Blow-by Emission Measurements

Blow-by gas is formed when gases from the combustion chamber leak past the piston rings into the crankcase. After combining with the oil vapor in the crankcase, the blow by gas consists mainly of oil droplets and may contribute significantly to the loss of lubricating oil and fouling of engine surfaces. Ventilation systems are used to release this gas from the crankcase either back to the engine air intake or to the atmosphere through a filter. Without a properly functioning ventilation and/or filtration system, the blow-by gases may contribute significantly to the overall PM emissions of the vehicle. The size of blow-by gas particles is typically larger than in tailpipe emissions and it varies depending on the type of engine, crankcase ventilation system, engine wear and operating conditions.

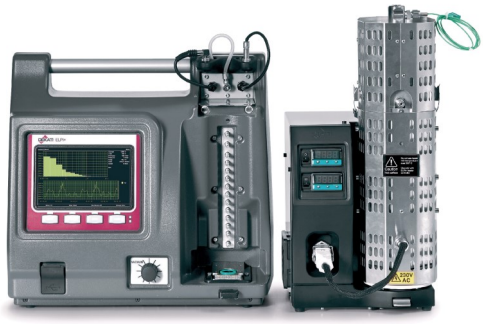
Dekati® Solutions for Blow-by Emission Measurements

- Real-time and gravimetric PM size distribution measurements
- Total concentration and detailed size distribution measurements
- Options for direct high-temperature measurement or measurement with a dilution system
- Complete setups available for a range of measurement conditions
- Measured PM result always independent of PM optical properties

Dekati® High Temperature ELPI®+ for direct real-time concentration and size distribution measurements

Dekati® High Temperature ELPI®+ (HT-ELPI®+, Electrical Low Pressure Impactor) is a unique instrument ideal for blow-by gas emission measurements. The HT-ELPI®+ can measure particle size distribution between 6 nm and 10 µm in real-time covering the complete size range needed to characterize blow-by gas emissions. The HT-ELPI®+ system uses one measurement method and one instrument throughout the complete size range eliminating the need for complicated calculation routines needed to combine data from several different instruments into one size distribution result. The entire measurement column of the HT-ELPI®+ can be heated up to 180 °C enabling direct measurement of high temperature particle samples. The HT-ELPI®+ additionally collects the particles in 14 size fractions during the real-time measurement; these collected particles can be analyzed after the real-time measurement with different chemical or physical analysis methods to gain further understanding on the composition and source of the particles in different size fractions.

- Real-time particle size distribution and concentration measurement at 10 Hz
- Particle size range of 6 nm—10 µm covering:
  - Fine and ultra-fine particles — for determining the filtration efficiency
  - Coarse particles — for oil consumption information
- Direct measurement from up to 180 °C - sensitive to mass concentrations from 0.01 mg/m^3
- Wide concentration range allows measurements pre– and post oil separator
- Additional heated Dekati® Diluter can be added in high concentration measurements at the HT-ELPI®+ inlet to decrease particle concentration
- Simple and easy to use setup: sample is led directly to HT-ELPI®+ via the provided heated sampling line



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Blow-by Emission Measurements

Dekati® High Temperature DLPI+ for direct, detailed gravimetric PM size distribution measurements

Impactor technology is a well known and well characterized method for the determination of mass concentration of airborne particulate matter. In impactors, size classified particles are collected on collection filters or substrates that are either weighed or analysed to determine particle mass and/or chemical composition in different particle size fractions.

The HT-DLPI+ (High Temperature Dekati® Low Pressure Impactor) is a well-characterized cascade impactor that is used to determine airborne particle mass size distribution. The HT-DLPI+ classifies and collects particles into 14 size fractions in the range of 16 nm - 10 µm. In each size fraction, the particles are collected on 25 mm collection substrates that are weighed before and after the measurement to obtain gravimetric mass size distribution of the particles. The complete HT-DLPI+ impactor unit can be heated up to 180 °C allowing direct measurement of hot aerosol samples without the risk of condensation or sample transformations. In blow-by gas measurements the setup is simple and includes a heated sampling line to transport the sample into the impactor unit and a pump for impactor flow (no additional flow control is required). The HT-DLPI+ impactor support and heater controller are all integrated into one easy-to-use unit which also allows control and adjustment of the impactor low pressure and flow rate. The HT-DLPI+ impactor design is the same as that in the ELPI®+/HT-ELPI®+ system enabling an easy upgrade into real-time particle size distribution measurement instrument.

- Gravimetric particle size distribution measurement at up to 180 °C
- Particle mass size distribution in 14 size fractions 16 nm - 10 µm (uppermost stage collects >10 µm particles
- Sample flow rate 10 lpm
- Concentrated mass collection on Ø25 mm collection substrates
- Possibility for chemical and microscopic analysis of collected samples
- Integrated impactor heater and temperature controller
- Integrated low pressure measurement and control, no additional flow control device needed
- Complete measurement setups available for various environments
- Can be upgraded into ELPI®+/HT-ELPI®+ for real-time data

HT-DLPI+ and HT-ELPI®+ collect particles in different size fractions on 25 mm filters

Additional dilution for blow-by gas measurements

In case the particle sample concentrations are very high, additional dilution systems can be added in the sampling line to decrease the particle concentration in a controlled manner. Dekati has wide range of particle sample conditioning and dilution devices suitable for use with any particle measurement device.

- Dekati® Diluter—one stage ejector diluter with fixed dilution factor of 1:8, max 450 °C
- Dekati® eDiluter™—two stage dilution system with fixed dilution factor of 1:60, first dilution stage temperature adjustable
- Dekati® eDiluter™ Pro—two stage dilution system with adjustable dilution factor between 1:25 and 1: 225 and adjustable dilution temperature

Dekati® Diluter can be used in blow-by gas measurements to decrease the particle concentration with a dilution factor of 8. The diluter can be heated up to 450 °´C.

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Blow-by Emission Measurements

Dekati® ELPI®+ with eDiluter™ Pro for real-time particle size distribution measurement with a versatile dilution system

ELPI®+ for real-time particle concentration and size distribution measurement

Real-time PM measurement is based on the proprietary Electrical Low Pressure Impactor+ (ELPI+) technology. The ELPI®+ is a unique, widely-used and well-characterized instrument for real-time particle size distribution and concentration measurements in the particle size range of 6 nm - 10 µm. Due to its wide operational particle size range, ELPI®+ can be used to measure particles in ultrafine -, fine - and coarse modes covering the complete size range with only one measurement technique. ELPI®+ measures particle concentration and size distribution in real-time at 10 Hz sampling rate enabling the detection of rapid changes in the sample concentration and size distribution. Since ELPI®+ uses an impactor for size classification, particles can also be analysed for chemical composition after the real-time measurement.

Dekati® eDiluter™ Pro for versatile blow by gas dilution

Blow-by gas dilution system is the Dekati® eDiluter™ Pro, the latest Dekati development in the field of aerosol sample conditioning. The Dekati® eDiluter™ Pro combines versatility with unmatched ease of use through an intuitive user interface and automated software features. Dilution is carried out in two stages, with the possibility to accurately control dilution factor and the first dilution stage temperature. The dilution stages are ejector diluters with an innovative sheath air flow designed to reduce particle losses in the diluter to a negligible level.

Dekati® eDiluter™ Pro and ELPI®+ for high concentration measurements

- Complete measurement setup with versatile dilution system and real-time particle detection
- Real-time PM mass and number concentration with up to 10 Hz sampling rate
- Real-time number and mass size distributions from 0.006 µm to 10 µm
- 14 size channels standard, up to 500 size channels with High Resolution ELPI®+
- Adjustable dilution factor between 1:25 and 1:225 for a wide range of PM concentrations
- Automatic pressure compensation eliminates the effect of sample pressure fluctuations in the dilution factor
- Adjustable first stage dilution temperature (ambient to 400 °C)
- Dekati® eDiluter™ Pro's high diluted sample output (~100 lpm) allows operation of multiple measurement instruments at the same time

Accessories

- Heated sampling line (1.5 or 3 m versions available) can be used between the source and the dilution system to transport the sample. The temperature is controlled with the eDiluter™ Pro's additional, integrated temperature controller.
- Dekati® Cyclone to remove >10 µm from the sample, to be connected in front of the sampling line. Heaters available for heating the cyclone
- Etc.

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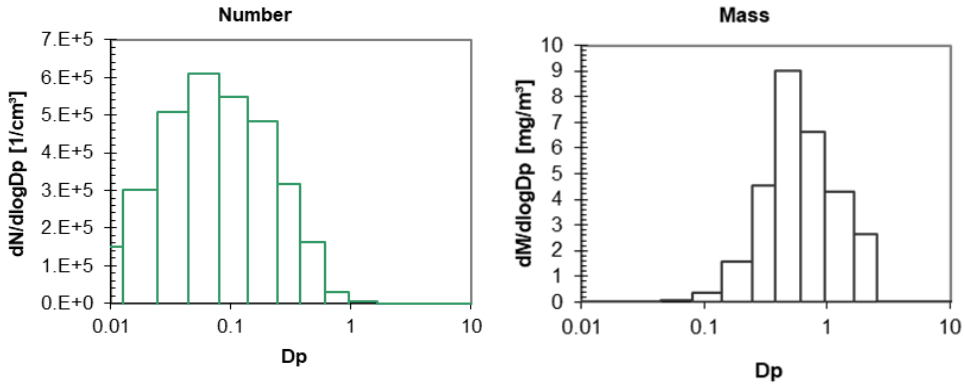
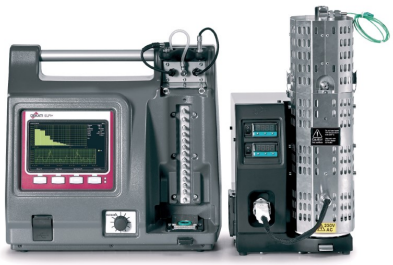
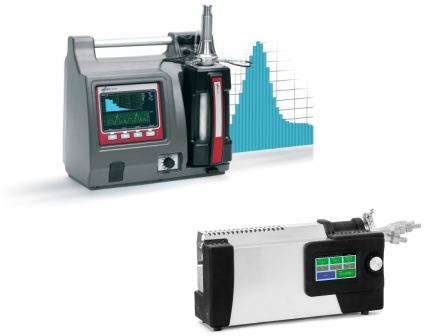
Blow-by Emission Measurements



Blow-by gas particle number and mass size distributions measured with the HT-ELPI®+

Dekati® Solutions for Blow-by Gas Measurements





Direct measurement with the

HT-ELPI®+

- Real-time number/LDSA/mass
- Real-time PM size distribution and concentration measurement
- Wide range 6 nm—10 µm
- Heated sampling line provided for direct connection to source
- Optional heated Dekati® Diluter can be added in the sampling line if needed

Direct measurement with the

HT-DLPI®+

- Gravimetric PM size distribution measurement
- Wide range 16 nm—10 µm
- Optional heated Dekati® Diluter can be added in the sampling line if needed

Measurement with dilution

ELPI®+ and eDiluter™ Pro

- Real-time number/LDSA/mass
- Real-time PM size distribution and concentration measurement
- Wide range 6 nm—10 µm in up to 500 size classes
- Dilution with eDiluter™ Pro with adjustable dilution factor and temperature

Contact us for details and we can recommend the best solution for your measurements!

▶ Dekati Ltd. is a world leader in designing and manufacturing innovative fine particle measurement solutions. We have over 25 years of experience in providing measurement instruments and complete measurement solutions to a wide variety of environments and sample conditions. All Dekati® Products are developed and manufactured in Finland and are available with up to five-year warranty.

ISO 9001
BUREAU VERITAS Certification
Nº FIHSK11145824A

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