Deutsche WindGuard
Wind Tunnel Services GmbH, Varel

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as calibration laboratory in the / *als Kalibrierlaboratorium im*

Deutschen Kalibrierdienst DKD

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

1514942
D-K-15140-01-00
09/2015

Calibration certificate
Kalibrierschein

Calibration mark
Kalibrierzeichen

Object *Gegenstand*	Cup Anemometer
Manufacturer *Hersteller*	Windspeed LTD Denbighshire LL18 2AB
Type *Typ*	A100LM
Serial number *Fabrikat/Serien-Nr.*	16844 FFBE
Customer *Auftraggeber*	Ammonit Measurement GmbH D-10997 Berlin
Order No. *Auftragsnummer*	L 23649
Project No. *Projektnummer*	VT150889
Number of pages *Anzahl der Seiten*	4
Date of Calibration *Datum der Kalibrierung*	30.09.2015

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*	Head of the calibration laboratory *Leiter des Kalibrierlaboratoriums*	Person in charge *Bearbeiter*
30.09.2015	Dipl. Phys. Dieter Westermann	Techniker Dirk Henninges

1514942
D-K-15140-01-00
09/2015

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 Servies GmbH, Varel

Test conditions
Messbedingungen

wind tunnel area	10000 cm²
anemometer frontal area	200 cm²
diameter of mounting pipe	27 mm
blockage ratio [1)]	0.020 [-]
software version	7.64

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

Ambient conditions
Umgebungsbedingungen

air temperature	20.9 °C ± 0.1 °C
air pressure	1037.9 hPa ± 0.3 hPa
relative air humidity	48.5 % ± 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)

Latest accreditation
Letzte Akkreditierung

04/2014

Additional remarks
Zusätzliche Anmerkungen

Calibrated with 405 Type Single Mount
Anemometer with 3 metre cable

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Calibration result
Kalibrierergebnis

Sensor out Hz	Tunnel speed m/s	Uncertainty (k=2) m/s
40.184	4.102	0.050
60.765	6.108	0.051
82.727	8.274	0.051
103.757	10.320	0.052
124.971	12.386	0.052
145.127	14.349	0.054
165.369	16.297	0.050
155.601	15.331	0.054
133.769	13.269	0.053
113.967	11.294	0.053
92.073	9.204	0.051
72.013	7.211	0.051
51.533	5.211	0.051

File: 1514942

Linear regression analysis

Slope	0.09746 (m/s)/(Hz) ±0.00014 (m/s)/(Hz)
Offset	0.1985 m/s ±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

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Graphical representation of the result
Grafische Darstellung des Ergebnisses

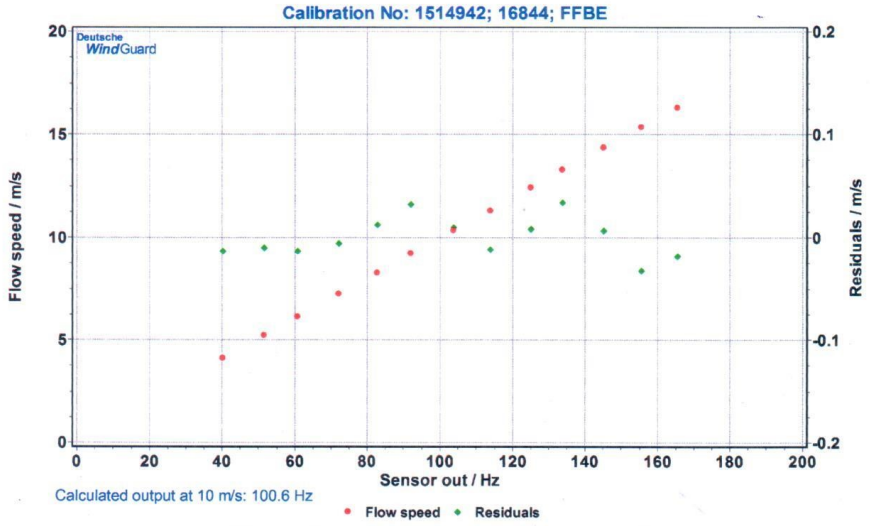
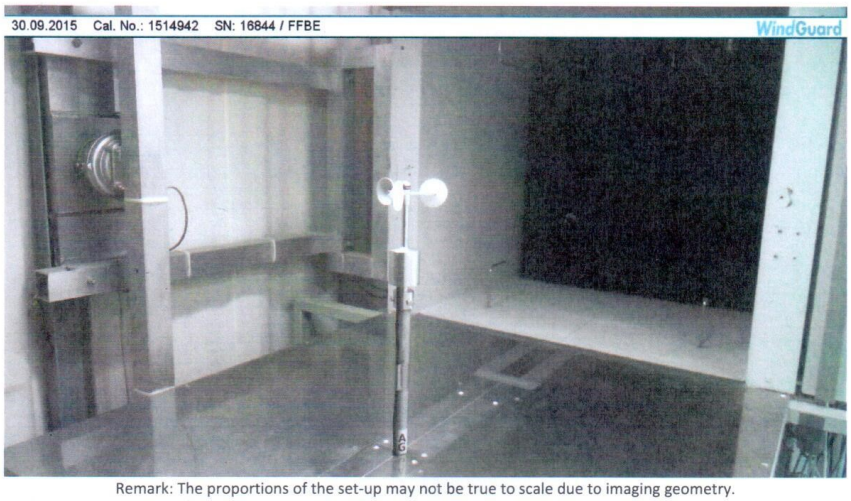


Photo of the measurement setup
Foto des Messaufbaus



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

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Deutschen Kalibrierdienst DKD

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Calibration certificate
Kalibrierschein

1513898

Calibration mark
Kalibrierzeichen

D-K-15140-01-00

08/2015

Object *Gegenstand*	Cup Anemometer
Manufacturer *Hersteller*	Thies Clima D-37083 Göttingen
Type *Typ*	4.3351.10.000
Serial number *Fabrikat/Serien-Nr.*	07157678
Customer *Auftraggeber*	Ammonit Measurement GmbH D-10997 Berlin
Order No. *Auftragsnummer*	L 23504
Project No. *Projektnummer*	VT150637
Number of pages *Anzahl der Seiten*	4
Date of Calibration *Datum der Kalibrierung*	04.08.2015

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Date *Datum*	Head of the calibration laboratory *Leiter des Kalibrierlaboratoriums*	Person in charge *Bearbeiter*
04.08.2015	D. Westermann	C. Ahrens
	Dipl. Phys. Dieter Westermann	Techniker Christian Ahrens

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D-K- 15140-01-00
08/2015

Calibration object
Kalibriergegenstand

Cup Anemometer

Calibration procedure
Kalibrierverfahren

- Deutsche WindGuard Wind Tunnel Services: Calibration of anemometers; Version 1.0 (2014)

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 Servies 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	25.6 °C ± 0.1 °C
air pressure	1011.5 hPa ± 0.3 hPa
relative air humidity	49.9 % ± 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)

Latest accreditation
Letzte Akkreditierung

04/2014

Additional remarks
Zusätzliche Anmerkungen

-

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Calibration result
Kalibrierergebnis

Sensor out Hz	Tunnel speed m/s	Uncertainty (k=2) m/s
82.543	4.038	0.050
126.638	6.073	0.050
173.686	8.246	0.051
219.348	10.318	0.051
263.216	12.358	0.052
306.262	14.338	0.053
347.760	16.276	0.050
328.178	15.305	0.052
282.592	13.261	0.052
239.060	11.280	0.052
194.211	9.179	0.051
150.688	7.191	0.051
106.819	5.174	0.050

File: 1513898

Linear regression analysis

Slope	0.04600 (m/s)/(Hz) ±0.00007 (m/s)/(Hz)
Offset	0.2515 m/s ±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

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Graphical representation of the result
Grafische Darstellung des Ergebnises

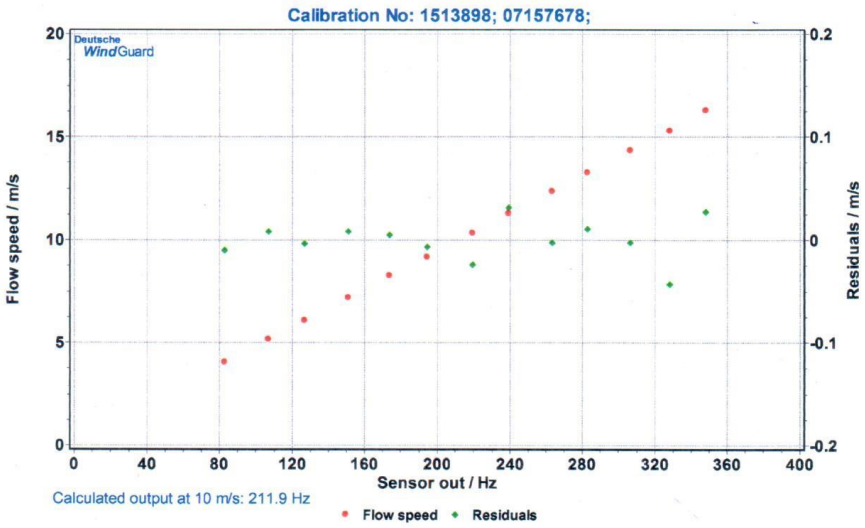

Photo of the measurement setup
Foto des Messaufbaus

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

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Deutschen Kalibrierdienst DKD

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

Calibration mark *Kalibrierzeichen*	1513899 D-K-15140-01-00 08/2015

Calibration certificate
Kalibrierschein

Object *Gegenstand*	Cup Anemometer
Manufacturer *Hersteller*	Thies Clima D-37083 Göttingen
Type *Typ*	4.3351.10.000
Serial number *Fabrikat/Serien-Nr.*	07157677
Customer *Auftraggeber*	Ammonit Measurement GmbH D-10997 Berlin
Order No. *Auftragsnummer*	L 23504
Project No. *Projektnummer*	VT150637
Number of pages *Anzahl der Seiten*	4
Date of Calibration *Datum der Kalibrierung*	04.08.2015

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Date *Datum*	Head of the calibration laboratory *Leiter des Kalibrierlaboratoriums*	Person in charge *Bearbeiter*
04.08.2015	D. Westermann	C. Ahrens
	Dipl. Phys. Dieter Westermann	Techniker Christian Ahrens

1513899
D-K- 15140-01-00
08/2015

Calibration object
Kalibriergegenstand

Cup Anemometer

Calibration procedure
Kalibrierverfahren

- Deutsche WindGuard Wind Tunnel Services: Calibration of anemometers; Version 1.0 (2014)

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 Servies 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	25.7 °C ± 0.1 °C
air pressure	1011.6 hPa ± 0.3 hPa
relative air humidity	50.3 % ± 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)

Latest accreditation
Letzte Akkreditierung

04/2014

Additional remarks
Zusätzliche Anmerkungen

-

1513899
D-K- 15140-01-00
08/2015

Calibration result
Kalibrierergebnis

Sensor out Hz	Tunnel speed m/s	Uncertainty (k=2) m/s
82.390	4.029	0.050
126.752	6.095	0.051
172.844	8.232	0.051
218.419	10.326	0.051
262.521	12.351	0.052
305.984	14.336	0.052
347.892	16.277	0.050
327.072	15.304	0.053
283.068	13.248	0.051
239.196	11.278	0.051
193.497	9.174	0.051
150.393	7.189	0.050
106.688	5.173	0.050

File: 1513899

Linear regression analysis	Slope	0.04600 (m/s)/(Hz) ±0.00006 (m/s)/(Hz)
	Offset	0.2640 m/s ±0.013 m/s
	Standard error (Y)	0.013 m/s
	Correlation coefficient	0.999992

Remarks The calibrated sensor complies with the demanded linearity of MEASNET

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D-K-15140-01-00
08/2015

Graphical representation of the result
Grafische Darstellung des Ergebnises

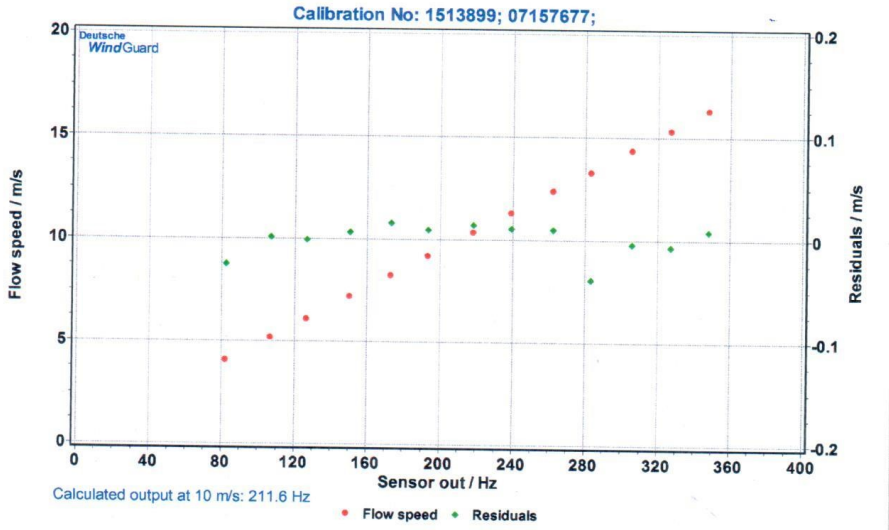
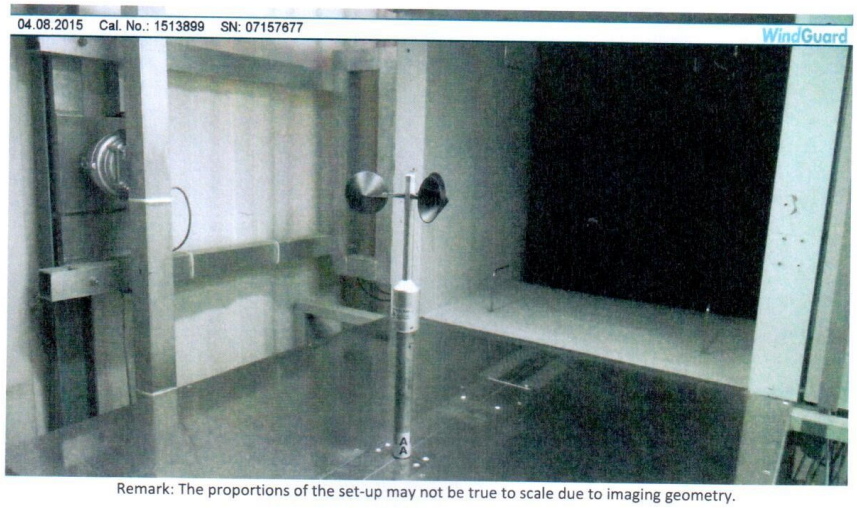


Photo of the measurement setup
Foto des Messaufbaus



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

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Wind Tunnel Services GmbH, Varel

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Deutschen Kalibrierdienst DKD

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

Calibration certificate
Kalibrierschein

Calibration mark
Kalibrierzeichen

1513900
D-K-15140-01-00
08/2015

Object *Gegenstand*	Cup Anemometer
Manufacturer *Hersteller*	Thies Clima D-37083 Göttingen
Type *Typ*	4.3351.10.000
Serial number *Fabrikat/Serien-Nr.*	07157676
Customer *Auftraggeber*	Ammonit Measurement GmbH D-10997 Berlin
Order No. *Auftragsnummer*	L 23504
Project No. *Projektnummer*	VT150637
Number of pages *Anzahl der Seiten*	4
Date of Calibration *Datum der Kalibrierung*	04.08.2015

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Date *Datum*	Head of the calibration laboratory *Leiter des Kalibrierlaboratoriums*	Person in charge *Bearbeiter*
04.08.2015	Dipl. Phys. Dieter Westermann	Techniker Christian Ahrens

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D-K-15140-01-00
08/2015

Calibration object
Kalibriergegenstand

Cup Anemometer

Calibration procedure
Kalibrierverfahren

- Deutsche WindGuard Wind Tunnel Services: Calibration of anemometers; Version 1.0 (2014)

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 Servies 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	25.8 °C ± 0.1 °C
air pressure	1012.0 hPa ± 0.3 hPa
relative air humidity	50.5 % ± 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)

Latest accreditation
Letzte Akkreditierung

04/2014

Additional remarks
Zusätzliche Anmerkungen

-

1513900
D-K-15140-01-00
08/2015

Calibration result
Kalibrierergebnis

Sensor out Hz	Tunnel speed m/s	Uncertainty (k=2) m/s
82.414	4.043	0.050
126.864	6.085	0.051
173.254	8.243	0.051
218.801	10.315	0.051
263.653	12.359	0.052
306.135	14.347	0.052
348.042	16.278	0.050
327.265	15.307	0.053
281.486	13.240	0.052
240.110	11.281	0.052
193.893	9.177	0.051
150.490	7.189	0.050
106.416	5.173	0.050

File: 1513900

Linear regression analysis

Slope	0.04600 (m/s)/(Hz) ±0.00006 (m/s)/(Hz)
Offset	0.2595 m/s ±0.014 m/s
Standard error (Y)	0.014 m/s
Correlation coefficient	0.999991

Remarks

The calibrated sensor complies with the demanded linearity of MEASNET

Graphical representation of the result
Grafische Darstellung des Ergebnises

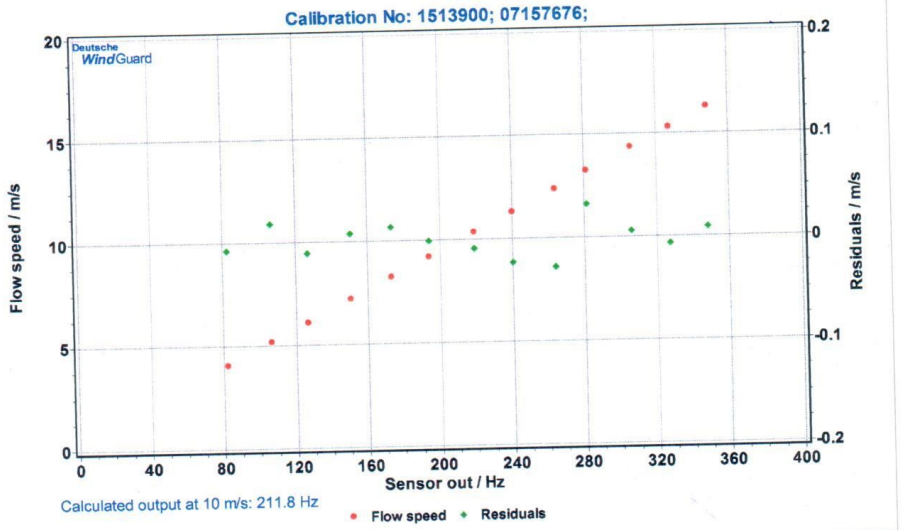
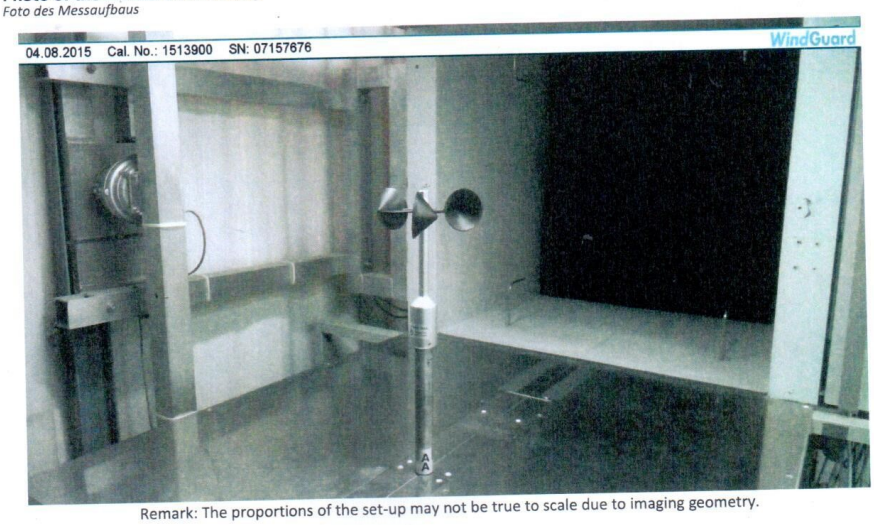


Photo of the measurement setup
Foto des Messaufbaus



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

Deutsche WindGuard
Wind Tunnel Services GmbH, Varel

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Deutsche Akkreditierungsstelle GmbH

as calibration laboratory in the / *als Kalibrierlaboratorium im*

Deutschen Kalibrierdienst DKD

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

Calibration certificate
Kalibrierschein

Calibration mark
Kalibrierzeichen

1513901
D-K-15140-01-00
08/2015

Object *Gegenstand*	Cup Anemometer
Manufacturer *Hersteller*	Thies Clima D-37083 Göttingen
Type *Typ*	4.3351.10.000
Serial number *Fabrikat/Serien-Nr.*	07157675
Customer *Auftraggeber*	Ammonit Measurement GmbH D-10997 Berlin
Order No. *Auftragsnummer*	L 23504
Project No. *Projektnummer*	VT150637
Number of pages *Anzahl der Seiten*	4
Date of Calibration *Datum der Kalibrierung*	04.08.2015

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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.

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Date *Datum*	Head of the calibration laboratory *Leiter des Kalibrierlaboratoriums*	Person in charge *Bearbeiter*
04.08.2015	Dipl. Phys. Dieter Westermann	Techniker Birger Herrmann

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Calibration object
Kalibriergegenstand

Cup Anemometer

Calibration procedure
Kalibrierverfahren

- Deutsche WindGuard Wind Tunnel Services: Calibration of anemometers; Version 1.0 (2014)

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 Servies 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	25.8 °C ± 0.1 °C
air pressure	1012.0 hPa ± 0.3 hPa
relative air humidity	50.7 % ± 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)

Latest accreditation
Letzte Akkreditierung

04/2014

Additional remarks
Zusätzliche Anmerkungen

-

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Calibration result
Kalibrierergebnis

Sensor out	Tunnel speed	Uncertainty (k=2)
Hz	m/s	m/s
82.661	4.048	0.050
126.283	6.081	0.050
174.008	8.249	0.051
218.740	10.333	0.051
263.654	12.362	0.052
305.688	14.344	0.053
347.955	16.279	0.050
327.825	15.306	0.053
282.710	13.253	0.052
239.748	11.294	0.051
194.859	9.194	0.051
151.518	7.217	0.051
106.447	5.176	0.050

File: 1513901

Linear regression analysis

Slope	0.04599 (m/s)/(Hz) ±0.00007 (m/s)/(Hz)
Offset	0.2578 m/s ±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

Deutsche WindGuard Wind Tunnel Services GmbH - measnet

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Graphical representation of the result
Grafische Darstellung des Ergebnises

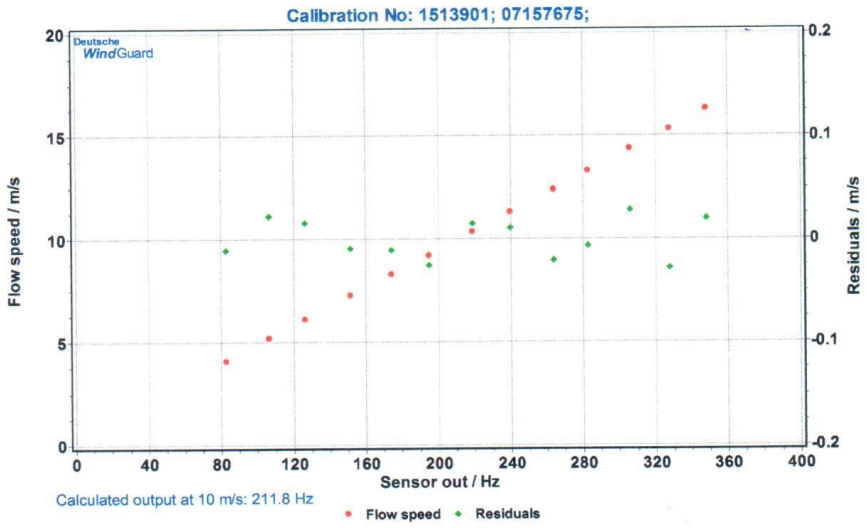
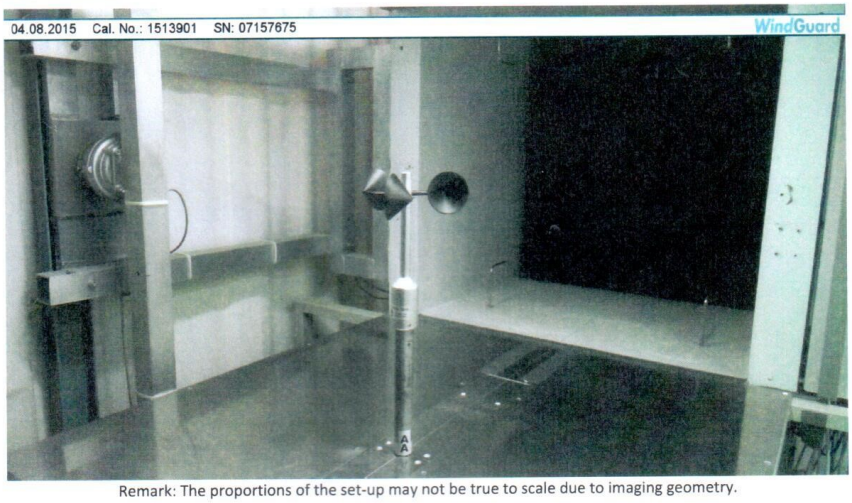


Photo of the measurement setup
Foto des Messaufbaus



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

Deutsche WindGuard
Wind Tunnel Services GmbH, Varel

DEUTSCHE WINDGUARD

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Deutsche Akkreditierungsstelle GmbH

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

as calibration laboratory in the / *als Kalibrierlaboratorium im*

Deutschen Kalibrierdienst DKD

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Calibration certificate
Kalibrierschein

Calibration mark
Kalibrierzeichen

Object *Gegenstand*	Wind Vane
Manufacturer *Hersteller*	Thies Clima D-37083 Göttingen
Type *Typ*	4.3151.00.901
Serial number *Fabrikat/Serien-Nr.*	05150035
Customer *Auftraggeber*	Ammonit Measurement GmbH D-10997 Berlin
Order No. *Auftragsnummer*	L 23473
Project No. *Projektnummer*	VT150598
Number of pages *Anzahl der Seiten*	6
Date of Calibration *Datum der Kalibrierung*	19.06.2015

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*
19.06.2015	Dipl. Phys. Dieter Westermann	Kai Schuster, B. Eng.

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Calibration object
Kalibriergegenstand

Wind Vane

Calibration procedure
Kalibrierverfahren

- Deutsche WindGuard Wind Tunnel Services: Calibration of wind direction sensors - 1.0 (2014)

Based on following standards:

- 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 16622: Meteorology - Sonic anemometers/thermometers
- ASTM 5366-96: Standard Test Method of Measuring the Dynamic Performance of Wind Vanes

Place of calibration
Ort der Kalibrierung

Windtunnel of Deutsche WindGuard WindTunnel Servies GmbH, Varel

Test conditions
Messbedingungen

wind tunnel area	10000 cm²
anemometer frontal area	200 cm²
diameter of mounting pipe	34 mm
blockage ratio [1)]	0.020 [-]
software version	7.64

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

Ambient conditions
Umgebungsbedingungen

air temperature	21.9 °C ± 0.1 °C
air pressure	1014.2 hPa ± 0.3 hPa
relative air humidity	53.5 % ± 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)

Latest accreditation
Letzte Akkreditierung

04/2014

Additional remarks
Zusätzliche Anmerkungen

-

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Calibration result (1/3)
Kalibrierergebnis (1/3)

Bin	Flow direction	Sensor out	Uncertainty	Flow speed
-	deg	deg	deg	m/s
1	4.95	5.81	0.8	7.878
2	9.99	10.79	0.8	7.877
3	15.00	15.80	0.8	7.877
4	20.01	20.75	0.8	7.878
5	25.05	25.91	0.8	7.878
6	30.06	30.99	0.8	7.878
7	35.07	36.04	0.8	7.880
8	40.04	41.07	0.8	7.880
9	45.01	46.13	0.8	7.878
10	50.00	51.10	0.8	7.882
11	55.02	56.06	0.8	7.882
12	60.02	61.11	0.8	7.878
13	65.03	66.17	0.8	7.880
14	70.03	71.19	0.8	7.881
15	75.03	76.16	0.8	7.879
16	79.58	80.54	0.8	7.878
17	85.02	85.84	0.8	7.876
18	90.06	90.82	0.8	7.878
19	95.05	95.58	0.8	7.879
20	100.04	100.57	0.8	7.878
21	105.04	105.76	0.8	7.880
22	110.04	110.92	0.8	7.875
23	115.00	116.02	0.8	7.878
24	119.98	121.14	0.8	7.877
25	125.00	126.16	0.8	7.877
26	130.01	131.05	0.8	7.877
27	135.05	136.09	0.8	7.883
28	140.04	141.11	0.8	7.875
29	145.02	146.11	0.8	7.878
30	149.98	151.20	0.8	7.880

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Calibration result (2/3)
Kalibrierergebnis (2/3)

Bin	Flow direction	Sensor out	Uncertainty	Flow speed
-	deg	deg	deg	m/s
31	154.91	156.12	0.8	7.875
32	159.98	161.19	0.8	7.876
33	165.01	166.28	0.8	7.878
34	169.99	171.34	0.8	7.880
35	175.00	176.21	0.8	7.876
36	179.97	181.01	0.8	7.877
37	184.99	185.85	0.8	7.876
38	190.10	190.83	0.8	7.880
39	195.09	195.83	0.8	7.877
40	199.98	200.80	0.8	7.882
41	205.00	205.96	0.8	7.881
42	210.02	211.10	0.8	7.878
43	215.02	216.13	0.8	7.879
44	219.99	221.22	0.8	7.881
45	224.99	226.16	0.8	7.879
46	230.03	231.15	0.8	7.879
47	234.96	236.21	0.8	7.876
48	240.01	241.15	0.8	7.879
49	244.99	246.13	0.8	7.882
50	249.98	251.19	0.8	7.879
51	255.04	256.22	0.8	7.878
52	260.04	261.11	0.8	7.880
53	265.07	265.96	0.8	7.880
54	270.05	270.83	0.8	7.875
55	275.06	275.81	0.8	7.878
56	280.07	280.82	0.8	7.876
57	285.04	285.77	0.8	7.881
58	289.94	290.84	0.8	7.878
59	294.95	296.05	0.8	7.879
60	299.99	301.20	0.8	7.878
61	304.92	306.10	0.8	7.880
62	309.91	311.05	0.8	7.881

Calibration result (3/3)
Kalibrierergebnis (3/3)

Bin	Flow direction	Sensor out	Uncertainty	Flow speed
-	deg	deg	deg	m/s
63	314.93	315.97	0.8	7.882
64	319.96	321.00	0.8	7.880
65	325.01	325.99	0.8	7.881
66	329.96	331.01	0.8	7.879
67	334.98	336.11	0.8	7.879
68	339.98	341.21	0.8	7.877
69	344.92	346.19	0.8	7.878
70	349.90	351.08	0.8	7.880
71	354.99	356.12	0.8	7.882

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Linear regression analysis

Slope	1.00052 deg/deg
Offset	0.9263 deg

Graphical representation of the result
Grafische Darstellung des Ergebnises

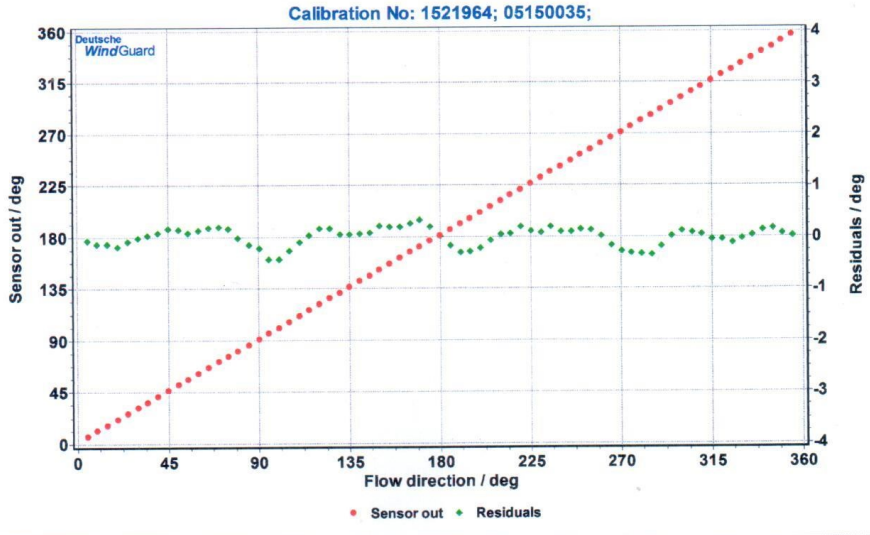
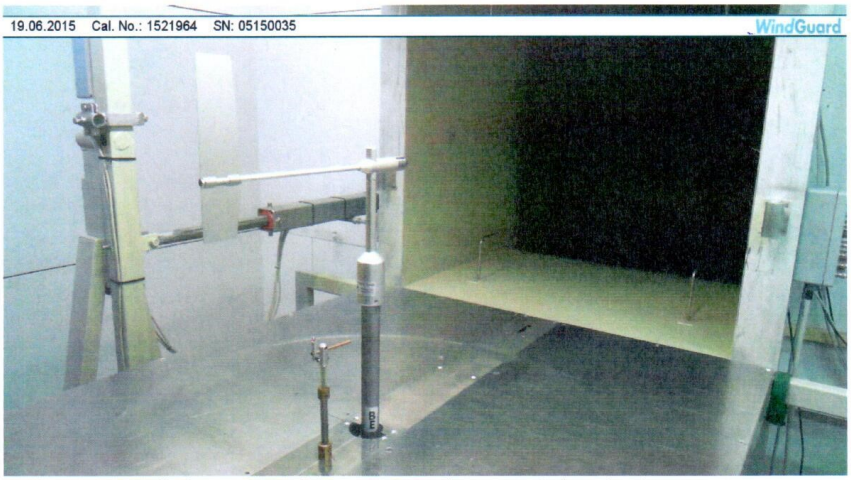


Photo of the measurement setup
Foto des Messaufbaus



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

Deutsche WindGuard
Wind Tunnel Services GmbH, Varel

DEUTSCHE WINDGUARD

accredited by the / *akkreditiert durch die*

Deutsche Akkreditierungsstelle GmbH

as calibration laboratory in the / *als Kalibrierlaboratorium im*

Deutschen Kalibrierdienst DKD

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

Calibration certificate *Kalibrierschein*	Calibration mark *Kalibrierzeichen*
	1521965
	D-K-15140-01-00
	06/2015

Object *Gegenstand*	Wind Vane
Manufacturer *Hersteller*	Thies Clima D-37083 Göttingen
Type *Typ*	4.3151.00.901
Serial number *Fabrikat/Serien-Nr.*	05150034
Customer *Auftraggeber*	Ammonit Measurement GmbH D-10997 Berlin
Order No. *Auftragsnummer*	L 23473
Project No. *Projektnummer*	VT150598
Number of pages *Anzahl der Seiten*	6
Date of Calibration *Datum der Kalibrierung*	19.06.2015

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Date *Datum*	Head of the calibration laboratory *Leiter des Kalibrierlaboratoriums*	Person in charge *Bearbeiter*
19.06.2015	Dipl. Phys. Dieter Westermann	Kai Schuster, B. Eng.

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Calibration object
Kalibriergegenstand

Wind Vane

Calibration procedure
Kalibrierverfahren

• Deutsche WindGuard Wind Tunnel Services: Calibration of wind direction sensors - 1.0 (2014)
Based on following standards:
• 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 16622: Meteorology - Sonic anemometers/thermometers
• ASTM 5366-96: Standard Test Method of Measuring the Dynamic Performance of Wind Vanes

Place of calibration
Ort der Kalibrierung

Windtunnel of Deutsche WindGuard WindTunnel Servies GmbH, Varel

Test conditions
Messbedingungen

wind tunnel area	10000 cm²
anemometer frontal area	200 cm²
diameter of mounting pipe	34 mm
blockage ratio [1)]	0.020 [-]
software version	7.64

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

Ambient conditions
Umgebungsbedingungen

air temperature	22.2 °C ± 0.1 °C
air pressure	1014.5 hPa ± 0.3 hPa
relative air humidity	53.3 % ± 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)

Latest accreditation
Letzte Akkreditierung

04/2014

Additional remarks
Zusätzliche Anmerkungen

-

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Calibration result (1/3)
Kalibrierergebnis (1/3)

Bin	Flow direction	Sensor out	Uncertainty	Flow speed
-	deg	deg	deg	m/s
1	4.95	6.28	0.8	7.885
2	10.02	11.23	0.8	7.885
3	14.99	16.11	0.8	7.886
4	19.98	21.13	0.8	7.881
5	25.00	26.20	0.8	7.883
6	29.99	31.33	0.8	7.885
7	35.04	36.40	0.8	7.883
8	40.02	41.52	0.8	7.883
9	44.97	46.54	0.8	7.881
10	49.96	51.60	0.8	7.884
11	55.00	56.63	0.8	7.883
12	59.98	61.62	0.8	7.887
13	65.00	66.56	0.8	7.886
14	70.02	71.53	0.8	7.882
15	74.87	76.32	0.8	7.884
16	80.04	81.36	0.8	7.878
17	85.05	86.33	0.8	7.881
18	90.07	91.28	0.8	7.887
19	95.06	96.25	0.8	7.881
20	100.03	101.29	0.8	7.880
21	105.05	106.49	0.8	7.886
22	110.08	111.68	0.8	7.882
23	115.04	116.69	0.8	7.887
24	120.04	121.75	0.8	7.881
25	125.00	126.78	0.8	7.880
26	130.04	131.80	0.8	7.884
27	135.08	136.71	0.8	7.882
28	139.98	141.64	0.8	7.887
29	144.96	146.72	0.8	7.882
30	150.00	151.86	0.8	7.882

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Calibration result (2/3)
Kalibrierergebnis (2/3)

Bin	Flow direction	Sensor out	Uncertainty	Flow speed
-	deg	deg	deg	m/s
31	155.06	156.71	0.8	7.879
32	159.99	161.51	0.8	7.885
33	164.93	166.32	0.8	7.882
34	169.98	171.22	0.8	7.883
35	175.06	176.11	0.8	7.882
36	180.03	180.87	0.8	7.887
37	184.99	185.67	0.8	7.882
38	190.01	190.73	0.8	7.880
39	195.04	196.01	0.8	7.882
40	200.01	201.24	0.8	7.882
41	204.96	206.48	0.8	7.879
42	210.00	211.85	0.8	7.882
43	215.03	217.09	0.8	7.884
44	220.03	222.06	0.8	7.883
45	225.06	226.94	0.8	7.885
46	230.03	231.79	0.8	7.883
47	235.00	236.71	0.8	7.888
48	240.03	241.68	0.8	7.885
49	245.02	246.68	0.8	7.883
50	250.06	251.64	0.8	7.886
51	255.05	256.60	0.8	7.883
52	260.02	261.44	0.8	7.886
53	265.08	266.26	0.8	7.886
54	270.11	271.20	0.8	7.886
55	275.08	276.10	0.8	7.885
56	280.10	281.20	0.8	7.886
57	285.04	286.29	0.8	7.885
58	289.99	291.39	0.8	7.885
59	294.95	296.60	0.8	7.888
60	299.98	301.81	0.8	7.885
61	304.93	306.94	0.8	7.887
62	309.91	311.91	0.8	7.888

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Calibration result (3/3)
Kalibrierergebnis (3/3)

Bin	Flow direction	Sensor out	Uncertainty	Flow speed
-	deg	deg	deg	m/s
63	314.99	316.82	0.8	7.885
64	319.95	321.69	0.8	7.884
65	325.02	326.66	0.8	7.883
66	329.93	331.59	0.8	7.884
67	334.89	336.65	0.8	7.889
68	339.92	341.82	0.8	7.888
69	344.93	346.83	0.8	7.883
70	349.99	351.83	0.8	7.885
71	354.98	356.74	0.8	7.888

File: 1521965

Linear regression analysis	Slope	1.00099 deg/deg
	Offset	1.3276 deg

Graphical representation of the result
Grafische Darstellung des Ergebnises

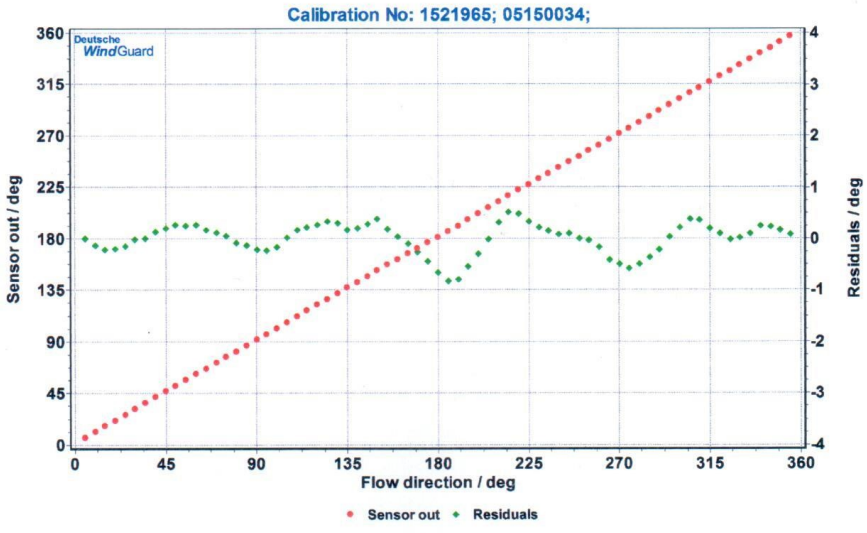
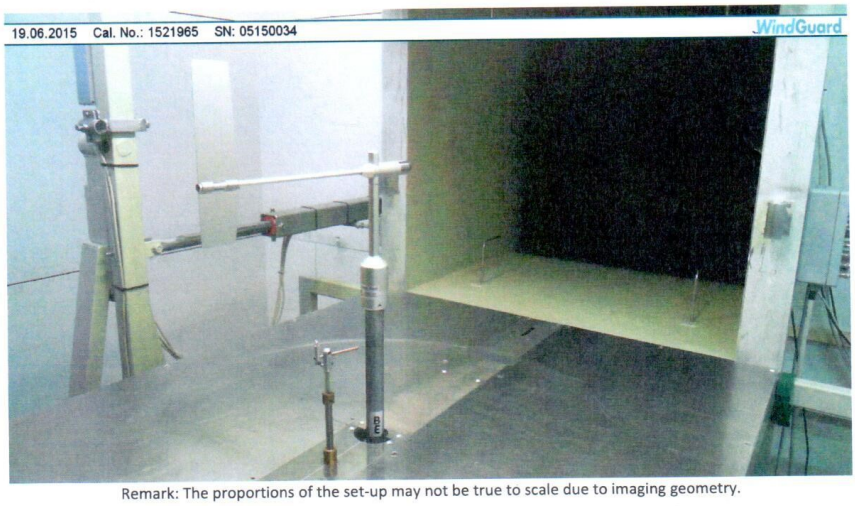


Photo of the measurement setup
Foto des Messaufbaus



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

WERKSZEUGNIS / *Specific report*

nach DIN EN 10 204 - 2.2 *acc. to EN 10 204 - 2.2*

Galltec +mela

zertifiziert nach DIN EN ISO 9001:2008

Benennung	*Name*	Temperatursensor
Typ	*Type*	**TPC1.S/6-ME**
Messbereich	*Measuring range*	-30...70°C
Ausgang	*Electr. Output*	0...1V
Serien-Nr.	*Serial-No.*	154298
Ihre Auftrags-Nr.	*Your Order-No.*	L23354
Unsere Auftrags-Nr.	*Our Confirmation-No.*	A66353A030 (AU18722 78464)

Hiermit bestätigen wir, dass das oben bezeichnete Messgerät unter Beachtung eines dokumentierten Werkstandards gefertigt und geprüft wurde.
- Justage im Konstantklima
- Warenausgangsprüfung im Konstantklima

We hereby confirm that the above-mentioned instrument was produced and tested according to the manufaction standard.
- *Adjustment at constant climate*
- *End products are checked at constant climate*

Die für die Prüfung verwendeten Referenz-Prüfmittel unterliegen einer regelmäßigen Kalibrierung und sind rückführbar auf nationale und internationale Normale. Wo keine nationalen Normale existieren, entspricht das Messverfahren den derzeit gültigen technischen Regeln.

The measuring installations used for testing are regularly calibrated and are based on the national or international standards. Should no national standards exist, the measuring procedure corresponds with the technical regulations and norms valid at the time of the measurement.

Bestätigung

Die standardisierte Bauform des Gerätes führt zu einem Standardverhalten dieses Messgerätes, bei Einhaltung der Produktinformation A1.

Confirmation

The standard reaction of the transmitter is caused by the standardized type of the measuring instrument, in compliance with Product Information A1.

Messgenauigkeit

Temperatur: (MB 10...40°C) ± **0,2 K**
Weiteres siehe Datenblatt.

Measurement accuracy

*Temperature: (MR 10...40°C) ± **0,2 K***
Further information at data sheet.

21.07.2015
Datum/
Date

Unterschrift/*Signature*
-Qualitätssicherung-/
- Quality assurance -

Mela Sensortechnik GmbH
Raasdorfer Str. 18
07987 Mohlsdorf-Teichwolframsdorf
Tel. (0 36 61) 62 70 40

WERKSZEUGNIS / *Specific report*

nach DIN EN 10 204 - 2.2 *acc. to EN 10 204 - 2.2*

Galltec +mela

zertifiziert nach DIN EN ISO 9001:2008

Benennung	*Name*	Klimasensor
Typ	*Type*	**KPC1.S/6-ME**
Messbereich	*Measuring range*	0...100% r.F. / -30...70°C
Ausgang	*Electr. Output*	2 x 0...1 V
Serien-Nr.	*Serial-No.*	154283
Ihre Auftrags-Nr.	*Your Order-No.*	L23213
Unsere Auftrags-Nr.	*Our Confirmation-No.*	A65630A110(AU18076 78461)

Hiermit bestätigen wir, dass das oben bezeichnete Messgerät unter Beachtung eines dokumentierten Werkstandards gefertigt und geprüft wurde.
- Justage im Konstantklima
- Warenausgangsprüfung im Konstantklima

We hereby confirm that the above-mentioned instrument was produced and tested according to the manufaction standard.
- *Adjustment at constant climate*
- *End products are checked at constant climate*

Die für die Prüfung verwendeten Referenz-Prüfmittel unterliegen einer regelmäßigen Kalibrierung und sind rückführbar auf nationale und internationale Normale. Wo keine nationalen Normale existieren, entspricht das Messverfahren den derzeit gültigen technischen Regeln.

The measuring installations used for testing are regularly calibrated and are based on the national or international standards. Should no national standards exist, the measuring procedure corresponds with the technical regulations and norms valid at the time of the measurement.

Bestätigung

Die standardisierte Bauform des Gerätes führt zu einem Standardverhalten dieses Messgerätes, bei Einhaltung der Produktinformation A1.

Confirmation

The standard reaction of the transmitter is caused by the standardized type of the measuring instrument, in compliance with Product Information A1.

Messgenauigkeit

Feuchte: (MB 5...95% r.F. bei 10…40°C) ± **2% r.F.**

Temperatur: (MB 10...40°C) ± **0,2 K**
Weiteres siehe Datenblatt.

Measurement accuracy

*Humidity: (MR 5...95% r.h. at 10…40°C) ± **2% r.h.***

*Temperature: (MR 10...40°C) ± **0,2 K***
Further information at data sheet.

21.07.2015
Datum/ *Date*

Unterschrift/*Signature*
-Qualitätssicherung-/
- Quality assurance -

Mela Sensortechnik GmbH
Raasdorfer Str. 18
07987 Mohlsdorf-Teichwolframsdorf
Tel. (0 36 61) 62 70 40

Quality Certificate - Declarations

for Ammonit pressure sensor AB100

Ammonit

We **Ammonit Measurement GmbH**
Wrangelstr. 100
10997 Berlin – Germany

for the Ammonit pressure sensor AB100 with serial number: **B14-0491**

declare under our sole responsibility:

1. CE Confirmation

It is confirmed that the products

Type: **Air pressure sensor**
Name: **AB100**

to which this declaration relates are in accordance with the following standards:

Imissions	EN 50082-1	Group standard
	IEC 1000-4-2	IEC 801-2
	IEC 1000-4-3	IEC 801-3
	IEC 1000-4-4	IEC 801-4
Emissions	EN 50081-1	Group standard
	EN 55014	
	EN 55022	

CE

2. Warranty

The products:

Type: **Air pressure sensor**
Name: **AB100**
including accessories manufactured by Ammonit

obtain the warranty for 12 months from the date of dispatch
and further 12 months on all repairs carried out by the supplier.

3. DIN EN ISO 9001:2008

We established and applied a

Quality Management System according to
DIN EN ISO 9001:2008

for development, manufacture, sales and distribution of Data Loggers and sensors for measuring and evaluating meteorological and wind measurand. The certificate is valid until 16 June 2012 and listed in the certificate register number E 00/03/01.

Ammonit Measurement GmbH
Wrangelstrasse 100; D-10997 Berlin; T: +49-30-6003188-0; E: info@ammonit.com; www.ammonit.com

Quality Certificate - Declarations
for Ammonit pressure sensor AB100

Ammonit

4. Measuring Accuracy

Operating range (-40 to +85°C, 0-98% r.h.)
Uncertainties of signal inputs are defined as (in the range -10 to +60°C))

Reference pressure hPa	Uncertainty hPa
650	± 5,00
800	± 5,00
1050	± 5,00

Berlin, September 2015
Ammonit Measurement GmbH

Vincent Camier (Managing Director)
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Ammonit Measurement GmbH
Wrangelstraße 100; 10997 Berlin – Germany

Amtsgericht Berlin-Charlottenburg
HRB: 31099 VAT-ID No. DE 136 567 928
Geschäftsführer: Vincent Camier
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Ammonit Measurement GmbH
Wrangelstrasse 100; D-10997 Berlin; T: +49-30-6003188-0; E: info@ammonit.com; www.ammonit.com