

Summary report AK151023-1.3 Version 1.0

Cup Anemometer - Class S - Classification

According to IEC 61400-12-1 Edition 2.0 (2017- 03) Classification Scheme

Description of Anemometer		
Manufacturer:	Adolf Thies GmbH&Co.KG Hauptstrasse 76 37083 Göttingen	
Identification:	First Class Advanced 4.3352.00.000; 4.3352.10.000 SN: 0113001; 0113002;0113003;0113004;0113005	
Dimension:		
Body diameter: 50 mm	Body length: 95 mm	
Total length: 290 mm	Shaft diameter: 18 mm	
Top: 38 mm		
Rotor diameter: 240 mm	Cup diameter: 80 mm	
Cup tilt angle: 2.5 deg	Flaps (approx): 28 x 31 mm	

Reference:

Deutsche WindGuard Wind Tunnel Services GmbH

Measuring period: 04.2014 – 05.2017

Test site: Varel, Germany

Wind Tunnel: Deutsche WindGuard Wind Tunnel Services GmbH, Varel

Procedure:

The classification is based on numerical integration of the differential equation which describes the response of a cup anemometer to fluctuating wind speeds. The chosen spectrum of the wind speed time series was a *Kaimal* spectrum for non-isotropic condition (turbulence length scale 350 m. The time series have been generated with a software tool provided by Risø - National Laboratory, Denmark. Other parameters which influence the response of an anemometer in fluctuating wind conditions are:

- Off axis response for different tilt angles
- Friction changes in bearings due different ambient temperatures and air pressure
- Driving and braking torque of the cups during rotation
- Inertia of the rotor
- Air density

All relevant parameters have been measured in various wind tunnels of Deutsche WindGuard Wind Tunnels Services GmbH. The driving and braking forces used in the numerical model have been derived from the measured step response (step up and step down test) of the tested anemometer according to IEC 61400-12-1 Edition 2.0. The direct influence of air density was measured using a specially designed variable air density wind tunnel, instead of calculating the influence of the air density by using torque measurements.

Class S - User defined range

	Range
Wind speed V (m/s)	4 to 16
Turbulence intensity	0.03 to 0.12 + 0.96/V
Turbulence structure $\sigma_U/\sigma_V/\sigma_W$	1/0.8/0.5
Air Temperature (°C)	-20 to 30
Air density (kg/m ³)	0.9 to 1.35
Average upflow angle (°)	-3 to 3
Wind direction (°)	0 - 360
Internal heating	not active

Table 1 Class S classification parameters used for classification

Classification index Class S

	-20	-15	-10	-5	0	5	10	15	20	25	30
SN	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C
1130001 Class S	4.8	3.8	2.7	2.5	2.3	2.1	1.9	1.8	1.8	1.8	1.8
1130002 Class S	4.2	3.5	2.7	2.5	2.3	2.1	1.8	1.8	1.8	1.8	1.8
1130003 Class S	4.2	3.5	2.7	2.4	2.0	1.9	1.8	1.8	1.8	1.8	1.8
1130004 Class S	4.3	3.6	2.9	2.7	2.5	2.3	2.2	2.0	1.9	1.9	1.9
1130005 Class S	4.6	3.1	3.1	2.7	2.3	2.0	1.7	1.6	1.5	1.5	1.5
Class 'S' ave	4.4	3.5	2.8	2.6	2.3	2.1	1.9	1.8	1.8	1.8	1.8

Table 2 Classification index Class S for different air temperatures

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Results presented in this report are valid for the items tested only.

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