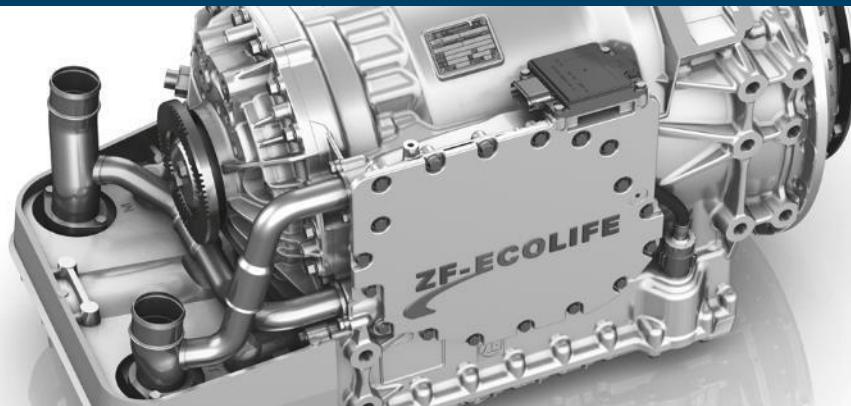




# EcoLife with Start-Stop Function

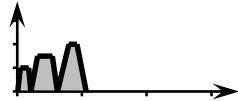
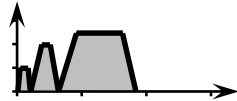
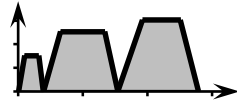
Commercial Vehicle Technology



# UITP Requirements



- SORT cycles for determining fuel consumption
- Basis for standardized consumption comparison

|                      | <b>SORT 1</b><br>Heavy Urban                                                        | <b>SORT 2</b><br>Easy Urban                                                         | <b>SORT 3</b><br>Sub Urban                                                          |
|----------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|
| Cycle course         |  |  |  |
| Stops/km             | 5.8                                                                                 | 3.3                                                                                 | 2.1                                                                                 |
| Average speed (km/h) | 12.1                                                                                | 18.0                                                                                | 25.3                                                                                |

# EcoLife With Start-Stop Function

## Theoretical Fuel Consumption Reduction



- Calculation of cost reduction with sample figures

|                                                    | <b>SORT 1</b><br>Heavy Urban | <b>SORT 2</b><br>Easy Urban | <b>SORT 3</b><br>Sub Urban |
|----------------------------------------------------|------------------------------|-----------------------------|----------------------------|
| SORT cycles/100 km                                 | 192                          | 109                         | 69                         |
| Stop time (sec)                                    | 11,538                       | 6,522                       | 2,759                      |
| Fuel consumption in idle position/h (l) *          | 1.6                          | 1.6                         | 1.6                        |
| Fuel consumption in idle position/100 km (l)       | 5.1                          | 2.9                         | 1.2                        |
| SORT fuel consumption/100 km (l) *                 | 42                           | 37                          | 32                         |
| <b>SORT fuel savings through stop/start system</b> | <b>12.2 %</b>                | <b>7.8 %</b>                | <b>3.8 %</b>               |

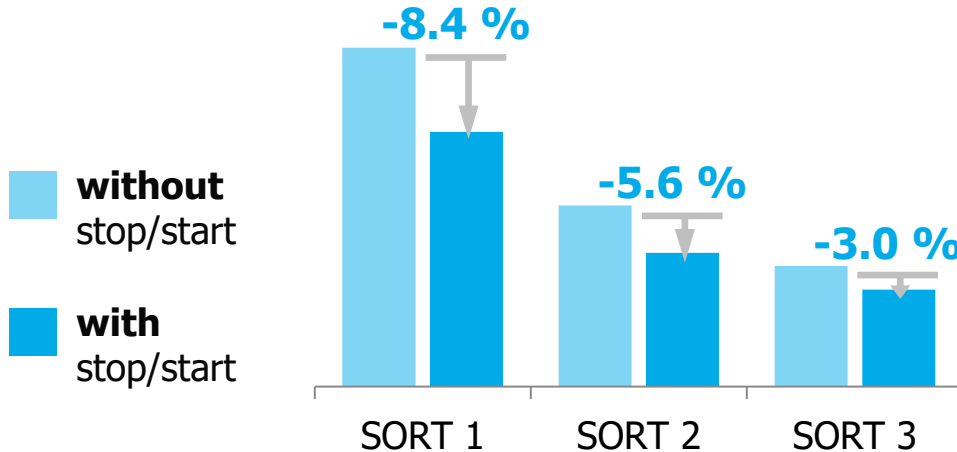
\* Values assumed for sample calculation

# EcoLife With Start-Stop Function

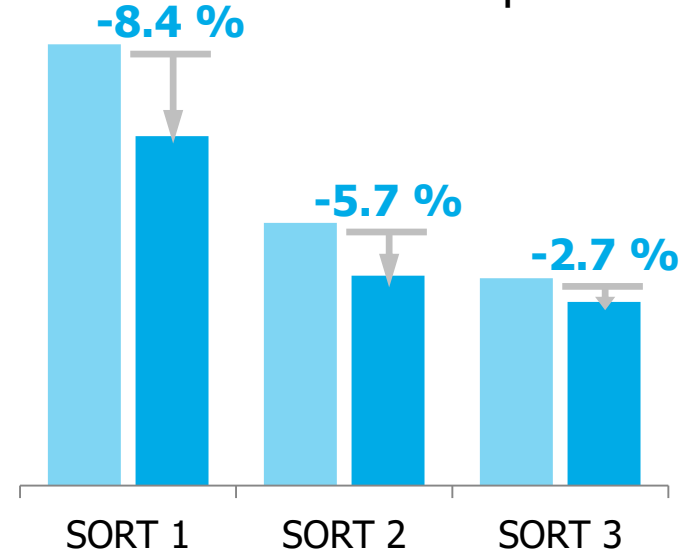
## Real SORT Measurements of a European OEM (2016)

Reduced consumption for 2 solo buses with Euro 6 diesel engine

Example 1



Example 2



# New Additional Function: Start-Stop Function With EcoLife Transmissions

Statistical data from ZF\* shows:  
**More than 80 % of the stops are less than 20 seconds**



\* Source: ZF statistics, Istanbul/TR, routes 78, 98, 7828, BRT and Moscow/RU, routes 3, 34, 627



# New Additional Function: Start-Stop Function With EcoLife Transmissions

## Example: Operation corresponding to SORT 1

Cycle with 20 seconds standstill time at each stop:

- 5.8 stops/km
- 12.1 km/h
- 40 % stop time

With an annual mileage of 60,000 km, this means:

- 348,000 stops
- 1,933 hours in standstill

**Up to 10 % fuel saving can be expected, depending on the start-stop system**



# New Additional Function: Start-Stop Function With EcoLife Transmissions

## Future-oriented:

EcoLife transmissions support further fuel savings with new start-stop function capability

Motor start-stop function is specially designed for

- Heavy duty operating conditions
- In combination with frequent start-ups
- Engine torques from 1,000 up to 1,600 Nm



# New Additional Function: Start-Stop Function With EcoLife Transmissions

## Advantages

- Fuel savings up to 10 %  
(depending on configuration level)
- Lower emissions (Noise, CO2)
- Increased robustness of hardware and strength  
of entire start-up device

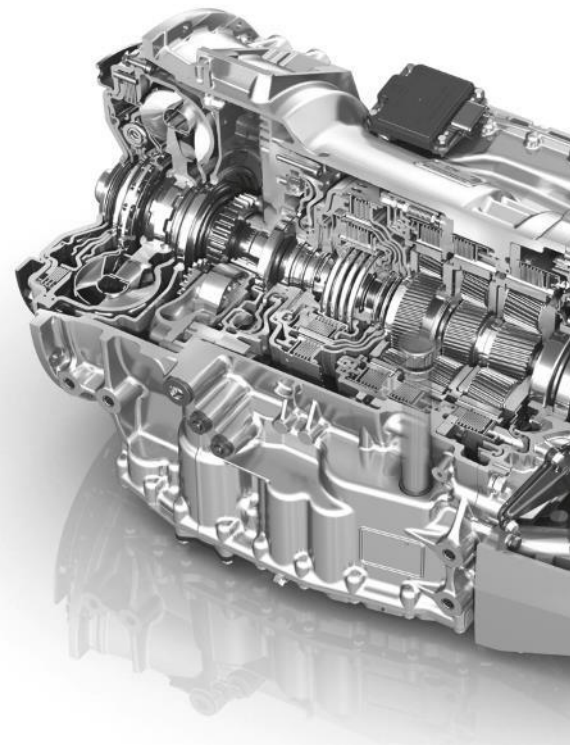


# Technical Modifications

- Adaptation of W370 torque converter to be start-stop capable
  - designed for torque up to 1,600 Nm
  - designed for high amount of load cycles
  - higher lock-up performance
- Optimization of transmission:
  - gearbox input and shift elements
  - hydraulic system

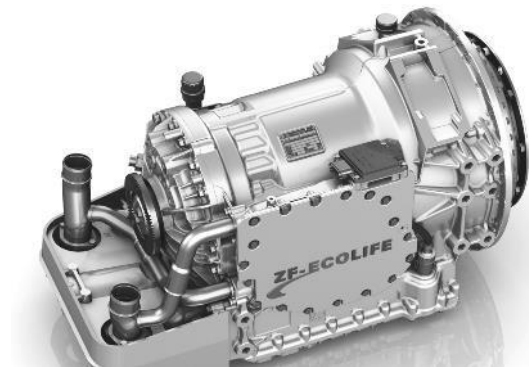
Advantages:

- **No change in transmission installation dimensions!**
- **EcoLife is well prepared for start-stop function**



# EcoLife with Start-Stop Function

## Technical Data



|            |                    | $T_{\text{mot max}}$<br>(Nm) | $T_{\text{tur max}}$<br>(Nm) | $T_{\text{ret max}}$<br>(Nm) | $GVW_{\text{max}}$<br>(kg) |
|------------|--------------------|------------------------------|------------------------------|------------------------------|----------------------------|
|            | <b>6 AP 1000 B</b> | 1,000                        | 1,400                        | 1,400                        | 19,000                     |
|            | <b>6 AP 1200 B</b> | 1,200                        | 1,600                        | 1,400                        | 28,000                     |
|            | <b>6 AP 1400 B</b> | 1,400                        | 1,800                        | 1,400                        | 28,000                     |
| <b>NEW</b> | <b>6 AP 1600 B</b> | 1,600                        | 2,000                        | up to » 1,600                | 28,000                     |