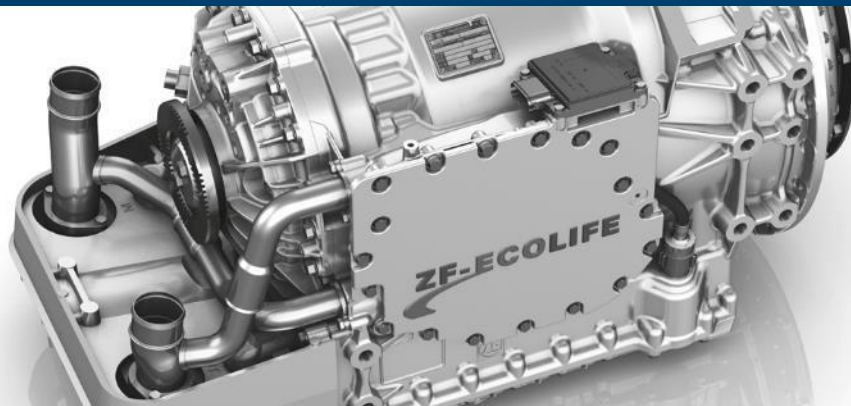




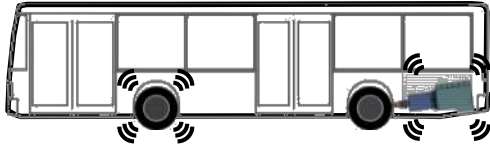
EcoLife – Noise Measurements

Commercial Vehicle Technology



Source of Noise: Line Service Bus

Main sources of noise in the line service bus



- Tire noises
- Engine noise

Noise situation at bus stops

The acceleration of buses driving away from the bus stop is perceived by many residents and passers-by as being particularly disturbing!

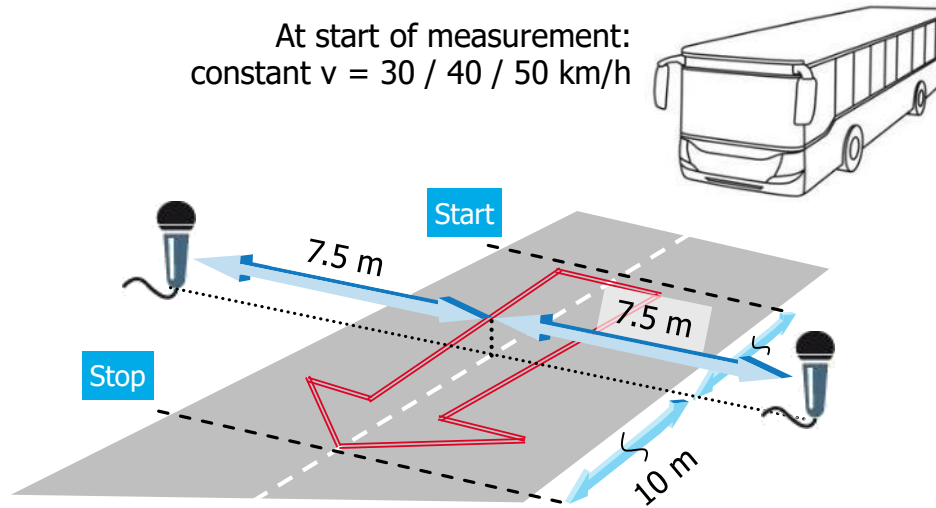
- Very low driving speed
- High engine speeds

Engine noises are dominant here



Unique EU-Test Procedure for Bus Noises

Accelerated pass-by according to ECE R51



The noise emission of buses departing with high engine speeds is **not taken into account!**

Comparative ZF Noise Measurements Certified by DEKRA

Measurements under real operating conditions at a typical bus stop

- **Focus: Noise emissions at the bus stop area**
- Procedure: Braking → Stopping → Setting off at full throttle
- Additionally: drive-by at constant 40 km/h
- Two comparable line service buses with different transmissions:
 - EcoLife
 - Voith DIWA.6



Monitored and certified by DEKRA, the independent expert organization

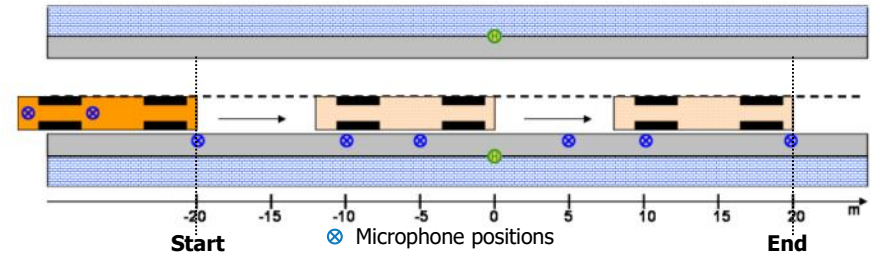
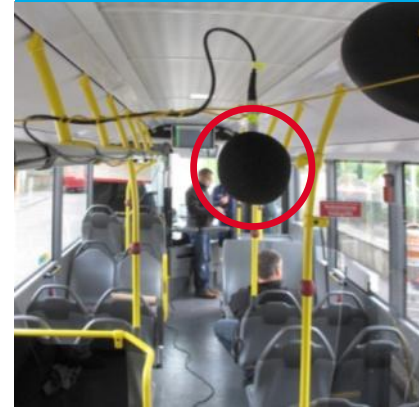


Microphone Positions

7 microphones on the sidewalk: starting 20 m before the bus stop, ending 20 m after the bus stop



2 microphones inside the bus
in the middle at the back



Measuring Vehicles



EcoLife 6 AP 1200

Voith D 854.6

Identical

- Mercedes-Benz Citaro 2
- Engine OM 936 hLA, Euro 6
- 7.7 liters, 220 kW, 1,200 Nm
- Rear axle $i = 5.77$
- Volume production status
- Similar mileage

Overview of Results

Departure from the bus stop



Drive-by at constant 40 km/h



Noise reduction with EcoLife compared to Voith DIWA.6:

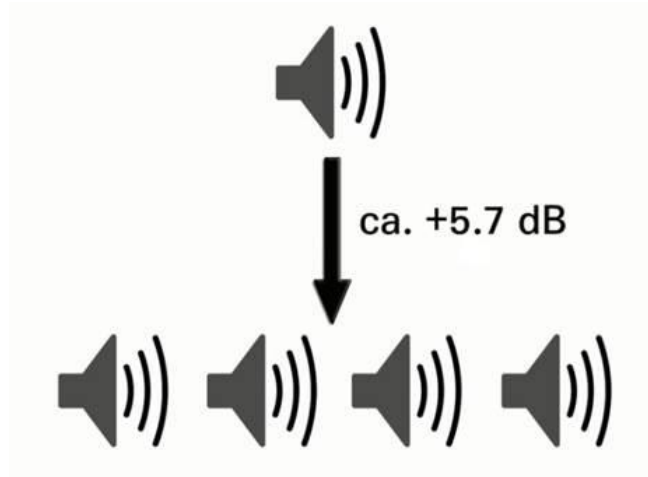
- Outside: up to **-6.0 dB(A)**
- Inside: up to **-7.6 dB(A)**
- Speed reduction: up to **750 rpm**

- Outside: up to **-3.2 dB(A)**
- Inside: up to **-5.4 dB(A)**
- Speed reduction: up to **430 rpm**

Results: Departure From Bus Stop

What Does a 6 dB Difference Mean on the Outside?

Explanation

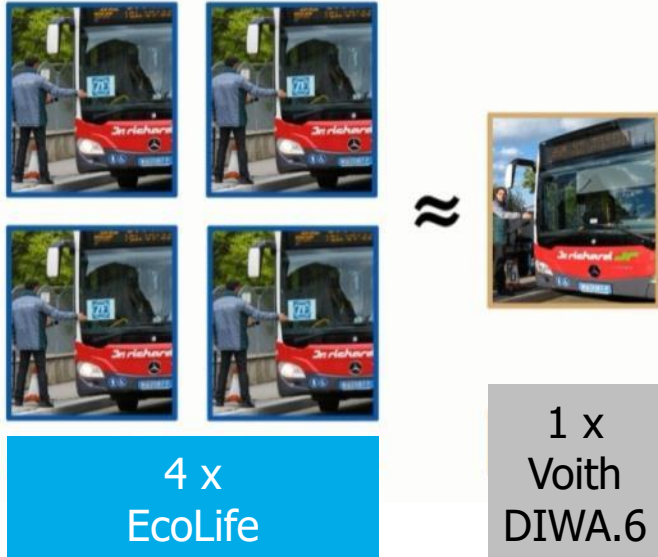


This noise level difference roughly equals the difference between **an acoustic source** and the **sum of four equally loud acoustic sources** in the same place.

Results: Departure From Bus Stop

What Does a 6 dB Difference Mean on the Outside?

As you can see, EcoLife provides a significant advantage

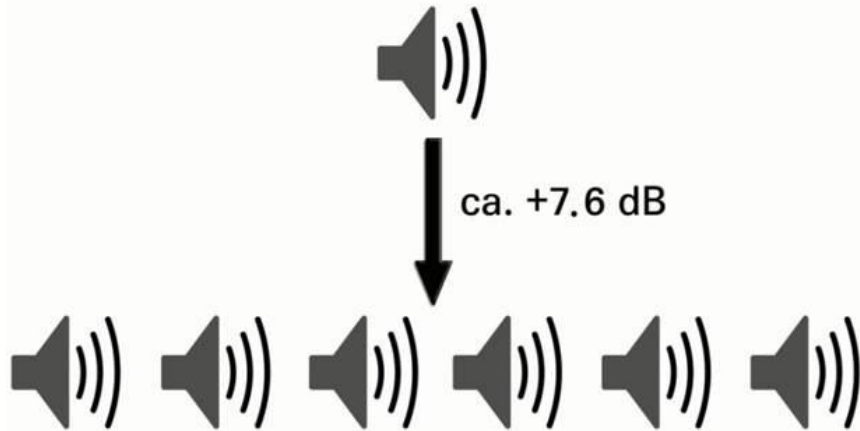


Even if **four buses with EcoLife transmissions** set off at the same time, they would just reach the noise level of **one bus setting off with a Voith DIWA.6 transmission**.

Results: Departure From Bus Stop

What Does a 7.6 dB Difference Mean on the Inside?

Explanation

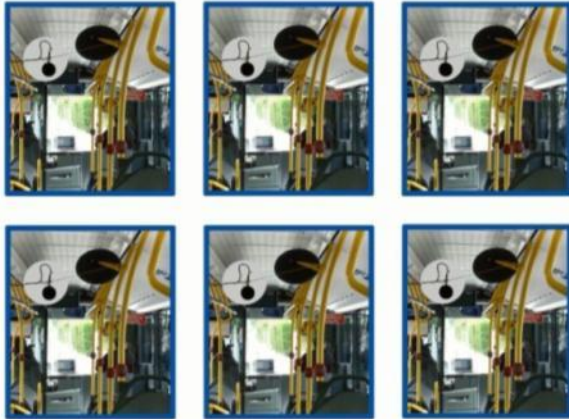


This noise level difference roughly equals the difference between **an acoustic source** and the **sum of six equally loud acoustic sources** in the same place.

Results: Departure From Bus Stop

What Does a 7.6 dB Difference Mean on the Inside?

As you can see, EcoLife provides a significant advantage



6 x
EcoLife

≈

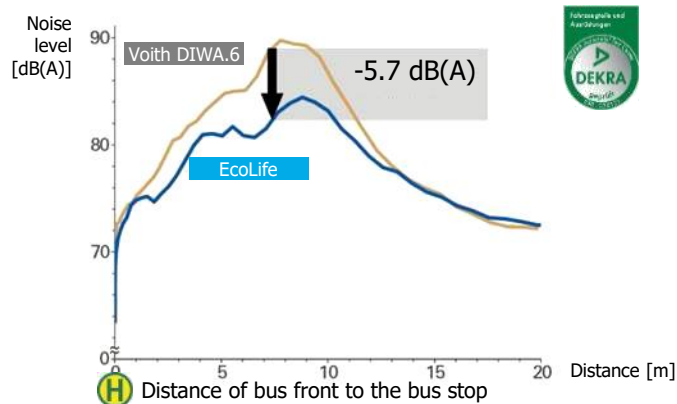


1 x
Voith
DIWA.6

If you heard the noise emission in a bus with **EcoLife transmission six times higher**, you would approximately reach the noise level of **a bus with Voith DIWA. 6 transmission**.

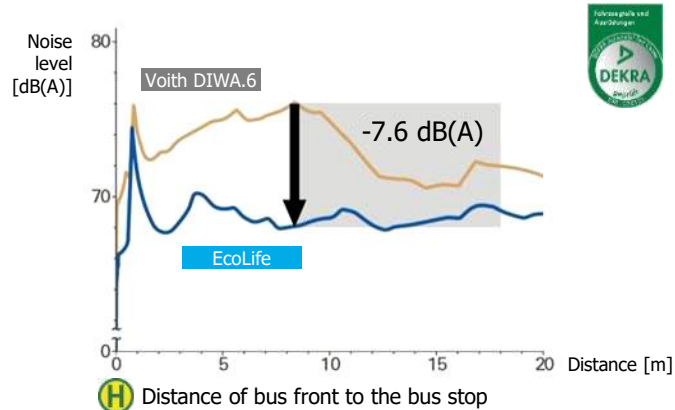
Detailed Results: Departure From Bus Stop

Outside microphone, 5 m before bus stop



Original recordings:
first EcoLife, then Voith
DIWA.6

Inside microphone, in the middle of the bus



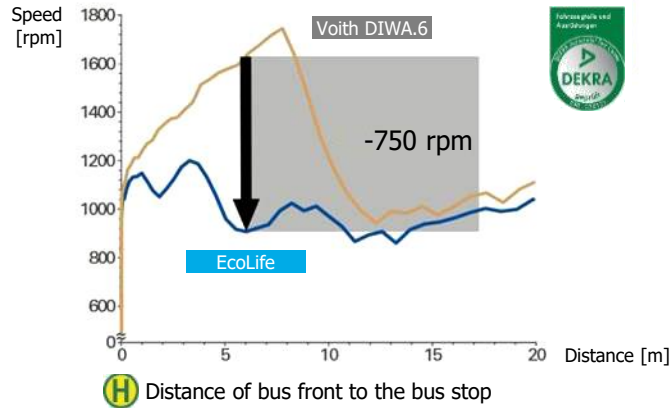
Original recordings:
first EcoLife, then Voith
DIWA.6

EcoLife makes buses quieter – the video (05:28 min.): [YouTube web link](#)

Why is the Bus Equipped With the EcoLife Quieter?

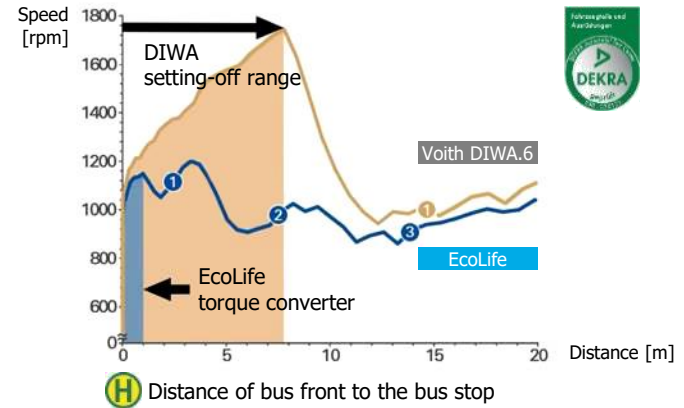
Curve of the Engine Speeds

Engine speed



The engine runs much more quietly across the entire measurement path.

Setting-off range and gears



While the Voith transmission still runs in the DIWA speed range, the EcoLife has already shifted up thanks to its 6 speeds and a large ratio range.

Three Measurements, One Result: Buses with EcoLife are Always Quieter!



	2014	2011	2010
	- Mercedes-Benz Citaro 2 - Engine: 7.7 liters, Euro 6, 220 kW, 1,200 Nm - EcoLife vs. Voith DIWA.6, $i = 5.77$ each	- Mercedes-Benz Citaro - Engine: 6.4 liters, Euro 5, 210 kW, 1,120 Nm - EcoLife / $i = 6.21$ vs. Voith DIWA.5 / $i = 7.38$	- MAN Lion's City - Engine: 10.5 liters, EEV, 206 kW, 1,250 Nm - EcoLife vs. Voith DIWA.5, $i = 5.13$ each
Bus stop cycle	Noise reduction with EcoLife		
outside inside Speed difference	max. -6.0 -7.6 dB(A) max. -750 rpm	max. -6.4 -5.1 dB(A) max. -690 rpm	max. -5.3 -4.2 dB(A) max. -500 rpm
Drive-by	Noise reduction with EcoLife 40 km/h		
		50 km/h	
outside inside Speed difference	max. -3.2 -5.4 dB(A) max. -430 rpm	max. -3.4 -4.5 dB(A) max. -430 rpm	No values

Significance of the Results for the Loudness Level

- The loudness level cannot be measured in an absolute manner; only the sound pressure level can be measured in this way.
- The human ear is varyingly sensitive to varying frequencies.



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- Nevertheless, there are reference values in the acoustics for subjective perception*:

10 dB(A) level reduction $\approx$ Halving of the perceived noise

**→ Level reduction by approx. 6 dB(A) when using EcoLife
 $\approx$ Reduction of the noise by one third!**

* Source, e.g.: "Psychoacoustics, Facts and Models"; E. Zwicker, H. Fastl; Springer 1990

EcoLife Makes Buses Quieter – Verifiably



EN:

<https://www.youtube.com/watch?v=4Z1vrmoYxeg>