



Test Report issued under the responsibility of:



Svend Ole Hansen ApS
Sct. Jørgens Allé 5C
DK-1615 København V
Denmark

TEST REPORT
IEC 61400-12-1 Annex F
Anemometer Calibration Certificate

IECRE Report Number. : IECRE.WE.TR.AC.24-45347-R0

RETL Calibration Certificate. : 24.02.14699

Date of issue : March 25, 2024

RE Testing Laboratory..... : Svend Ole Hansen ApS
(Name & Address) Sct. Jørgens Allé 5C
DK-1615 København V
Denmark

Applicant : WindSensor, Frederiksborgvej 399, DK-4000 Roskilde, Denmark
(Name & Address)

Test item description : Anemometer

Manufacturer..... : WindSensor, Frederiksborgvej 399, DK-4000 Roskilde, Denmark

Model/Type reference : WindSensor P2546D-OPR Cup Anemometer

Ratings / Serial number : 67878

Tested by (name, function, signature)	Printed name/function	Signature
..... :	Operator, JPK	

Approved by (name, function, signature)	Printed name/function	Signature
..... :	Calibration engineer, sfo	

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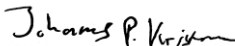
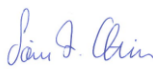


CERTIFICATE OF CALIBRATION

Calibrated item

Type	WindSensor P2546D-OPR Cup Anemometer
Serial No.	67878
Manufacturer	WindSensor, Frederiksborgvej 399, DK-4000 Roskilde, Denmark
Item received	March 22, 2024
Remarks	-

Calibration

Calibration institute	Svend Ole Hansen ApS, Sct. Jørgens Allé 5C, DK-1615 København V
Procedure	IEC 61400-12-1:2022, Annex F
Client	WindSensor, Frederiksborgvej 399, DK-4000 Roskilde, Denmark
Calibrated by	Operator, JPK 
Date of calibration	March 23, 2024
Approved by	Calibration engineer, sfo 
Post calibration	No
Re-calibration due	-

Certificate

Certificate No.	24.02.14699
Date of issue	March 25, 2024
Issued by	ca
Number of pages	5

Accreditation

Accredited to ISO 17025 by DANAK. DANAK is signatory to the European co-operation for Accreditation (EA) Multilateral Agreement and to the International Laboratory Accreditation Cooperation (ILAC) Mutual Recognition Arrangement.

The calibration institute is approved by MEASNET and IECRE.





Calibration conditions

Turbulence intensity	< 2 % (alongwind)
Air temperature	24.3 °C (average value)
Barometric pressure	998.9 hPa (average value)
Relative humidity	29.8 % (average value)
Air density	1.17 kg/m ³ (average value)
Flow inclination	< 0.2°
Anemometer yaw orientation	Not relevant
Remarks	(none)

Calibration results

Calibration equation $v \text{ [m/s]} = 0.62049 \cdot f \text{ [Hz]} + 0.21721$

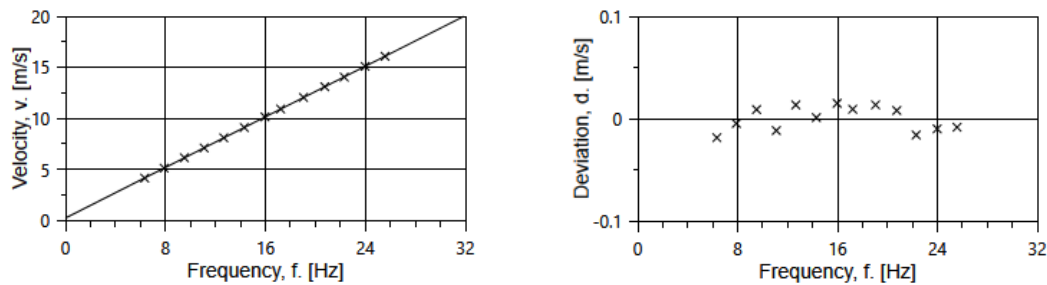
The calibration equation is obtained from a linear regression of the reference air velocity upon the Device Under Test (DUT) output. The residual is the deviation of the calibration equation prediction from the reference air velocity.

The calibration results relate only to the calibrated item.

Succession #	Velocity pressure [Pa]	Air temperature [°C]	Air density [kg/m ³]	Ref. air velocity, v [m/s]	Uncertainty $U (k = 2)$ [m/s]	DUT output Frequency, f [Hz]	Residual, d [m/s]
1-first	9.96	23.8	1.17	4.130	0.027	6.3363	-0.019
13-last	15.23	24.2	1.17	5.111	0.031	7.8949	-0.005
2	21.95	23.7	1.17	6.129	0.036	9.5130	0.009
12	29.30	24.4	1.17	7.090	0.041	11.0955	-0.012
3	38.20	23.7	1.17	8.087	0.046	12.6610	0.013
11	48.18	24.5	1.16	9.095	0.051	14.3055	0.001
4	60.03	23.8	1.17	10.138	0.056	15.9649	0.015
10	69.27	24.7	1.16	10.909	0.060	17.2160	0.009
5	84.72	23.9	1.17	12.048	0.066	19.0444	0.013
9	99.81	24.9	1.16	13.097	0.072	20.7452	0.008
6	114.96	24.2	1.17	14.040	0.077	22.3028	-0.016
8	132.43	24.9	1.16	15.086	0.082	23.9793	-0.010
7	150.52	24.6	1.16	16.077	0.087	25.5729	-0.008



Visual presentation of calibration results



Linear regression results

Method	Least squares linear regression
Slope	0.62049 (m/s)/Hz
Offset	0.21721 m/s
Coefficient of correlation	$\rho = 0.999995$
Standard error of estimate	0.0126 m/s
Slope standard error	0.00058 (m/s)/Hz
Offset standard error	0.00988 m/s
Slope and offset covariance	-0.000005378 (m/s) ² /Hz
Remarks	Linearity complies with IEC 61400-12-1, Annex F.

Uncertainties

The uncertainties stated under *Calibration results* relate to the reference air velocity at each calibration point. The reported, expanded uncertainty is stated as the total combined standard uncertainty u_c multiplied by a coverage factor of $k = 2$, such that the coverage probability corresponds to approximately 95 %, in accordance with EA-4/02. The uncertainty complies with the requirements in IEC 61400-12-1, Annex F. The uncertainty due to the wind tunnel correction function has been documented to be 0.1 % ($k = 2$).

The slope and offset uncertainties and their covariance stated under *Linear regression results* are related to the linear regression only, and do not relate to the reference air velocity uncertainties. The slope and offset uncertainties have $\nu = 11$ degrees of freedom.



Calibration wind tunnel

ID	DK1
Test section	Octagonal, h _{xw} = 1.20x1.75 m
Effective area of test section	2.10 m ²
Setup report	SOH document No. 18.1.001
Blockage ratio*	~1.0 % (Anemometer and mounting pole)

* The effect of blockage is taken into account in the calibration results.

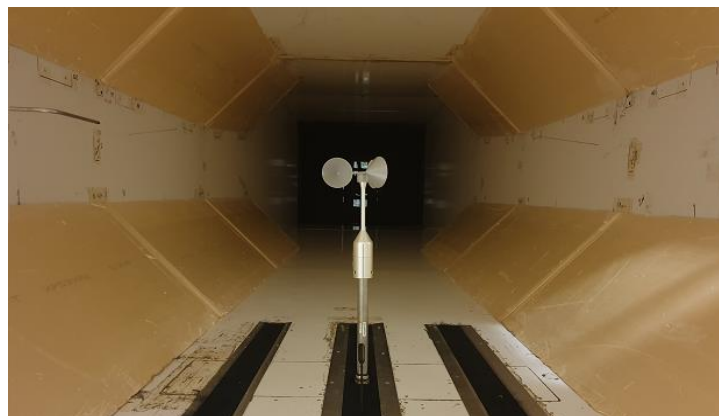
Equipment used

Function	ID	Model / comments	Re-calibration due
QC Anemometer	11641	11641	-
Mounting	-	Mounting tube, diameter = 25 mm	-
Tunnel Temperature	T4	PT100 Temperature sensor	2025-04-12
Differential Pressure	1501197	FCO560 Pressure manometer	2025-05-03
Relative Humidity	Z0420014	HMW71U Humidity transmitter	2025-04-11
Barometric Pressure	U4220037	PTB100A Analogue barometer	2025-04-04
Pitot tube	A37AB	Ellipsoidal tip pitot tube	2027-02-22
Data acquisition	1A841F0	Computer Board: ME-REDLAB 1608GX.	-
Computer	-	PC dedicated to data acquisition	-

Calibrations of the relevant equipment are carried out by external accredited institutions, and are traceable to national standards. A real-time analysis module within the data acquisition software detects pulse frequency.

Setup photo

The shown anemometer is of the same type as the one calibrated.



(End of certificate)