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als Kalibrierlaboratorium im / as calibration laboratory in the

**Deutschen Kalibrierdienst**



Kalibrierschein  
Calibration certificate

Kalibrierzeichen  
Calibration mark

12345
D-K-
19142-01-00
09/2016

Gegenstand  
*Object*  
Hersteller  
*Manufacturer*

Cup Anemometer  
Adolf Thies GmbH & Co. KG  
D-37083 Göttingen - Germany

Typ  
*Type*  
Fabrikat/Serien-Nr.  
*Serial Number*  
Auftraggeber  
*Customer*

4.3351.010.000  
Body / Cup  
ProfEC Ventus GmbH  
26127 Oldenburg - Germany

Auftragsnummer  
*Order No.*

12345

Anzahl der Seiten des Kalibrierscheines  
*Number of pages of the certificate*

6

Datum der Kalibrierung  
*Date of calibration*

29.09.2016

Dieser Kalibrierschein darf nur vollständig und unverändert weiterverbreitet werden. Auszüge oder Änderungen bedürfen der Genehmigung sowohl der Deutschen Akkreditierungsstelle als auch des ausstellenden Kalibrierlaboratoriums. Kalibrierscheine ohne Unterschrift haben keine Gültigkeit.

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Datum  
*Date*  
29.09.16

Leiter des Kalibrierlaboratoriums  
*Head of the calibration laboratory*

Bearbeiter  
*Person in charge*

MSc. B.Hons. Andreas Jansen

Dipl.-Phy. Mathias Hölzer



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**Object**

Kalibriergegenstand	Cup Anemometer
<b>Calibration procedure</b>	IEC 61400-12-1 ED.1: 2005 – Power performance measurements of electricity producing wind turbines;
Kalibrierverfahren	CDV IEC 61400-12-1 ED.2: July – 2015 – Power performance measurements of electricity producing wind turbines; MEASNET Anemometer Calibration Procedure – Version 2: 2009; ISO 3966: 2008-07 – Measurement of fluid flow in closed conduits

**Place of calibration**

Ort der Kalibrierung Wind tunnel of the Carl von Ossietzky University, Oldenburg

**Test Conditions**

Messbedingungen	wind tunnel area / Wind Tunnel Querschnittsfläche <sup>1</sup> /	8000	cm <sup>2</sup>
	anemometer frontal area / Anemometer Querschnittsfläche <sup>2</sup>	274	cm <sup>2</sup>
	diameter of mounting pipe / Durchmesser des Montagerohrs <sup>3</sup>	35	mm
	blockage ratio of tested object / Vorstauverhältnis des Prüflings <sup>4</sup>	0.034	[-]

**Test Conditions**

Umgebungsbedingungen	air temperature / Luft Temperatur	25.1 °C	± 0.2 K
	air pressure / Luftdruck	1015.1 hPa	± 0.0 hPa
	relative air humidity / Relative Luftfeuchtigkeit	57.2 %	± 1.7 %

**Remarks**

Anmerkungen none

**Software version**

Auswertesoftware CAC\_Prog\_v1.0

**This calibration certificate has been generated electronically and signed manually.**

Dieser Kalibrierschein wurde elektronisch erzeugt und manuell signiert.

<sup>1</sup>Nozzle cross-section area of the tested object incl. mounting pipe / Querschnitt der Auslassdüse des Windkanals

<sup>2</sup>Projected cross-section area of the tested object incl. mounting pipe / Querschnittsfläche (Schattenwurf) des Prüflings inkl. Montagerohr

<sup>3</sup>Diameter of mounting pipe / Durchmesser des Montagerohrs

<sup>4</sup>Ratio<sup>2</sup> to<sup>1</sup> /Verhältnis von<sup>2</sup> zu<sup>1</sup>



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## Result <sup>5</sup>

Kalibrierergebnis

File: 12345

Windgeschwindigkeit Windkanal / Wind Speed Wind Tunnel	Messung Prüfling / Measurement Anemometer	Erweiterte Messunsicherheit * / Extended Uncertainty * (k=2)
m/s	Hz	m/s
3.995	6.033	0.10
5.956	9.200	0.10
7.932	12.400	0.10
9.955	15.667	0.10
11.964	18.967	0.10
13.945	22.200	0.10
15.927	25.467	0.10
14.957	23.867	0.10
12.970	20.600	0.10
10.924	17.267	0.10
8.929	14.000	0.10
6.931	10.800	0.10
4.992	7.667	0.10

## Remark /

Vermerk:

**The calibrated sensor, regarding its regression parameters, slope, regression coefficient and standard deviation, complies with the requirements as set forth in pertinent norms and standards (IEC / MEASNET).**

**\* The extended 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 measured value lies within the assigned range of values with a probability of 95%.**

**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.**

\*Angegeben ist die erweiterte Messunsicherheit, die sich aus der Standardmessunsicherheit durch Multiplikation mit dem Erweiterungsfaktor k=2 ergibt. Sie wurde gemäß DAkkS-DKD-3 ermittelt. Der Wert der Messgröße liegt mit einer Wahrscheinlichkeit von 95% im zugeordneten Wertintervall. Die Deutsche Akkreditierungsstelle GmbH ist Unterzeichnerin der multilateralen Übereinkommen der European cooperation for Accreditation (EA) und der International Laboratory Accreditation Cooperation (ILAC) zur gegenseitigen Anerkennung der Kalibrierscheine.

<sup>5</sup>Calibration results only count for the tested circumstances and environmental conditions during which calibration took place.



## Annex

## 1. Detailed Calibration Results

DAkKS calibration no.	12345
Test object	Cup Anemometer
Manufacturer Type	Adolf Thies GmbH & Co. KG / 4.3351.010.000
Body serial number <sup>6</sup>	Body
Cup serial number	Cup
Date of calibration	29.09.2016



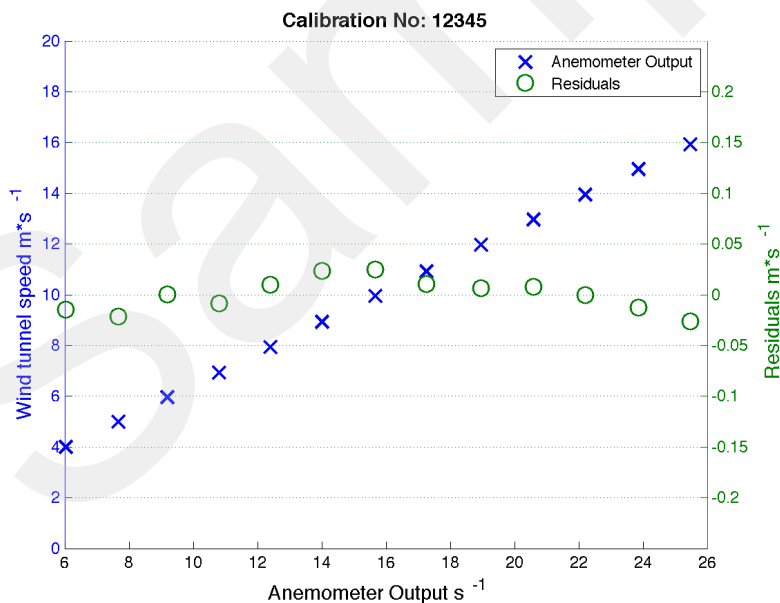
## Ambient conditions

Air temperature	25.1 °C
Air pressure	1015.1 hPa
Humidity	57.2 %

## Linear regression analysis

Range of regression	4 m/s – 16 m/s
Slope	0.61454 (m/s)/(Hz) ± 0.00080 (m/s)/(Hz)
Offset	0.3021 m/s ± 0.0134 m/s
Standard error y	0.017 m/s
Correlation coefficient	0.999983 [-]

Remarks none



ProfEC Ventus GmbH is accredited by the German Accreditation Body (Deutsche Akkreditierungsstelle, DAkKS), registration: D-K-19142-01-00

<sup>6</sup>Body serial number OR device serial number if only one serial number is given for the test object



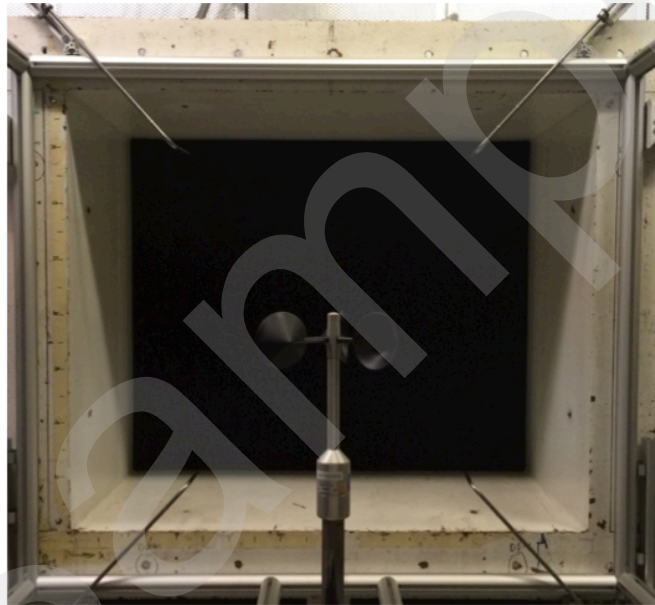
## Annex

## 2. Instrumentation

Position	Sensor	Manufacturer	Type	Calibration	Calibration Report-#	Range
1	Pitot static and dynamic tube	Airflow	NPL 8 mm	09.04.15	18121 PTB 15	-
2	Pitot static and dynamic tube	Airflow	NPL 8 mm	08.04.15	18122 PTB 15	-
3	Pitot static and dynamic tube	Airflow	NPL 8 mm	02.04.15	18123 PTB 15	-
4	Pitot static and dynamic tube	Airflow	NPL 8 mm	10.04.15	18124 PTB 15	-
5	Differential Pressure	Setra	239	07.04.15	S4508	0 Pa - 170 Pa
6	Differential Pressure	Setra	239	07.04.15	S4509	0 Pa - 170 Pa
7	Differential Pressure	Setra	239	07.04.15	S4510	0 Pa - 170 Pa
8	Differential Pressure	Setra	239	07.04.15	S4511	0 Pa - 170 Pa
9	Barometer	Vaisala	PTP110	31.03.15	S4431	500 hPa - 1100 hPa
10	Thermometer	Galltec	KRC 1/5-ME	08.04.15	10026	-30°C - +70°C
11	Humidity sensor	Galltec	KRC 1/5-ME	08.04.15	10026	0% - 100%
12	Wind tunnel control	ProfEC Ventus	CPU 7728-12500	20.05.16	124556-01	-
13	Reference Anemometer ProfEC Ventus GmbH	Thies Clima	First Class Advanced	0513_15	0513_15	-

Table1: Description of the data acquisition system

## 3. Photo of the calibration set-up



Calibration set-up of the anemometer calibration in the wind tunnel of Carl von Ossietzky University, Oldenburg<sup>7</sup>. The anemometer shown may differ from the calibrated one. Remark: The proportion of the set-up is not true to scale due to imaging geometry.

## 4. Compliance with IEC procedure

The calibration procedure in all aspects is in compliance with procedure IEC 61400-12-1.

<sup>7</sup>Carl-von-Ossietzky-Straße 11, 26129 Oldenburg



## Annex

### 5. References

- [1] M. Hölzer, 2015 - Working Instruction: Measuring Velocity of Gases for Cup Anemometer Calibration
- [2] IEC 61400-12-1 ED.1: 2005 - Power performance measurements of electricity producing wind turbines
- [3] CDV IEC 61400-12-1 ED.2: July 2015 - Power performance measurements of electricity producing wind turbines
- [4] MEASNET Anemometer Calibration Procedure - Version 2: 2009
- [5] ISO 3966 2008 - Measurement of fluid flow in closed conduits

### 6. Contact Information of Calibration Laboratory



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