EMISSION MEASUREMENT INSTRUMENTS

AVL Smoke Meter

THE CHALLENGE

Increasingly stringent emission regulations for combustion engines are the main drivers for high-performance emission measurement instruments. For some applications, such as durability tests, reliability and robustness are important factors.

In engines with exhaust aftertreatment systems, the high pressures and temperatures at the exhaust sampling point combined with high emission rates pose a real measuring challenge. Furthermore, engines emit hardly any soot after reducing the exhaust emissions with a diesel particulate filter system (DPF), which also requires a very low detection limit as well as a high accuracy for the soot measurement equipment.

The total cost of ownership also plays a crucial role as they need to be kept as low as possible.

THE SOLUTION

The AVL Smoke Meter uses the filter paper method to determine the Filter Smoke Number (FSN defined according to ISO 10054) and the soot concentration in mg/m³. The variable sampling volume and the thermal conditioning of the exhaust gas ensure an extremely high reproducibility and a wide range of applications. This innovative device can measure emissions in both large and heavy-duty engines as well as in smaller engines installed in passenger cars. The main application areas are combustion optimization on prototype engines and emission monitoring up to the start of series production and thereafter. In addition, soot concentration measurements in raw exhaust (e.g. upstream a DPF) as well as black carbon (BC) mass concentration measurements in line with ISO 8178-3 standards or measurements up to 5,000 m altitude can be performed by using device options. The AVL Smoke Meter meets many essential factors to minimize operating costs, such as short service times, easy integration into the testbed automation system, short training periods thanks to its intuitive operation and remote maintenance options.

MEASUREMENTS WITH HIGH REPRODUCIBILITY

Additional injections in exhaust aftertreatment systems, which are used to clean and burn out the particulate filter, often cause heavy contamination inside the exhaust measurement equipment. In order to prevent this, the AVL Smoke Meter can be equipped with a compressed air purge option. It purges the entire gas path with compressed air from the inlet to the measurement block and back to the sampling probe. The higher pressure compared to purging with the diaphragm pump has the key advantage of reducing particulate deposits in the device and in the sample lines. Therefore, purging with compressed air ensures a higher reproducibility of the measured values and reduces hang-up effects.

REMAINING PAPER INDICATOR FOR SEAMLESS OPERATION

By default the AVL Smoke Meter is equipped with a remaining filter paper indicator on the front of the housing. The LED is clearly visible from the outside and indicates when the paper supply is low, making it easy to tell whether the paper roll should be replaced, for example before starting a durability test. The remaining paper quantity can also be queried numerically with AK commands on the testbed PC.

ALTITUDE SIMULATIONS AND ALTITUDE MEASUREMENTS

The AVL Smoke Meter also enables altitude simulations using low pressure in the exhaust gas system and measurements up to 5,000 m above sea level. For low pressure simulations the simulated pressure in the exhaust gas system can be entered via software, while an integrated absolute pressure sensor takes over this task in real altitude measurements.

TECHNICAL DATA

Measurement principle	Filter paper blackening
Measured value output	FSN (filter smoke number), mg/m³ (soot concentration)
Measurement range	0 to 10 FSN
Detection limit	0.002 FSN or 0.02 mg/m³
Exhaust pressure ranges	• (–300*)–100 to +400 mbar • (–500*)–200 to +750 mbar with special sampling option • 0 to +3,000 mbar with the high-pressure option
Maximum exhaust temperature	600 °C with standard 340 mm sample probe (800 °C with 780 mm long sample probe)
Interfaces	2 × RS232 with AK protocol TCP/IP with AK protocol Digital IN / OUT Analog IN / OUT
Power supply	100–115 VAC or 230 VAC, 50/60 Hz
Compressed air (optional)	~150 l/min during purge
Weight	< 40 kg
Dimensions (w × h × d)	560 × 620 × 300 mm
Ambient conditions	5 to 55 °C / max. 95 % relative humidity (non-condensing)
Repeatability	Standard deviation 1 σ ≤ ± (0.005 FSN +3 % @ 10 sec intake time)

*) with activated altitude simulation

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