

accredited by the / akkreditiert durch die

Deutsche Akkreditierungsstelle GmbH

as calibration laboratory in the / als Kalibrierlaboratorium im

Deutschen Kalibrierdienst



Deutsche
Akkreditierungsstelle
D-K-15140-01-00

Calibration certificate
Kalibrierschein

Calibration mark
Kalibrierzeichen

1710706
D-K-
15140-01-00
02/2017

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>	02176245
Customer <i>Auftraggeber</i>	HydroWind BVBA B-1850 Grimbergen (Brussels)
Order No. <i>Auftragsnummer</i>	Email 2017-02-06, Wery
Project No. <i>Projektnummer</i>	VT170257
Number of pages <i>Anzahl der Seiten</i>	4
Date of Calibration <i>Datum der Kalibrierung</i>	10.02.2017

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

The DAkkS is signatory to the multilateral agreements of the European co-operation for Accreditation (EA) and of the International Laboratory Accreditation Cooperation (ILAC) for the mutual recognition of calibration certificates. The user is obliged to have the object recalibrated at appropriate intervals.

Dieser Kalibrierschein dokumentiert die Rückführung auf nationale Normale zur Darstellung der Einheiten in Übereinstimmung mit dem Internationalen Einheitensystem (SI).

Die DAkkS ist Unterzeichner der multilateralen Übereinkommen der European co-operation for Accreditation (EA) und der International Laboratory Accreditation Cooperation (ILAC) zur gegenseitigen Anerkennung der Kalibrierscheine. Für die Einhaltung einer angemessenen Frist zur Wiederholung der Kalibrierung ist der Benutzer verantwortlich.

This calibration certificate may not be reproduced other than in full except with the permission of both the German Accreditation Body and the issuing laboratory. Calibration certificates without signature are not valid. This calibration certificate has been generated electronically.

Dieser Kalibrierschein darf nur vollständig und unverändert weiterverbreitet werden. Auszüge oder Änderungen bedürfen der Genehmigung sowohl der Deutschen Akkreditierungsstelle als auch des ausstellenden Kalibrierlaboratoriums. Kalibrierscheine ohne Unterschrift haben keine Gültigkeit. Dieser Kalibrierschein wurde elektronisch erzeugt.

Date
Datum

10.02.2017

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	19.1 °C ± 0.1 °C
air pressure	1026.7 hPa ± 0.3 hPa
relative air humidity	29.1 % ± 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

-

Calibration result

Kalibrierergebnis

Sensor out	Tunnel speed	Uncertainty (k=2)
Hz	m/s	m/s
82.190	4.006	0.050
124.026	5.929	0.050
166.702	7.914	0.051
210.310	9.922	0.052
255.348	11.955	0.051
296.402	13.887	0.052
338.276	15.846	0.052
318.284	14.847	0.052
276.497	12.943	0.052
231.604	10.890	0.052
187.927	8.903	0.051
145.763	6.967	0.051
102.792	4.967	0.050

File: 1710706

Statistical analysis

Slope	0.04602 (m/s)/(Hz) \pm 0.00008 (m/s)/(Hz)
Offset	0.2346 m/s \pm 0.018 m/s
Standard error (Y)	0.018 m/s
Correlation coefficient	0.999983

Remarks

The calibrated sensor complies with the demanded linearity of MEASNET



Graphical representation of the result

Grafische Darstellung des Ergebnisses

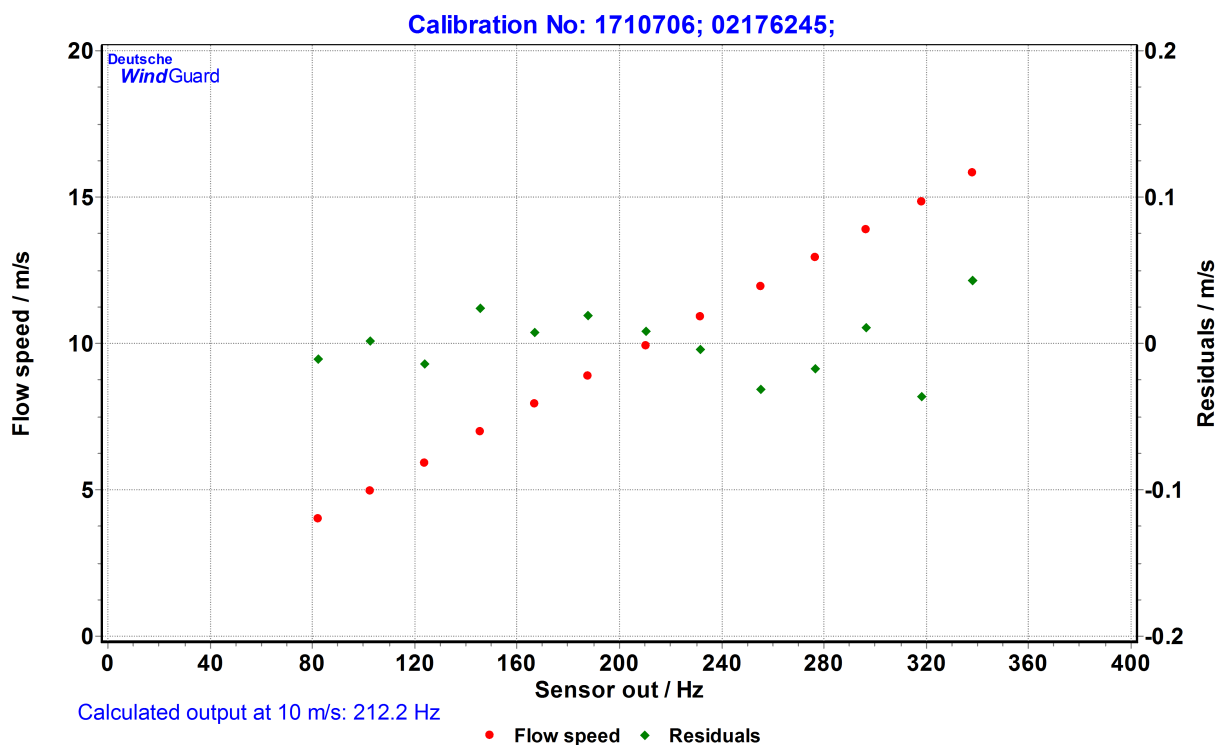
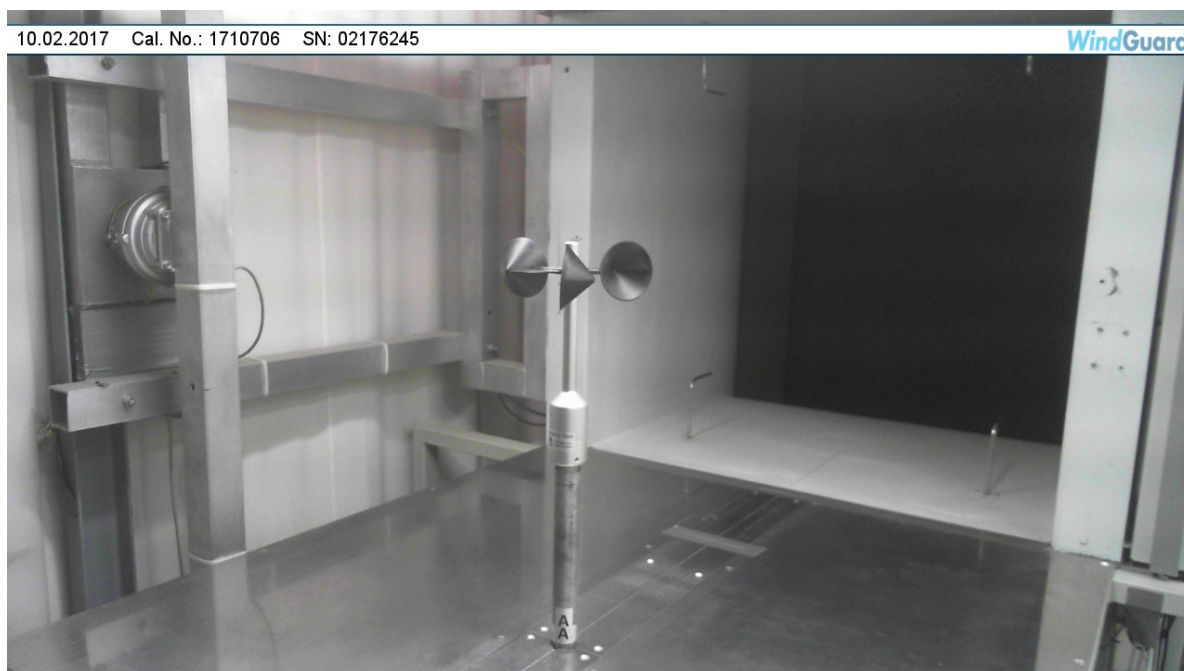


Photo of the measurement setup

Foto des Messaufbaus



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