CERTIFICADO DE CALIBRACION

Certificate of Calibration

Número **24173AC**
Number

Instituto Universitario de Microgravedad "Ignacio Da Riva"
Laboratorio de Calibración en Túnel Aerodinámico, LAC, IDR/UPM
E.T.S.I. Aeronáutica y del Espacio
Plaza del Cardenal Cisneros, 3, E-28040 Madrid
Tel.: 91 336 63 53, Fax: 91 336 63 63
http://www.idr.upm.es, email: lac@idr.upm.es

OBJETO *Item*	Cup Anemometer
MARCA *Mark*	THIES CLIMA
MODELO *Model*	4.3351.10.000
IDENTIFICACION *Identification*	06162207
SOLICITANTE *Applicant*	KINTECH INGENIERIA, S.L. Avda. Anselmo Clavé, nº 37-45, local bajo 50004 Zaragoza
FECHA DE CALIBRACION *Date of Calibration*	July 15, 2016

Signatarios autorizados
Authorized signatories

Fecha de emisión:
Date of issue
July 15, 2016

Firmado digitalmente por VEGA RAMIRO, ENRIQUE (FIRMA)
Fecha: 2016.07.15 11:04:06 +02'00'

Dirección Técnica
Technical Direction

Sello/*Seal*

1. ORDER IDENTIFICATION

Order reference number: 2016090165
Arrival date: 05/07/2016

2. MEASUREMENTS

Measurements were made at the Wind Tunnel of LAC, IDR/UPM following procedure PE-02 of LAC, IDR/UPM, according to the guidelines set by the MEASNET network .
The reference velocity was measured using a Pitot tube ISO3966.
The anemometer was placed on the mounting pilar of the wind tunnel test section which is rectangular of 0.9 m height and 0.9 m width. Before calibration, the anemometer was run at a steady wind tunnel velocity of 10 m/s for 5 minutes in order to avoid the effect that the temperature variations may have on the mechanical friction of the anemometer bearings. Calibration was performed under both rising and falling wind speed in the range of 4 to 16 m/s. The sampling frequency was 10 Hz and the sampling interval was 30 s. Before collecting data at each wind speed, 1 minute delay was allowed for stable conditions to become established.
The calibration campaign is described in Report "ANEMOMETER CALIBRATION REPORT. CAMPAIGN 2000".

3. LIST OF EQUIPMENT USED

Instrument	Manufacturer	Type	Serial Number	Code	Calibration	
					Date	Traceability
Pitot Tube	AIRFLOW	0.48	N.A.	9410011	27/10/2010	PTB-1.41-4049848
Pressure Transducer	DRUCK	LPM 9481	30066	7111008	25/09/2015	EUROPASCAL S 5093
Digital Multimeter	KEITHLEY	2000	0980771	1011007	13/09/2014	ENAC 1250-307058846
Barometer Transmitter	VAISALA	PTU 303	C4840003	9711004	31/03/2015	ENAC 94008
Temp.-humid. Sensor		PTU 303	C4840003		26/03/2015	ENAC 93959
Universal Counter	AGILENT	53131A	MY40003942	2011003	19/09/2014	ENAC 1250-307058845

IDR UPM

Sello/*Seal*

4. AMBIENT CONDITIONS

		Mean	Min.	Max.
Air temperature:	[ºC]	27.38	27.09	27.63
Air pressure:	[hPa]	948.65	948.60	948.71
Air humidity:	[%]	23.3	23.0	23.5

5. RESULTS

The results included in this certificate are only applicable to the calibrated instrument and to the time instant and conditions at which the calibration was carried out.

Table 1. Calibration Results

Anemometer Output F [Hz]	Reference Wind Speed V [m/s]	Uncertainty of V (k=2) [m/s]	Residuals* [m/s]
85.343	4.20	0.10	-0.0180
125.258	6.03	0.10	-0.0233
167.577	8.01	0.10	0.0125
210.939	10.00	0.10	0.0117
253.801	12.00	0.12	0.0471
299.433	14.05	0.14	-0.0013
342.429	15.98	0.16	-0.0453
320.716	15.02	0.15	-0.0087
276.770	13.03	0.13	0.0187
233.406	11.02	0.11	-0.0002
189.932	9.02	0.10	-0.0036
145.586	7.01	0.10	0.0262
103.235	5.02	0.10	-0.0158

* Residuals: difference between the anemometer output and the linear regression result. These calculations are not covered by the accreditation.

"The reported expanded uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor k = 2, which for a normal distribution corresponds to a coverage probability of approximately 95%. The standard uncertainty of measurement has been determined in accordance with EAL Publication EA -4/02".

IDR UPM

Sello/*Seal*

Linear Regression Results**

The statistical uncertainty is given by

$$\sigma(y_a) = \left\{ x_a^2 \ \sigma_A^2 + \sigma_B^2 + 2x_a \ \mathrm{COV}(A,B) \right\}^{1/2}.$$

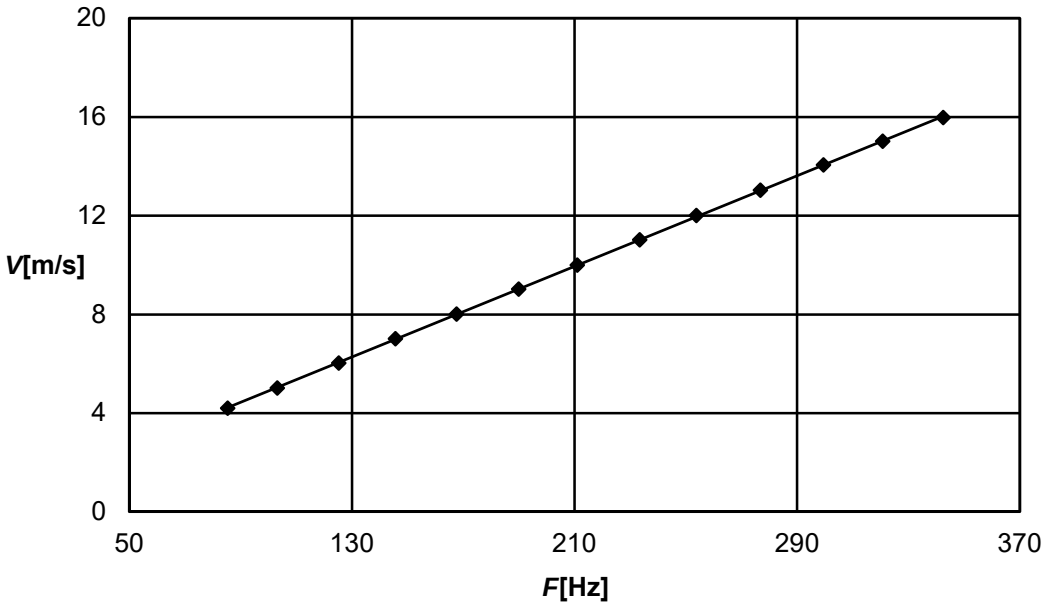
For 10 m/s wind speed the statistical uncertainty $\sigma(y_a)$ is 0.0069 [m/s].

Table 2. Linear Regression Results

V [m/s] = A ([m/s]/[Hz])*F [Hz]+B [m/s]

Parameter	Value	sd	Comments
A	0.04593	0.00009	Slope
B	0.29871	0.01934	Offset
r	0.99998		Regression Coefficient
sd(V)	0.02488		Standard Deviation

**The linear regression has been carried out by using a least squares fitting. These calculations are not covered by the accreditation.



IDR UPM

Sello/*Seal*

Photo of the Anemometer in the Wind Tunnel

Remarks:
The photo does not correspond to the actual calibration but shows a representative arrangement of the mounting of that type of anemometers.

References

Nikolai A. Bezdenejnykh, "Anemometer Calibration Report. Campaign 2000", Ref. T/ICC/C0011

IDR UPM

Sello/*Seal*