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

1514326
D-K-15140-01-00
08/2015

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.*	16799 FEVD
Customer *Auftraggeber*	Ammonit Measurement GmbH D-10997 Berlin
Order No. *Auftragsnummer*	L 23589
Project No. *Projektnummer*	VT150767
Number of pages *Anzahl der Seiten*	4
Date of Calibration *Datum der Kalibrierung*	31.08.2015

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.
Dieser Kalibrierschein dokumentiert die Rückführung auf nationale Normale zur Darstellung der Einheiten in Übereinstimmung mit dem Internationalen Einheitensystem (SI).
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Date *Datum*	Head of the calibration laboratory *Leiter des Kalibrierlaboratoriums*	Person in charge *Bearbeiter*
31.08.2015	Dipl. Phys. Dieter Westermann	Techniker Dirk Henninges

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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	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	23.9 °C ± 0.1 °C
air pressure	1012.5 hPa ± 0.3 hPa
relative air humidity	56.3 % ± 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
Calibrated with 405 Type Single Mount Anemometer with 3 metre cable

1514326
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Calibration result
Kalibrierergebnis

Sensor out Hz	Tunnel speed m/s	Uncertainty (k=2) m/s
39.964	4.048	0.050
60.855	6.078	0.051
83.185	8.247	0.051
104.325	10.330	0.052
125.473	12.377	0.052
145.768	14.358	0.053
166.101	16.306	0.050
156.110	15.326	0.053
134.613	13.274	0.053
114.076	11.301	0.052
92.433	9.193	0.051
72.274	7.220	0.051
51.679	5.177	0.051

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Linear regression analysis	Slope	0.09726 (m/s)/(Hz) ±0.00015 (m/s)/(Hz)
	Offset	0.1726 m/s ±0.017 m/s
	Standard error (Y)	0.017 m/s
	Correlation coefficient	0.999987

Remarks The calibrated sensor complies with the demanded linearity of MEASNET

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Graphical representation of the result
Grafische Darstellung des Ergebnises

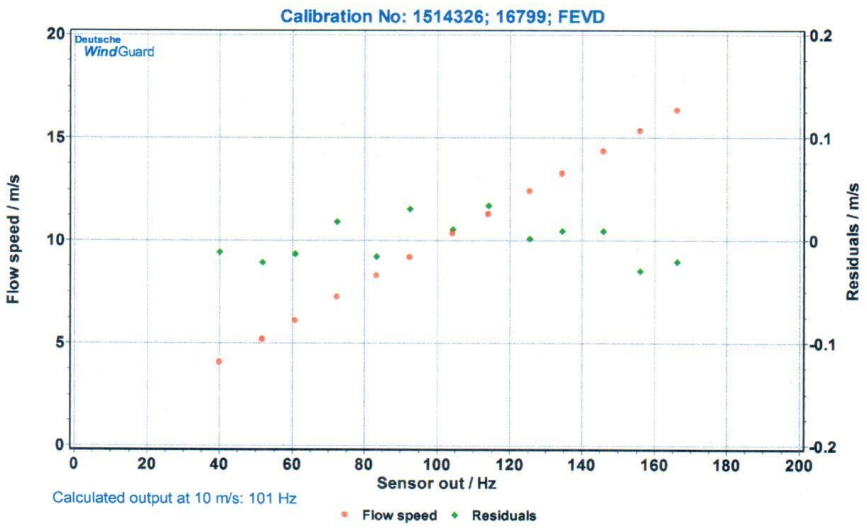
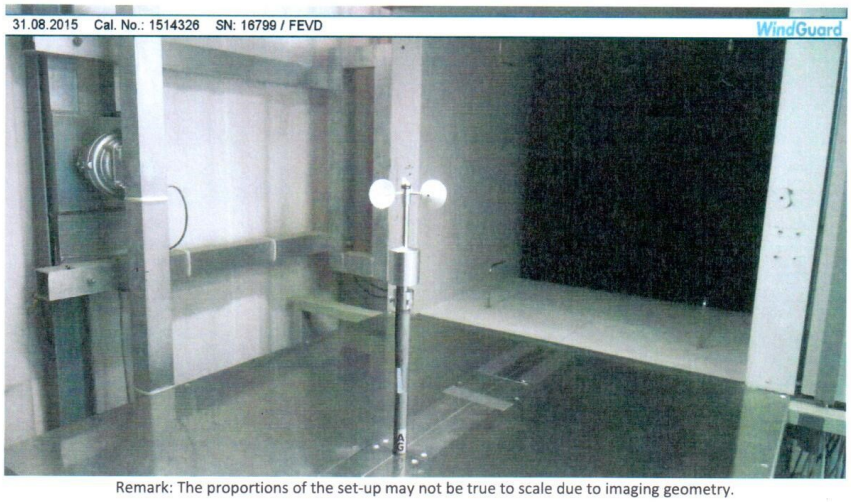


Photo of the measurement setup
Foto des Messaufbaus



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

Deutsche WindGuard
Wind Tunnel Services GmbH, Varel

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Deutschen Kalibrierdienst DKD

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

1533640
D-K-15140-01-00
08/2015

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.*	07157646
Customer *Auftraggeber*	Ammonit Measurement GmbH D-10997 Berlin
Order No. *Auftragsnummer*	L 23504
Project No. *Projektnummer*	VT150636
Number of pages *Anzahl der Seiten*	4
Date of Calibration *Datum der Kalibrierung*	03.08.2015

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Date *Datum*	Head of the calibration laboratory *Leiter des Kalibrierlaboratoriums*	Person in charge *Bearbeiter*
03.08.2015	Dipl. Phys. Dieter Westermann	Dipl.-Ing. (FH) Peter Busche

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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	22.3 °C ± 0.1 °C
air pressure	1015.2 hPa ± 0.3 hPa
relative air humidity	50.9 % ± 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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D-K- 15140-01-00
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Calibration result
Kalibrierergebnis

Sensor out Hz	Tunnel speed m/s	Uncertainty (k=2) m/s
81.440	3.985	0.050
124.090	5.968	0.050
167.623	7.988	0.050
211.154	9.959	0.051
254.580	11.956	0.051
298.416	13.986	0.051
339.800	15.859	0.051
318.371	14.880	0.051
277.097	12.975	0.051
233.183	10.972	0.051
190.202	8.983	0.050
146.734	6.990	0.050
103.603	5.002	0.050

File: 1533640

Linear regression analysis	Slope	0.04596 (m/s)/(Hz) ±0.00005 (m/s)/(Hz)
	Offset	0.2528 m/s ±0.011 m/s
	Standard error (Y)	0.010 m/s
	Correlation coefficient	0.999994

Remarks The calibrated sensor complies with the demanded linearity of MEASNET

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08/2015

Graphical representation of the result
Grafische Darstellung des Ergebnises

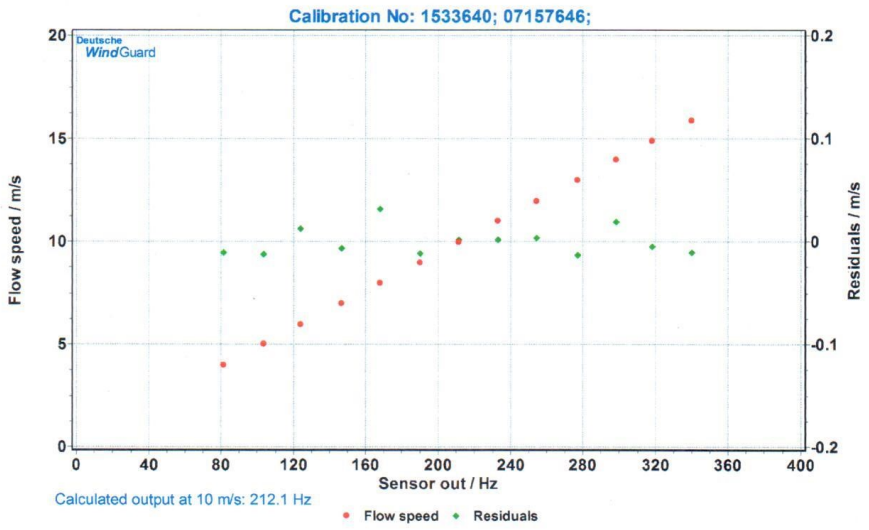
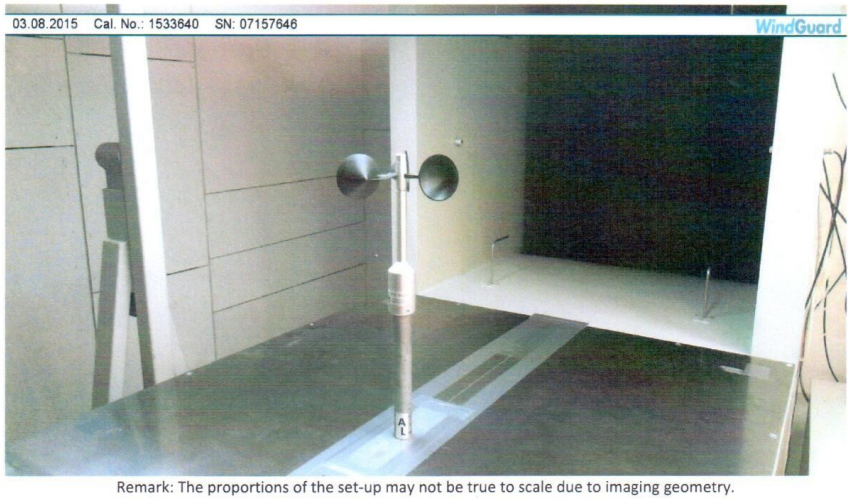


Photo of the measurement setup
Foto des Messaufbaus



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

Deutsche WindGuard
Wind Tunnel Services GmbH, Varel

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

1533641
D-K-15140-01-00
08/2015

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.*	07157645
Customer *Auftraggeber*	Ammonit Measurement GmbH D-10997 Berlin
Order No. *Auftragsnummer*	L 23504
Project No. *Projektnummer*	VT150636
Number of pages *Anzahl der Seiten*	4
Date of Calibration *Datum der Kalibrierung*	03.08.2015

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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*
03.08.2015	Dipl. Phys. Dieter Westermann	Dipl.-Ing. (FH) Peter Busche

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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	22.4 °C ± 0.1 °C
air pressure	1015.0 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

-

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08/2015

Calibration result
Kalibrierergebnis

Sensor out Hz	Tunnel speed m/s	Uncertainty (k=2) m/s
81.474	3.983	0.050
124.150	5.960	0.050
168.244	7.989	0.050
210.964	9.956	0.051
254.171	11.954	0.051
298.401	13.982	0.051
340.073	15.852	0.052
318.447	14.884	0.051
277.052	12.970	0.051
232.976	10.964	0.051
189.636	8.981	0.050
146.073	6.988	0.050
103.213	5.001	0.050

File: 1533641

Linear regression analysis	Slope	0.04591 (m/s)/(Hz) ±0.00005 (m/s)/(Hz)
	Offset	0.2641 m/s ±0.012 m/s
	Standard error (Y)	0.012 m/s
	Correlation coefficient	0.999993

Remarks The calibrated sensor complies with the demanded linearity of MEASNET

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08/2015

Graphical representation of the result
Grafische Darstellung des Ergebnises

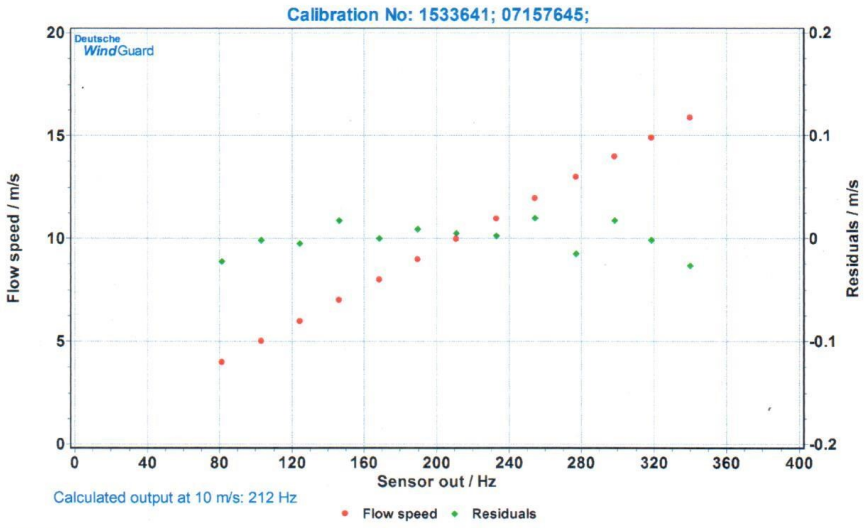
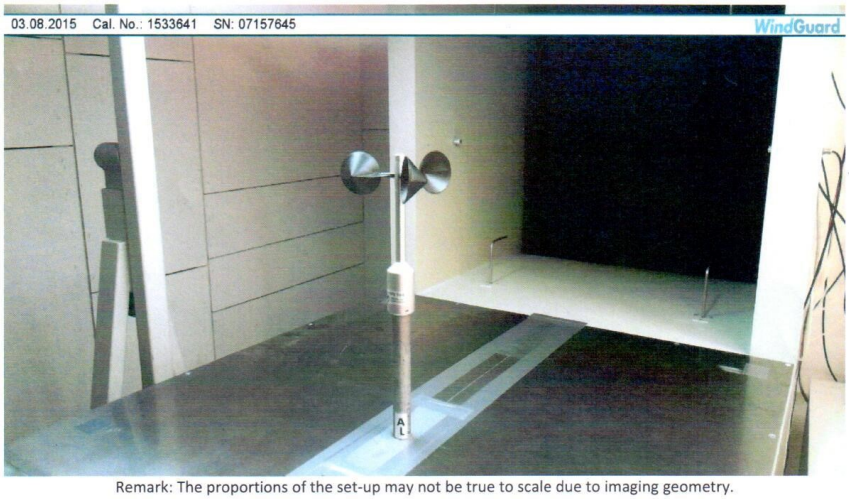


Photo of the measurement setup
Foto des Messaufbaus



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

Deutsche WindGuard
Wind Tunnel Services GmbH, Varel

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Deutschen Kalibrierdienst DKD

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

Calibration certificate *Kalibrierschein*	Calibration mark *Kalibrierzeichen*	1533642 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.*	07157644
Customer *Auftraggeber*	Ammonit Measurement GmbH D-10997 Berlin
Order No. *Auftragsnummer*	L 23504
Project No. *Projektnummer*	VT150636
Number of pages *Anzahl der Seiten*	4
Date of Calibration *Datum der Kalibrierung*	03.08.2015

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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*
03.08.2015	Dipl. Phys. Dieter Westermann	Dipl.-Ing. (FH) Peter Busche

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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	22.6 °C ± 0.1 °C
air pressure	1014.9 hPa ± 0.3 hPa
relative air humidity	50.2 % ± 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

-

1533642
D-K- 15140-01-00
08/2015

Calibration result
Kalibrierergebnis

Sensor out Hz	Tunnel speed m/s	Uncertainty (k=2) m/s
81.880	3.986	0.050
124.753	5.960	0.050
168.507	7.985	0.050
211.425	9.958	0.050
254.909	11.952	0.051
298.761	13.982	0.051
339.915	15.855	0.051
318.660	14.890	0.051
277.425	12.970	0.051
233.641	10.961	0.051
190.146	8.983	0.051
146.953	6.988	0.050
103.591	4.998	0.050

File: 1533642

Linear regression analysis

Slope	0.04599 (m/s)/(Hz) ±0.00003 (m/s)/(Hz)
Offset	0.2279 m/s ±0.007 m/s
Standard error (Y)	0.004 m/s
Correlation coefficient	0.999997

Remarks

The calibrated sensor complies with the demanded linearity of MEASNET

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08/2015

Graphical representation of the result
Grafische Darstellung des Ergebnises

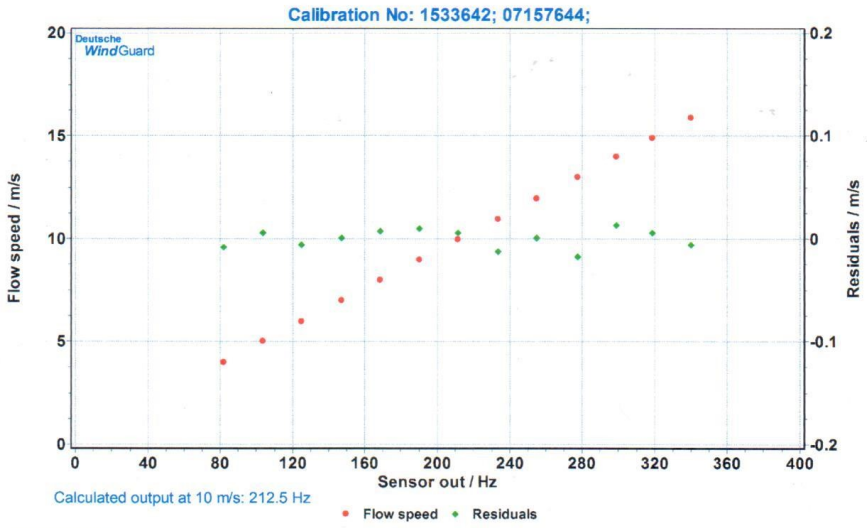
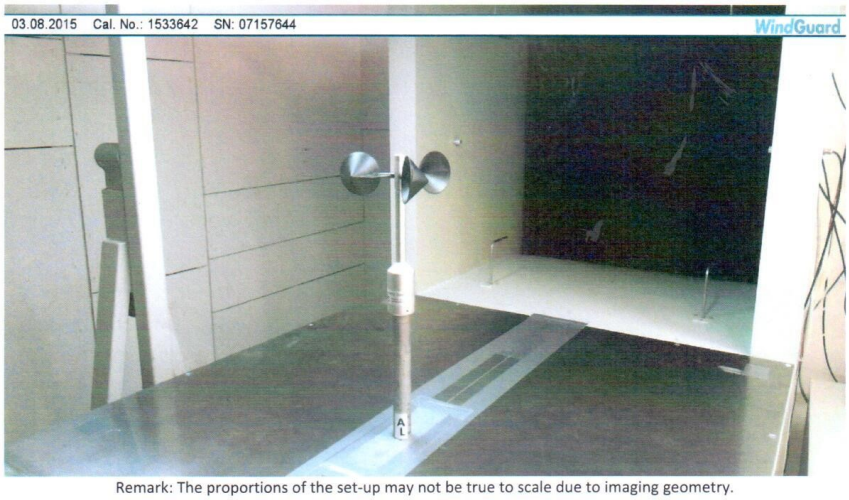


Photo of the measurement setup
Foto des Messaufbaus



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

Deutsche WindGuard
Wind Tunnel Services GmbH, Varel

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Deutschen Kalibrierdienst DKD

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

Calibration mark *Kalibrierzeichen*	1533643 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.*	07157643
Customer *Auftraggeber*	Ammonit Measurement GmbH D-10997 Berlin
Order No. *Auftragsnummer*	L 23504
Project No. *Projektnummer*	VT150636
Number of pages *Anzahl der Seiten*	4
Date of Calibration *Datum der Kalibrierung*	03.08.2015

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Date *Datum*	Head of the calibration laboratory *Leiter des Kalibrierlaboratoriums*	Person in charge *Bearbeiter*
03.08.2015	Dipl. Phys. Dieter Westermann	Dipl.-Ing. (FH) Peter Busche

1533643
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:

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- 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	22.7 °C ± 0.1 °C
air pressure	1014.8 hPa ± 0.3 hPa
relative air humidity	50.0 % ± 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)

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
81.705	3.982	0.050
124.304	5.958	0.050
167.882	7.983	0.050
211.243	9.957	0.051
254.613	11.955	0.051
298.275	13.979	0.051
339.316	15.848	0.052
318.236	14.881	0.051
277.317	12.966	0.051
233.480	10.961	0.051
189.968	8.979	0.050
146.346	6.986	0.050
103.434	4.998	0.050

File: 1533643

Linear regression analysis

Slope	0.04600 (m/s)/(Hz) ±0.00005 (m/s)/(Hz)
Offset	0.2399 m/s ±0.012 m/s
Standard error (Y)	0.012 m/s
Correlation coefficient	0.999993

Remarks

The calibrated sensor complies with the demanded linearity of MEASNET

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Graphical representation of the result
Grafische Darstellung des Ergebnises

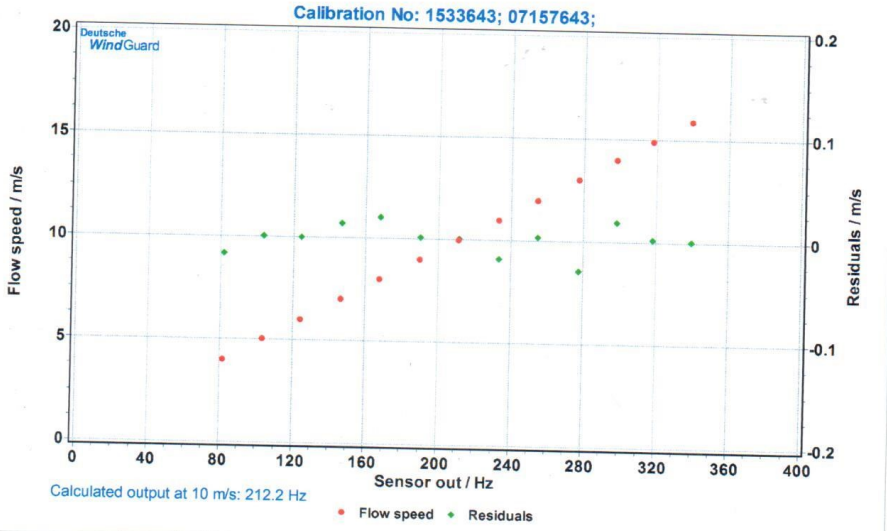
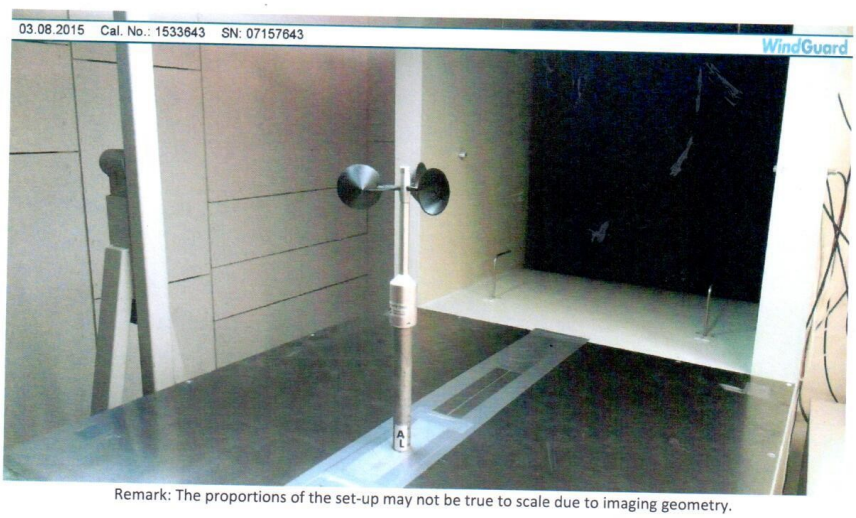


Photo of the measurement setup
Foto des Messaufbaus



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

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

1521962
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.*	05150037
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.
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*
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	21.7 °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	4.99	6.39	0.8	7.976
2	10.02	11.39	0.8	7.978
3	15.01	16.41	0.8	7.976
4	20.02	21.28	0.8	7.978
5	25.03	26.02	0.8	7.978
6	30.04	30.93	0.8	7.973
7	35.07	35.81	0.8	7.974
8	40.06	40.75	0.8	7.975
9	45.06	46.01	0.8	7.974
10	50.07	51.29	0.8	7.975
11	55.10	56.58	0.8	7.974
12	60.07	61.90	0.8	7.976
13	65.04	67.06	0.8	7.974
14	69.97	72.16	0.8	7.977
15	74.91	77.17	0.8	7.975
16	79.84	81.99	0.8	7.980
17	85.00	87.04	0.8	7.979
18	90.01	91.94	0.8	7.979
19	94.98	96.65	0.8	7.974
20	99.91	101.35	0.8	7.980
21	104.87	106.08	0.8	7.975
22	109.92	111.03	0.8	7.977
23	114.94	115.90	0.8	7.976
24	119.94	120.76	0.8	7.979
25	124.95	125.57	0.8	7.977
26	129.99	130.48	0.8	7.977
27	134.95	135.51	0.8	7.976
28	139.95	140.72	0.8	7.980
29	144.93	146.11	0.8	7.976
30	149.93	151.50	0.8	7.980

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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	155.14	156.94	0.8	7.974
32	160.03	162.19	0.8	7.972
33	165.04	167.37	0.8	7.977
34	170.02	172.49	0.8	7.977
35	175.04	177.46	0.8	7.974
36	180.07	182.32	0.8	7.980
37	185.04	187.13	0.8	7.974
38	190.09	191.93	0.8	7.978
39	195.05	196.69	0.8	7.977
40	200.03	201.53	0.8	7.975
41	205.02	206.34	0.8	7.979
42	210.04	211.37	0.8	7.977
43	214.96	216.24	0.8	7.977
44	219.87	221.20	0.8	7.974
45	224.89	226.18	0.8	7.972
46	229.92	231.35	0.8	7.972
47	234.92	236.48	0.8	7.974
48	239.93	241.50	0.8	7.977
49	244.94	246.57	0.8	7.979
50	249.99	251.74	0.8	7.977
51	254.94	256.70	0.8	7.978
52	259.88	261.64	0.8	7.975
53	264.94	266.63	0.8	7.978
54	269.95	271.62	0.8	7.976
55	274.90	276.51	0.8	7.971
56	279.93	281.37	0.8	7.976
57	284.97	286.35	0.8	7.979
58	289.94	291.25	0.8	7.976
59	294.96	296.33	0.8	7.977
60	299.98	301.30	0.8	7.976
61	304.96	306.43	0.8	7.975
62	309.98	311.62	0.8	7.973

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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	314.93	316.64	0.8	7.978
64	320.02	321.83	0.8	7.974
65	325.06	326.93	0.8	7.979
66	330.02	331.90	0.8	7.975
67	335.04	336.96	0.8	7.976
68	340.04	341.87	0.8	7.976
69	345.00	346.63	0.8	7.974
70	349.99	351.58	0.8	7.973
71	354.92	356.41	0.8	7.976

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Linear regression analysis	Slope	1.00107 deg/deg
	Offset	1.3334 deg

Graphical representation of the result
Grafische Darstellung des Ergebnises

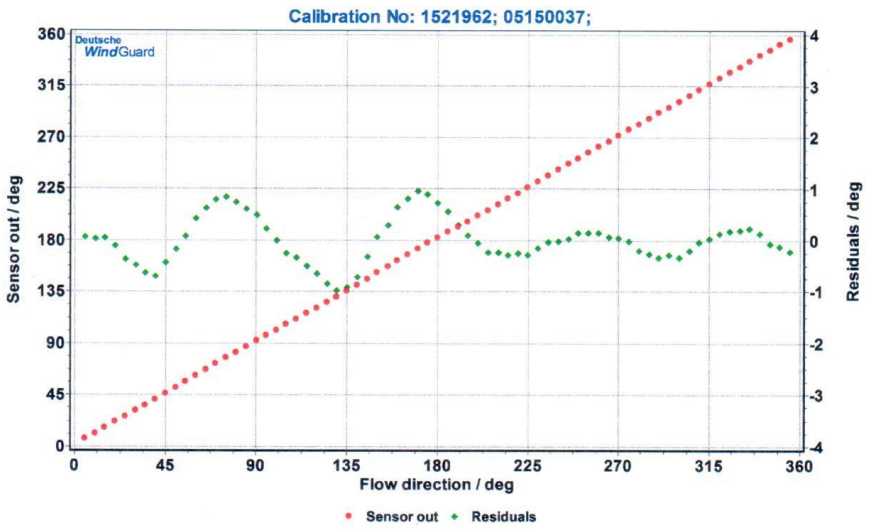
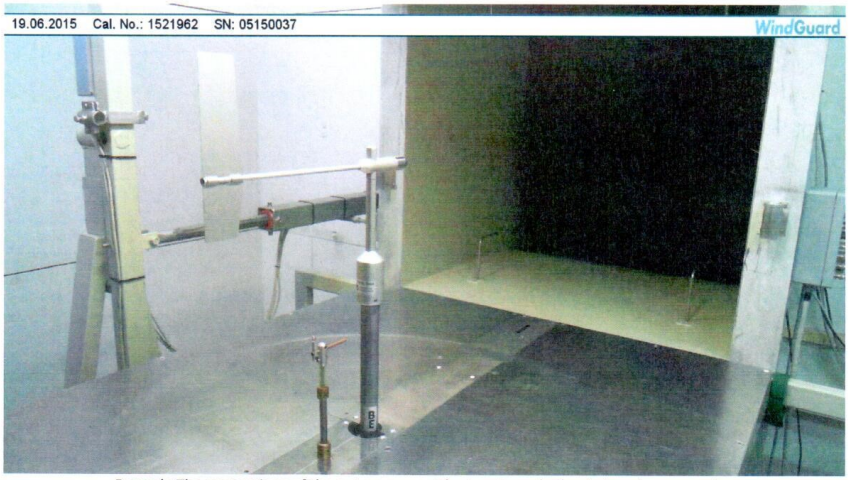


Photo of the measurement setup
Foto des Messaufbaus



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

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06/2015

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.*	05150036
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).
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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*
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	21.8 °C ± 0.1 °C
air pressure	1014.1 hPa ± 0.3 hPa
relative air humidity	53.6 % ± 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	4.99	5.86	0.8	7.880
2	10.00	10.86	0.8	7.882
3	14.95	15.85	0.8	7.882
4	20.01	20.92	0.8	7.884
5	25.03	25.88	0.8	7.883
6	29.99	30.91	0.8	7.882
7	35.00	35.98	0.8	7.884
8	40.04	41.14	0.8	7.884
9	45.10	46.24	0.8	7.882
10	50.06	51.28	0.8	7.880
11	55.07	56.24	0.8	7.884
12	60.03	61.28	0.8	7.882
13	64.96	66.28	0.8	7.883
14	70.02	71.34	0.8	7.882
15	75.07	76.41	0.8	7.884
16	79.69	80.92	0.8	7.880
17	85.07	86.18	0.8	7.881
18	90.06	91.05	0.8	7.882
19	95.04	95.93	0.8	7.879
20	100.03	100.84	0.8	7.881
21	105.03	105.87	0.8	7.882
22	110.04	110.97	0.8	7.879
23	115.06	116.00	0.8	7.881
24	120.01	120.98	0.8	7.887
25	125.06	126.06	0.8	7.880
26	130.01	130.96	0.8	7.883
27	134.93	135.88	0.8	7.883
28	139.99	140.95	0.8	7.882
29	144.96	146.00	0.8	7.880
30	149.96	151.08	0.8	7.881

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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	155.01	156.11	0.8	7.881
32	159.93	160.99	0.8	7.883
33	165.02	166.30	0.8	7.879
34	170.03	171.30	0.8	7.881
35	175.00	176.25	0.8	7.878
36	179.95	181.15	0.8	7.880
37	184.95	185.98	0.8	7.880
38	190.04	190.90	0.8	7.882
39	195.07	195.80	0.8	7.883
40	200.05	200.82	0.8	7.881
41	205.05	205.90	0.8	7.881
42	210.05	210.95	0.8	7.879
43	215.01	215.92	0.8	7.881
44	220.00	220.96	0.8	7.879
45	225.07	226.14	0.8	7.882
46	230.03	231.14	0.8	7.880
47	235.05	236.15	0.8	7.880
48	240.13	241.25	0.8	7.880
49	245.06	246.22	0.8	7.879
50	249.99	251.21	0.8	7.881
51	255.00	256.25	0.8	7.881
52	260.06	261.25	0.8	7.879
53	264.99	266.12	0.8	7.878
54	269.96	271.04	0.8	7.881
55	274.93	275.93	0.8	7.883
56	279.93	280.87	0.8	7.883
57	284.97	285.93	0.8	7.882
58	289.89	290.88	0.8	7.881
59	294.90	295.96	0.8	7.884
60	299.96	300.96	0.8	7.882
61	304.94	306.02	0.8	7.885
62	309.94	311.07	0.8	7.881

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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	314.96	316.00	0.8	7.878
64	319.93	321.17	0.8	7.881
65	324.99	326.25	0.8	7.882
66	329.96	331.26	0.8	7.881
67	334.97	336.31	0.8	7.883
68	339.98	341.39	0.8	7.885
69	345.00	346.34	0.8	7.882
70	349.94	351.17	0.8	7.883
71	354.97	356.10	0.8	7.877

File: 1521963

Linear regression analysis

Slope	1.00047 deg/deg
Offset	0.9840 deg

Graphical representation of the result
Grafische Darstellung des Ergebnises

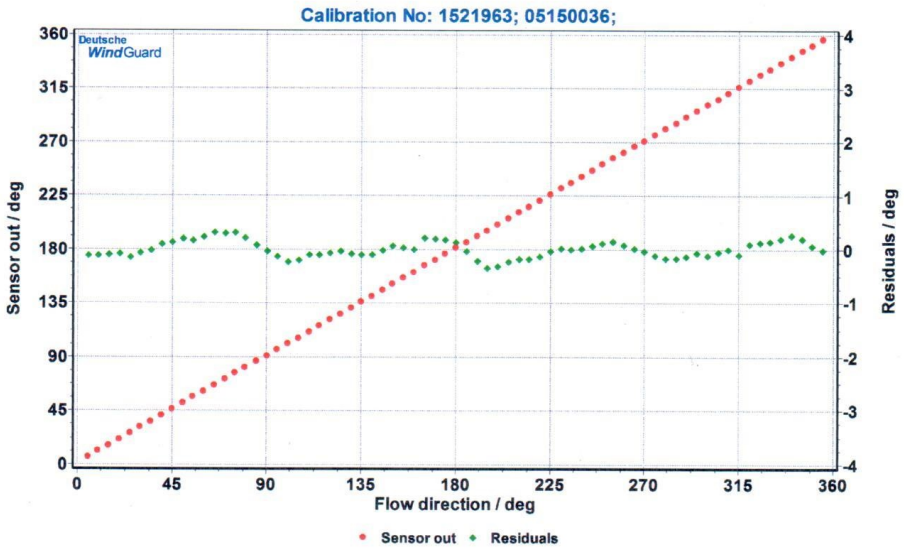
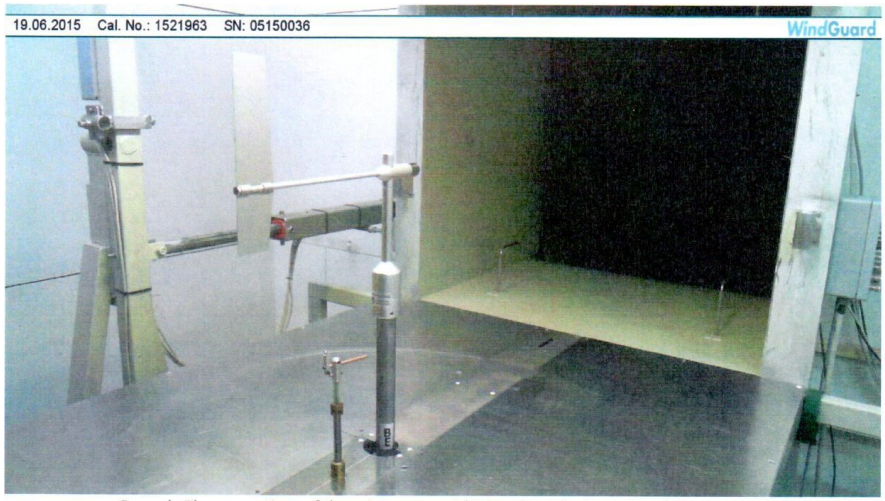


Photo of the measurement setup
Foto des Messaufbaus



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.*	154309
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*

R. Gö...
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.*	154329
Ihre Auftrags-Nr.	*Your Order-No.*	L23213
Unsere Auftrags-Nr.	*Our Confirmation-No.*	A65630A120(AU18076 78474)

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

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.

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*

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.

11.08.2015
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: **B15-0242**

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

V Camier

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
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