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MEASNET approved test laboratory

Calibration Certificate / Kalibrierschein

Issued by the calibration laboratory / *Erstellt durch das Kalibrierlaboratorium*

ProfEC Ventus GmbH

Member of / *Mitglied im*

Deutschen Kalibrierdienst

accredited to / *akkreditiert nach*

DIN EN ISO/IEC 17025:2018

DAkkS Deutsche Akkreditierungsstelle D-K-19142-01-00

Calibration Mark *Kalibrierzeichen*	26677 D-K-19142-01-00 2024-12-17

Object *Gegenstand*	Cup Anemometer
Manufacturer *Hersteller*	Adolf Thies GmbH & Co. KG D-37083 Goettingen Germany
Type *Typ*	4.3351.10.000
Serial Number *Fabrikat/Serien-Nr.*	01244165
Customer *Auftraggeber*	SerFac. co. Ltd. Republic of Korea
Order No. *Auftragsnummer*	3238-2024
Numer of pages *Anzahl der Seiten*	6
Date of Calibration *Datum der Kalibrierung*	2024-12-17

This calibration certificate documents the metrological 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 metrologische 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*	Approval of the certificate of calibration by *Freigabe des Kalibrierscheins durch*
07. 01. 25	

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Object Kalibriergegenstand	Cup Anemometer		
Calibration procedure Kalibrierverfahren	ISO / IEC 61400-50-1: 2022, Chapter 8		
Place of calibration Ort der Kalibrierung	Wind Tunnel Center (MEASNET) at Carl von Ossietzky University, Oldenburg		
Test Conditions Messbedingungen	Wind tunnel area / Wind Tunnel Querschnittsfläche [1]	8000 cm^2	
	Anemometer frontal area / Anemometer Querschnittsfläche [2]	274.0 cm^2	
	Diameter of mounting pipe / Durchmesser des Montagerohrs [3]	33.7 mm	
	Blockage ratio of tested object / Vorstauverhältnis des Prüflings [4]	0.99831 [-]	
	Software Version / Auswertesoftware	CAC Prog v2.1	
Ambient Conditions Umgebungsbedingungen	Air temperature / Luft Temperatur	21.0 °C	± 0.2 K
	Air pressure / Luftdruck	1024.0 hPa	± 0.3 hPa
	Relative air humidity / Relative Luftfeuchtigkeit	45.9 %	± 0.2 %
Remarks Anmerkungen	-		
Revision Revision	0		

This calibration certificate has been generated electronically and signed manually.
Dieser Kalibrierschein wurde elektronisch erzeugt und manuell signiert.

[1] Nozzle cross-section area of the tested object incl. mounting pipe / Querschnitt der Auslassdüse des Windkanals
[2] Projected cross-section area of the tested object incl. mounting pipe / Querschnittsfläche (Schattenwurf) des Prüflings inkl. Montagerohr
[3] Diameter of mounting pipe / Durchmesser des Montagerohrs
[4] Ratio[2] to[1] /Verhältnis von[2] zu[1]

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Calibration Result [5]

Kalibrierergebnis

File: 26677

Wind Speed Wind Tunnel Windgeschwindigkeit Windkanal	**Measurement Sensor** Messung Prüfling	**Extended Uncertainty* (*k*=2)** Erweiterte Messunsicherheit* (*k*=2)
m/s	Hz	m/s
3.919	80.400	0.10
5.848	122.633	0.10
7.785	164.633	0.10
9.767	208.600	0.10
11.730	250.600	0.10
13.756	295.067	0.10
15.665	336.633	0.10
14.729	316.600	0.10
12.756	273.300	0.10
10.758	229.033	0.10
8.772	185.933	0.10
6.814	143.167	0.10
4.873	101.067	0.10

Remark:

Vermerk:

*** 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 EA-4/02 M: 2022. 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 EA-4/02 M: 2022 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.

[5] Calibration results only count for the tested circumstances, the tested sensor and environmental conditions during which calibration took place.

Annex

Detailed Calibration Results

DAkkS calibration no.	26677
Test object	Cup Anemometer
Manufacturer / Type	Adolf Thies GmbH & Co. KG / 4.3351.10.000
Body serial number [6]	01244165
Cup serial number	-
Date of calibration	2024-12-17

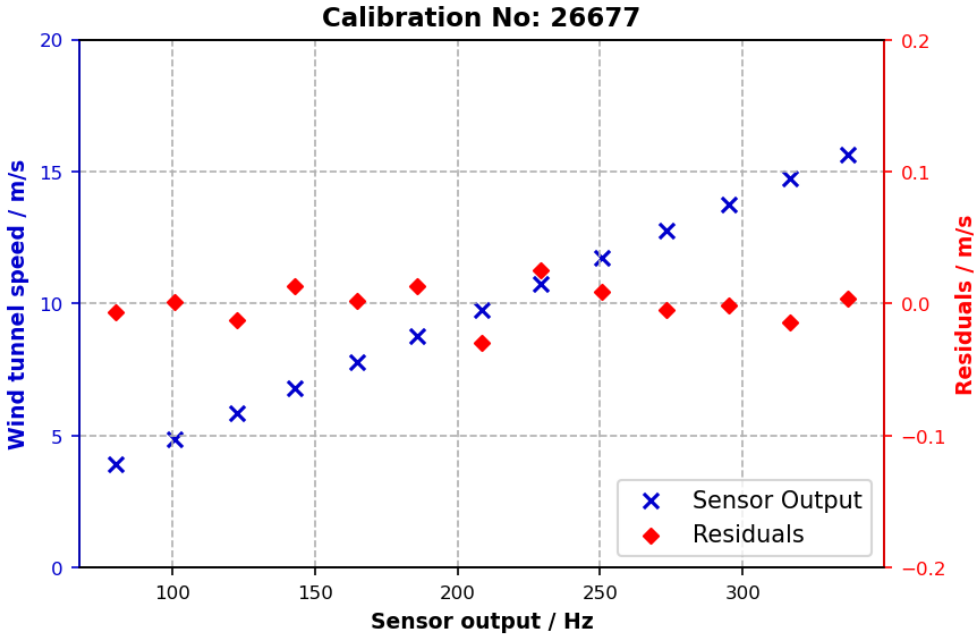
Ambient conditions

Air temperature	21.0 °C
Air pressure	1024.0 hPa
Humidity	45.9 %

Linear regression analysis

Range of regression	4 m/s – 16 m/s
Slope	0.04580 (m/s)/(Hz) ± 0.00005 (m/s)/(Hz)
Offset	0.2434 m/s ± 0.0119 m/s
Standard error y	0.015 m/s
Correlation coefficient	0.999986 [-]

Remarks -



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

ProfEC Ventus GmbH is member of MEASNET (Measuring Network of Wind Energy Institutes) and participating in the anemometer and wind vane calibration expert working group of MEASNET.

[6] Body serial number OR device serial number if only one serial number is given for the test object

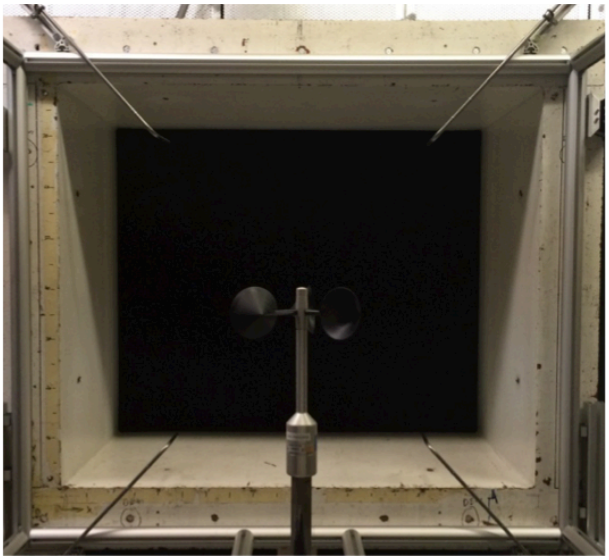
Annex

Instrumentation

Position	Sensor	Manufacturer	Type	Calibration
1	Pitot static and dynamic tube	Airflow	NPL 8 mm	09.04.15
2	Pitot static and dynamic tube	Airflow	NPL 8 mm	08.04.15
3	Pitot static and dynamic tube	Airflow	NPL 8 mm	02.04.15
4	Pitot static and dynamic tube	Airflow	NPL 8 mm	10.04.15
5	Differential Pressure	Setra	239	27.07.23
6	Differential Pressure	Setra	239	27.07.23
7	Differential Pressure	Setra	239	27.07.23
8	Differential Pressure	Setra	239	27.07.23
9	Barometer	Vaisala	PTB110	27.07.23
10	Thermometer	Galltec	KRC 1/5-ME	08.08.23
11	Humidity sensor	Galltec	KRC 1/5-ME	08.08.23
12	Wind tunnel control	ProfEC Ventus	CPU 44172	30.01.23

Table1: Description of the data acquisition system

Photo of the calibration set-up



Calibration set-up of the anemometer calibration in the wind tunnel at Carl von Ossietzky University, Oldenburg[7]. 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.

Compliance with IEC and MEASNET calibration procedure

The calibration procedure in all aspects is in compliance with procedure ISO / IEC 61400-50-1:2022.

The calibration procedure in all aspects is in compliance with MEASNET Anemometer Calibration Procedure - Version 3: 2020

[7] Carl-von.Ossietzky-Straße 11, 26129 Oldenburg

Annex

References

[1] M. Hölzer, 2023 - Working Instruction: Measuring Velocity of Gases for Cup Anemometer Calibration

[2] ISO / IEC 61400-50-1 Ed.1: 2022 - Wind measurement - Application of meteorological mast, nacelle and spinner mounted instruments

[3] MEASNET Anemometer Calibration Procedure - Version 3: 2020

[4] EA-4/02 M: 2022 Evaluation of the Uncertainty of Measurement In Calibration

Contact Information of Calibration Laboratory

ProfEC Ventus GmbH
Marie-Curie-Str 1
26129 Oldenburg
Germany

www.profec-ventus.com
shop.profec-ventus.com
info@profec-ventus.com

Contact Information of Customer

SerFac. co. Ltd.
c/o Ji-Hun, Ban
15, Pyeonghwa-ro 140beon-gil
Mokpo-si, Jeollanam-do
Republic of Korea

– END OF CALIBRATION CERTIFICATE / Ende des Kalibrierscheins –