

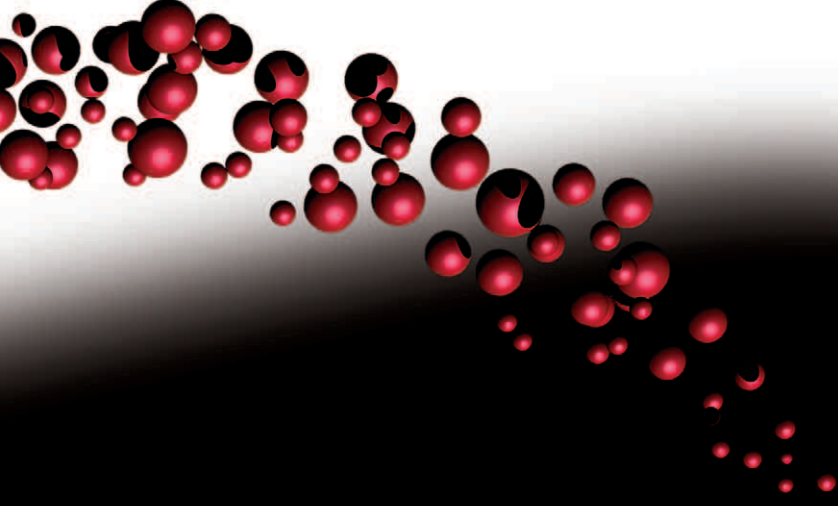
# DEKATI ELPI™

## Electrical Low Pressure Impactor

Real-time particle size  
distribution  
Wide particle size range  
Wide range of applications



Excellence in Particle Measurements



# DEKATI ELPI™

## Electrical Low Pressure Impactor

ELPI™ (Electrical Low Pressure Impactor) enables measurement of real-time particle size distribution and concentration in the size range of 7nm - 10µm. With the ELPI™, well-known impactor technology is combined with particle charging and electrical detection. The result is a robust instrument which measures particle size distribution in a wide size and concentration range, accurately and in real-time. The use of impactor technology also enables post-measurement chemical analysis of size classified particles. The ELPI™ can also be used for real-time particle charge distribution and gravimetric impactor measurements.

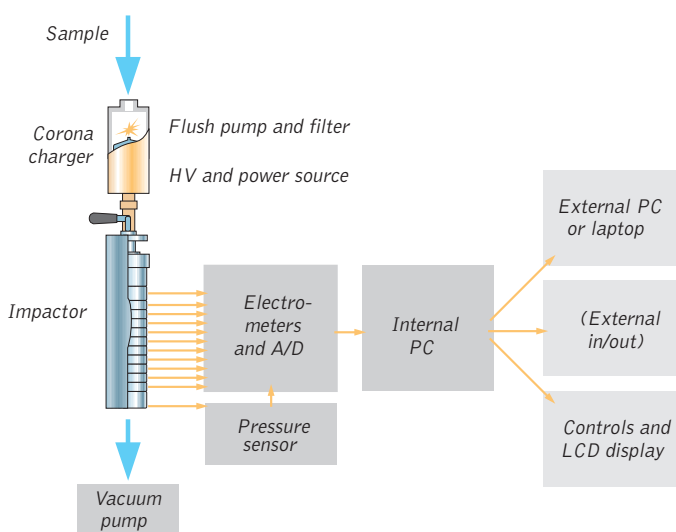
During measurement, the ELPI™ instrument is completely controlled and data is saved with easy-to-use ELPIVI software. In addition to controlling the instrument operations,

the ELPIVI enables the monitoring of total concentration and particle size distribution of the sample in real-time. The software enables operating of several ELPI™ units with one piece of software and sending the data or using the instrument via a network connection.

## Operating Principle

The ELPI™ operating principle can be divided into three major parts: particle charging in a unipolar corona charger, size classification in a cascade impactor and electrical detection with sensitive electrometers. The particles are first charged into a known charge level in the corona charger. After charging, the particles enter a cascade low pressure impactor with electrically insulated collection stages. The particles are collected in the different impactor stages according to their aerodynamic diameter, and the electric charge carried by particles into each impactor stage is measured in real time by sensitive multi-channel electrometers. This measured current signal is directly proportional to particle number concentration and size. The components are housed in a single compact unit. A standard RS232 port is used for communication with a laptop or PC using ELPIVI software, also provided with the instrument.

The particle collection into each impactor stage is dependent on the aerodynamic size of the particles. Measured current signals are converted to (aerodynamic) size distribution using particle size dependent relations describing the properties of the charger and the impactor stages. The result is particle number concentration and size distribution in real-time. By switching the charger unit off, the ELPI can be used for particle charge distribution measurements.





Excellence in Particle Measurements

## Applications

The ELPI™ can be applied to several different types of measurements where the requirements for the instrument include wide particle size range and fast response time. Because of its rapid response, the ELPI™ is an ideal instrument for the analysis of unstable concentrations and size distributions, or the evolution of size distributions.

Typical applications for the ELPI™ include:

- Automotive exhaust measurements
- Combustion studies
- Outdoor and indoor air quality measurements
- Pharmaceutical inhaler studies
- Particle charge distribution measurements
- Filter grade efficiency studies

## Benefits

- Real-time particle size distribution and total concentration
- Wide particle size range; 7nm - 10µm \*
- Real-time charge distribution measurements
- Gravimetric impactor measurements
- Possibility for chemical characterization of size classified samples
- Wide operational concentration range
- Two sample flow rate versions; 10 or 30 lpm
- Simple construction
- Robust structure
- Wide range of applications

\*with the filter stage accessory



## Outdoor Air ELPI

The Outdoor Air ELPI™ is a modified version of the standard ELPI™ instrument. Like the standard version, the Outdoor Air ELPI™ measures airborne particle size distribution and concentration in real-time. It operates in the size range of 7 nm – 10 µm with the filter stage accessory, and can be applied to various different types of measurements where the requirements for the instrument include a wide particle size range and fast response time. The Outdoor Air version is specially designed for ambient air measurements, although it can be used in other applications as well. The operating principle of the Outdoor Air ELPI™ is the same as that of the ELPI™'s.

Some features have been added to the Outdoor Air version to make it more suitable for ambient air monitoring:

- Higher sample flow rate (30 lpm) to increase sensitivity
- Integrated humidity and temperature sensor for monitoring the sample
- Option for stand-alone operation

# Accessories

## Filter stage

The ELPI™ filter stage extends the standard ELPI™ measurement range from 30 nm – 10 µm to 7 nm – 10 µm. The filter stage is a back-up filter installed under the impactor stages; stage 12 is removed from the impactor assembly to enable an easy upgrade and use of the existing electrometers. The upgrade is fully reversible; the ELPI™ can be used with or without the filter stage after the upgrade.



## Sintered Collection Plates

Sintered collection plates are designed to prevent common problems in impactor measurements: impactor overloading and particle bounce. Instead of collecting the particles on smooth aluminium foil, the collection area is vacuum oil embedded porous metal. When the particles are collected on the plates, the oils seep up due to capillary forces and thus the impaction always occurs to a liquid surface effectively eliminating bouncing.

## External Heating Assembly

The ELPI™ External Heating Assembly Set Allows the ELPI™ charger and impactor to be heated up to 200 °C. The use of the External Assembly Set requires some modifications to the standard ELPI™ unit since the impactor and charger have to be pulled out of the ELPI™ box. For example, the external heating assembly can be used in combustion aerosol and ambient air measurements to prevent the effect of VOCs and humidity on the aerosol size distribution.



## Other Accessories and Consumables Include:

- Aluminium and polycarbonate Impactor collection foils, 25mm
- Collection substrate spray (DS-515) with a stencil (DS-125)
- Vacuum pumps for 10 and 30µm ELPIs
- Spare Impactors (10 or 30µm)
- Dekati Fine Particle Sampler (FPS-4000) for diluting and conditioning sample from combustion flue gas and automotive exhaust.
- Dekati Dryer (DD-600) for removing water from ambient air aerosol

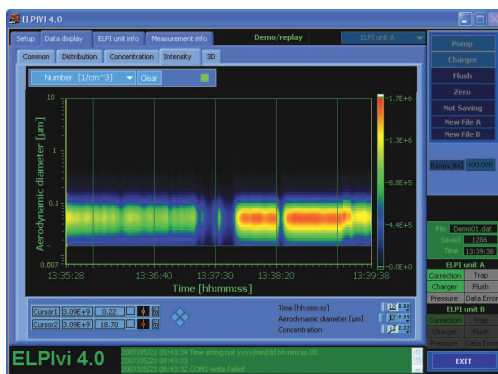


# Software

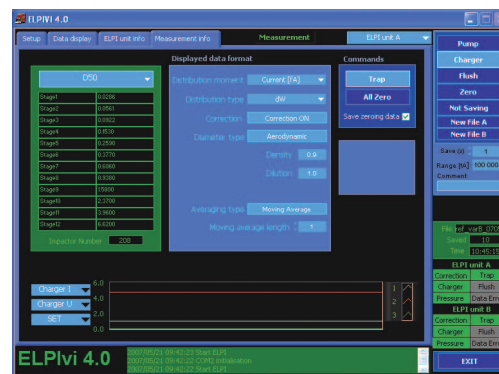
ELPIVI software features a graphic user interface to control the ELPI™ or Outdoor Air ELPI™ instrument, and save the measured data. A real-time display of particle concentration, intensity and size distribution is displayed during data acquisition. Data can be displayed either on a number, volume, area or mass basis. Measured data is saved in an ASCII text file which can be processed later with e.g. ELPIxls spreadsheet. The software is equipped with user informative displays and warnings for all critical instrument operations.



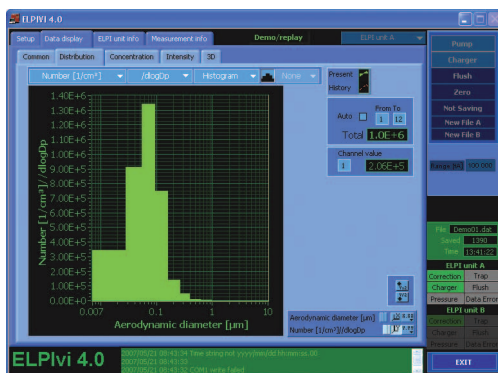
General view: Particle size distribution and time variation in concentration and intensity in the same view



Own window for each data format



Detailed measurement setup data



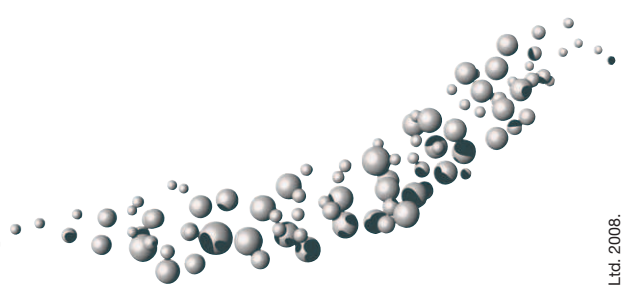
Own window for each data format



Unit info: measurement parameters

# DEKATI ELPI™

## Electrical Low Pressure Impactor



### Specifications

|                           |   |
|---------------------------|---|
| Particle size range       | 0.007 – 10 µm with filter stage<br>0.030 – 10 µm standard                             |
| Number of size classes    | 12  |
| Sample flow rate          | 10 or 30 l/min  |
| Impactor dimensions       | Ø 65 x 300 mm   |
| ELPI dimensions           | H 570 x W 400 x D 230 mm  |
| Collection plate diameter | 25 mm   |
| Unit weight               | 35 kg   |
| Lowest stage pressure     | 100 mbar  |
| Pump requirements*        | 7 m <sup>3</sup> /h at 100 mbar (10 lpm)<br>21 m <sup>3</sup> /h at 100 mbar (30 lpm) |
| Operating temperature     | 5 – 40 °C   |
| Operating humidity        | 0- 90 % RH Non-condensing   |
| Response time             | < 5 sec   |
| Computer requirements     | Pentium III 500 MHz, 512 MB RAM, MS-Windows NT™, 2000™, XP™ or Vista™                 |

\*Suitable pumps available at Dekati Ltd.

| Stage        | D50%<br>[µm] | Di<br>[µm] | Number min<br>[1/cm <sup>3</sup> ] | Number max<br>[1/cm <sup>3</sup> ] | Mass min<br>[µg/m <sup>3</sup> ] | Mass max<br>[mg/m <sup>3</sup> ] |
|--------------|--------------|------------|------------------------------------|------------------------------------|----------------------------------|----------------------------------|
| 13           | 10           |            |                                    |                                    |                                  |                                  |
| 12           | 6,8          | 8,4        | 0,10                               | 2,0E+04                            | 31                               | 8300                             |
| 11           | 4,4          | 5,3        | 0,10                               | 2,0E+04                            | 10                               | 2700                             |
| 10           | 2,5          | 3,2        | 0,17                               | 4,5E+04                            | 3                                | 810                              |
| 9            | 1,6          | 2          | 0,33                               | 8,8E+04                            | 1,4                              | 370                              |
| 8            | 1            | 1,3        | 0,6                                | 1,6E+05                            | 0,70                             | 180                              |
| 7            | 0,65         | 0,81       | 1,1                                | 2,9E+05                            | 0,30                             | 80,0                             |
| 6            | 0,4          | 0,51       | 2                                  | 5,4E+05                            | 0,10                             | 40,0                             |
| 5            | 0,26         | 0,33       | 3,7                                | 9,8E+05                            | 0,07                             | 18,00                            |
| 4            | 0,17         | 0,21       | 6                                  | 1,7E+06                            | 0,03                             | 8,00                             |
| 3            | 0,108        | 0,14       | 12                                 | 3,1E+06                            | 0,02                             | 4,00                             |
| 2            | 0,06         | 0,081      | 23                                 | 6,1E+06                            | 0,006                            | 1,70                             |
| 1            | 0,03         | 0,042      | 50                                 | 1,4E+07                            | 0,002                            | 0,50                             |
| Filter stage | 0,007        | 0,014      | 250                                | 6,9E+07                            | 0,0004                           | 0,11                             |

Values are for 10lpm ELPI - with 30lpm ELPI the sensitivity is improved by approximately 300%.

### Acknowledgements

This instrument originated through work carried out at the Aerosol Research Group at Tampere University of Technology, Tampere, Finland. The ELPI low pressure impactor was designed in co-operation with the Finnish Meteorological Institute, Aerosol Research Group.

Labview is a trademark of National Instruments Inc. ELPI is a trademark of Dekati Ltd. Related patent 6401553.

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