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Federal Institute of Metrology METAS

Measurement Report No 235-10383

Object	**Diluter**	**:**	**Thermodiluter for PMP**
	Manufacturer	:	Palas GmbH
	Modell	:	PMPD 100
	Serial	:	0001

Order

Evaluation of the efficiency of a thermodiluter using a volatile Aerosol, according to "VPR Calibration Procedure AEA/ED47382/Issue 5" (Volatile Particle Removal Efficiency)

Applicant

Palas GmbH
Greschbachstrasse 3B
DE 76229 Karlsruhe

Traceability

The reported measurement values are traceable to national standards and thus to internationally supported realizations of the SI-units.

Date of Measurement

11.12.2012

3003 Bern-Wabern, 05th of June 2014

For the Measurements

Kevin Auderset

Laboratory Particles and Aerosols

Konstantina Vasilatou, Head of Laboratory

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Extent of Measurement

The efficiency of the thermodiluter has been determined by using an aerosol generated from Tetracontane (C40H82., CAS-Number: [4181-95-7]) with an electrical mobility diameter of 30 nm; according to "VPR Calibration Procedure AEA/ED47382/Issue 5" ("Volatile Particle Removal Efficiency").

Measurement Procedure

By using reference instruments the number concentration of an aerosol generated from Tetracontane with an electrical mobility diameter of 30 nm has been measured upstream and downstream of the device under test (DUT).
The data has been collected at a rate of 1 Hz.
The result is an average of 120 measurements.

The size distribution of the aerosol exhibited a geometric mean of 29 nm and a geometric standard deviation of 1.4.

By using external mass flow meters (MFM) the readings of the concentration of the CPCs ("Condensation Particle Counters") are converted to the measured flow at ambient conditions.
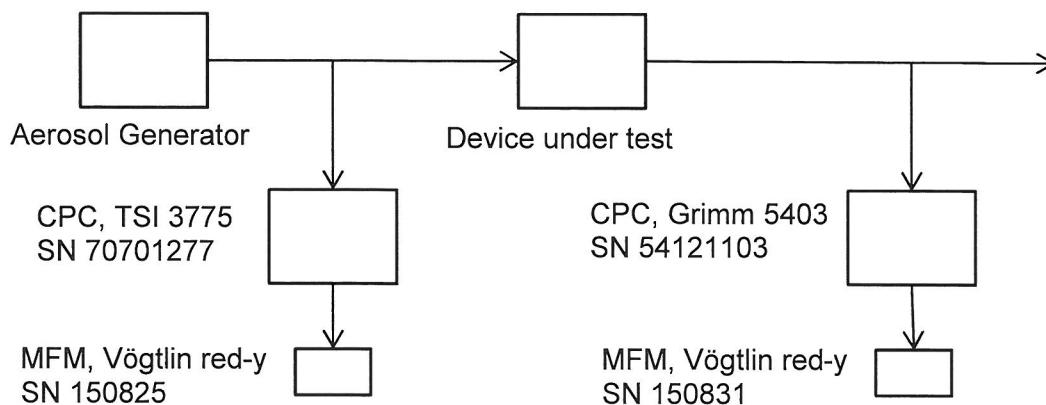
Detail Device under test
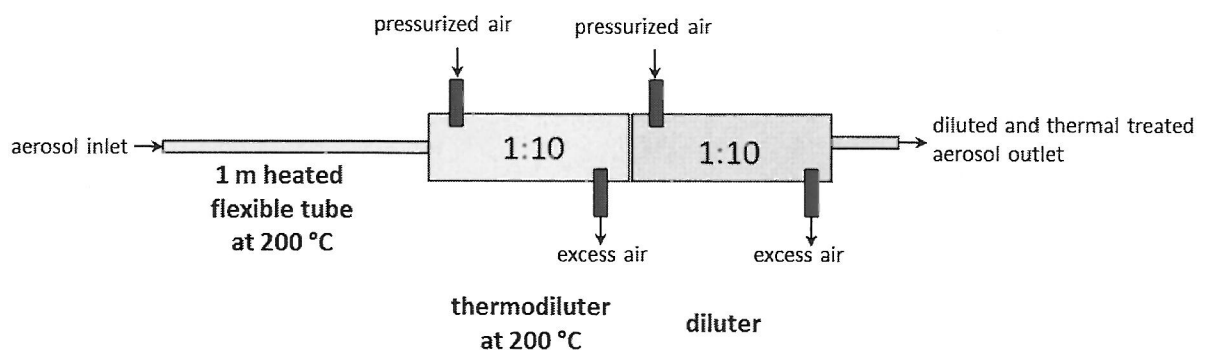
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Measurement Conditions

Ambient conditions: (21 ± 2) °C and (957 ± 10) hPa
The measurement values are converted to these ambient conditions.

Parameter device under test

$T_{Diluter}$ =   200 °C
P_{Dilute} =   1.5 bar rel.

The nominal dilution factor of the device under test is f_V = 100:1 .

Measurement Results

$C_{upstream}$:   Average of the measured particle concentration upstream of the DUT

$C_{downstream}$:   Average of the measured particle concentration downstream of the DUT

$S_{average}$:   Standard Deviation

E_{VPR} :   "Volatile Particle Removal Efficiency" $\rightarrow E_{VPR} = 1 - \dfrac{C_{downstream} * f_V}{C_{upstream}}$

U_E :   Uncertainty of Measurement

$C_{upstream}$ (1/cm^3)	$S_{average}$ (1/cm^3)	$C_{downstream}$ (1/cm^3)	$S_{average}$ (1/cm^3)	E_{VPR}	U_E
20685	11	0.07	0.01	0.99967	0.00024

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 measurement method, from the environmental conditions and from the object being measured. The long-term characteristic of the object being measured is not included.