Dekati® ELPI®+

- Real-time particle size distribution
- Wide particle size range with one measurement method
- One instrument for several measurement applications

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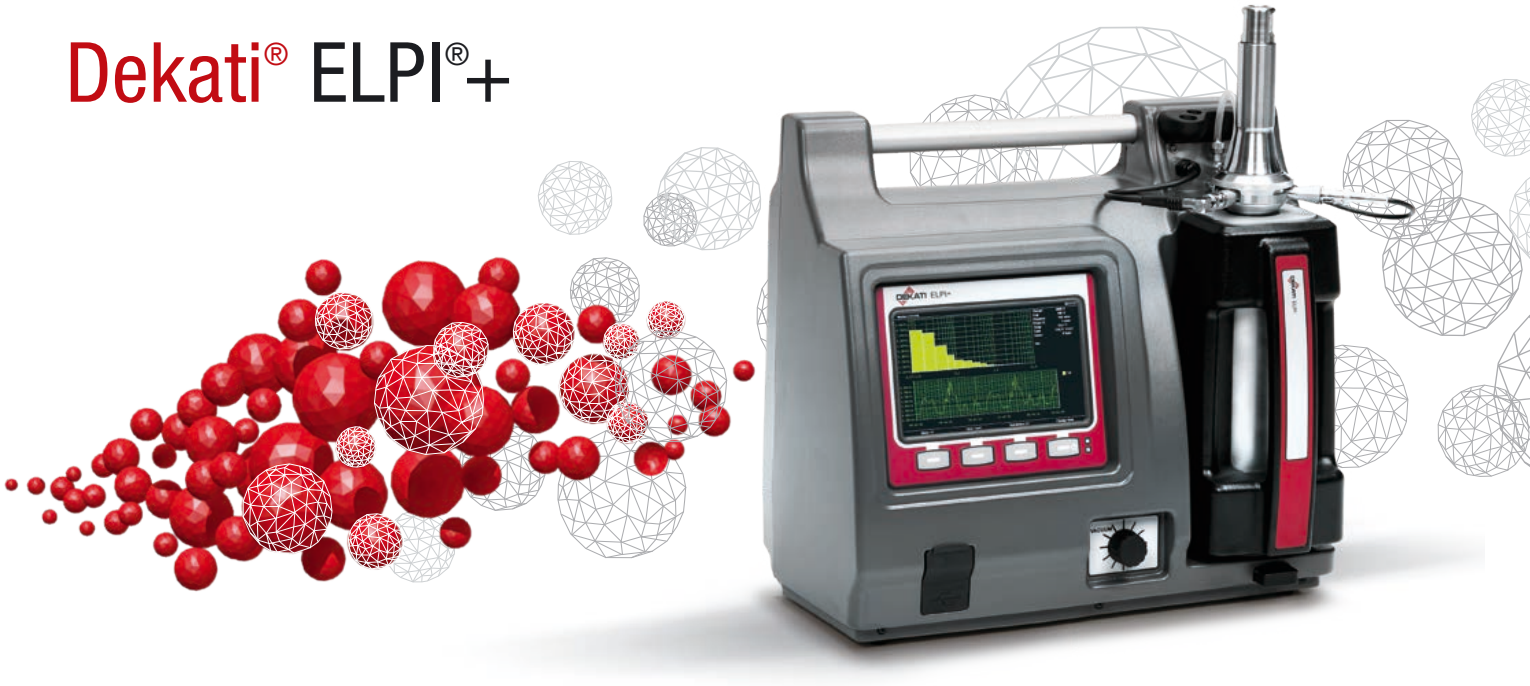
Excellence in Particle Measurements

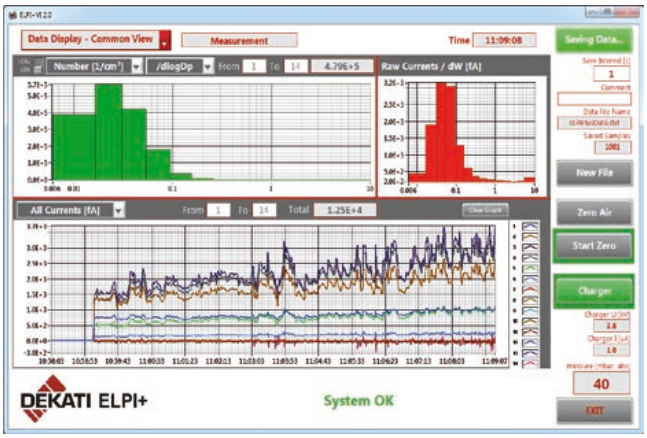
Dekati® ELPI®+



Description

Dekati's **Electrical Low Pressure Impactor, 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. The measurement method of the ELPI®+ is the same for all of the particle sizes, making the ELPI®+ the only instrument available in the market that operates in such a broad particle size range using only one measurement technique. Since the ELPI®+ also operates in a wide particle concentration range, it is well suited for both high and low concentration applications such as environmental air quality or direct combustion source measurements. The ELPI®+'s robust structure is designed to be used even in harsh environmental and sample conditions, and the High Temperature version of the ELPI®+ can even be used to sample aerosols directly from 180 °C.

ELPI®+ measures particle concentration and size distribution in real-time at 10 Hz sampling rate. In the ELPI®+, particles are size classified into 14 size fractions in a cascade impactor. The size resolution of the ELPI®+ can be increased up to 500 size bins with the High Resolution ELPI®+ software upgrade where an inversion calculation based on the actual stage collection efficiencies is used. Since the particles are size classified in a cascade impactor, they can be collected and analysed for chemical composition after the real-time measurement. Additionally, ELPI®+ can be used for particle charge size distribution measurements, as well as for traditional gravimetric impactor measurements.



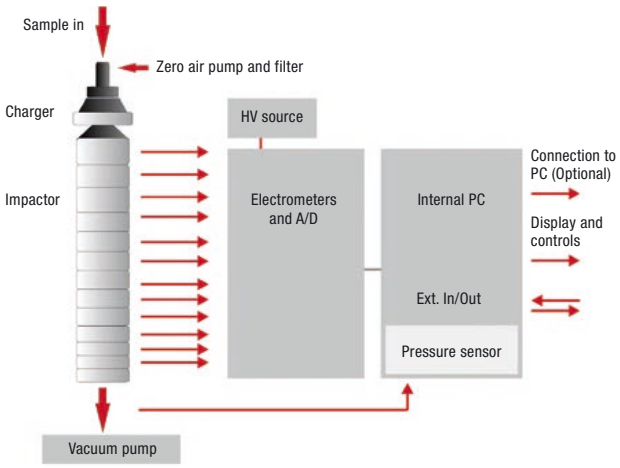
ELPI®+VI software can be used for instrument control

Operating principle*

The ELPI®+ operating principle can be divided into three stages: 1) particle charging, 2) inertial size classification of the particles in a cascade impactor, and 3) electrical detection of particle charge with sensitive electrometers.

First, the particles pass through a unipolar corona charger where they are charged up to a known positive charge level. Second, the particles are size classified in a cascade impactor into 14 size classes depending on their aerodynamic size. The classification of particles is based on the inertia of the particles, with larger particles getting collected on the upper impactor stages and smaller particles getting collected on the lower stages.

All the impactor stages are electrically insulated from each other and each of the impactor stages is connected to an electrometer. As the charged particles get collected in the different impactor stages, the charge carried by them is detected by the electrometers. This measured current signal is directly related to the number of particles, thus enabling the ELPI®+ to measure particle number size distribution and concentration in real-time. If the ELPI®+ charger is switched off, the electrometers are measuring the charge size distribution of the particles in the sample.



* Järvinen, A., Aitomaa, M., Rostedt, A., Keskinen, J. & Yli-Ojanperä, J. 2014. Calibration of the new electrical low pressure impactor (ELPI+). 2014 J. Aerosol Sci. 69, pp. 150-159.

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High Temperature ELPI®+ allows direct measurements from up to 180 °C

Measurement Applications

Since the structure of the ELPI®+ is very robust, the operational size range of the instrument wide, and it operates in real-time, ELPI®+ is an ideal choice for various measurement applications. With Dekati® Sample Conditioning Instruments, Dekati can provide complete ELPI®+ measurement solutions for a very broad range of applications and even demanding measurement conditions.

Typical applications for the ELPI®+ include:

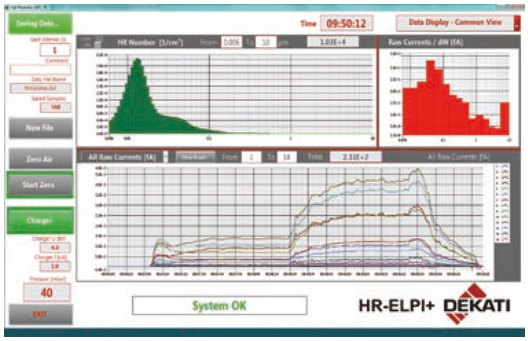
- Combustion process studies and emission measurements
- Outdoor and indoor air quality measurements
- Occupational health studies
- Engine exhaust measurements
- Brake and tire wear measurements
- Blow-by gas measurements
- Pharmaceutical inhaler studies
- Particle charge distribution measurements
- Filter grade efficiency studies
- Nanoparticle measurements

Accessories

- Aluminium and polycarbonate impactor collection foils, 25 mm
- Collection substrate spray (DS-515) with a stencil (DS-125)
- Vacuum pumps
- Spare impactors and collection plate sets
- Sintered collection plate sets for high concentration measurements
- High Resolution ELPI®+ software for improved particle size resolution. Calculation in the software is based on the actual, measured impactor stage collection efficiency curves (Järvinen et al), no curve fits used.
- High Temperature ELPI®+ for direct hot aerosol sampling up to 180 °C
- Dekati® Dilution Systems for conditioning sample from combustion flue gas and automotive exhaust
- Sample inlets for air quality measurements

Features and Benefits

- Real-time particle size distribution and total concentration measurements with one measurement method and one instrument throughout the complete size range
- Wide particle size range; 6 nm-10 µm
- 14 particle size fractions standard, up to 500 size classes with the High Resolution ELPI®+ upgrade
- Real-time (10 Hz) data on particle number, active surface and mass concentration
- Long-term, maintenance free operation with sintered collection plates
- Possibility for post-measurement chemical characterization of size classified impactor samples
- Automated particle charge size distribution measurements
- Wide operational concentration range
- Insensitivity to variations in sample pressure
- Sophisticated calibration made for each manufactured unit
- Integrated flow control and pressure adjustment
- Independent stand-alone operation or control via laptop using ELPI®+VI software
- ISO16000-34 compliant measurement method for real-time determination of PM indoors
- EN17199-1 and EN17199-4 compliant method for real-time dustiness measurements
- ISO/TS 21361 compliant method to quantify air concentrations of carbon black and amorphous silica in the nanoparticle size range in a mixed dust manufacturing environment
- ISO 17536 compliant method to determine separation efficiency of blowby filters in internal combustion engines
- Measurement method to determine ambient air number concentration and size distribution according to VDI guideline 3867 Blatt 6



High Resolution ELPI®+ software gives up to 500 size channels

Dekati® ELPI®+

ELPI®+ Specifications

Particle size range	0.006 - 10 µm
Number of size classes	14
	100/500 with High Resolution ELPI®+
Sample flow rate	10 lpm
ELPI®+ dimensions	H407 x W454 x D242 mm
Collection plate diameter	25 mm
Unit weight	15 kg without impactor
	22 kg with impactor in its place
Pump requirements*	20 m³/h @ 40 mbars
Sample temperature	10-50 ºC
	10-180 °C with the High Temperature ELPI®+
	Up to 1200 °C when combined with Dekati® Sample Conditioning Instruments
Sample humidity	0-90 % RH Non-condensing
Sampling rate	10 Hz
Power	100-250 V, 50-60 Hz, 200 W
Computer requirements	MS-Windows 8™, MS-Windows 10™
Connection to PC	RS-232 or Ethernet
6 analogue inputs	0-5 V
3 analogue outputs	0-10 V

* Suitable pumps available at Dekati Ltd.

ELPI®+ impactor and charger unit

Stage	D50% [µm]	Di [µm]	Number min [1/cm³]	Number max [1/cm³]	Mass min [µg/m³]	Mass max [mg/m³]
15	10					
14	5,3	7,3	0,1	1,7E+04	11	3400
13	3,6	4,4	0,1	3,0E+04	4	1300
12	2,5	3,0	0,16	5,2E+04	2,3	730
11	1,6	2,0	0,3	9,7E+04	1,3	400
10	0,94	1,2	0,6	2,0E+05	0,6	195
9	0,60	0,75	1,2	3,9E+05	0,3	85
8	0,38	0,48	2	6,8E+05	0,12	38
7	0,25	0,31	4	1,2E+06	0,06	17
6	0,15	0,19	6	2,0E+06	0,03	7,7
5	0,094	0,12	12	3,7E+06	0,01	3,2
4	0,054	0,071	21	7,0E+06	0,004	1,3
3	0,030	0,040	42	1,4E+07	0,0015	0,47
2	0,016	0,022	90	3,0E+07	0,0005	0,16
1	0,006	0,010	240	7,9E+07	0,0002	0,03

Each ELPI®+ unit is individually calibrated before delivery; the calibration includes detailed determination of the exact sample flow rate and D50% values. The values presented in this table are nominal values.

Acknowledgements

The ELPI® instrument originated through work carried out at the Aerosol Research Group at the Tampere University of Technology, Tampere, Finland.

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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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