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Deutsche
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D-K-15140-01-00

Calibration certificate
Kalibrierschein

Calibration mark
Kalibrierzeichen

1522884
D-K-
15140-01-00
09/2015

Object <i>Gegenstand</i>	Cup Anemometer
Manufacturer <i>Hersteller</i>	Thies Clima D-37083 Göttingen
Type <i>Typ</i>	4.3351.00.000
Serial number <i>Fabrikat/Serien-Nr.</i>	11131456
Customer <i>Auftraggeber</i>	HydroWind BVBA B-1850 Grimbergen (Brussels)
Order No. <i>Auftragsnummer</i>	Email 2015-08-31, Wery
Project No. <i>Projektnummer</i>	VT150738
Number of pages <i>Anzahl der Seiten</i>	4
Date of Calibration <i>Datum der Kalibrierung</i>	03.09.2015

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

03.09.2015

Head of the calibration laboratory
Leiter des Kalibrierlaboratoriums

Dipl. Phys. Dieter Westermann

Person in charge
Bearbeiter

Kai Schuster, B. Eng.

Calibration object
Kalibriergegenstand

Cup Anemometer

Calibration procedure
Kalibrierverfahren

- Deutsche WindGuard Wind Tunnel Services: Calibration of anemometers; Version 1.0 (2014)
- 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 Servies 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	23.7 °C ± 0.1 °C
air pressure	1011.5 hPa ± 0.3 hPa
relative air humidity	58.5 % ± 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 %, $k=2$)

Latest accreditation
Letzte Akkreditierung

04/2014

Additional remarks
Zusätzliche Anmerkungen

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Calibration result

Kalibrierergebnis

Sensor out	Tunnel speed	Uncertainty (k=2)
Hz	m/s	m/s
81.086	3.941	0.050
122.708	5.870	0.050
168.027	7.960	0.050
211.252	9.950	0.051
256.233	12.003	0.051
296.617	13.917	0.051
340.693	15.938	0.051
320.084	14.973	0.051
276.236	12.984	0.051
231.700	10.945	0.051
189.511	8.969	0.051
146.315	6.972	0.050
100.974	4.879	0.050

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Linear regression analysis

Slope	0.04618 (m/s)/(Hz) \pm 0.00007 (m/s)/(Hz)
Offset	0.2083 m/s \pm 0.015 m/s
Standard error (Y)	0.019 m/s
Correlation coefficient	0.999989

Remarks

The calibrated sensor complies with the demanded linearity of MEASNET



Graphical representation of the result *Grafische Darstellung des Ergebnisses*

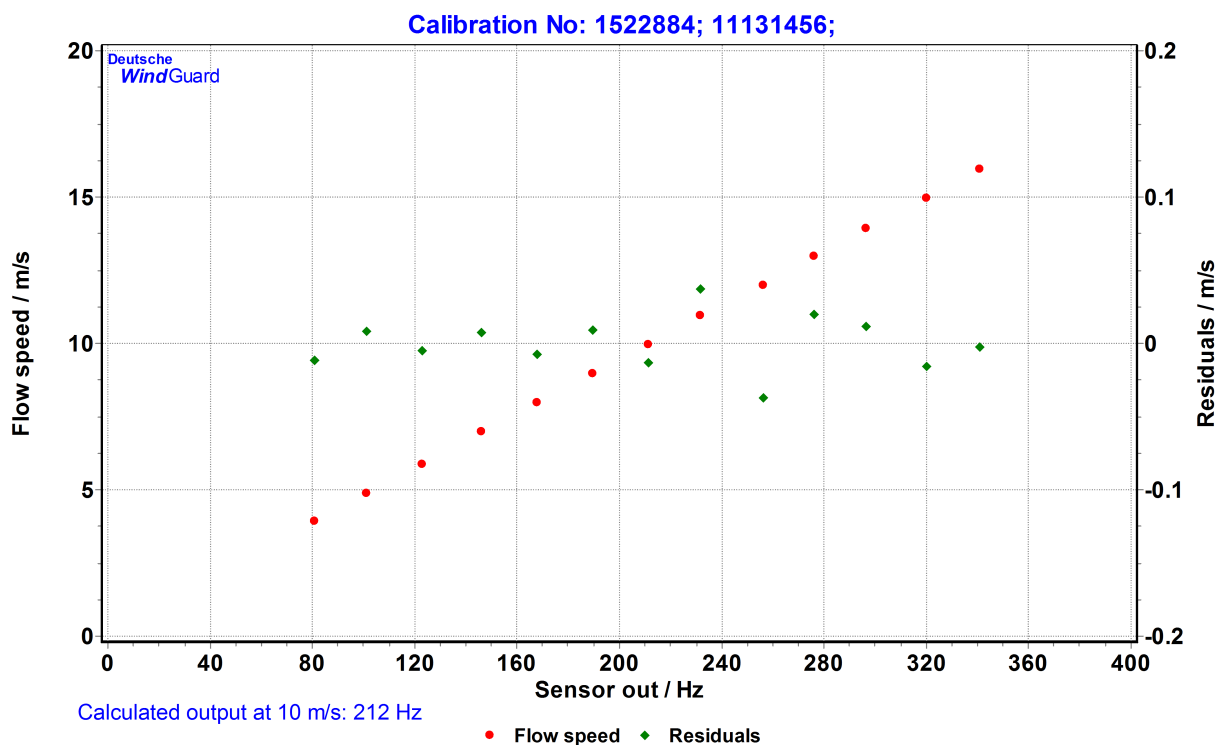
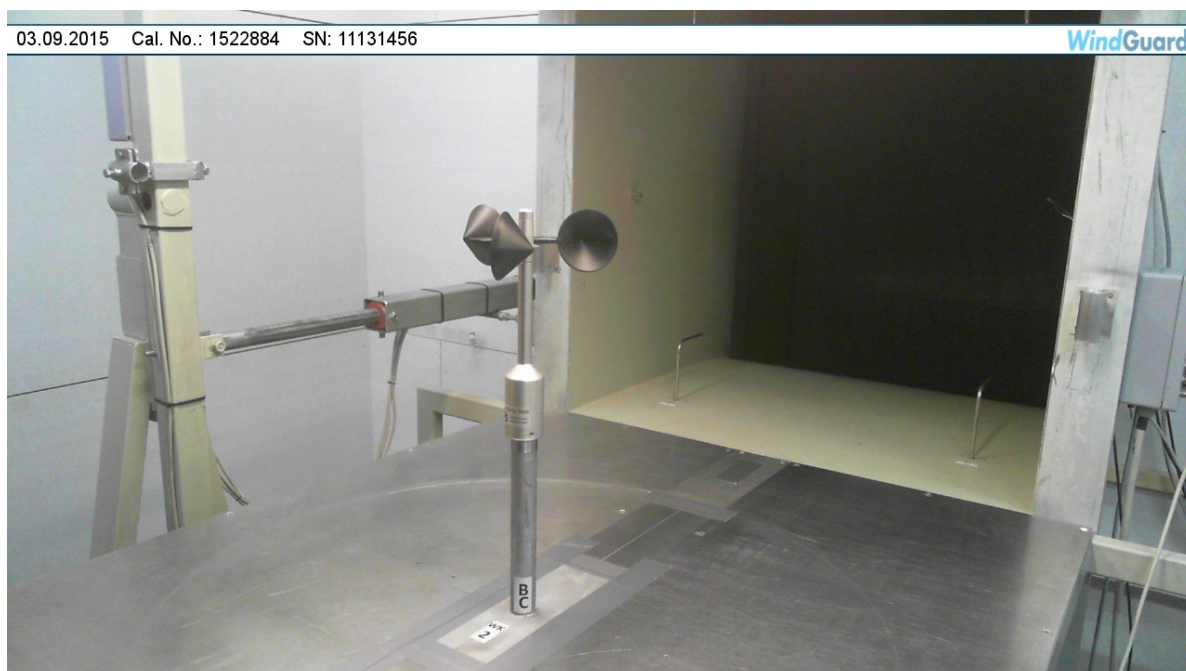


Photo of the measurement setup *Foto des Messaufbaus*



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