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DKD



Deutsche
Akkreditierungsstelle
D-K-15140-01-00

Calibration certificate
Kalibrierschein

Calibration mark
Kalibrierzeichen

| |
|-------------|
| 1710707 |
| 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> | 02176246 |
| 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).

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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 | 29.0 % ± 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 |
| 82.307 | 4.014 | 0.050 |
| 123.302 | 5.918 | 0.050 |
| 166.816 | 7.912 | 0.051 |
| 210.826 | 9.918 | 0.051 |
| 254.668 | 11.952 | 0.052 |
| 296.404 | 13.873 | 0.053 |
| 339.474 | 15.845 | 0.053 |
| 317.867 | 14.850 | 0.053 |
| 276.958 | 12.942 | 0.052 |
| 231.482 | 10.904 | 0.051 |
| 187.510 | 8.908 | 0.051 |
| 145.612 | 6.962 | 0.051 |
| 102.576 | 4.979 | 0.050 |

File: 1710707

Statistical analysis

| | |
|-------------------------|---|
| Slope | 0.04590 (m/s)/(Hz) \pm 0.00007 (m/s)/(Hz) |
| Offset | 0.2624 m/s \pm 0.016 m/s |
| Standard error (Y) | 0.016 m/s |
| Correlation coefficient | 0.999988 |

Remarks

The calibrated sensor complies with the demanded linearity of MEASNET



Graphical representation of the result

Grafische Darstellung des Ergebnisses

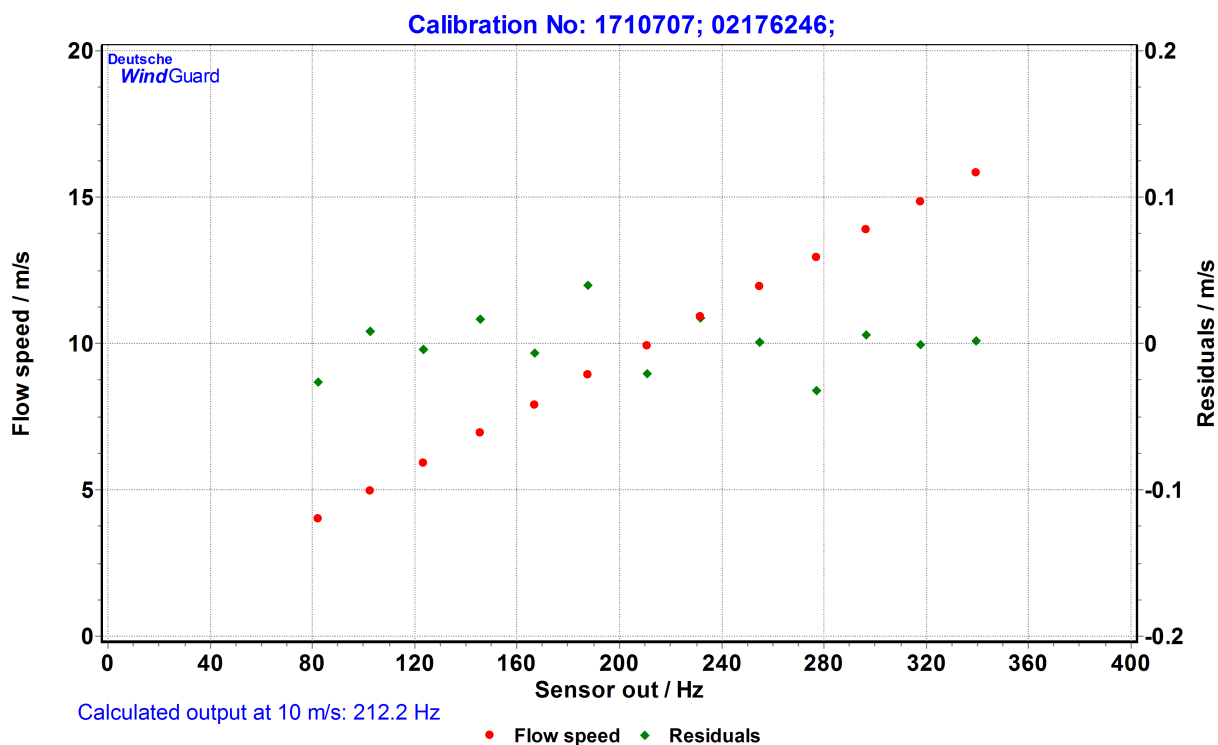
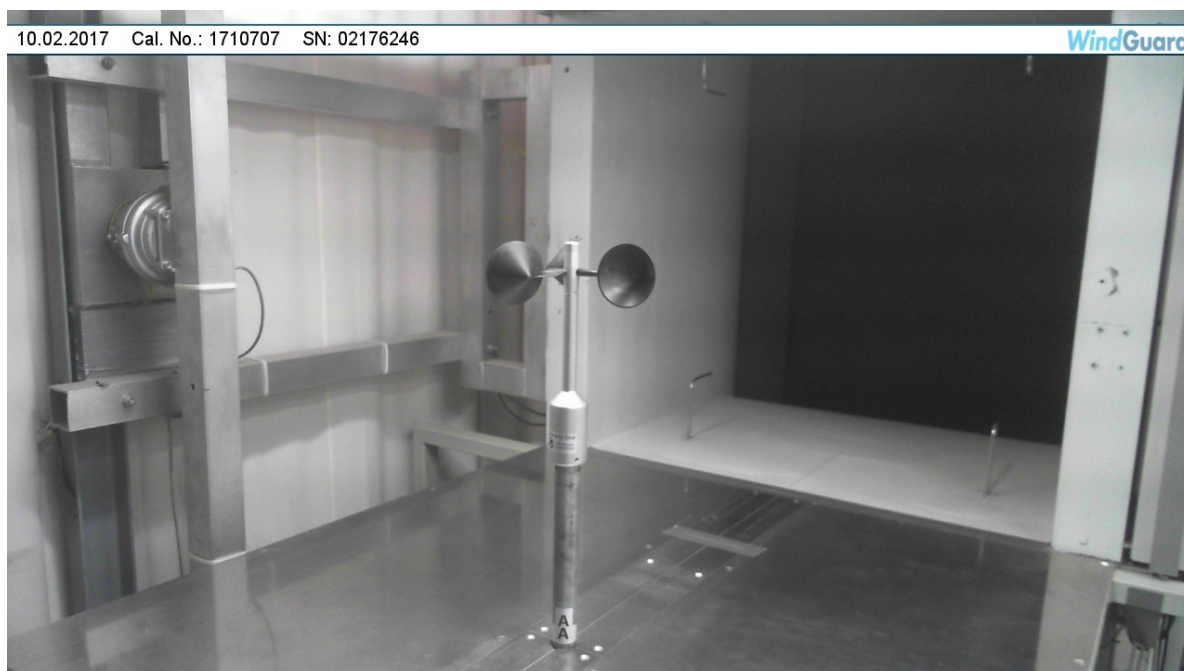


Photo of the measurement setup

Foto des Messaufbaus



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