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Deutsche
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D-K-15140-01-00

Calibration certificate
Kalibrierschein

Calibration mark
Kalibrierzeichen

1536181
D-K-
15140-01-00
12/2015

Object <i>Gegenstand</i>	Cup Anemometer
Manufacturer <i>Hersteller</i>	Thies Clima D-37083 Göttingen
Type <i>Typ</i>	4.3351.10.000
Serial number <i>Fabrikat/Serien-Nr.</i>	11159434
Customer <i>Auftraggeber</i>	Ammonit Measurement GmbH D-10997 Berlin
Order No. <i>Auftragsnummer</i>	L 23677
Project No. <i>Projektnummer</i>	VT150935
Number of pages <i>Anzahl der Seiten</i>	4
Date of Calibration <i>Datum der Kalibrierung</i>	05.12.2015

This calibration certificate documents the traceability to national standards, which realize the units of measurement according to the International System of Units (SI).

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Date
Datum

05.12.2015

Head of the calibration laboratory
Leiter des Kalibrierlaboratoriums

Dipl. Phys. Dieter Westermann

Person in charge
Bearbeiter

Techniker Dirk Henniges

Calibration object
Kalibriergegenstand

Cup Anemometer

Calibration procedure
Kalibrierverfahren

- Deutsche WindGuard Wind Tunnel Services: QM-KL-AK-VA
- Based on following standards:
- MEASNET: Anemometer calibration procedure
 - IEC 61400-12-1: Power performance measurements of electricity producing wind turbines
 - IEC 61400-12-2: Power performance of electricity producing wind turbines based on nacelle anemometry
 - ISO 3966: Measurement of fluid in closed conduits
 - ISO 16622: Meteorology - Sonic anemometers/thermometers

Place of calibration
Ort der Kalibrierung

Windtunnel of Deutsche WindGuard WindTunnel Services GmbH, Varel

Test conditions
Messbedingungen

wind tunnel area	10000 cm ²
anemometer frontal area	230 cm ²
diameter of mounting pipe	34 mm
blockage ratio ¹⁾	0.023 [-]
software version	7.64

¹⁾ Due to the special construction of the test section no blockage correction is necessary.

Ambient conditions
Umgebungsbedingungen

air temperature	21.0 °C ± 0.1 °C
air pressure	1016.3 hPa ± 0.3 hPa
relative air humidity	42.2 % ± 2.0 %

Measurement uncertainty
Messunsicherheit

The expanded uncertainty assigned to the measurement results is obtained by multiplying the standard uncertainty by the coverage factor $k = 2$. It has been determined in accordance with DAkkS-DKD-3. The value of the measurand lies within the assigned range of values with a probability of 95%.

The reference flow speed measurement is traceable to the German NMI (Physikalisch-Technische Bundesanstalt) standard for flow speed. It is realized by using a PTB owned and calibrated Laser Doppler Anemometer (Standard Uncertainty 0.2 %, $k=2$)

Additional remarks
Zusätzliche Anmerkungen

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Calibration result

Kalibrierergebnis

Sensor out	Tunnel speed	Uncertainty (k=2)
Hz	m/s	m/s
82.008	3.983	0.050
125.616	5.978	0.050
168.340	7.979	0.050
211.144	9.945	0.051
255.142	11.944	0.051
298.625	13.961	0.051
339.402	15.828	0.051
318.804	14.864	0.051
276.540	12.959	0.051
233.402	10.952	0.051
190.112	8.977	0.051
146.800	6.986	0.050
103.733	5.003	0.050

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Linear regression analysis

Slope	0.04598 (m/s)/(Hz) \pm 0.00005 (m/s)/(Hz)
Offset	0.2262 m/s \pm 0.011 m/s
Standard error (Y)	0.012 m/s
Correlation coefficient	0.999994

Remarks

The calibrated sensor complies with the demanded linearity of MEASNET



Graphical representation of the result

Grafische Darstellung des Ergebnisses

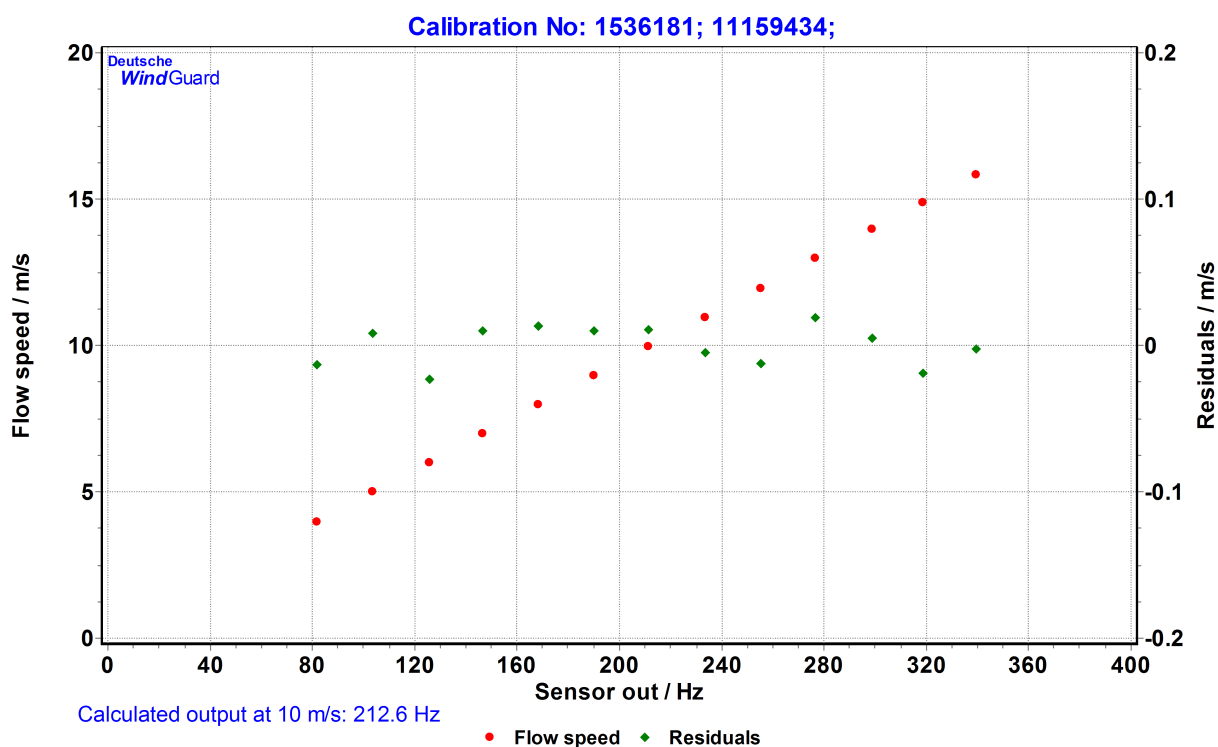
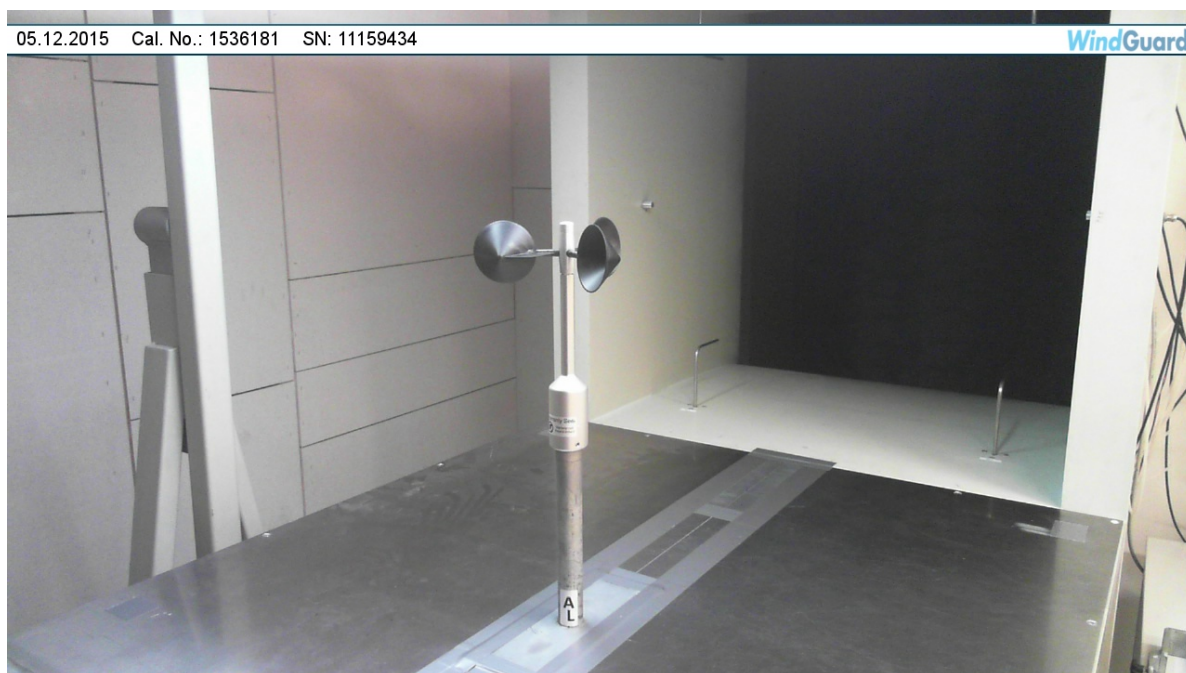


Photo of the measurement setup

Foto des Messaufbaus



Remark: The proportions of the set-up may not be true to scale due to imaging geometry.