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WIND ENGINEERING FLUID DYNAMICS

# CERTIFICATE FOR CALIBRATION OF CUP ANEMOMETER

**Certificate number:** 11.02.0739 **Date of issue:** February 2, 2011

**Type:** Thies 4.3351.00.000 **Serial number:** 1209527

**Manufacturer:** ADOLF THIES GmbH & Co.KG, Hauptstrasse 76, 37083 Göttingen, Germany

**Client:** Grupo Telsat , P. I Valdeconsejo, c/Pena Oroel 10C 3D, Naves 4 y 5, 50410 Cuarte de Huerva, Zar

**Anemometer received:** January 20, 2011 **Anemometer calibrated:** February 2, 2011

**Calibrated by:** mr **Calibration procedure:** IEC 61400-12-1, MEASNET

**Certificate prepared by:** jsa **Approved by:** Calibration engineer, soh

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**Calibration equation obtained:** $v$ [m/s] = 0.04666 · f [Hz] + 0.20037

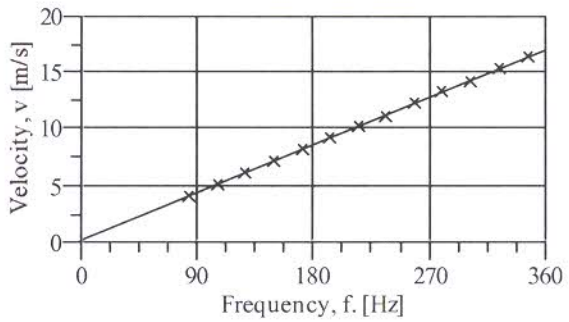
**Standard uncertainty, slope:** 0.00109 **Standard uncertainty, offset:** 0.05851

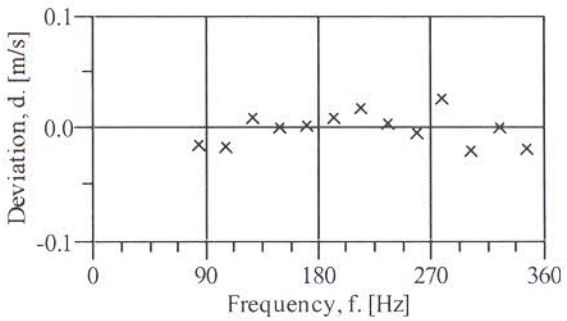
**Covariance:** -0.0000006 (m/s)²/Hz **Coefficient of correlation:** $\rho = 0.999993$

**Absolute maximum deviation:** 0.027 m/s at 13.249 m/s

**Barometric pressure:** 1015.8 hPa **Relative humidity:** 17.9%

| Succession | Velocity pressure, q. [Pa] | Temperature in wind tunnel [°C] | Temperature in control room [°C] | Wind velocity, $v$. [m/s] | Frequency, f. [Hz] | Deviation, d. [m/s] | Uncertainty $u_c$ (k=2) [m/s] |
|---|---|---|---|---|---|---|---|
| 2 | 9.92 | 29.3 | 23.9 | 4.124 | 84.3765 | -0.014 | 0.028 |
| 4 | 15.29 | 29.2 | 23.9 | 5.118 | 105.7422 | -0.016 | 0.032 |
| 6 | 22.10 | 29.1 | 23.8 | 6.152 | 127.3503 | 0.010 | 0.038 |
| 8 | 30.15 | 29.0 | 23.8 | 7.185 | 149.6583 | 0.001 | 0.043 |
| 10 | 39.14 | 28.9 | 23.8 | 8.185 | 171.0724 | 0.002 | 0.049 |
| 12 | 49.26 | 28.8 | 23.8 | 9.181 | 192.2612 | 0.009 | 0.054 |
| 13-last | 61.11 | 28.8 | 23.8 | 10.225 | 214.4512 | 0.018 | 0.060 |
| 11 | 73.22 | 28.9 | 23.8 | 11.194 | 235.4990 | 0.005 | 0.066 |
| 9 | 87.78 | 29.0 | 23.8 | 12.259 | 258.5140 | -0.004 | 0.072 |
| 7 | 102.49 | 29.1 | 23.8 | 13.249 | 279.0651 | 0.027 | 0.078 |
| 5 | 118.83 | 29.2 | 23.9 | 14.268 | 301.9201 | -0.020 | 0.084 |
| 3 | 137.18 | 29.3 | 23.9 | 15.334 | 324.3122 | 0.001 | 0.090 |
| 1-first | 155.61 | 29.5 | 23.9 | 16.338 | 346.2478 | -0.019 | 0.096 |






ilac-MRA

DANAK
CAL Reg.nr. 452
Accreditation to ISO 17025

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## EQUIPMENT USED

| Serial number | Description |
|---|---|
| - | Boundary layer wind tunnel. |
| 1256 | Control cup anemometer. |
| - | Mounting tube, D = 35 mm |
| t1 | PT100 temperature sensor, wind tunnel. |
| t2 | PT100 temperature sensor, control room. |
| 9904031 | PPC500 Furness pressure manometer |
| X4650038 | HMW71U Humidity transmitter |
| X4350042 | PTB100AVaisala analogue barometer. |
| P11 | Pitot tube |
| 001551 | Computer Board. 16 bit A/D data acquisition board. |
| - | PC dedicated to data acquisition. |

Traceable calibrations of the equipment are carried out by external accredited institutions: Furness (PPC500) and Saab Metech. A real-time analysis module within the data acquisition software detects pulse frequency.

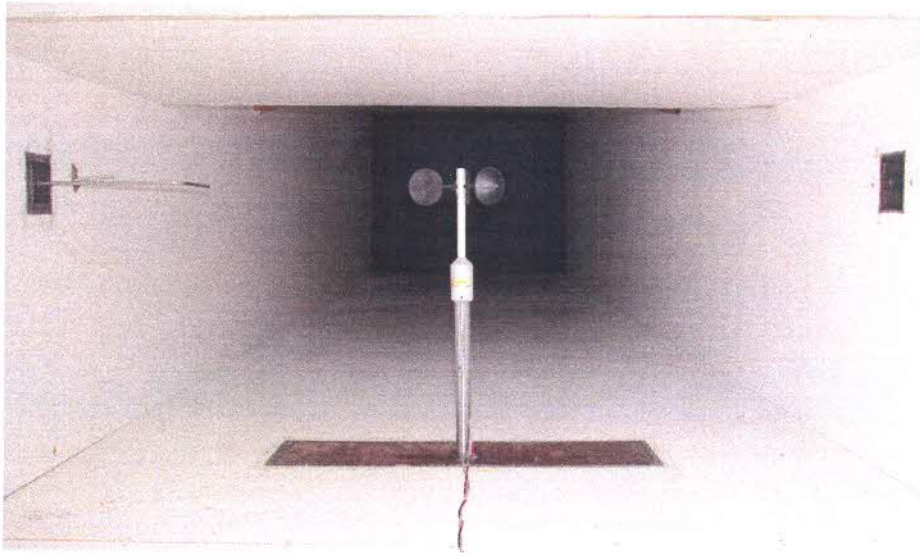

Photo of a cup anemometer in the wind tunnel. The shown anemometer is of the same type as the calibrated one.

## UNCERTAINTIES

The documented uncertainty is the total combined uncertainty at 95% confidence level (k=2) in accordance with EA-4/02. The uncertainty at 10 m/s comply with the requirements in the MEASNET procedure that prescribes an absolute uncertainty less than 0.1 m/s at a mean wind velocity of 10 m/s, that is 1%. See Document 97.00.004 "MEASNET - Test report on the calibration campaign" for further details.

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