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Deutsche
Akkreditierungsstelle
D-K-15140-01-00

Calibration certificate
Kalibrierschein

Calibration mark
Kalibrierzeichen

| |
|-------------|
| 1721109 |
| D-K- |
| 15140-01-00 |
| 04/2017 |

| | |
|---|--|
| Object <i>Gegenstand</i> | Combined Wind Sensor |
| Manufacturer <i>Hersteller</i> | BARANI DESIGN, s.r.o. Slovakia |
| Type <i>Typ</i> | Elliptic Anemometer 3 / MeteoWind 2 |
| Serial number <i>Fabrikat/Serien-Nr.</i> | - |
| Customer <i>Auftraggeber</i> | BARANI DESIGN, s.r.o. Slovakia |
| Order No. <i>Auftragsnummer</i> | Email 2017-03-29, Jeneiova |
| Project No. <i>Projektnummer</i> | VT170471 |
| Number of pages <i>Anzahl der Seiten</i> | 4 |
| Date of Calibration <i>Datum der Kalibrierung</i> | 25.04.2017 |

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

23.06.2017

Head of the calibration laboratory
Leiter des Kalibrierlaboratoriums



Dipl. Phys. Dieter Westermann

Person in charge
Bearbeiter



Heiko Westermann, B. Sc.

Calibration object
Kalibriergegenstand

Combined Wind Sensor

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 | 200 cm ² |
| diameter of mounting pipe | 34 mm |
| blockage ratio ¹⁾ | 0.020 [-] |
| software version | 7.7 |

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

Ambient conditions
Umgebungsbedingungen

| | |
|-----------------------|----------------------|
| air temperature | 25.2 °C ± 0.1 °C |
| air pressure | 1006.7 hPa ± 0.3 hPa |
| relative air humidity | 28.0 % ± 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

Revision 1.0 (replaces certificate dated 08.06.2017)

Calibration result
Kalibrierergebnis

| Sensor out | Tunnel Speed | Uncertainty (k=2) |
|------------|--------------|-------------------|
| Hz / 2 | m/s | m/s |
| 4.227 | 3.926 | 0.050 |
| 6.461 | 5.896 | 0.051 |
| 8.631 | 7.814 | 0.050 |
| 10.905 | 9.803 | 0.051 |
| 13.323 | 11.888 | 0.052 |
| 15.686 | 13.894 | 0.052 |
| 17.806 | 15.763 | 0.052 |
| 16.812 | 14.881 | 0.052 |
| 14.458 | 12.853 | 0.051 |
| 12.144 | 10.861 | 0.051 |
| 9.754 | 8.815 | 0.051 |
| 7.543 | 6.870 | 0.050 |
| 5.239 | 4.857 | 0.050 |

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| | | |
|-----------------------------|-------------------------|--|
| Statistical analysis | Slope | 0.86825 (m/s)/(Hz/2) ±0.00170 (m/s)/(Hz/2) |
| | Offset | 0.3054 m/s ±0.020 m/s |
| | Standard error (Y) | 0.025 m/s |
| | Correlation coefficient | 0.999979 |

Remarks The calibrated sensor complies with the demanded linearity of MEASNET



Graphical representation of the result
Grafische Darstellung des Ergebnisses

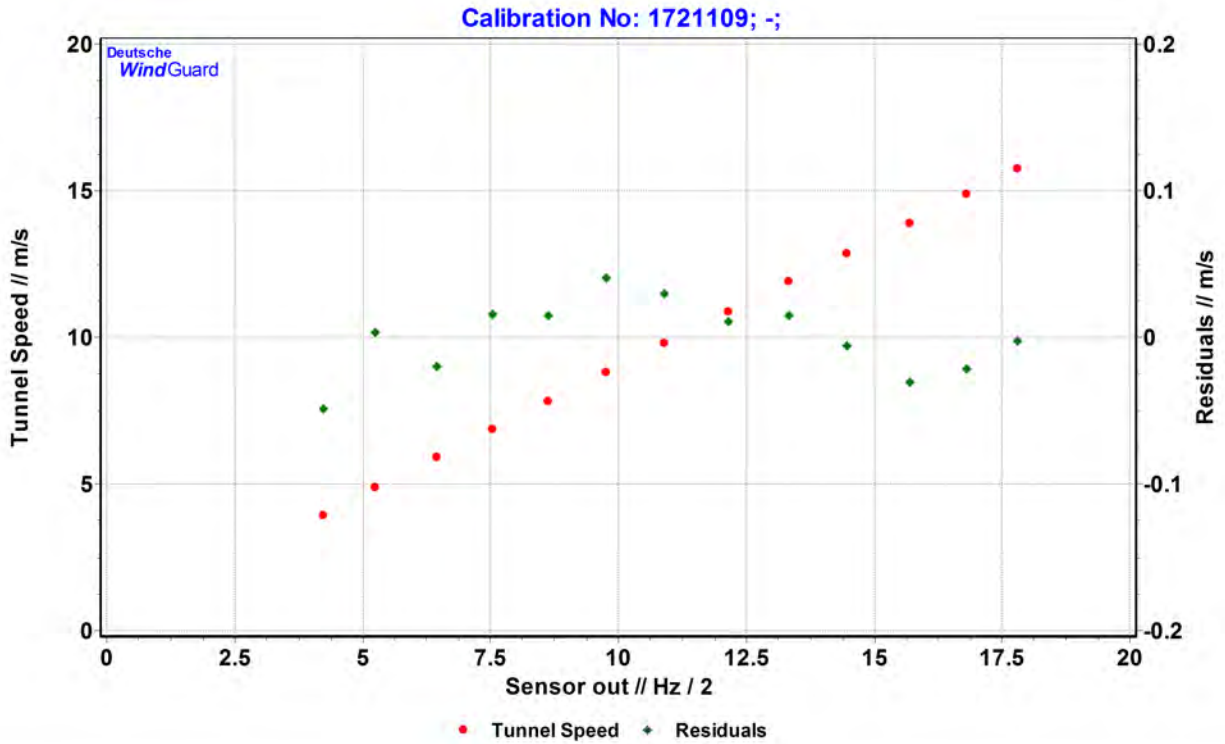


Photo of the measurement setup
Foto des Messaufbaus



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