Deutsche WindGuard
Wind Tunnel Services GmbH, Varel

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Deutschen Kalibrierdienst

Deutsche Akkreditierungsstelle D-K-15140-01-00

Calibration certificate *Kalibrierschein*	Calibration mark *Kalibrierzeichen*
	1614421
	D-K-15140-01-00
	08/2016

Object *Gegenstand*	Cup Anemometer
Manufacturer *Hersteller*	Thies Clima D-37083 Göttingen
Type *Typ*	4.3351.10.000
Serial number *Fabrikat/Serien-Nr.*	08162992
Customer *Auftraggeber*	KinTech Ingenieria S.L. ES 50004 Zaragoza
Order No. *Auftragsnummer*	2016090194
Project No. *Projektnummer*	VT160747
Number of pages *Anzahl der Seiten*	4
Date of Calibration *Datum der Kalibrierung*	24.08.2016

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.
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Date *Datum*	Head of the calibration laboratory *Leiter des Kalibrierlaboratoriums*	Person in charge *Bearbeiter*
24.08.2016	Dipl. Phys. Dieter Westermann	Techniker Dirk Henninges

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 cm²
anemometer frontal area	230 cm²
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	26.1 °C ± 0.1 °C
air pressure	1021.2 hPa ± 0.3 hPa
relative air humidity	55.8 % ± 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
82.646	4.005	0.050
124.362	5.936	0.050
168.251	7.956	0.051
212.438	9.976	0.051
256.105	12.001	0.052
298.165	13.947	0.052
343.440	15.972	0.053
319.594	14.933	0.052
277.582	13.002	0.051
233.708	11.002	0.051
189.012	8.938	0.051
146.797	6.979	0.051
102.804	4.963	0.050

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Statistical analysis	Slope	0.04598 (m/s)/(Hz) ±0.00007 (m/s)/(Hz)
	Offset	0.2269 m/s ±0.016 m/s
	Standard error (Y)	0.016 m/s
	Correlation coefficient	0.999987

Remarks The calibrated sensor complies with the demanded linearity of MEASNET

Graphical representation of the result
Grafische Darstellung des Ergebnisses

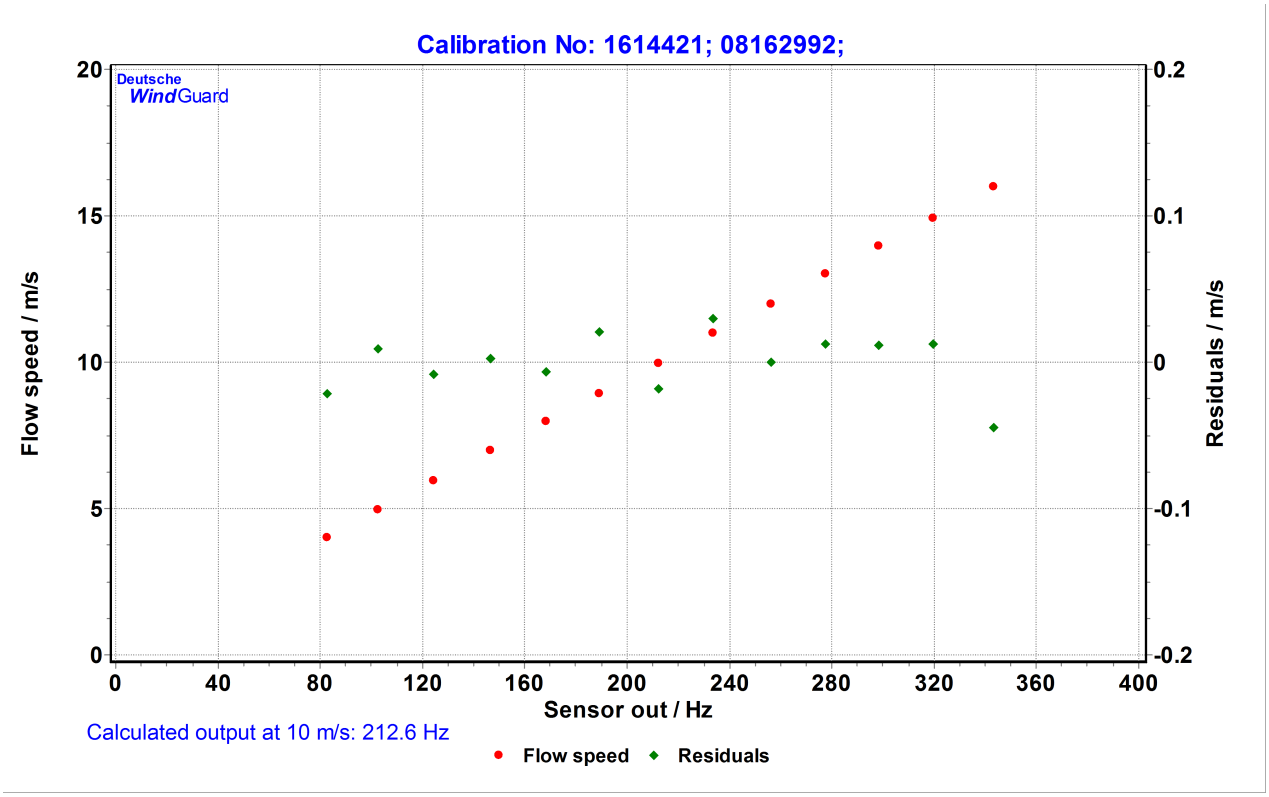

Photo of the measurement setup
Foto des Messaufbaus

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