[2nd] should be applied to the necessary structure of the body.
☐	Check Vehicle Paint	Paint control should be done. If there are any scratches and paint damage, the paint of the damaged area should be renewed.

1: Candle: EFCOAT WH 492 A1
2: Underbody Coating HENKEL MS9320

Kurum/Şirket İçi / Internal Only

8.29 WINTER MAINTENANCE LİST (YEAR 10)

Service/Dealer Signature

Maintenance Date:

Kilometer

Registration plate :

Repair Maintenance Service (Workshop)

	Maintenance	explanation
☐	Wash Undebody and Check Coating	The lower body should be washed with low pressure water. It should be checked whether there is peeling and peeling on the underbody coating, If there is wear, the coating[one] should be renewed where necessary.
☐	Check Vehicle Paint	Paint control should be done. If there are any scratches and paint damage, the paint of the damaged area should be renewed.

1: Coating: Dinitrol 3641 A 80 - AB-01-027Y - Wide min 300 µ

Kurum/Şirket İçi / Internal Only

8.30 SPRING MAINTENANCE LİST (YEAR 10)

Service/Dealer Signature

Maintenance Date:

Kilometer

Registration plate :

Repair Maintenance Service (Workshop)

	Maintenance	explanation
☐	Wash Undebody and Check Coating	The lower body should be washed with low pressure water. It should be checked whether there is peeling and peeling on the underbody coating, If there is wear, the coating[one] should be renewed where necessary.
☐	Check Engine Room	The engine room should be checked for any traces of corrosion and if there is any damage, the damage should be repaired.
☐	Check Zone-B	The undersides (Zone B) should be checked for any signs of corrosion and any damage (due to rock impact, etc.) should be repaired.
☐	Check external moving parts and brackets	Exterior moving parts should be cleaned and lubricated (e.g. Bumper hinges, Door mechanism, Door locks, Wiper mechanism, Front lighting brackets, Side mirror, Door handles, Rear doors suspension, Rear light brackets, Exhaust cap screws and nuts, Radiator cap).
☐	Check hatches and doors	Covers and doors should be checked for signs of corrosion and any damage should be repaired.
☐	Check inside the building profiles	Internal profiles should be checked, if wax or rusting is observed, wax work[2nd] should be applied to the necessary structure of the body.
☐	Check Vehicle Paint	Paint control should be done. If there are any scratches and paint damage, the paint of the damaged area should be renewed.

1: Candle: EFCOAT WH 492 A1
2: Underbody Coating HENKEL MS9320