„SULEV30 & RDE“

Low emission approach

The solutions for the stringent SULEV emission legislation pave the way to the forthcoming European RDE (Real Drive Emissions) requirements

The diesel, with its highly attractive driving characteristics, has achieved a high market share in Europe and thus contributes significantly to CO_2 reduction. With its inherent efficiency, he plays an important role in the improvement of fleet fuel economy. A certain proportion of diesel cars in the fleet is therefore an essential component of fuel consumption reduction strategy. Also in America, this logic is fundamentally equally valid. However, there are still some challenges in the market acceptance, not least due to the higher fuel price in relation to petrol and current public discussions.

At the moment the SULEV legislation is the most stringent emission regulation worldwide.
AVL has shown, that the ambitious SULEV30 emission targets can be achieved with both new as well as aged exhaust systems on the basis of a demonstration vehicle

Besides optimizing the combustion system itself the aftertreatment (EAS) layout and optimization is key for emission compliance. To comply with the SULEV30 emission limit different EAS layouts were considered. The two main targets were on the one hand to position the EAS component as close to the engine as possible to achieve a fast light off and on the other hand to ensure the best NH3 distribution without an increase of exhaust backpressure.
These requirements resulted in the development of the EAS layout shown in Figure 1:

- Electrically heated catalyst from Emitec, E-cat (1kW heating power)
- LNT (Lean NOx Trap) from Emitec, NSK(volume 1.9l)
- SCR coated Diesel particle filter, SDPF (volume 2.7l)
- Zone coated ammonia slip catalyst, ASC (volume 1.9l)

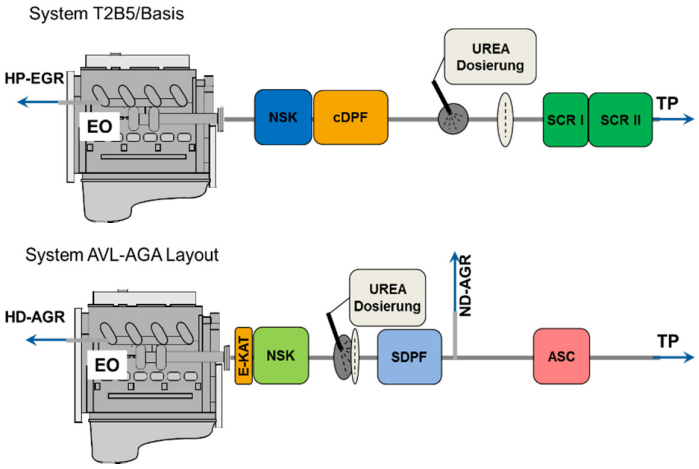

Figure 1: Comparison of the exhaust aftertreatment layouts (Production vs. new AVL layout)

Figure 2: Final EAS design after CFD optimization

Figure 3: SULEV30 Demonstrator vehicle

The base vehicle was provided by BMW and was a Tier2Bin5 Vehicle (BMW 328xd all-wheel drive with a 2.0l four-cylinder engine and a rated power of 135kW). The production exhaust system for this model includes an LNT / DPF and underfloor SCR system.

For the LEVIII legislation an aged exhaust aftertreatment system has to be considered, since the emissions must meet the SULEV30 limits even with "End of Life" (EOL) parts. For this purpose, it is necessary to bring the exhaust aftertreatment hardware to an aged state corresponding to 150,000 miles in vehicle. To generate the aged EAS components within a short time frame a rapid aging procedure with several stages was developed.

- The first stage included a system aging (entire EAS) on the engine testbed
- The second stage consisted of a hydrothermal aging of the SDPF in an oven

This additional aging stage was intended to simulate the thermal damage during active DPF regeneration. To evaluate the performance of the LNT and SDPF after each aging stage, special measurements were carried out on the test bench.

In addition, the fuel consumption has been positively influenced by the introduction of a hybrid EGR system with cooled LP EGR in addition to the existing cooled high pressure EGR system.

For future production applications, further measures and improvements needs to be taken to allow for production tolerances, and additional engine aging phenomena, thus ensuring a greater safety margin to the legal limit.

The SULEV30 emission concept approach forms the basis for the processing of the forthcoming European RDE (Real Driving Emission) requirements and will be implemented in current development programs.