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Federal Department of Justice and Police FDJP

Federal Office of Metrology METAS

Certificate of Calibration No 235-10XXX

Object	**Optical Particle counter** Manufacturer : Model : Serial number :
Order	Calibration of the particle concentration with an aerosol consisting of dry air with polystyrene spheres (PSL) with a certified diameter.
Applicant	**OurClient Inc.** Clearskyavenue 110, CH-9999 Breathfresh
Traceability	The reported measurement values are traceable to national standards and thus to internationally supported realizations of the SI-units.
Date of Calibration	25.03.20XX (ISO 21501-4 recommends a recalibration after one year or less)
Marking	Calibration label METAS 03.20XX

CH-3003 Bern-Wabern, 28.03.20XX

For the Measurements	Laboratory Particles and Aerosols
Andreas Ackermann	Dr. Jürg Schlatter, head of laboratory

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Extent of the Calibration

The particle counter was calibrated by an aerosol with particles of various sizes and various concentrations.

Measurement Procedure

The measuring standard consists of a Laser-Particle-Counter (Laser-Partikelzähler LAPAZ) installed at METAS. This standard measures the light scattered by single particles passing through a collimated laser beam (0.45 W, wavelength 532 nm). The intensity of the scattered light under an angle of 90° is recorded and classified. In order to validate the optical system the light intensities are related to the diameters of polystyrene spheres (PSL).

LAPAZ integrates the particles during a time period of 60 s. The particle concentration is calculated from these counts and the known and traceable flow rate of the aerosol.

The device under test (DUT) integrates during 60 s and indicates the particle number N_{DUT} for a sucked volume V_{DUT} = 14.15 L (= 0.5 cubic foot). The device under test gives the results with the differential mode[1].

The particle number concentration C_{DUT} is calculated as follows $C_{DUT} = \frac{N_{DUT}}{V_{DUT}}$.

Every measurement was repeated at least 25 times.

Measurement Conditions

Ambient conditions:	(21 ± 2) °C and (955 ± 10) hPa
Rel. Humidity of the aerosol	< 25 % rh
Measurement sample flow:	(14.6 ± 1.5) L/min at 955 hPa and 21 °C

The sample flow is measured with the flow standard GCM-D3SA-FN00 (SN 103960), in such a way the sub pressure is below 15 mbar at the instruments entrance.

Above indications are averages and their uncertainties.

The sample flow has been adjusted to the displayed value of 0.50 cfm before the calibration.

[1] With "differential mode" the particles were given within a range of diameters, then for example the "class 0.3 µm" indicates the range 0.3 … 0.5 µm. With the "cumulative mode" particles are counted, if their diameter is larger than a limit, then for example the "class 0.5 µm" comprises all particles above > 0.5 µm.

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Particle Number Concentration Measurement Results

d	[nm]	:	certified diameter of PSL
C_{DUT}	[1/cm^3]	:	average particle concentration of the DUT within the size range (SR) (uncorrected instrument reading at above measurement conditions)
s	[1/cm^3]	:	empirical standard deviation of C_{DUT}
C_{LAPAZ}	[1/cm^3]	:	average particle concentration of LAPAZ (results refer to above measurement conditions)
SR	[µm]	:	considered size range(s) of the DUT. All results are given within specified diameter limits. Possible contributions to the measurements beyond these limits are neglected.

$d \pm U$	$C_P \pm s$	$C_{LAPAZ} \pm U$	C_P / $C_{LAPAZ} \pm U$	SR
300 ± 7	1.181 ± 0.011	1.16 ± 0.09	1.02 ± 0.08	0.24…0.3 & 0.3…0.5
300 ± 7	2.221 ± 0.017	2.22 ± 0.16	1.00 ± 0.07	0.24…0.3 & 0.3…0.5
498 ± 6	1.223 ± 0.018	1.18 ± 0.10	1.04 ± 0.08	0.3…0.5 & 0.5…1.0
498 ± 6	2.101 ± 0.037	2.08 ± 0.16	1.01 ± 0.08	0.3…0.5 & 0.5…1.0
1'005 ± 22	0.987 ± 0.019	0.96 ± 0.09	1.03 ± 0.09	0.5…1.0 & 1.0…5.0
1'005 ± 22	1.841 ± 0.012	1.77 ± 0.13	1.04 ± 0.07	0.5…1.0 & 1.0…5.0

Uncertainty of Measurement

The reported uncertainty of measurement is stated as the combined standard uncertainty multiplied by a coverage factor $k = 2$. The measured value (y) and the associated expanded uncertainty (U) represent the interval ($y \pm U$) which contains the value of the measured quantity with a probability of approximately 95%. The uncertainty was estimated following the guidelines of the ISO (GUM: 1995).

The measurement uncertainty contains contributions originating from the measurement standard, from the calibration method, from the environmental conditions and from the object being calibrated. The long-term characteristic of the object being calibrated is not included.