



ACTRIS Recommendation for measurements with mobility particle size spectrometers - Part III Standard Operation Procedure

Alfred Wiedensohler and Wolfram Birmili

Leibniz Institute for Tropospheric Research

Standard Operation Procedure and System Checks

This recommendation is based on the article of Wiedensohler et al. (2012).

For long-term mobility particle size spectrometer measurements, we recommend the following listed items to improve the quality of the measurements.

- Pressure transducers employed to measure the aerosol flow rate or mass flow meters used to determine the sheath air flow rate have to be calibrated at least twice a year. The aerosol and sheath air flow rates should be regularly measured once per month with an independent flow standard such as an electrical bubble flow. The reference standard should have a low pressure drop. The flow rate at the pressure within the DMA should be determined.
- In case of a closed-loop instrument, the pump/blower must be sealed and leak testing should be part of the regular maintenance schedule for the instrument.
- Humidity and temperature sensors for the aerosol and sheath air flow have to be checked prior to their deployment and afterwards at least once per year.
- The response function of the high voltage (HV) supply should be calibrated. This should include the analogue output module if high voltage supply is controlled through an analogue voltage. The calibration function of the high voltage should be implemented into the scanning software or the data analysis. Correct sizing of small particles is highly sensitive to accurate knowledge of the applied HV. Particular care is, hence, required in the low voltage range. A HV-probe with ultralow impedance should be used here. The HV power supply has to be checked monthly.
- Furthermore, CPCs have to be calibrated regularly at least once per year to detect malfunctions such as degradation of the laser diode, temperature instabilities, or internal pollution. CPCs should be only used after determining the flow rate and after a calibration of the detection efficiency curve (see also Wiedensohler et al., 1997) and the plateau detection efficiency. Often, the CPC flow rate is controlled by a critical orifice. It should not differ more than few percent from the nominal value. The deviation of the flow rate from the nominal value should then be taken into account in the calculation of the particle number size distribution. The volume flow rate should be checked on a monthly basis.
- The sizing accuracy of mobility particle size spectrometers have to be verified using 200 nm PSL spheres frequently. The use of 200 nm PSL particles is a compromise obtaining a

sufficient particle number concentration and a minimum of residual material on the particles. The measured peak diameter should be within the nominal uncertainties of the PSL spheres ($\pm 2.5\%$) and the sheath air flow rate ($\pm 1\%$). Due to a pressure drop over the external volumetric flow meter, it is often difficult to precisely measure the actual flow rate of the sheath air. In this case, the sheath air flow rate might be slightly adjusted by few percent to match the nominal PSL sphere size.

- For scanning mobility particle size spectrometers, an incorrect plumbing delay time can only be determined by the PSL sphere check. The plumbing time is correct if up- and down-scans show the same result. The scan time has to be long enough because of the slow CPC response and to avoid smearing effects. We recommend an up- or down-scan time of minimum 2 min.
- Mobility particle size spectrometers should also be regularly compared to a reference instrument for a period of few days once per year (if a reference system is available). This intercomparison can be done either within an intercomparison workshop or at the sampling site. If a reference mobility particle size spectrometer is not available, also the total particle number concentration measured by a CPC can be compared to the number integral of the size distribution. The integral of the particle number size distribution should be compared to the directly measured total particle number concentration if no nucleation mode particles are present. Ideally, the difference in particle number concentrations should be smaller than 10% after correction for internal diffusional losses.
- The Zero-check of the system should be also done every month. An absolute particle filter should be connected to the system inlet and scanned for several size distributions. Ideally, the background should be close to zero.
- The DMA and the laminar flow element to determine the aerosol flow rate have to be cleaned once per year. CPCs have to be serviced by an experienced person to clean the saturator and the optics.
- The bipolar diffusion charger should not be opened. The instructions of the manufacturer have to be followed.
- The mobility particle size spectrometers should be operated in an environment of 15-30°C to avoid a malfunction of the particle counter.

References

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