DEUTSCHE WINDGUARD

Deutsche WindGuard Wind Tunnel Services GmbH

IECRE and MEASNET approved test laboratory

accredited by the / *akkreditiert durch die*

Deutsche Akkreditierungsstelle GmbH

as calibration laboratory in the / *als Kalibrierlaboratorium im*

Deutschen Kalibrierdienst

DAkkS Deutsche Akkreditierungsstelle D-K-15140-01-00

1715123
D-K-15140-01-00
12/2017

Calibration certificate
Kalibrierschein

Calibration mark
Kalibrierzeichen

Object *Gegenstand*	Cup Anemometer
Manufacturer *Hersteller*	Thies Clima D-37083 Göttingen
Type *Typ*	4.3351.10.000
Serial number *Fabrikat/Serien-Nr.*	12179373
Customer *Auftraggeber*	HydroWind BVBA B-1850 Grimbergen (Brussels)
Order No. *Auftragsnummer*	Email 2017-11-20, Wery
Project No. *Projektnummer*	VT171188
Number of pages *Anzahl der Seiten*	4
Date of Calibration *Datum der Kalibrierung*	14.12.2017

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.

Date *Datum*	Head of the calibration laboratory *Leiter des Kalibrierlaboratoriums*	Person in charge *Bearbeiter*
14.12.2017	Dipl. Phys. Dieter Westermann	Hendrik Jansen, B. Eng.

Calibration object
Kalibriergegenstand

Cup Anemometer

Calibration procedure
Kalibrierverfahren

• Deutsche WindGuard Wind Tunnel Services: VA Anemometerkalibrierung
Based on following standards:
• MEASNET ANEMOMETER CALIBRATION PROCEDURE Version 2 / 2009
• IEC 61400-12-1:2017 Power performance measurements of electricity producing wind turbines
• IEC 61400-12-2:2013 Power performance of electricity producing wind turbines based on nacelle anemometry
• ISO 3966:2008 Measurement of fluid in closed conduits
• ISO 16622:2002 Meteorology - Sonic anemometers/thermometers

Place of calibration
Ort der Kalibrierung

Wind tunnel of Deutsche WindGuard WindTunnel Services GmbH, Varel

Test conditions
Messbedingungen

wind tunnel area	10000 cm²
anemometer frontal area	230 cm²
diameter of mounting pipe	34 mm
blockage ratio [1)]	0.023 [-]
software version	7.7

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

Ambient conditions
Umgebungsbedingungen

air temperature	20.5 °C ± 0.1 °C
air pressure	987.6 hPa ± 0.3 hPa
relative air humidity	35.1 % ± 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

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Calibration result
Kalibrierergebnis

Sensor	Tunnel Speed	Uncertainty
Hz	m/s	m/s
81.153	3.961	0.050
123.023	5.881	0.050
166.445	7.884	0.051
210.030	9.889	0.051
252.655	11.893	0.052
295.539	13.824	0.052
338.041	15.784	0.052
315.671	14.796	0.053
273.808	12.894	0.051
230.086	10.851	0.051
186.234	8.857	0.051
144.939	6.923	0.051
101.584	4.929	0.050

File: 1715123

Statistical analysis	Slope	0.04609 (m/s)/(Hz) ±0.00009 (m/s)/(Hz)
	Offset	0.2336 m/s ±0.020 m/s
	Standard error (Y)	0.021 m/s
	Correlation coefficient	0.99998

Remarks

The calibrated sensor complies with the demanded linearity of MEASNET

Graphical representation of the result
Grafische Darstellung des Ergebnisses

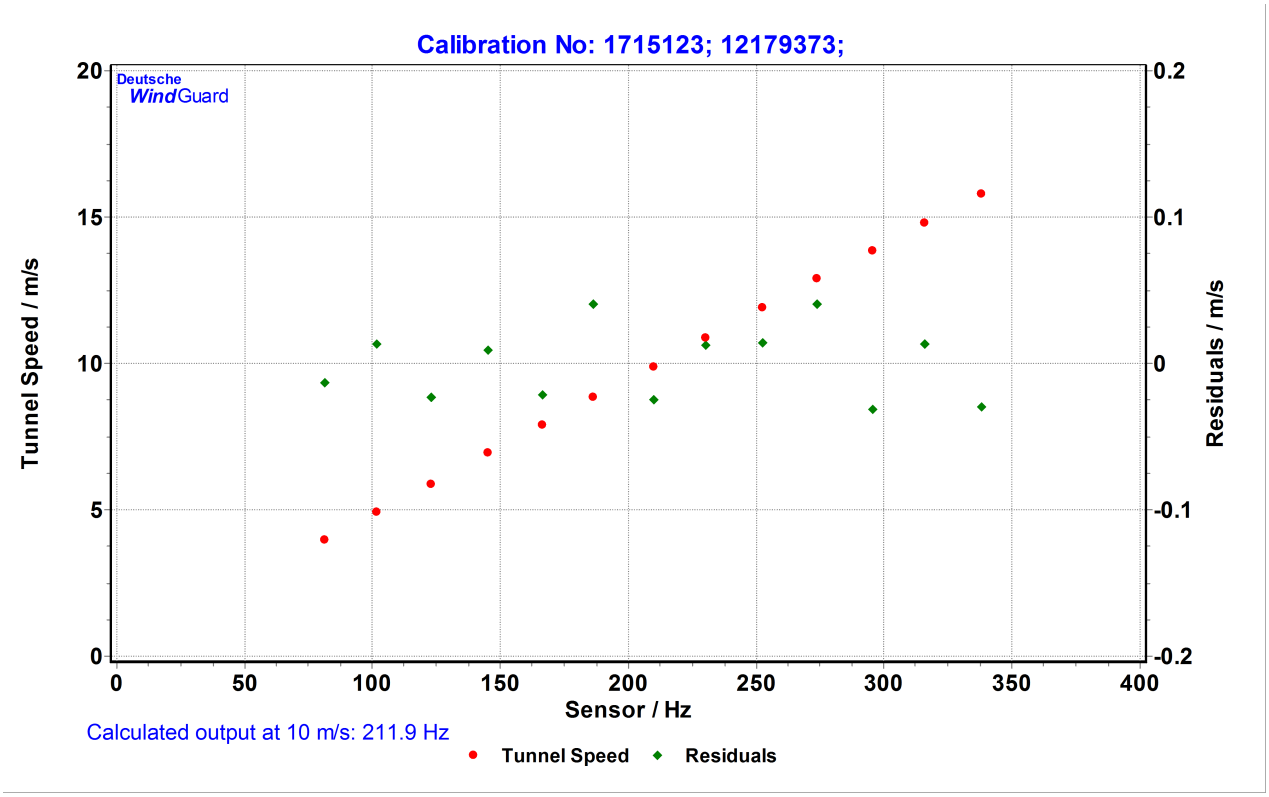
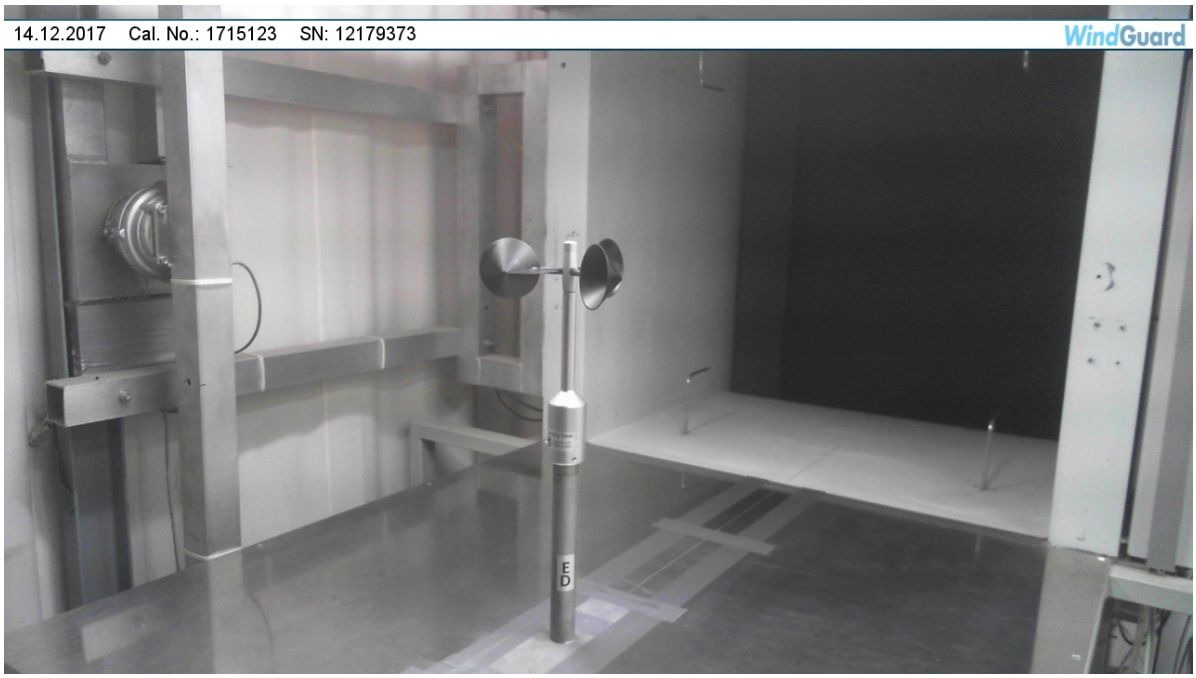


Photo of the measurement setup
Foto des Messaufbaus



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