Comune di Venosa

Regione Basilicata

Comune di Maschito

Committente:

E.ON CLIMATE & RENEWABLES ITALIA S.R.L.
via A. Vespucci, 2 - 20124 Milano
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Titolo del Progetto:

PARCO EOLICO "VENUSIA"

Documento:

PROGETTO DEFINITIVO

Richiesta Autorizzazione Unica ai sensi del D. Lgs. 387 del 29/09/2003

N° Documento: **PEVE-A.5**

ID PROGETTO:	**PEVE**	DISCIPLINA:	**P**	TIPOLOGIA:	**R**	FORMATO:	**A4**

Elaborato:

RELAZIONE SPECIALISTICA - STUDIO ANEMOLOGICO

FOGLIO:		SCALA:		Nome file:	**PEVE_A.5_Studio Anemologico.pdf**

il redattore:

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E.ON Climate & Renewables

Rev:	Data Revisione	Descrizione Revisione	Redatto	Controllato	Approvato
00	13/05/2019	PRIMA EMISSIONE	E.V.C.	Matthew Eberhard	Matthew Eberhard

INDICE

1. INTRODUZIONE

Il presente documento rappresenta la valutazione preliminare di ventosità e di produzione del sito eolico situato nei comuni di Genzano di Lucania e Banzi (PZ) con l'obiettivo di provare il possedimento dei requisiti anemologici richesti dal PIEAR Basilicata paragrafo 1.2.1.5.

2. DESCRIZIONE DEL SITO

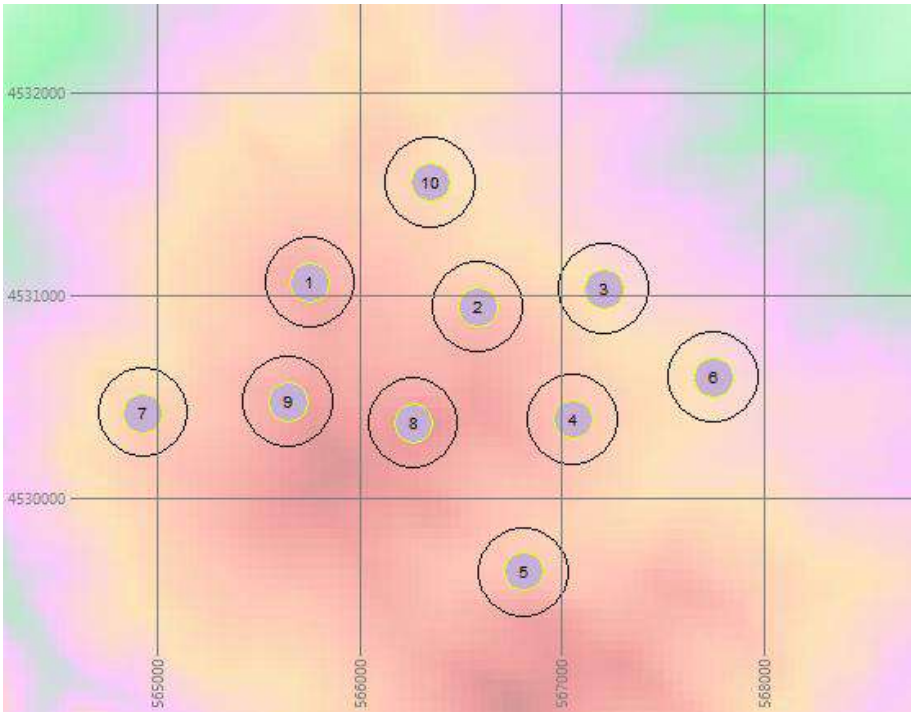
Il sito oggetto dello studio è situato nel Comune di Venosa (PZ).

L'area di posizionamento degli aerogeneratori è caratterizzata da una complessità orografica media con un' altezza compresa tra 630 e 800 metri sul livello del mare.

Si è considerata una temperatura media annua di 15 °C, derivante dalle rilevazioni effettuate presso le stazioni meteo presenti sul sito, perciò la densità media dell'aria nel sito all'altezza del mozzo è: ρ=1,13Kg/m^3 .

Attualmente, l'uso del suolo è in gran parte agricolo. Vi è scarsa copertura vegetazionale arborea e perciò l'area in studio si caratterizza per una rugosità media, caratteristica favorevole per lo sfruttamento eolico. Gli aerogeneratori saranno situati in modo non omogeneo, perpendicolarmente al vento dominante, SO, sfruttando le alture in cui si troveranno le maggiori risorse di vento.

Qui di seguito è indicato il layout proposto del sito.



3. Rilevazioni anemologiche

3.1 Caratteristiche delle Torre di Misura

Per la caratterizzazione anemologica del sito si è utilizzato i dati provenienti da una torre di misurazione anemometrica installata per un periodo di rilevazione di circa tre anni. La torre anemometrica è stata installata seguendo le norme IEC 61400 sul posizionamento dei sensori e sulle dimensioni caratteristiche delle diverse parti che compongono la torre medesima.

I appendice sono allegati:

1. Report di installazione

2. Certificati di Calibrazione dei sensori

La torre presenta le seguenti caratteristiche:

- **Altezza massima:** 60 metri
- **Coordinate:** 590918 E, 4525965 N - UTM WGS84 fuso 33
- **Altitudine: 604 m s.l.m.**
- **Periodo di misurazione:** 24 Marzo 2009 a 20 Marzo 2012.

				Mounting Arrangement			Calibration		Recovery rate after validation [%]
Height (m)	Sensor	Type	Serial Number	Type	Orientation (° True)	Boom Length (cm)	Slope	Offset	
60	Aneo	Thies 4.3350.00.0	0106524	Boom	180	155	0.04781	0.276	92.0
40	Aneo	Thies 4.3350.00.0	0106525	Boom	0	155	0.04782	0.265	91.7
30	Aneo	Thies 4.3350.00.0	0106527	Boom	180	155	0.04786	0.258	91.7
20	Aneo	Thies 4.3350.00.0	0106531	Boom	0	155	0.04774	0.273	95.2
60	Vane	NRG #200P	-	Boom	0	155	-	-	77.5
30	Vane	NRG #200P	-	Boom	0	155	-	-	89.5
6m	Temp	NRG #110S	-	-	-	-	-	-	

Tabella 1

Inoltre a completamento della campagna anemometrica è stata installata una seconda Torre anemometrica avente le seguenti caratteristiche:

- **Altezza massima:** 98 metri
- **Coordinate:** 565895 E, 4530735 N UTM WGS84 fuso 33
- **Altitudine:** 746 m s.l.m.
- **Periodo di misurazione:** minimo un anno completo di misurazioni

Height (m)	Sensor	Type	Serial Number	Type	Orientation (° True)
98	Aneo	Thies First Class	03113578	Top	-
96	Aneo	Thies First Class	0306715	Boom	135
96	Aneo	Risø P2546C	6031	Boom	315
75	Aneo	Thies First Class	0306716	Boom	135
75	Aneo	Risø P2546C	7328	Boom	315
50	Aneo	Thies First Class	0306726	Boom	135
50	Aneo	Risø P2546C	7329	Boom	315
94	Vane	NRG 200P		Boom	135
48	Vane	NRG 200P		Boom	135
96	Temp	Thies	81328	Tower	-
50	Temp	Thies	95051	Tower	-

Tabella 2

4. Analisi dei dati

Prima della modellizzazione, i dati del vento sono stati puliti: i dati d'ombreggiamento e i dati non validi sono stati rimossi, mentre calibrazione e offset degli anemometri e velette sono stati verificati in base ai certificati di calibrazione. Il lavoro di pulizia dei dati è stato eseguito mediante un'ispezione visiva e grafica dei dati del vento disponibili utilizzando il software Windographer v3.0.10.

Sono stati rimossi i seguenti periodi di dati:

- Tutti i sensori tranne l'anemometro da 20 m sono stati rimossi per il periodo dal 6 febbraio 2012 al 20 marzo 2012, a causa della scarsa qualità.
- Altri dati isolati sono stati invalidati a causa della loro bassa qualità.
- L'albero met ha iniziato a registrare i dati nel 2009.03.24 e l'ultimo dato registrato era il 2012.03.20.

Nel complesso sono stati eliminati perchè non validi circa l'8% dei dati rilevati nel periodo 2009.03.24 - 2012.03.20. Il dettaglio dei dati validi nella tabella 1 (Recovery rate after validation).

Nessuna intramast correlation è stata necessaria data la alta disponibilità di dati per ciascun anemometro. Per la stima della velocità del vento all'altezza mozzo è stato utilizzato l'anemometro più alto.

4.1 Wind Shear – Profilo verticale

Il fattore medio esponenziale della legge di potenza è stato calcolato per ogni ora e per ogni direzione.

Start of Data	End of Data	Elevation (m)	Mast Height (m)	Shear Exponent	% Recovery
2009-03-24	2012-03-20	604	60	0.153	92

Tabella 3

4.2 Long Term Adjustment – correzione di lungo periodo

I dati misurati sono stati corretti a lungo termine utilizzando un set di dati virtuali di 20 anni (Vortex 20 year SERIES dataset derived from ERA Interim reanalysis dataset).

La serie temporale della Mast di Genzano è stata correlata al data set di Vortex usando il metodo dei minimi quadrati lineari su base giornaliera. La correlazione ha portato a un R^2 di 0,79 e una correzione a lungo termine di 0.997. Il fattore di scala 0,997 è stato applicato alle serie temporali all'altezza del mozzo. La media risultante di velocità del vento a lungo termine al mozzo è mostrata di seguito.

Start of Data	End of Data	Elevation (m)	MH (m)	% Recovery	Velocità vento altezza mast (m/s)	Velocità vento altezza mast a lungo termine (m/s)	Velocità vento altezza mozzo (112m) a lungo termine (m/s)
20090324	20120320	604	60	92	6.28	6.26	6.83

Tabella 4

4.3 Direzione del vento

La direzione del vento nel sito mostra chiaramente una direzione prevalente del vento del Sud Ovest, sia in frequenza che in energia:

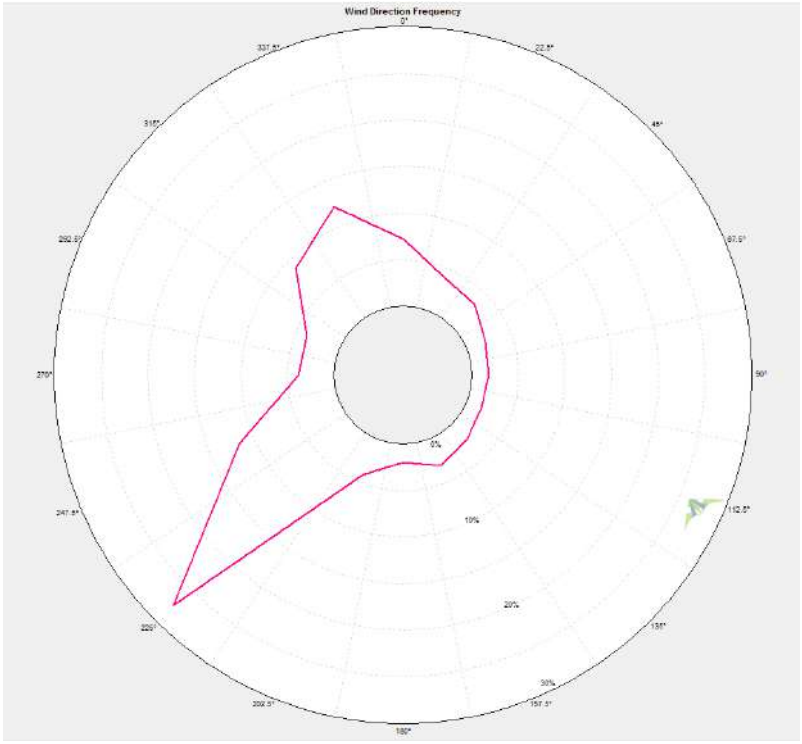


Figura 1. Rosa della frequenza

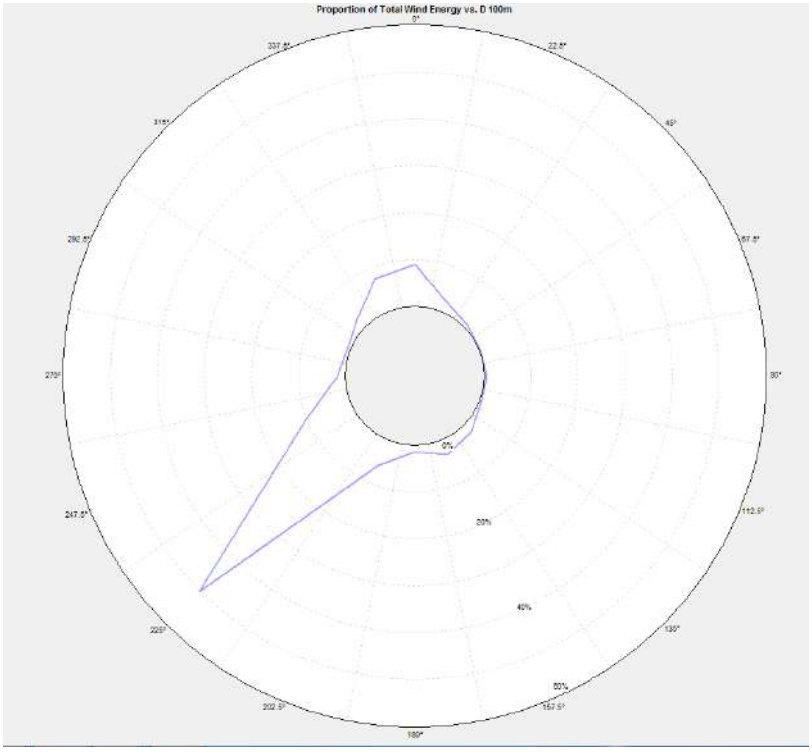


Figura 2 Rosa di Energia

4.4 Velocità media annua del vento a 25m

La Velocità media annua del vento a 25m è stata stimata **in 5,49 m/s.**

4.5 Distribuzione del vento ad altezza mozzo

m/s	0°	30°	60°	90°	120°	150°	180°	210°	240°	270°	300°	330°
0-0.5	0.03%	0.02%	0.02%	0.02%	0.01%	0.02%	0.03%	0.02%	0.03%	0.04%	0.04%	0.03%
0.5-1.5	0.24%	0.24%	0.16%	0.15%	0.14%	0.22%	0.23%	0.26%	0.23%	0.24%	0.28%	0.27%
1.5-2.5	0.60%	0.53%	0.34%	0.37%	0.43%	0.56%	0.50%	0.51%	0.42%	0.38%	0.48%	0.73%
2.5-3.5	0.98%	0.64%	0.30%	0.34%	0.59%	1.09%	0.83%	0.70%	0.52%	0.50%	0.73%	1.40%
3.5-4.5	1.17%	0.66%	0.31%	0.30%	0.52%	1.47%	1.15%	0.76%	0.67%	0.57%	0.95%	2.23%
4.5-5.5	1.22%	0.69%	0.33%	0.23%	0.39%	1.50%	1.23%	0.75%	0.85%	0.68%	1.05%	2.94%
5.5-6.5	1.03%	0.58%	0.29%	0.19%	0.25%	1.53%	0.90%	0.69%	0.92%	0.78%	1.12%	3.21%
6.5-7.5	0.81%	0.43%	0.19%	0.18%	0.16%	1.37%	0.58%	0.57%	0.87%	0.89%	1.06%	3.27%
7.5-8.5	0.62%	0.30%	0.13%	0.12%	0.14%	1.21%	0.37%	0.41%	0.75%	0.82%	1.00%	3.11%
8.5-9.5	0.49%	0.19%	0.10%	0.07%	0.11%	0.92%	0.26%	0.25%	0.63%	0.71%	0.92%	2.85%
9.5-10.5	0.35%	0.12%	0.07%	0.03%	0.09%	0.75%	0.17%	0.18%	0.51%	0.63%	0.81%	2.74%
10.5-11.5	0.25%	0.08%	0.05%	0.02%	0.06%	0.54%	0.13%	0.09%	0.39%	0.43%	0.63%	2.18%
11.5-12.5	0.18%	0.07%	0.04%	0.01%	0.03%	0.33%	0.08%	0.06%	0.30%	0.31%	0.39%	1.67%
12.5-13.5	0.13%	0.06%	0.03%	0.00%	0.03%	0.25%	0.05%	0.05%	0.19%	0.19%	0.18%	1.17%
13.5-14.5	0.09%	0.04%	0.01%	0.00%	0.02%	0.22%	0.03%	0.03%	0.15%	0.15%	0.08%	0.79%
14.5-15.5	0.05%	0.02%	0.00%	0.00%	0.00%	0.14%	0.02%	0.02%	0.09%	0.09%	0.05%	0.55%
15.5-16.5	0.04%	0.02%	0.00%	0.00%	0.00%	0.09%	0.01%	0.02%	0.06%	0.05%	0.02%	0.42%
16.5-17.5	0.02%	0.02%	0.00%	0.00%	0.00%	0.07%	0.00%	0.01%	0.06%	0.03%	0.01%	0.27%
17.5-18.5	0.02%	0.00%	0.00%	0.00%	0.00%	0.02%	0.00%	0.01%	0.03%	0.02%	0.01%	0.19%
18.5-19.5	0.01%	0.00%	0.00%	0.00%	0.00%	0.01%	0.00%	0.00%	0.01%	0.01%	0.00%	0.09%
19.5-20.5	0.01%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.02%	0.01%	0.00%	0.05%
20.5-21.5	0.01%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.00%	0.00%	0.02%
21.5-22.5	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%	0.00%	0.01%
22.5-23.5	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.00%	0.00%	0.01%
23.5-24.5	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%
24.5-25.5	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
25.5-26.5	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
26.5-27.5	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
27.5-28.5	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
28.5-29.5	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
29.5-30.5	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Overall	**8.35%**	**4.71%**	**2.35%**	**2.04%**	**2.98%**	**12.30%**	**6.56%**	**5.41%**	**7.74%**	**7.52%**	**9.82%**	**30.22%**

Tabella 5

5. WIND FLOW MODEL

L'estrapolazione orizzontale dei dati del vento è stata eseguita sulla base del Computational Fluidic Model, WindSim®. La scelta di tale modello è stata fatta sulla base dell'orografia del sito, dato che modelli lineari non sono raccomandati per i siti complessi.

5.1 Orography and Elevation maps

Per le analisi è stata usata una elevation map con una risoluzione verticale di 5m e una rugisità del sito e dei dintorni basata sui seguenti valori:

- Forest 0.5000
- Vegetated Land 0.1000
- Cultivated Land 0.1000
- Clear fell areas 0.0300
- Water 0.0001
- Cities 0.5000

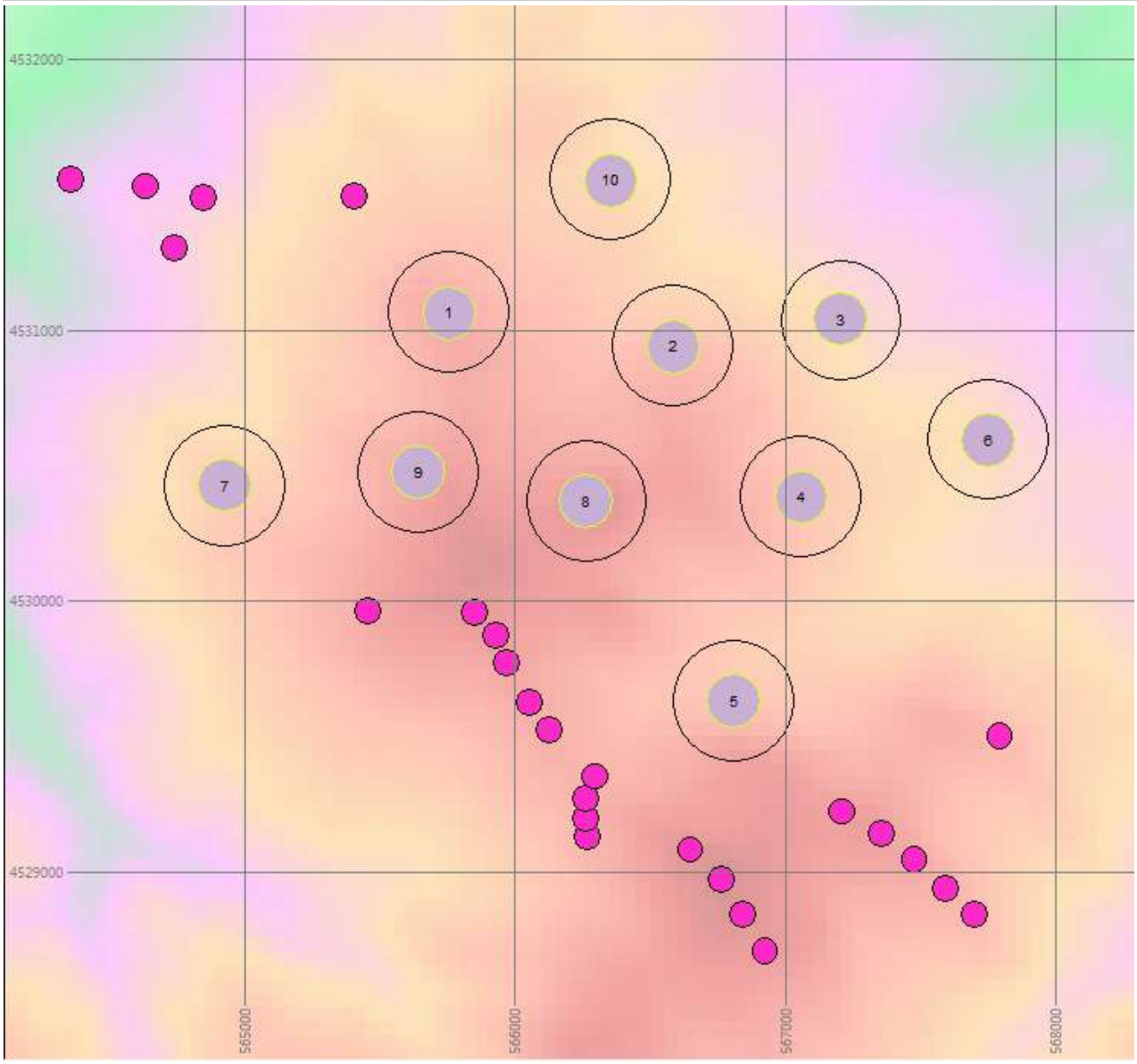
5.2 Energy Calculation

Il calcolo dell'energia è stato effettuato usando il software openWind® e il wake model Deep Array Eddy Viscosity.

La produzione lorda è risulata essere di **142.07** GWh/anno.

5.3 Losses - Perdite

Per le wake losses sono state considerate anche le turbine presenti sul sito in un raggio di 3 km.


4532000
4531000
4530000
4529000
565000
566000
567000
568000
1
2
3
4
5
6
7
8
9
10

Per il calcolo di energia per il parco eolico di Venusia sono state considerate le seguenti perdite:a

- Wakes (Internal and external): calculated
- Electrical efficiency: 3%
- Turbine performance: 3.8%
- Performance degradation: 1%
- Availability: 2.5%

5.4 Incertezze totali

Wind speed uncertainties [%]	
Mast Measurement [%]	2.82%
Period of long-term [yrs]	20
Inter-mast Correlation [%]	0.00%
Long-term correlation [%]	2.14%
Extrapolation to hub height [%]	2.50%
Wind flow model [%]	4.29%
Energy uncertainties [%]	
Wake modeling [%]	0.23%
Windrose [%]	0.00%
Power curve [%]	0.75%
Air density [%]	1.91%
Availability [%]	0.71%
Environmental losses [%]	0.58%
Electrical losses [%]	1.00%

Tabella 6 – incertezze totali

5.6 Risultati

Venusia	Hub Height [m]	Rotor Diameter [m]	Terrain Elevation [m]	Mean Free WS Hub [m/s]	Air Density [kg/m3]	Net Yield [MWh]	Full load hours (net)
TOTALE	112	150	700	6.7	1.134	114762	2732

Tabella 7

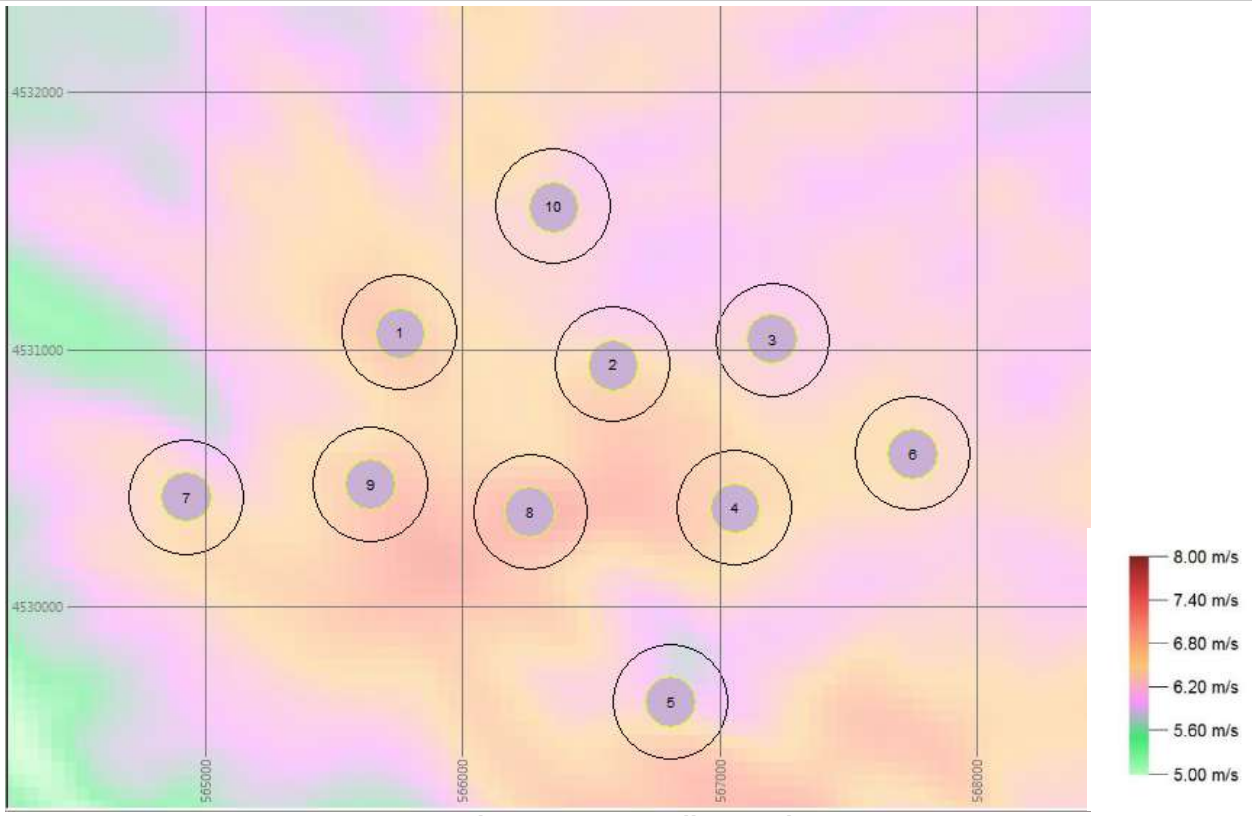


Figura 3. Layout di Venusia

Allegati

1. Report di installazione
2. Certificati di Calibrazione dei sensori

COMMITTENTE

ABN WindEnergy S.r.l.
C/so Italia, 112
80063 Piano di Sorrento (NA)

STAZIONE ANEMOMETRICA DI

GENZANO DI LUCANIA (PZ) H 60

LOCALITÁ

CODICE STAZIONE

06814

Gestione stazione anemometrica
Allegati alla pratica operativa

ALLEGATO A 1 alla pratica operativa

Rapporto di prima installazione stazione

Stazione Anemometrica di	**GENZANO DI LUCANIA (PZ) H 60**
Codice Stazione	**06814**

SITO

Località					
Reticolo **UTM**	Map datum: **European 1950**	Altitudine: **qt. s.l.m. 604**	Zone: **33 T**	Longitudine X: EST **0590991**	Latitudine Y: NORD **4526154**

Suolo	Prevalenza Terra	Misto Terra-Roccia	Prevalenza Roccia
		X	

Terreno	Incolto	Seminativo	Frutteto	Abitativo	Industriale	Pascolo
		X				

Vegetazione	Assente	Brullo	Macchia	Foresta	Alberi Sparsi
		X			

Morfologia	Pianura	Collina	Fondovalle	Altopiano	Sommità	Crinale
		X				

STRUMENTI

Descrizione	Matricola	Tipo	Orientamento direzioni	Orientamento supporti sensori	Lunghezza supporti sensori
Sensore Velocità a m 60	0106524	THIES	----	180°	155 cm
Sensore Velocità a m 40	0106525	THIES	----	0°	155 cm
Sensore Velocità a m 30	0106527	THIES	----	180°	155 cm
Sensore Velocità a m 20	0106531	THIES	----	0°	155 cm
Sensore Velocità a m	----	----	----	----	----
Sensore Direzione a m 60	----	NRG #200P	0°	0°	155 cm
Sensore Direzione a m 30	----	NRG #200P	0°	0°	155 cm
Sensore Direzione a m	----	----	----	----	----
Sensore Direzione a m	----	----	----	----	----
Sensore Pressione a m	----	----			
Sensore Umidità	----	----			
Sensore Temperatura m 6	----	NRG #110S			
Logger	06814	Nomad 2 GSM			
Luce di Segnalazione	SI ~~NO~~				

Memory Card	Compact Flash Card	
Torre tipo	ES 60	**Altezza:** m 60
Cavo schermato tripolare	Cavo UL Style 3×20 AWG	**Metri:** m 62+32
Cavo schermato bipolare	Cavo UL Style 2×20 AWG	**Metri:** m 62+42+32+22
Calata in rame per scarico a terra	Gialloverde Ø 16	**Metri:** m 63
Captatore di fulmini	Asta + captatore di rame	**Metri:** m 3.00
Dispersore di terra	N. 2 puntazze in acciaio ramato	**Metri:** m 1.50

MONTAGGIO

Installatori	EURO SERVICE S.r.l.		
Installazione	Data: **24/03/2009**		
Avvio Logger	Data: **24/03/2009**	Ora: **15.00.00**	
Verifica corretta installazione e registrazione (Allegato A 6)		**SI**	**NO**

Data: **24/03/2009**	Responsabile Montaggio: **Daniele De Ieso**	
	Responsabile Euro Service S.r.l.: **Geom. Giuseppe Russo**	
	Responsabile Gestione: **Dott. Michele Iaccarino**	

ALLEGATO A 2 alla pratica operativa

Rapporto di prima installazione stazione

Stazione Anemometrica di	GENZANO DI LUCANIA (PZ) H 60
Codice Stazione	06814

COMPONENTI STRUTTURALI

Descrizione	Fornitore	Note
n.18 pezzi tubolari da ml 3,00 Ø 152	ES	
n. 6 pezzi tubolari da ml 1,50 Ø 152	ES	
n. 8 stralli compresi di cavi d'acciaio	ES	
n. 96 morsetti chiave 10 per cavi	ES	
n. 12 picchetti da mt 1,50	ES	
n. 1 piastra d'ancoraggio torre	ES	
n. 1 perno d'ancoraggio	ES	
n. 32 tenditori mm 16	ES	
n. 20 grilli mm 16	ES	
n. 32 grilli mm 14	ES	
n. 5 supporti sensori	ES	
n. 1 perno per base	ES	
n. 1 cassetta logger	ES	
Note:		

MONTAGGIO

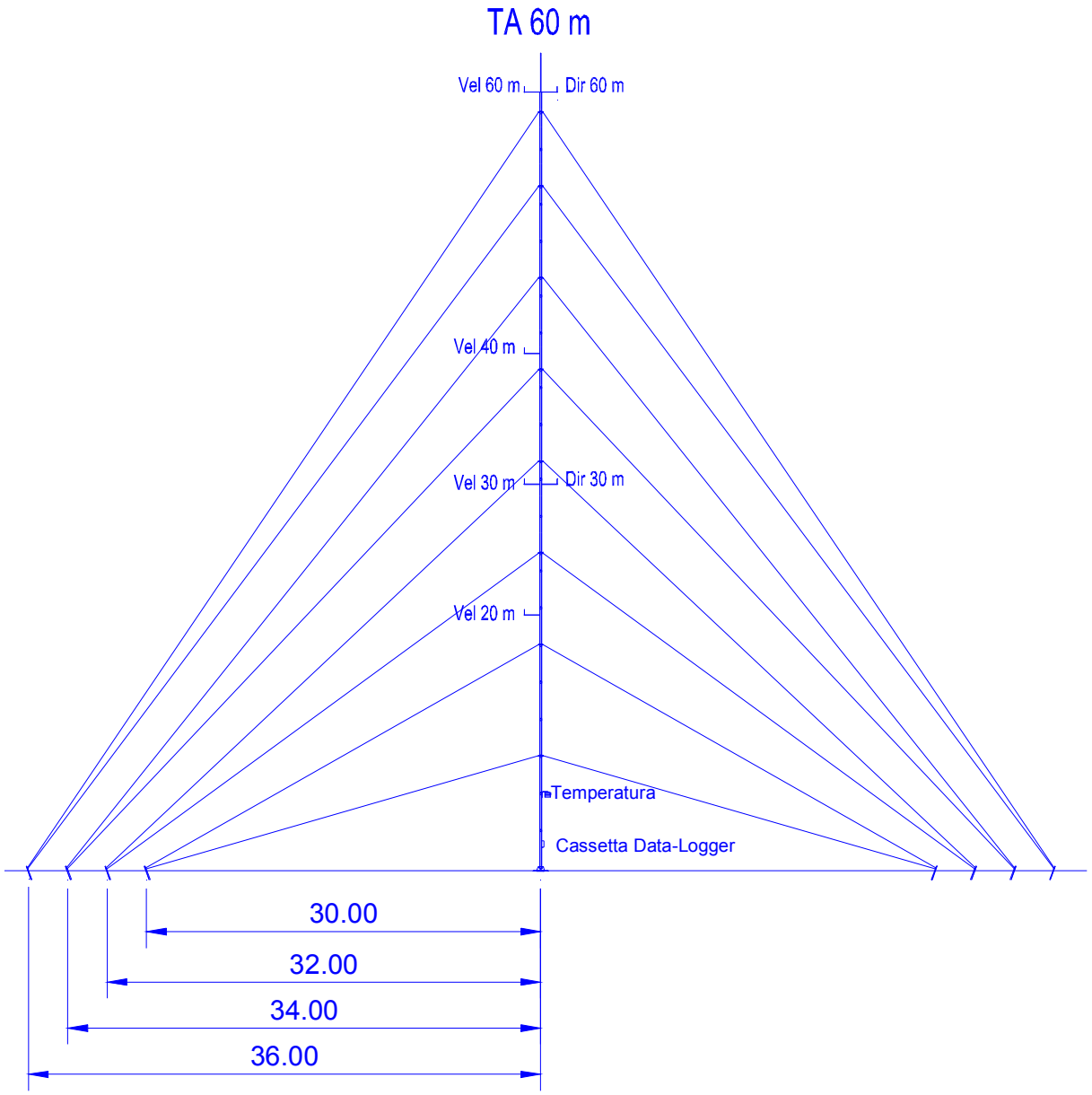
Installatori	EURO SERVICE S.r.l.		
Installazione	Data: 24/03/2009		
Avvio Logger	Data: 24/03/2009	Ora: 15.00.00	
Verifica corretta installazione e registrazione (Allegato A 6)		SI	NO

Data: 24/03/2009	Responsabile Montaggio: Daniele De Ieso	De Ieso Daniele
	Responsabile Euro Service S.r.l.: Geom. Giuseppe Russo	Giuseppe Russo
	Responsabile Gestione: Dott. Michele Iaccarino	

ALLEGATO A 3 alla pratica operativa

Rapporto di prima installazione stazione

Stazione Anemometrica di	**GENZANO DI LUCANIA (PZ) H 60**
Codice Stazione	**06814**



Data: **24/03/2009**

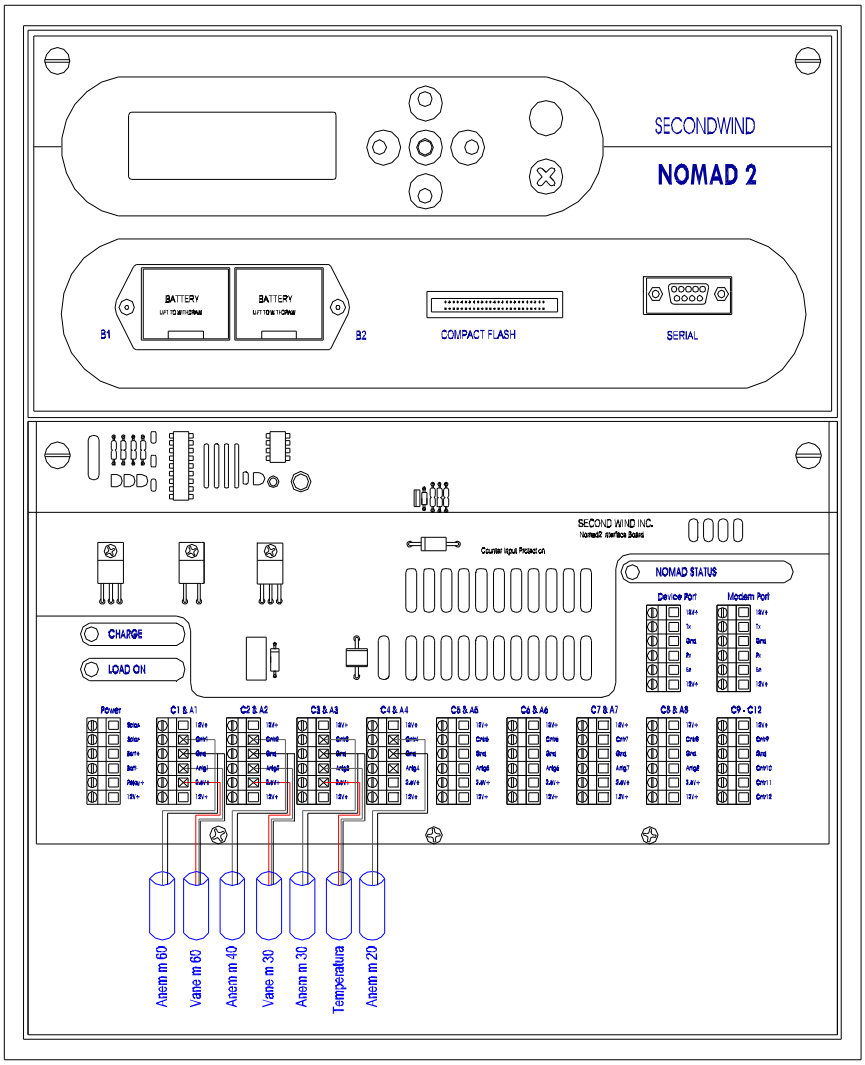
Firma dell'operatore: **Daniele De Ieso**

De Ieso Daniele

ALLEGATO A 4 alla pratica operativa

Rapporto di prima installazione stazione

Stazione Anemometrica di	**GENZANO DI LUCANIA (PZ) H 60**
Codice Stazione	**06814**



Data: **24/03/2009**	Firma dell'operatore: **Daniele De Ieso**

ALLEGATO A 5/1 alla pratica operativa

Rapporto di prima installazione stazione

Stazione Anemometrica di	**GENZANO DI LUCANIA (PZ) H 60**
Codice Stazione	**06814**

Immagine Satellitare del Sito

Data: **24/03/2009**	Firma dell'operatore: **Daniele De Ieso**

ALLEGATO A 5/2 alla pratica operativa

Rapporto di prima installazione stazione

Stazione Anemometrica di	**GENZANO DI LUCANIA (PZ) H 60**
Codice Stazione	**06814**

Foto del sito prima dell'intervento

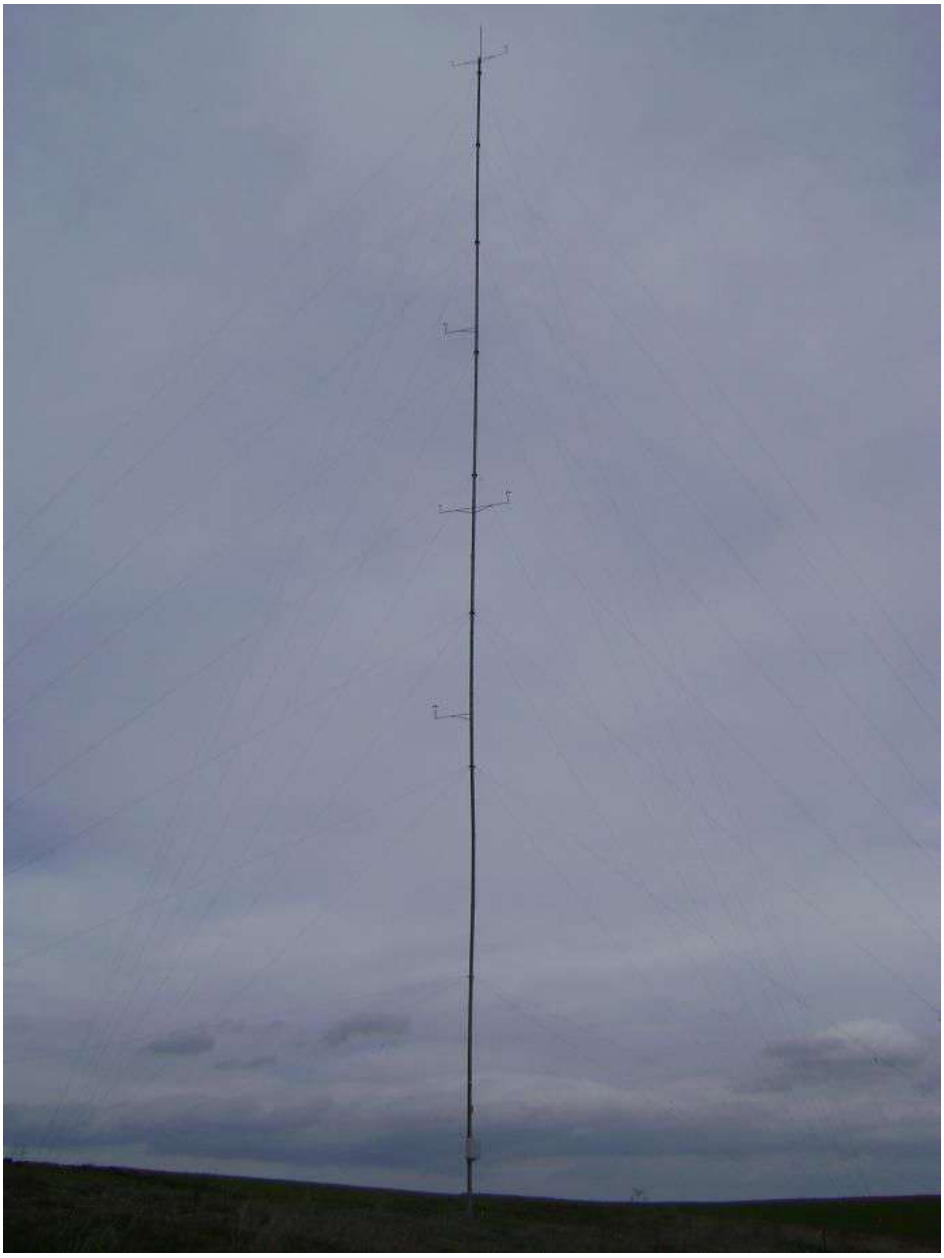
Data: **24/03/2009**	Firma dell'operatore: **Daniele De Ieso**

ALLEGATO A 5/3 alla pratica operativa

Rapporto di prima installazione stazione

Stazione Anemometrica di	**GENZANO DI LUCANIA (PZ) H 60**
Codice Stazione	**06814**

Foto del sito dopo l'intervento



Data: **24/03/2009**	Firma dell'operatore: **Daniele De Ieso**

ALLEGATO A 5/4 alla pratica operativa

Rapporto di prima installazione stazione

Stazione Anemometrica di	**GENZANO DI LUCANIA (PZ) H 60**
Codice Stazione	**06814**

Vista N

Vista NE

Vista E

Vista SE

Data: **24/03/2009**	Firma dell'operatore: **Daniele De Ieso**

ALLEGATO A 5/5 alla pratica operativa

Rapporto di prima installazione stazione

Stazione Anemometrica di	**GENZANO DI LUCANIA (PZ) H 60**
Codice Stazione	**06814**

Vista S

Vista SO

Vista O

Vista NO

Data: **24/03/2009**	Firma dell'operatore: **Daniele De Ieso**

ALLEGATO A 6 alla pratica operativa

Verifica prima installazione

Stazione Anemometrica di	**GENZANO DI LUCANIA (PZ) H 60**
Codice Stazione	**06814**

N° codice sensore di velocità a m 60	**0106524**	**Verifica Struttura**	**C**	**NC**
N° codice sensore di velocità a m 40	**0106525**	Verifica ancoraggi	**X**	
N° codice sensore di velocità a m 30	**0106531**	Tensione degli stralli	**X**	
N° codice sensore di velocità a m 20	**0106531**	Linearità della torre	**X**	
N° codice sensore di velocità a m		Perpendicolarità della torre	**X**	
N° codice sensore di direzione a m 60	**----**	Controllo parafulmine	**X**	
N° codice sensore di direzione a m 30	**----**	Controllo dei supporti	**X**	
N° codice sensore di direzione a m		Controllo angolo di direzione	**X**	
N° codice sensore di direzione a m				
N° codice sensore di pressione a m 3	**----**	**Verifica Trasmissione Dati**		
N° codice sensore di umidità a m		Test e-mail	**X**	
N° codice sensore di temperatura a m 6	**----**	Prova collegamento	**X**	
N° codice logger **Nomad 2 GSM**	**06814**	Copertura GSM	**75%**	

	Verifica Strumentazione Elettrica		**C**	**NC**	**Note**
	Controllo orario e data		**X**		
	ora e data logger	ora attuale			
	15.00.00 24/03/2009	**15.00.00**			
	Controllo voltaggio batterie		**X**		**B1 = 9.60 V; B2 = 9.50 V; P = 13.00 V;**
	Controllo presenza segnale canale C1-A1		**X**		
	Controllo presenza segnale canale C2-A2		**X**		
	Controllo presenza segnale canale C3-A3		**X**		
	Controllo presenza segnale canale C4		**X**		
	Controllo presenza segnale canale ____				
	Controllo presenza segnale canale ____				
	Controllo luce di segnalazione				
	Controllo allacciamento cavi elettrici		**X**		
	Controllo sensore di velocità a m 60		**X**		**10.30 m/s** velocità all'inserimento della scheda
	Controllo sensore di velocità a m 40		**X**		**9.70 m/s** velocità all'inserimento della scheda
	Controllo sensore di velocità a m 30		**X**		**8.30 m/s** velocità all'inserimento della scheda
	Controllo sensore di velocità a m 20		**X**		**7.60 m/s** velocità all'inserimento della scheda
	Controllo sensore di velocità a m				**m/s** velocità all'inserimento della scheda
	Controllo sensore di direzione a m 60		**X**		**214 °** direzione all'inserimento della scheda
	Controllo sensore di direzione a m 30		**X**		**215 °** direzione all'inserimento della scheda
	Controllo sensore di direzione a m				direzione all'inserimento della scheda
	Controllo sensore di direzione a m				direzione all'inserimento della scheda
	Controllo sensore di pressione a m				**mB** pressione all'inserimento della scheda
	Controllo sensore di umidità				**%** umidità all'inserimento della scheda
	Controllo sensore di temperatura a m 6		**X**		**12.80 °C** temperatura all'inserimento della scheda
	Controllo della Memory Card		**X**		**100%** - **534** days left

LEGENDA: C = CONFORME ÷ NC = NON CONFORME

Note aggiuntive:

Data: **24/03/2009**	Firma dell'operatore: **Daniele De Ieso**

ALLEGATO A 7 alla pratica operativa

Rapporto di prima installazione stazione

Stazione Anemometrica di	**GENZANO DI LUCANIA (PZ) H 60**
Codice Stazione	**06814**

RACCOMANDAZIONI IMPORTANTI

È buona norma eseguire un controllo periodico della torre anche se essa è stata studiata per un uso temporaneo e non definitivo nel suo sito d'installazione. Si consiglia di eseguire un controllo dei picchetti e della tensione dei tiranti entro il 1° mese dall'installazione e successivamente ogni tre mesi. È da tenere presente che la tensione dei cavi è soggetta a piccole variazioni in funzione del vento e della temperatura.

Non eseguire alcuna riparazione sui cavi in condizioni di forte vento.

Si raccomanda la revisione periodica della struttura nelle zone di alta concentrazione di salinità (zone costiere) e zone con ambienti corrosivi.

È importante che le installazioni e le manutenzioni delle torri vengano valutate ed eseguite solo da personale specializzato

Data: **24/03/2009**	Firma dell'operatore: **Daniele De Ieso**

ALLEGATO A 8 alla pratica operativa

Rapporto di prima installazione stazione

Stazione Anemometrica di	**GENZANO DI LUCANIA (PZ) H 60**
Codice Stazione	**06814**

CERTIFICATO DI QUALITÁ

PLC Srl
ISPEZIONI
VERIFICHE
CERTIFICAZIONI

00198 Roma
Viale Regina Margherita, 216
Tel. 06.85.35.28.30
Fax 06.85.30.09.69
www.plcert.com
E.mail: info@plcert.com
Iscr. R.E.A. 1074669
C.F. / P.IVA 08118691004

SINCERT
SGQ N°059A

SISTEMA GESTIONE QUALITÀ

CERTIFICATO N° 453/A/2008

Si attesta che il Sistema di Gestione per la Qualità di:

EURO SERVICE S.R.L.

P.zza Roma, 4 – 82020 San Giorgio La Molara (BN)

Applicato nell'Unità Operativa sita in
P.zza Roma, 4 – 82020 San Giorgio La Molara (BN)

È conforme ai requisiti della norma

UNI EN ISO 9001:2000

E valutato secondo le prescrizioni del documento SINCERT RT - 05

Relativamente al seguente campo applicativo:
Progettazione, fornitura, assemblaggio, installazione, manutenzione, rimozione di torri anemometriche e relativa strumentazione.
Elaborazione ed analisi dei dati del vento.

Classificazione EA: 28 - 35

Data 1° emissione	2008-06-03
Data di aggiornamento	2008-06-03
Data di scadenza	2011-06-02

La Direzione
Dott.ssa Antonella De Vitis

La presente certificazione si intende riferita agli aspetti gestionali dell'impresa nel suo complesso ed è utilizzabile ai fini della qualificazione delle imprese di costruzione ai sensi dell'articolo 8 della legge 11 Febbraio 1994 e successive modificazioni e del DPR 25 Gennaio 2000, N° 34.

La validità del presente certificato è subordinata a sorveglianza periodica e al riesame completo del sistema di gestione aziendale con periodicità triennale.

Riferirsi al Manuale della Qualità per i dettagli delle esclusioni dei requisiti della Norma ISO 9001:2000 e per i processi affidati in outsourcing.
Per informazioni puntuali e aggiornate circa eventuali variazioni intervenute nello stato della certificazione di cui al presente certificato, si prega di contattare PLC S.r.l. ai recapiti a lato riportati.

Data: **24/03/2009**	Firma dell'operatore: **Daniele De Ieso**

DEUTSCHER KALIBRIERDIENST DKD

Kalibrierlaboratorium für Strömungsgeschwindigkeit von Luft
Calibration laboratory for velocity of air flow
Akkreditiert durch die / *accredited by the*
Akkreditierungsstelle des DKD bei der
PHYSIKALISCH-TECHNISCHEN BUNDESANSTALT (PTB)

Deutsche WindGuard
Wind Tunnel Services GmbH
Varel

Deutscher Akkreditierungs Rat
DAR
DKD-K- 36801

Kalibrierschein
Calibration Certificate

Kalibrierzeichen *Calibration label*	DKD-K-36801
	06_0061

Gegenstand *Object*	Cup Anemometer
Hersteller *Manufacturer*	Thies Clima D-37083 Göttingen
Typ *Type*	4.3350.00.000
Fabrikat/Serien-Nr. *Serial number*	Body: 0106524 Cup: 0106524
Auftraggeber *Customer*	KinTech Ingeneria S.L. E 50004 Zaragoza
Auftragsnummer *Order No.*	VT06101
Anzahl der Seiten des Kalibrierscheines *Number of pages of the certificate*	3
Datum der Kalibrierung *Date of calibration*	20.01.2006

Dieser Kalibrierschein dokumentiert die Rückführung auf nationale Normale zur Darstellung der Einheiten in Übereinstimmung mit dem Internationalen Einheitensystem (SI).
Der DKD ist Unterzeichner der multi- lateralen 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.
This calibration certificate documents the traceability to national standards, which realize the units of measurement according to the International System of Units (SI).
The DKD 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.

Stempel *Seal*	Datum *Date*	Leiter des Kalibrierlaboratoriums *Head of the calibration laboratory*	Bearbeiter *Person in charge*
Deutscher Kalibrierdienst DKD-K-36801	20.01.2006	Dipl. Phys. D. Westermann	Tech. Ass. Inf. H. Westermann

Deutsche WindGuard Wind Tunnel Services GmbH
Oldenburger Str. 65
26316 Varel ; Tel. ++49 (0)4451 9515 0

DKD-K-36801
06_0061

Kalibriergegenstand
Object Cup Anemometer

Kalibrierverfahren
Calibration procedure MEASNET - Cup Anemometer Calibration Procedure – 09 1997
ISO 3966 – Measurement of fluid in closed conduits - 1977

Ort der Kalibrierung
Place of calibration Windtunnel of Deutsche WindGuard, Varel

Messbedingungen
Test Conditions

wind tunnel area [1]	10000 cm²
anemometer frontal area [2]	230 cm²
diameter of mounting pipe [3]	35 mm
blockage ratio [4]	0.023 [-]
blockage correction [5]	0.998 [-]
average WindGuard reference [6]	203.8 1/s (Thies First Class)
present WindGuard reference [7]	203.4 1/s

Umgebungsbedingungen
Test conditions

air temperature	19.4 deg
air pressure	1009.5 hPa
relative air humidity	46.4 %

Dateiinformation
File info C:\ak\aktuell\06_0061.kor

Anmerkungen
Remarks -

Auswertesoftware
Software version 2.0

[1] Querschnittsfläche der Auslassdüse des Windkanals
[2] Vereinfachte Querschnittsfläche (Schattenwurf) des Prüflings inkl. Montagerohr
[3] Durchmesser des Montagerohrs
[4] Verhältnis von 2) zu 1)
[5] Korrekturfaktor durch die Verdrängung der Strömung durch den Prüfling
[6] Referenzwert des Referenzanemometers bei 10 m/s (Mittelwert)
[7] Aktueller Wert des Referenzanemometers

DKD-K-36801
06_0061

Kalibrierergebnis:
Result:

Anzeige Pruefling	Stroemungs-geschwindigkeit	Erweiterte Messunsicherheit
1/s	m/s	m/s
82.998	4.211	0.09
122.094	6.114	0.07
161.734	8.026	0.07
202.475	9.960	0.08
244.001	11.941	0.09
285.234	13.888	0.10
325.791	15.843	0.11
305.358	14.863	0.10
262.281	12.835	0.09
221.159	10.866	0.08
180.607	8.918	0.07
141.605	7.043	0.07
102.676	5.189	0.08

Angegeben ist die erweiterte Messunsicherheit, die sich aus der Standardmessunsicherheit durch Multiplikation mit dem Erweiterungsfaktor k=2 ergibt. Sie wurde gemäß DKD-3 ermittelt. Der Wert liegt mit einer Wahrscheinlichkeit von 95 % im zugeordneten Wertintervall.

Der Deutsche Kalibrierdienst ist Unterzeichner der multilateralen Übereinkommen der European co-operation for Accreditation (EA) und der International Laboratory Accreditation Cooperation (ILAC) zur gegenseitigen Anerkennung der Kalibrierscheine. Die anderen Unterzeichner aus Europa sind zur Zeit die Akkreditierungsstellen in Belgien, Dänemark, Finnland, Frankreich, Irland, Italien, den Niederlanden, Norwegen, Österreich, Portugal, Schweden, der Schweiz, der Slowakei, Spanien, der Tschechischen Republik und dem Vereinigten Königreich. Außerhalb Europas sind zur Zeit Akkreditierungsstellen der Länder Australien, Brasilien, China, Indien, Japan, Kanada, Neuseeland, Singapur, Südafrika, Taiwan, Vereinigte Staaten von Amerika und Vietnam Mitunterzeichner der Übereinkommen.

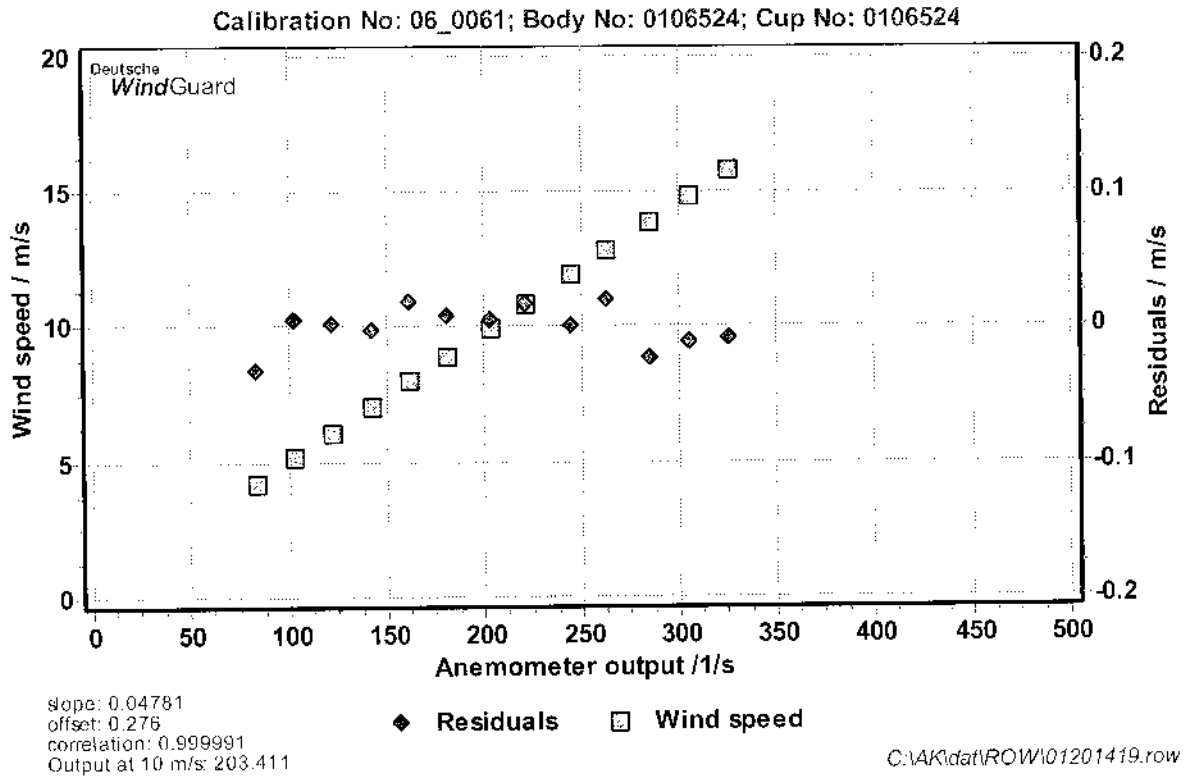
1 Detailed MEASNET[1] Calibration Results

DKD calibration no.	06_0061
Body no.	0106524
Cup no.	0106524
Date	20.01.2006
Air temperature	19.4 deg
Air pressure	1009.5 hPa
Humidity	46.4 %

Linear regression analysis

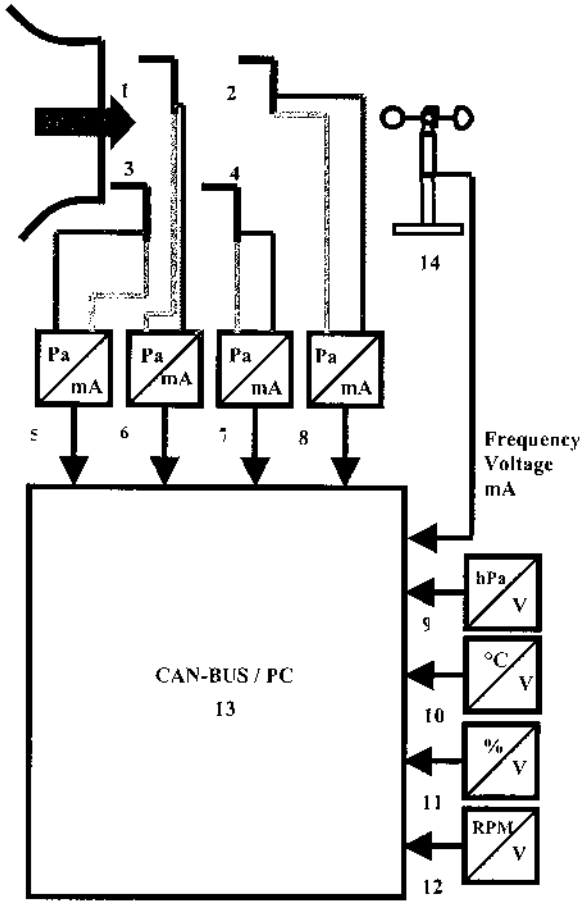
Slope	0.04781 (m/s)/(1/s) ±0.00006 (m/s)/(1/s)
Offset	0.276 m/s ±0.013 m/s
St.err(Y)	0.018 m/s
Correlation coefficient	0.999991

Remarks no



[1]) According to MEASNET Cup Anemometer Calibration Procedure 09/1997.
Deutsche WindGuard Wind Tunnel Services is accredited by MEASNET and by the Deutscher Kalibrierdienst – DKD (German Calibration Service) and Physikalisch Technische Bundesanstalt – PTB (Federal Office for Physics and Technique). Registration: DKD – K – 36801

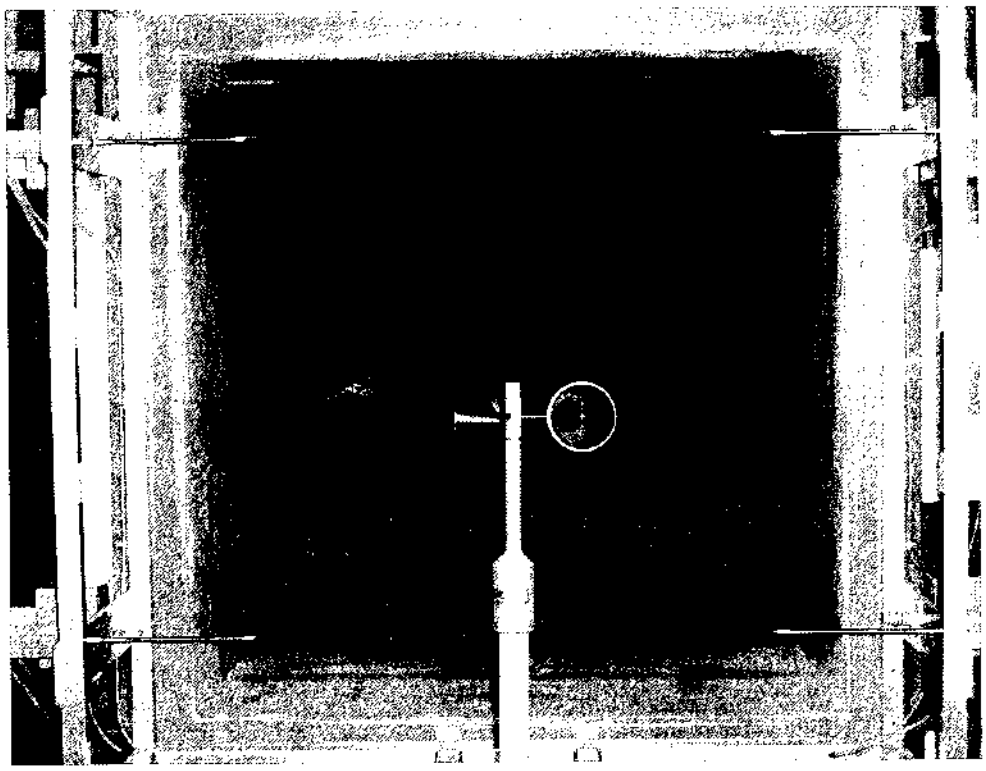
2 Instrumentation



Pos.	Sensor	Manufa.	Identification	Year	Calibration
1	Pitot static tube	Airflow	483/8 Nr. 000142	02	06/02
2	Pitot static tube	Airflow	483/8 Nr. 000143	02	06/02
3	Pitot static tube	Airflow	483/8 Nr. 000144	02	06/02
4	Pitot static tube	Airflow	483/8 Nr. 000145	02	06/02
5	Pressure transducer	Setra	C 239 Nr. 1688081	02	12/04
6	Pressure transducer	Setra	C 239 Nr. 1688082	02	12/04
7	Pressure transducer	Setra	C 239 Nr. 1688083	02	12/04
8	Pressure transducer	Setra	C 239 Nr. 1688084	02	12/04
9	El. Barometer	Vaisala	100 A Nr. X2010004	02	12/04
10	El. Thermometer	Galltec	KPK 1/6-ME	02	12/04
11	El. Humidity sensor	Galltec	KPK 1/6-ME	02	12/04
12	Wind tunnel control	-	-	-	-
13	CAN-BUS / PC	esd	-	04	05/04
14	Anemometer			-	-

Table 1 Description of the data acquisition system

3 Photo of the calibration set up



Measuring set-up of the anemometer calibration in the wind tunnel of Deutsche WindGuard, Varel.
The anemometer shown is of the same type as the calibrated one.
Remark: The proportion of the set-up are not true to scale due to imaging geometry.

4 Deviation to the MEASNET calibration procedure

The calibration procedure is in all aspects in accordance with the IEC 61400 Procedure
(formerly MEASNET Procedure)

5 References

[1] J. Mander, D. Westermann, 08 2005
Verfahrensanweisung DKD-Kalibrierung von Windgeschwindigkeitssensoren

[2] IEC 61400-121 CD
Wind Turbine Power Performance Testing
June 2002

[3] ISO 3966 1977
Measurement of fluid flow in closed conduits

[4] MEASNET
Cup Anemometer Calibration Procedure
09 1997

DEUTSCHER KALIBRIERDIENST DKD

Kalibrierlaboratorium für Strömungsgeschwindigkeit von Luft
Calibration laboratory for velocity of air flow
Akkreditiert durch die / *accredited by the*
Akkreditierungsstelle des DKD bei der
PHYSIKALISCH-TECHNISCHEN BUNDESANSTALT (PTB)

Deutsche WindGuard
Wind Tunnel Services GmbH
Varel

Deutscher Akkreditierungs Rat
DAR
DKD-K- 36801

Kalibrierschein
Calibration Certificate

Kalibrierzeichen / *Calibration label*: DKD-K-36801 **06_0066**

Gegenstand *Object*	Cup Anemometer
Hersteller *Manufacturer*	Thies Clima D-37083 Göttingen
Typ *Type*	4.3350.00.000
Fabrikat/Serien-Nr. *Serial number*	Body: 0106525 Cup: 0106525
Auftraggeber *Customer*	KinTech Ingeneria S.L. E 50004 Zaragoza
Auftragsnummer *Order No.*	VT06101
Anzahl der Seiten des Kalibrierscheines *Number of pages of the certificate*	3
Datum der Kalibrierung *Date of calibration*	20.01.2006

Dieser Kalibrierschein dokumentiert die Rückführung auf nationale Normale zur Darstellung der Einheiten in Übereinstimmung mit dem Internationalen Einheitensystem (SI).
Der DKD ist Unterzeichner der multi- lateralen 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.
This calibration certificate documents the traceability to national standards, which realize the units of measurement according to the International System of Units (SI).
The DKD 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.

Stempel *Seal*	Datum *Date*	Leiter des Kalibrierlaboratoriums *Head of the calibration laboratory*	Bearbeiter *Person in charge*
Deutscher Kalibrierdienst DKD-K- 36801	20.01.2006	Dipl. Phys. D. Westermann	Tech. Ass. Inf. H. Westermann

Deutsche WindGuard Wind Tunnel Services GmbH
Oldenburger Str. 65
26316 Varel ; Tel. ++49 (0)4451 9515 0

measnet

Deutsche WindGuard Wind Tunnel Services

DKD-K-36801
06_0066

Kalibriergegenstand
Object Cup Anemometer

Kalibrierverfahren
Calibration procedure MEASNET - Cup Anemometer Calibration Procedure – 09 1997
ISO 3966 – Measurement of fluid in closed conduits - 1977

Ort der Kalibrierung
Place of calibration Windtunnel of Deutsche WindGuard, Varel

Messbedingungen
Test Conditions

wind tunnel area [1]	10000 cm²
anemometer frontal area [2]	230 cm²
diameter of mounting pipe [3]	35 mm
blockage ratio [4]	0.023 [-]
blockage correction [5]	0.998 [-]
average WindGuard reference [6]	203.8 1/s (Thies First Class)
present WindGuard reference [7]	203.4 1/s

Umgebungsbedingungen
Test conditions

air temperature	19.3 deg
air pressure	1010.0 hPa
relative air humidity	46.3 %

Dateiinformation
File info C:\ak\aktuell\06_0066.kor

Anmerkungen
Remarks -

Auswertesoftware
Software version 2.0

[1] Querschnittsfläche der Auslassdüse des Windkanals
[2] Vereinfachte Querschnittsfläche (Schattenwurf) des Prüflings inkl. Montagerohr
[3] Durchmesser des Montagerohrs
[4] Verhältnis von 2) zu 1)
[5] Korrekturfaktor durch die Verdrängung der Strömung durch den Prüfling
[6] Referenzwert des Referenzanemometers bei 10 m/s (Mittelwert)
[7] Aktueller Wert des Referenzanemometers

DKD-K-
36801
06_0066

Kalibrierergebnis:
Result:

Anzeige Pruefling	Stroemungs-geschwindigkeit	Erweiterte Messunsicherheit
1/s	m/s	m/s
82.715	4.204	0.09
122.323	6.110	0.07
161.966	8.012	0.07
202.270	9.950	0.08
243.944	11.951	0.09
284.715	13.871	0.10
326.054	15.836	0.11
305.554	14.866	0.10
262.310	12.828	0.09
221.565	10.866	0.08
180.283	8.893	0.07
141.690	7.049	0.07
102.630	5.163	0.08

Angegeben ist die erweiterte Messunsicherheit, die sich aus der Standardmessunsicherheit durch Multiplikation mit dem Erweiterungsfaktor k=2 ergibt. Sie wurde gemäß DKD-3 ermittelt. Der Wert liegt mit einer Wahrscheinlichkeit von 95 % im zugeordneten Wertintervall.

Der Deutsche Kalibrierdienst ist Unterzeichner der multilateralen Übereinkommen der European co-operation for Accreditation (EA) und der International Laboratory Accreditation Cooperation (ILAC) zur gegenseitigen Anerkennung der Kalibrierscheine. Die anderen Unterzeichner aus Europa sind zur Zeit die Akkreditierungsstellen in Belgien, Dänemark, Finnland, Frankreich, Irland, Italien, den Niederlanden, Norwegen, Österreich, Portugal, Schweden, der Schweiz, der Slowakei, Spanien, der Tschechischen Republik und dem Vereinigten Königreich. Außerhalb Europas sind zur Zeit Akkreditierungsstellen der Länder Australien, Brasilien, China, Indien, Japan, Kanada, Neuseeland, Singapur, Südafrika, Taiwan, Vereinigte Staaten von Amerika und Vietnam Mitunterzeichner der Übereinkommen.

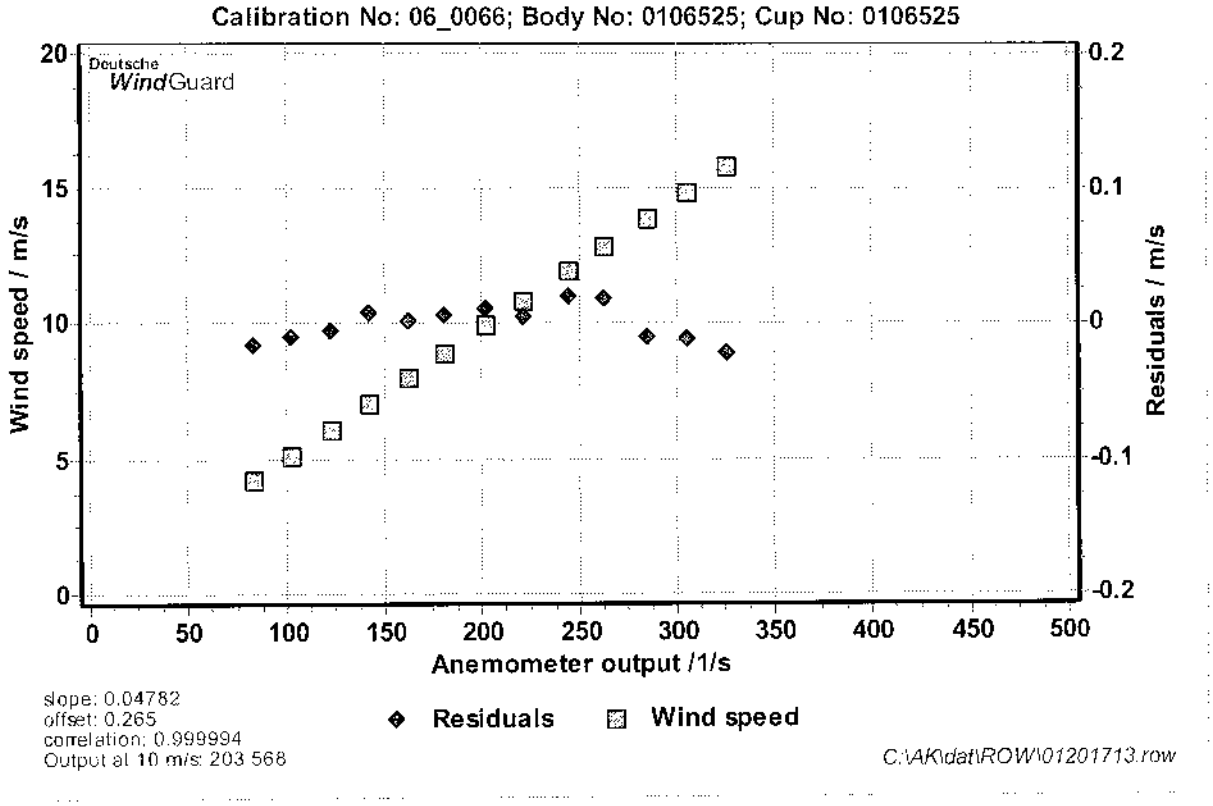
1 Detailed MEASNET[1] *Calibration Results*

DKD calibration no.	06_0066
Body no.	0106525
Cup no.	0106525
Date	20.01.2006
Air temperature	19.3 deg
Air pressure	1010.0 hPa
Humidity	46.3 %

Linear regression analysis

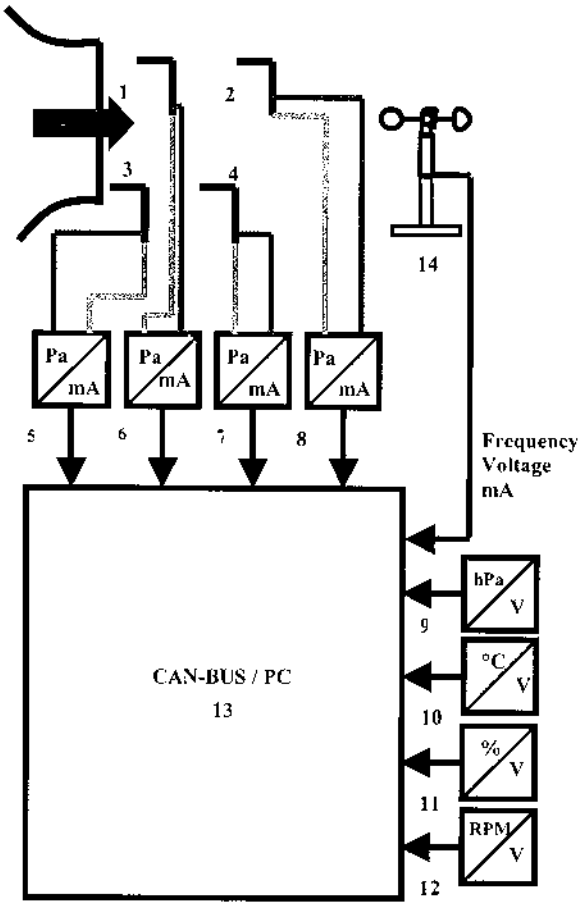
Slope	0.04782 (m/s)/(1/s) ±0.00005 (m/s)/(1/s)
Offset	0.265 m/s ±0.011 m/s
St.err(Y)	0.015 m/s
Correlation coefficient	0.999994

Remarks no



[1]) According to MEASNET Cup Anemometer Calibration Procedure 09/1997.
Deutsche WindGuard Wind Tunnel Services is accredited by MEASNET and by the Deutscher Kalibrierdienst – DKD (German Calibration Service) and Physikalisch Technische Bundesanstalt – PTB (Federal Office for Physics and Technique). Registration: DKD – K – 36801

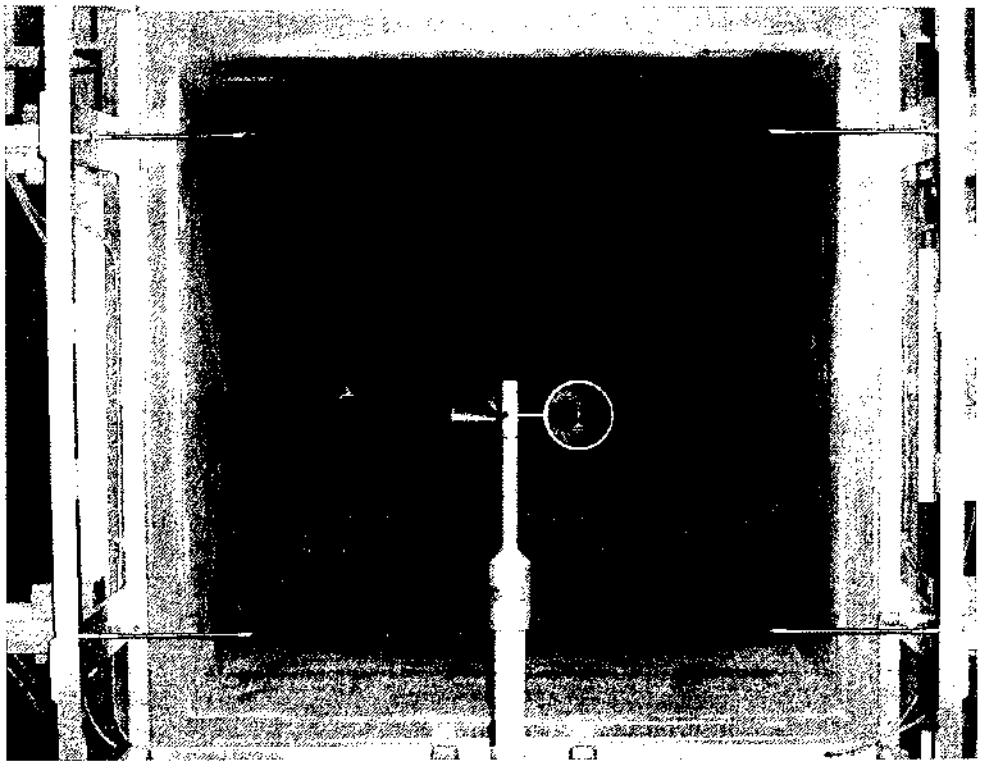
2 Instrumentation



Pos.	Sensor	Manufa.	Identification	Year	Calibration
1	Pitot static tube	Airflow	483/8 Nr. 000142	02	06/02
2	Pitot static tube	Airflow	483/8 Nr. 000143	02	06/02
3	Pitot static tube	Airflow	483/8 Nr. 000144	02	06/02
4	Pitot static tube	Airflow	483/8 Nr. 000145	02	06/02
5	Pressure transducer	Setra	C 239 Nr. 1688081	02	12/04
6	Pressure transducer	Setra	C 239 Nr. 1688082	02	12/04
7	Pressure transducer	Setra	C 239 Nr. 1688083	02	12/04
8	Pressure transducer	Setra	C 239 Nr. 1688084	02	12/04
9	El. Barometer	Vaisala	100 A Nr. X2010004	02	12/04
10	El. Thermometer	Galltec	KPK 1/6-ME	02	12/04
11	El. Humidity sensor	Galltec	KPK 1/6-ME	02	12/04
12	Wind tunnel control	-	-	-	-
13	CAN-BUS / PC	esd	-	04	05/04
14	Anemometer			-	-

Table 1 Description of the data acquisition system

3 Photo of the calibration set up



Measuring set-up of the anemometer calibration in the wind tunnel of Deutsche WindGuard, Varel.
The anemometer shown is of the same type as the calibrated one.
Remark: The proportion of the set-up are not true to scale due to imaging geometry.

4 Deviation to the MEASNET calibration procedure

The calibration procedure is in all aspects in accordance with the IEC 61400 Procedure
(formerly MEASNET Procedure)

5 References

[1] J. Mander, D. Westermann, 08 2005
Verfahrensanweisung DKD-Kalibrierung von Windgeschwindigkeitssensoren

[2] IEC 61400-121 CD
Wind Turbine Power Performance Testing
June 2002

[3] ISO 3966 1977
Measurement of fluid flow in closed conduits

[4] MEASNET
Cup Anemometer Calibration Procedure
09 1997

DEUTSCHER KALIBRIERDIENST DKD

Kalibrierlaboratorium für Strömungsgeschwindigkeit von Luft
Calibration laboratory for velocity of air flow
Akkreditiert durch die / *accredited by the*
Akkreditierungsstelle des DKD bei der
PHYSIKALISCH-TECHNISCHEN BUNDESANSTALT (PTB)

Deutsche WindGuard
Wind Tunnel Services GmbH
Varel

Deutscher Akkreditierungs Rat
DAR
DKD-K- 36801

Kalibrierschein
Calibration Certificate

Kalibrierzeichen / *Calibration label*: DKD-K-36801 / 06_0060

Gegenstand *Object*	Cup Anemometer
Hersteller *Manufacturer*	Thies Clima D-37083 Göttingen
Typ *Type*	4.3350.00.000
Fabrikat/Serien-Nr. *Serial number*	Body: 0106527 Cup: 0106527
Auftraggeber *Customer*	KinTech Ingeneria S.L. E 50004 Zaragoza
Auftragsnummer *Order No.*	VT06101
Anzahl der Seiten des Kalibrierscheines *Number of pages of the certificate*	3
Datum der Kalibrierung *Date of calibration*	20.01.2006

Dieser Kalibrierschein dokumentiert die Rückführung auf nationale Normale zur Darstellung der Einheiten in Übereinstimmung mit dem Internationalen Einheitensystem (SI).
Der DKD ist Unterzeichner der multi- lateralen 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.
This calibration certificate documents the traceability to national standards, which realize the units of measurement according to the International System of Units (SI).
The DKD 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.

Stempel *Seal*	Datum *Date*	Leiter des Kalibrierlaboratoriums *Head of the calibration laboratory*	Bearbeiter *Person in charge*
Deutscher Kalibrierdienst DKD-K- 36801	20.01.2006	Dipl. Phys. D. Westermann	Tech. Ass. Inf. H. Westermann

Deutsche WindGuard Wind Tunnel Services GmbH
Oldenburger Str. 65
26316 Varel ; Tel. ++49 (0)4451 9515 0

DKD-K-36801
06_0060

Kalibriergegenstand
Object Cup Anemometer

Kalibrierverfahren
Calibration procedure MEASNET - Cup Anemometer Calibration Procedure – 09 1997
ISO 3966 – Measurement of fluid in closed conduits - 1977

Ort der Kalibrierung
Place of calibration Windtunnel of Deutsche WindGuard, Varel

Messbedingungen
Test Conditions

wind tunnel area [1]	10000 cm²
anemometer frontal area [2]	230 cm²
diameter of mounting pipe [3]	35 mm
blockage ratio [4]	0.023 [-]
blockage correction [5]	0.998 [-]
average WindGuard reference [6]	203.8 1/s (Thies First Class)
present WindGuard reference [7]	203.4 1/s

Umgebungsbedingungen
Test conditions

air temperature	19.3 deg
air pressure	1010.5 hPa
relative air humidity	46.3 %

Dateiinformation
File info C:\ak\aktuell\06_0060.kor

Anmerkungen
Remarks -

Auswertesoftware
Software version 2.0

[1] Querschnittsfläche der Auslassdüse des Windkanals
[2] Vereinfachte Querschnittsfläche (Schattenwurf) des Prüflings inkl. Montagerohr
[3] Durchmesser des Montagerohrs
[4] Verhältnis von 2) zu 1)
[5] Korrekturfaktor durch die Verdrängung der Strömung durch den Prüfling
[6] Referenzwert des Referenzanemometers bei 10 m/s (Mittelwert)
[7] Aktueller Wert des Referenzanemometers

DKD-K-
36801
06_0060

Kalibrierergebnis:
Result:

Anzeige Pruefling	Stroemungs-geschwindigkeit	Erweiterte Messunsicherheit
1/s	m/s	m/s
82.886	4.207	0.09
122.577	6.113	0.07
162.281	8.024	0.07
202.955	9.962	0.08
244.101	11.944	0.09
284.865	13.884	0.10
325.708	15.842	0.11
305.565	14.868	0.10
262.559	12.825	0.09
220.893	10.862	0.08
180.319	8.906	0.07
141.261	7.030	0.07
102.869	5.182	0.08

Angegeben ist die erweiterte Messunsicherheit, die sich aus der Standardmessunsicherheit durch Multiplikation mit dem Erweiterungsfaktor k=2 ergibt. Sie wurde gemäß DKD-3 ermittelt. Der Wert liegt mit einer Wahrscheinlichkeit von 95 % im zugeordneten Wertintervall.

Der Deutsche Kalibrierdienst ist Unterzeichner der multilateralen Übereinkommen der European co-operation for Accreditation (EA) und der International Laboratory Accreditation Cooperation (ILAC) zur gegenseitigen Anerkennung der Kalibrierscheine. Die anderen Unterzeichner aus Europa sind zur Zeit die Akkreditierungsstellen in Belgien, Dänemark, Finnland, Frankreich, Irland, Italien, den Niederlanden, Norwegen, Österreich, Portugal, Schweden, der Schweiz, der Slowakei, Spanien, der Tschechischen Republik und dem Vereinigten Königreich. Außerhalb Europas sind zur Zeit Akkreditierungsstellen der Länder Australien, Brasilien, China, Indien, Japan, Kanada, Neuseeland, Singapur, Südafrika, Taiwan, Vereinigte Staaten von Amerika und Vietnam Mitunterzeichner der Übereinkommen.

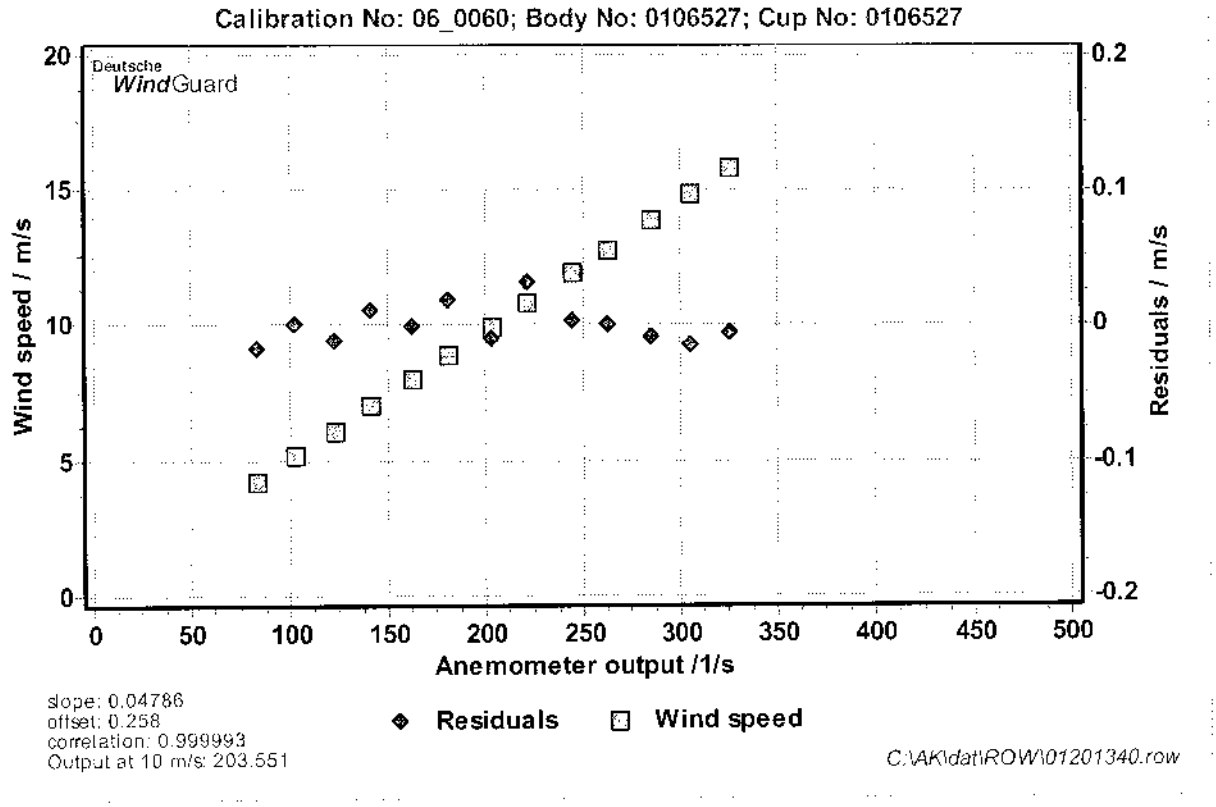
1 Detailed MEASNET[1] Calibration Results

DKD calibration no.	06_0060
Body no.	0106527
Cup no.	0106527
Date	20.01.2006
Air temperature	19.3 deg
Air pressure	1010.5 hPa
Humidity	46.3 %

Linear regression analysis

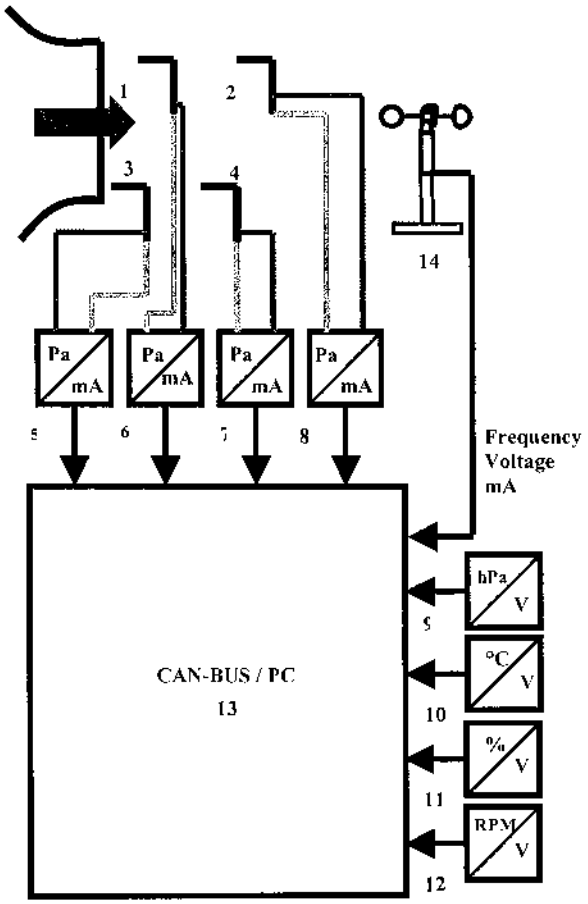
Slope	0.04786 (m/s)/(1/s) ±0.00005 (m/s)/(1/s)
Offset	0.258 m/s ±0.011 m/s
St.err(Y)	0.016 m/s
Correlation coefficient	0.999993

Remarks no



[1]) According to MEASNET Cup Anemometer Calibration Procedure 09/1997.
Deutsche WindGuard Wind Tunnel Services is accredited by MEASNET and by the Deutscher Kalibrierdienst – DKD (German Calibration Service) and Physikalisch Technische Bundesanstalt – PTB (Federal Office for Physics and Technique). Registration: DKD – K – 36801

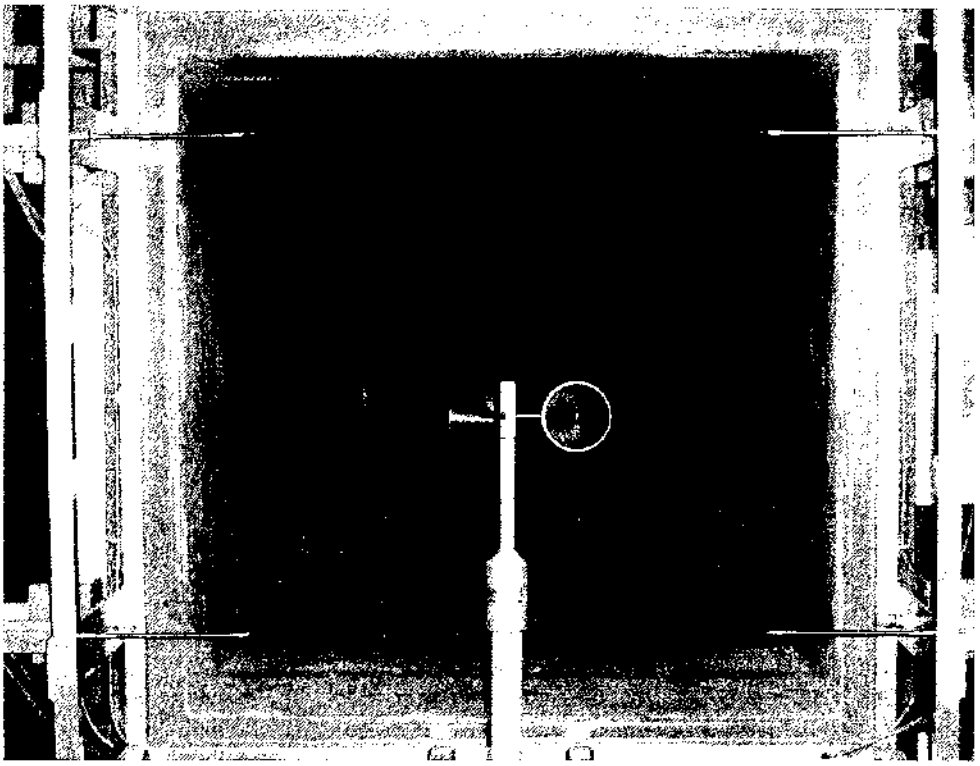
2 Instrumentation



Pos.	Sensor	Manufa.	Identification	Year	Calibration
1	Pitot static tube	Airflow	483/8 Nr. 000142	02	06/02
2	Pitot static tube	Airflow	483/8 Nr. 000143	02	06/02
3	Pitot static tube	Airflow	483/8 Nr. 000144	02	06/02
4	Pitot static tube	Airflow	483/8 Nr. 000145	02	06/02
5	Pressure transducer	Setra	C 239 Nr. 1688081	02	12/04
6	Pressure transducer	Setra	C 239 Nr. 1688082	02	12/04
7	Pressure transducer	Setra	C 239 Nr. 1688083	02	12/04
8	Pressure transducer	Setra	C 239 Nr. 1688084	02	12/04
9	El. Barometer	Vaisala	100 A Nr. X2010004	02	12/04
10	El. Thermometer	Galltec	KPK 1/6-ME	02	12/04
11	El. Humidity sensor	Galltec	KPK 1/6-ME	02	12/04
12	Wind tunnel control	-	-	-	-
13	CAN-BUS / PC	esd	-	04	05/04
14	Anemometer			-	-

Table 1 Description of the data acquisition system

3 Photo of the calibration set up



Measuring set-up of the anemometer calibration in the wind tunnel of Deutsche WindGuard, Varel.
The anemometer shown is of the same type as the calibrated one.
Remark: The proportion of the set-up are not true to scale due to imaging geometry.

4 Deviation to the MEASNET calibration procedure

The calibration procedure is in all aspects in accordance with the IEC 61400 Procedure
(formerly MEASNET Procedure)

5 References

[1] J. Mander, D. Westermann, 08 2005
Verfahrensanweisung DKD-Kalibrierung von Windgeschwindigkeitssensoren

[2] IEC 61400-121 CD
Wind Turbine Power Performance Testing
June 2002

[3] ISO 3966 1977
Measurement of fluid flow in closed conduits

[4] MEASNET
Cup Anemometer Calibration Procedure
09 1997

DEUTSCHER KALIBRIERDIENST DKD

Kalibrierlaboratorium für Strömungsgeschwindigkeit von Luft
Calibration laboratory for velocity of air flow
Akkreditiert durch die / *accredited by the*
Akkreditierungsstelle des DKD bei der
PHYSIKALISCH-TECHNISCHEN BUNDESANSTALT (PTB)

Deutsche WindGuard
Wind Tunnel Services GmbH
Varel

Deutscher Akkreditierungs Rat
DAR
DKD-K- 36801

Kalibrierschein
Calibration Certificate

Kalibrierzeichen / *Calibration label*: DKD-K-36801 **06_0064**

Gegenstand *Object*	Cup Anemometer
Hersteller *Manufacturer*	Thies Clima D-37083 Göttingen
Typ *Type*	4.3350.00.000
Fabrikat/Serien-Nr. *Serial number*	Body: 0106531 Cup: 0106531
Auftraggeber *Customer*	KinTech Ingeneria S.L. E 50004 Zaragoza
Auftragsnummer *Order No.*	VT06101
Anzahl der Seiten des Kalibrierscheines *Number of pages of the certificate*	3
Datum der Kalibrierung *Date of calibration*	20.01.2006

Dieser Kalibrierschein dokumentiert die Rückführung auf nationale Normale zur Darstellung der Einheiten in Übereinstimmung mit dem Internationalen Einheitensystem (SI).
Der DKD ist Unterzeichner der multi- lateralen 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.
This calibration certificate documents the traceability to national standards, which realize the units of measurement according to the International System of Units (SI).
The DKD 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.

Stempel *Seal*	Datum *Date*	Leiter des Kalibrierlaboratoriums *Head of the calibration laboratory*	Bearbeiter *Person in charge*
Deutscher Kalibrierdienst DKD-K- 36801	20.01.2006	Dipl. Phys. D. Westermann	Tech. Ass. Inf. H. Westermann

Deutsche WindGuard Wind Tunnel Services GmbH
Oldenburger Str. 65
26316 Varel ; Tel. ++49 (0)4451 9515 0

meaznet

Deutsche WindGuard Wind Tunnel Services

DKD-K-36801
06_0064

Kalibriergegenstand
Object Cup Anemometer

Kalibrierverfahren
Calibration procedure MEASNET - Cup Anemometer Calibration Procedure – 09 1997
ISO 3966 – Measurement of fluid in closed conduits - 1977

Ort der Kalibrierung
Place of calibration Windtunnel of Deutsche WindGuard, Varel

Messbedingungen
Test Conditions

wind tunnel area [1]	10000 cm²
anemometer frontal area [2]	230 cm²
diameter of mounting pipe [3]	35 mm
blockage ratio [4]	0.023 [-]
blockage correction [5]	0.998 [-]
average WindGuard reference [6]	203.8 1/s (Thies First Class)
present WindGuard reference [7]	203.4 1/s

Umgebungsbedingungen
Test conditions

air temperature	18.7 deg
air pressure	1009.4 hPa
relative air humidity	47.3 %

Dateiinformation
File info C:\ak\aktuell\06_0064.kor

Anmerkungen
Remarks -

Auswertesoftware
Software version 2.0

[1] Querschnittsfläche der Auslassdüse des Windkanals
[2] Vereinfachte Querschnittsfläche (Schattenwurf) des Prüflings inkl. Montagerohr
[3] Durchmesser des Montagerohrs
[4] Verhältnis von 2) zu 1)
[5] Korrekturfaktor durch die Verdrängung der Strömung durch den Prüfling
[6] Referenzwert des Referenzanemometers bei 10 m/s (Mittelwert)
[7] Aktueller Wert des Referenzanemometers

DKD-K-36801
06_0064

Kalibrierergebnis:
Result:

Anzeige Pruefling	Stroemungs-geschwindigkeit	Erweiterte Messunsicherheit
1/s	m/s	m/s
82.766	4.209	0.09
122.564	6.113	0.07
162.217	8.022	0.07
202.439	9.951	0.08
244.204	11.942	0.09
284.690	13.879	0.10
326.523	15.840	0.11
305.901	14.860	0.10
262.766	12.822	0.09
221.417	10.851	0.08
180.961	8.908	0.07
141.393	7.024	0.07
102.612	5.175	0.08

Angegeben ist die erweiterte Messunsicherheit, die sich aus der Standardmessunsicherheit durch Multiplikation mit dem Erweiterungsfaktor k=2 ergibt. Sie wurde gemäß DKD-3 ermittelt. Der Wert liegt mit einer Wahrscheinlichkeit von 95 % im zugeordneten Wertintervall.

Der Deutsche Kalibrierdienst ist Unterzeichner der multilateralen Übereinkommen der European co-operation for Accreditation (EA) und der International Laboratory Accreditation Cooperation (ILAC) zur gegenseitigen Anerkennung der Kalibrierscheine. Die anderen Unterzeichner aus Europa sind zur Zeit die Akkreditierungsstellen in Belgien, Dänemark, Finnland, Frankreich, Irland, Italien, den Niederlanden, Norwegen, Österreich, Portugal, Schweden, der Schweiz, der Slowakei, Spanien, der Tschechischen Republik und dem Vereinigten Königreich. Außerhalb Europas sind zur Zeit Akkreditierungsstellen der Länder Australien, Brasilien, China, Indien, Japan, Kanada, Neuseeland, Singapur, Südafrika, Taiwan, Vereinigte Staaten von Amerika und Vietnam Mitunterzeichner der Übereinkommen.

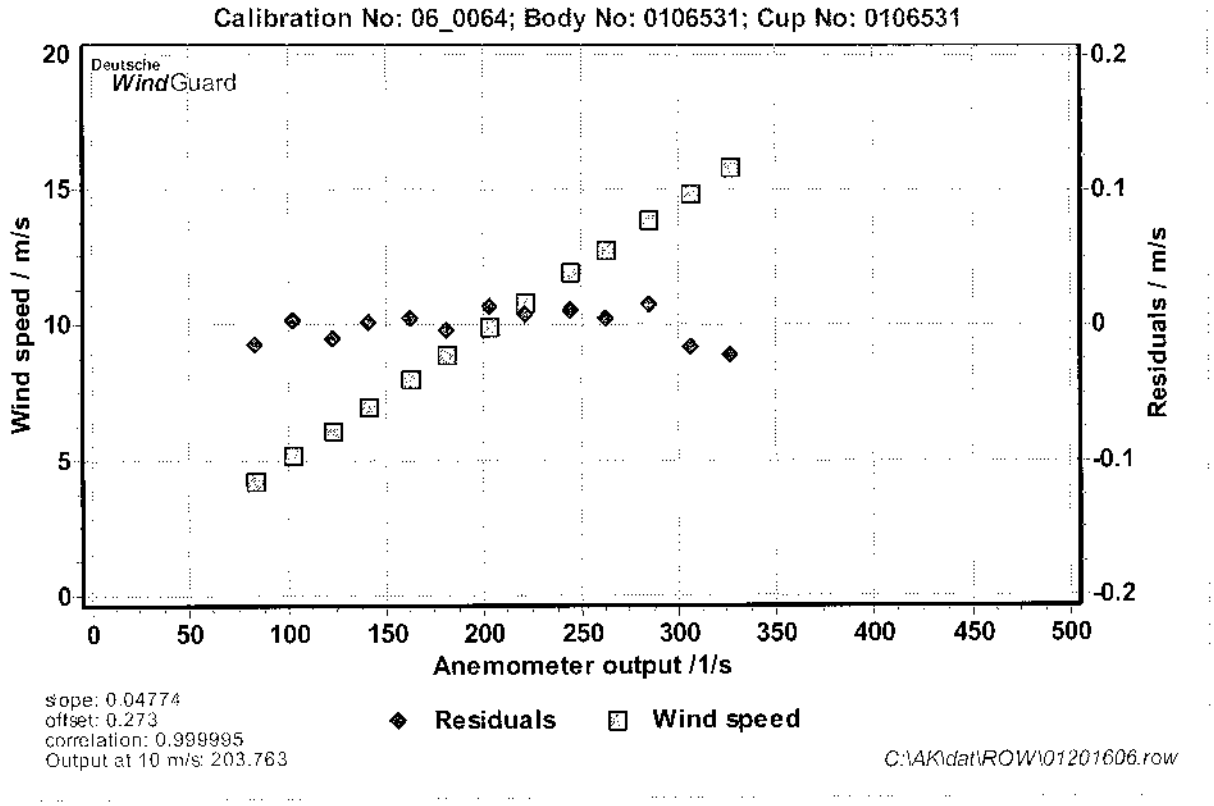
1 Detailed MEASNET[1] *Calibration Results*

DKD calibration no.	06_0064
Body no.	0106531
Cup no.	0106531
Date	20.01.2006
Air temperature	18.7 deg
Air pressure	1009.4 hPa
Humidity	47.3 %

Linear regression analysis

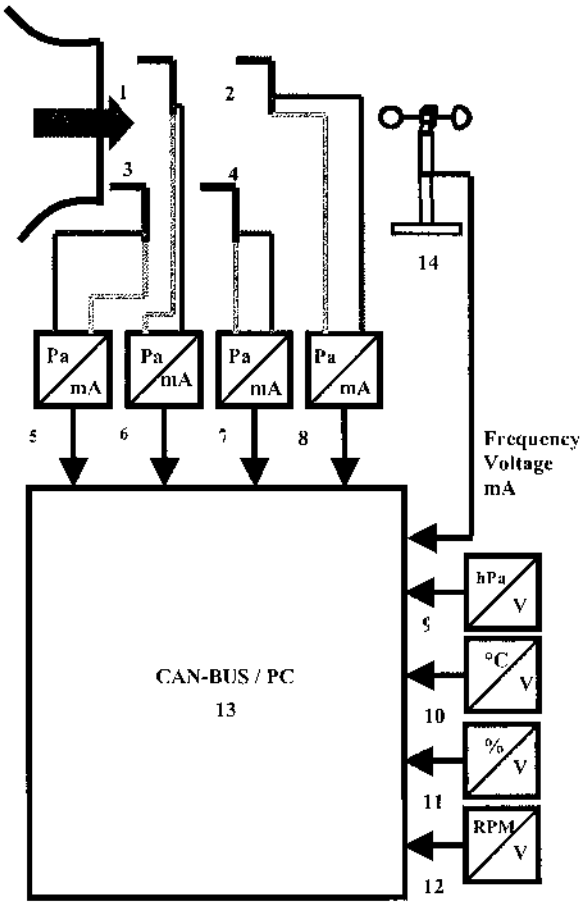
Slope	0.04774 (m/s)/(1/s) ±0.00005 (m/s)/(1/s)
Offset	0.273 m/s ±0.010 m/s
St.err(Y)	0.014 m/s
Correlation coefficient	0.999995

Remarks no



[1]) According to MEASNET Cup Anemometer Calibration Procedure 09/1997.
Deutsche WindGuard Wind Tunnel Services is accredited by MEASNET and by the Deutscher Kalibrierdienst – DKD (German Calibration Service) and Physikalisch Technische Bundesanstalt – PTB (Federal Office for Physics and Technique). Registration: DKD – K – 36801

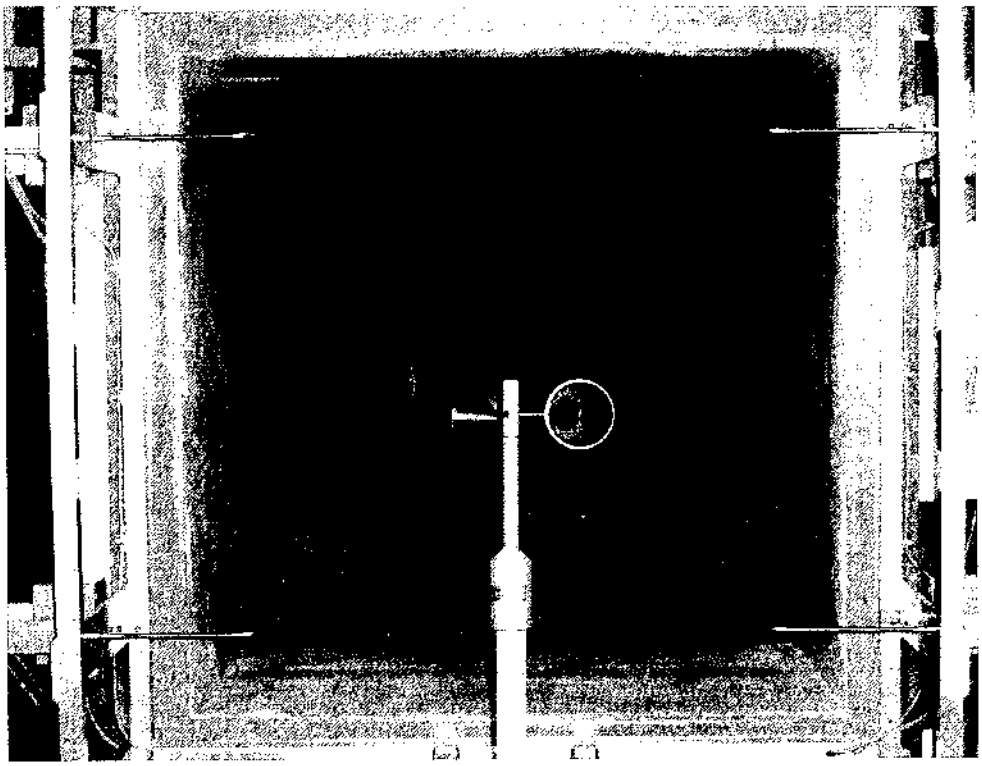
2 Instrumentation



Pos.	Sensor	Manufa.	Identification	Year	Calibration
1	Pitot static tube	Airflow	483/8 Nr. 000142	02	06/02
2	Pitot static tube	Airflow	483/8 Nr. 000143	02	06/02
3	Pitot static tube	Airflow	483/8 Nr. 000144	02	06/02
4	Pitot static tube	Airflow	483/8 Nr. 000145	02	06/02
5	Pressure transducer	Setra	C 239 Nr. 1688081	02	12/04
6	Pressure transducer	Setra	C 239 Nr. 1688082	02	12/04
7	Pressure transducer	Setra	C 239 Nr. 1688083	02	12/04
8	Pressure transducer	Setra	C 239 Nr. 1688084	02	12/04
9	El. Barometer	Vaisala	100 A Nr. X2010004	02	12/04
10	El. Thermometer	Galltec	KPK 1/6-ME	02	12/04
11	El. Humidity sensor	Galltec	KPK 1/6-ME	02	12/04
12	Wind tunnel control	-	-	-	-
13	CAN-BUS / PC	esd	-	04	05/04
14	Anemometer			-	-

Table 1 Description of the data acquisition system

3 Photo of the calibration set up



Measuring set-up of the anemometer calibration in the wind tunnel of Deutsche WindGuard, Varel.
The anemometer shown is of the same type as the calibrated one.
Remark: The proportion of the set-up are not true to scale due to imaging geometry.

4 Deviation to the MEASNET calibration procedure

The calibration procedure is in all aspects in accordance with the IEC 61400 Procedure (formerly MEASNET Procedure)

5 References

[1] J. Mander, D. Westermann, 08 2005
Verfahrensanweisung DKD-Kalibrierung von Windgeschwindigkeitssensoren

[2] IEC 61400-121 CD
Wind Turbine Power Performance Testing
June 2002

[3] ISO 3966 1977
Measurement of fluid flow in closed conduits

[4] MEASNET
Cup Anemometer Calibration Procedure
09 1997

DEUTSCHE
WINDGUARD

Deutsche WindGuard
Wind Tunnel Services GmbH

IECRE and MEASNET approved test laboratory

accredited by the / *akkreditiert durch die*

Deutsche Akkreditierungsstelle GmbH

as calibration laboratory in the / *als Kalibrierlaboratorium im*

Deutschen Kalibrierdienst

DAkkS Deutsche Akkreditierungsstelle D-K-15140-01-00

Calibration certificate *Kalibrierschein*	1813718
Calibration mark *Kalibrierzeichen*	D-K-15140-01-00 09/2018

Object *Gegenstand*	Cup Anemometer
Manufacturer *Hersteller*	Thies Clima D-37083 Göttingen
Type *Typ*	4.3351.00.000
Serial number *Fabrikat/Serien-Nr.*	03113578
Customer *Auftraggeber*	IDNAMIC ITALIA S.r.L IT-82020 Pietrelcina (BN)
Order No. *Auftragsnummer*	A18/19
Project No. *Projektnummer*	VT180886
Number of pages *Anzahl der Seiten*	4
Date of Calibration *Datum der Kalibrierung*	20.09.2018

This calibration certificate documents the 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 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*	Head of the calibration laboratory *Leiter des Kalibrierlaboratoriums*	Person in charge *Bearbeiter*
20.09.2018	Dipl. Phys. Dieter Westermann	Jens-Martin Herold, B. Eng.

1813718
D-K-15140-01-00
09/2018

Calibration object
Kalibriergegenstand

Cup Anemometer

Calibration procedure
Kalibrierverfahren

IEC 61400-12-1:2017

Place of calibration
Ort der Kalibrierung

Wind tunnel of Deutsche WindGuard WindTunnel Services GmbH, Varel

Test conditions
Messbedingungen

wind tunnel area	10000 cm²
anemometer frontal area	230 cm²
diameter of mounting pipe	33.7 mm EN 10217
blockage ratio [1)]	0.023 [-]
software version	P_7.8.05

[1)] Due to the special construction of the test section no blockage correction is necessary.

Ambient conditions
Umgebungsbedingungen

air temperature	25.3 °C ± 0.1 °C
air pressure	1013.1 hPa ± 0.3 hPa
relative air humidity	47.7 % ± 2.0 %

Measurement uncertainty
Messunsicherheit

The expanded 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 DAkkS-DKD-3. The value of the measurand lies within the assigned range of values with a probability of 95%.
The reference flow speed measurement is traceable to the German NMI (Physikalisch-Technische Bundesanstalt) standard for flow speed. It is realized by using a PTB owned and calibrated Laser Doppler Anemometer (Standard Uncertainty 0.2 %, k=2)

Additional remarks
Zusätzliche Anmerkungen

-

1813718
D-K-15140-01-00
09/2018

Calibration result
Kalibrierergebnis

Reference Air velocity m/s	Reference Unc m/s	Test item Output Hz
3.928	0.05	81.127
5.864	0.05	122.796
7.858	0.05	165.710
9.878	0.05	209.050
11.877	0.05	253.406
13.808	0.05	295.621
15.784	0.05	338.280
14.774	0.05	315.485
12.871	0.05	274.804
10.855	0.05	230.426
8.854	0.05	186.771
6.912	0.05	145.122
4.900	0.05	101.200

Statistical analysis

Slope	0.04604 (m/s)/(Hz) ±0.00008 (m/s)/(Hz)
Offset	0.2266 m/s ±0.017 m/s
Standard error (Y)	0.017 m/s
Correlation coefficient	0.999985

Remarks

The calibrated sensor complies with the demanded linearity of MEASNET

1813718
D-K-15140-01-00
09/2018

Graphical representation of the result
Grafische Darstellung des Ergebnisses

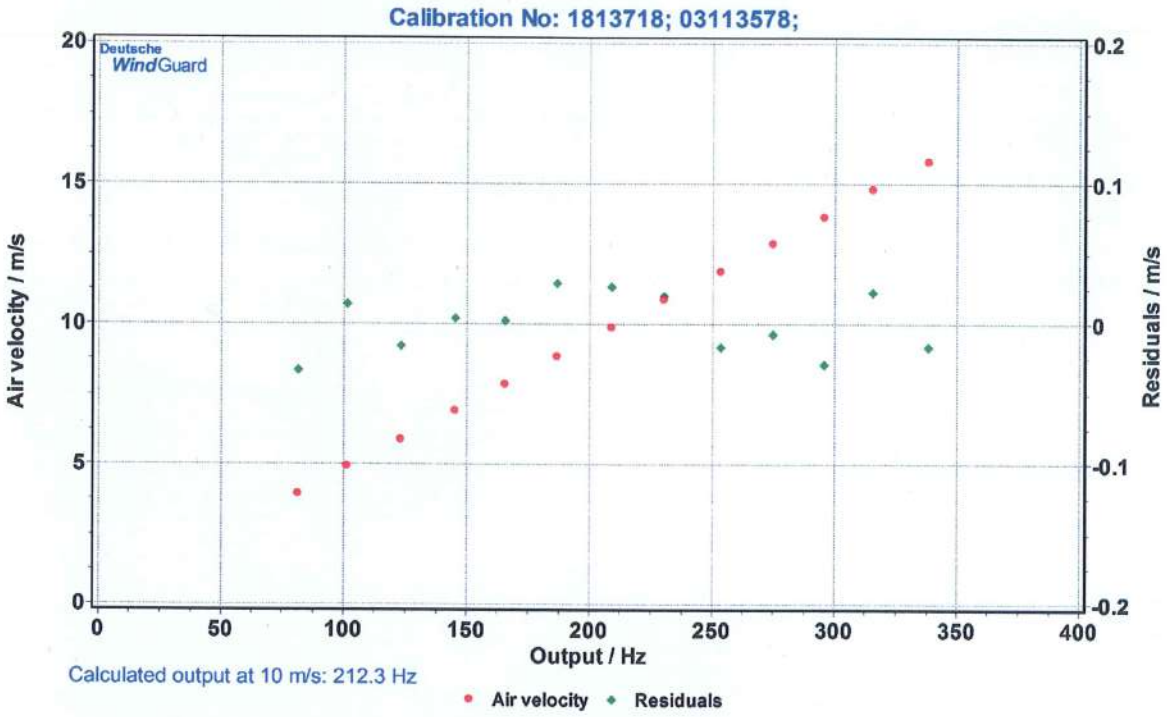


Photo of the measurement setup
Foto des Messaufbaus

Remark: The proportions of the set-up may not be true to scale due to imaging geometry.

DEUTSCHE
WINDGUARD

Deutsche WindGuard
Wind Tunnel Services GmbH

IECRE and MEASNET approved test laboratory

accredited by the / *akkreditiert durch die*

Deutsche Akkreditierungsstelle GmbH

as calibration laboratory in the / *als Kalibrierlaboratorium im*

Deutschen Kalibrierdienst

DAkkS Deutsche Akkreditierungsstelle D-K-15140-01-00

Calibration certificate *Kalibrierschein*	1814176
Calibration mark *Kalibrierzeichen*	D-K-15140-01-00 10/2018

Object *Gegenstand*	Cup Anemometer
Manufacturer *Hersteller*	Thies Clima D-37083 Göttingen
Type *Typ*	4.3350.10.000
Serial number *Fabrikat/Serien-Nr.*	0306726
Customer *Auftraggeber*	IDNAMIC ITALIA S.r.L IT-82020 Pietrelcina (BN)
Order No. *Auftragsnummer*	A18/111
Project No. *Projektnummer*	VT181008
Number of pages *Anzahl der Seiten*	4
Date of Calibration *Datum der Kalibrierung*	24.10.2018

This calibration certificate documents the traceability to national standards, which realize the units of measurement according to the International System of Units (SI).
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Für die Einhaltung einer angemessenen Frist zur Wiederholung der Kalibrierung ist der Benutzer verantwortlich.

Date *Datum*	Head of the calibration laboratory *Leiter des Kalibrierlaboratoriums*	Person in charge *Bearbeiter*
24.10.2018	Dipl. Phys. Dieter Westermann	Techniker Dirk Henninges

1814176
D-K-15140-01-00
10/2018

Calibration object
Kalibriergegenstand

Cup Anemometer

Calibration procedure
Kalibrierverfahren

IEC 61400-12-1:2017

Place of calibration
Ort der Kalibrierung

Wind tunnel of Deutsche WindGuard WindTunnel Services GmbH, Varel

Test conditions
Messbedingungen

wind tunnel area	10000 cm²
anemometer frontal area	230 cm²
diameter of mounting pipe	33.7 mm EN 10217
blockage ratio [1)]	0.023 [-]
software version	P_7.8.07

[1)] Due to the special construction of the test section no blockage correction is necessary.

Ambient conditions
Umgebungsbedingungen

air temperature	21.9 °C ± 0.1 °C
air pressure	1019.7 hPa ± 0.3 hPa
relative air humidity	46.4 % ± 2.0 %

Measurement uncertainty
Messunsicherheit

The expanded 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 DAkkS-DKD-3. The value of the measurand lies within the assigned range of values with a probability of 95%.
The reference flow speed measurement is traceable to the German NMI (Physikalisch-Technische Bundesanstalt) standard for flow speed. It is realized by using a PTB owned and calibrated Laser Doppler Anemometer (Standard Uncertainty 0.2 %, k=2)

Additional remarks
Zusätzliche Anmerkungen

-

1814176
D-K-15140-01-00
10/2018

Calibration result
Kalibrierergebnis

Reference Air velocity m/s	Reference Unc m/s	Test item Output Hz
3.968	0.05	78.399
5.864	0.05	117.722
7.887	0.05	159.655
9.900	0.05	202.127
11.907	0.05	244.145
13.834	0.05	284.624
15.795	0.05	325.758
14.806	0.05	304.318
12.890	0.05	265.100
10.843	0.05	221.661
8.873	0.05	179.881
6.944	0.05	139.294
4.945	0.05	98.313

Statistical analysis

Slope	0.04775 (m/s)/(Hz) ±0.00007 (m/s)/(Hz)
Offset	0.2551 m/s ±0.016 m/s
Standard error (Y)	0.016 m/s
Correlation coefficient	0.999986

Remarks

The calibrated sensor complies with the demanded linearity of MEASNET

1814176
D-K-15140-01-00
10/2018

Graphical representation of the result
Grafische Darstellung des Ergebnisses

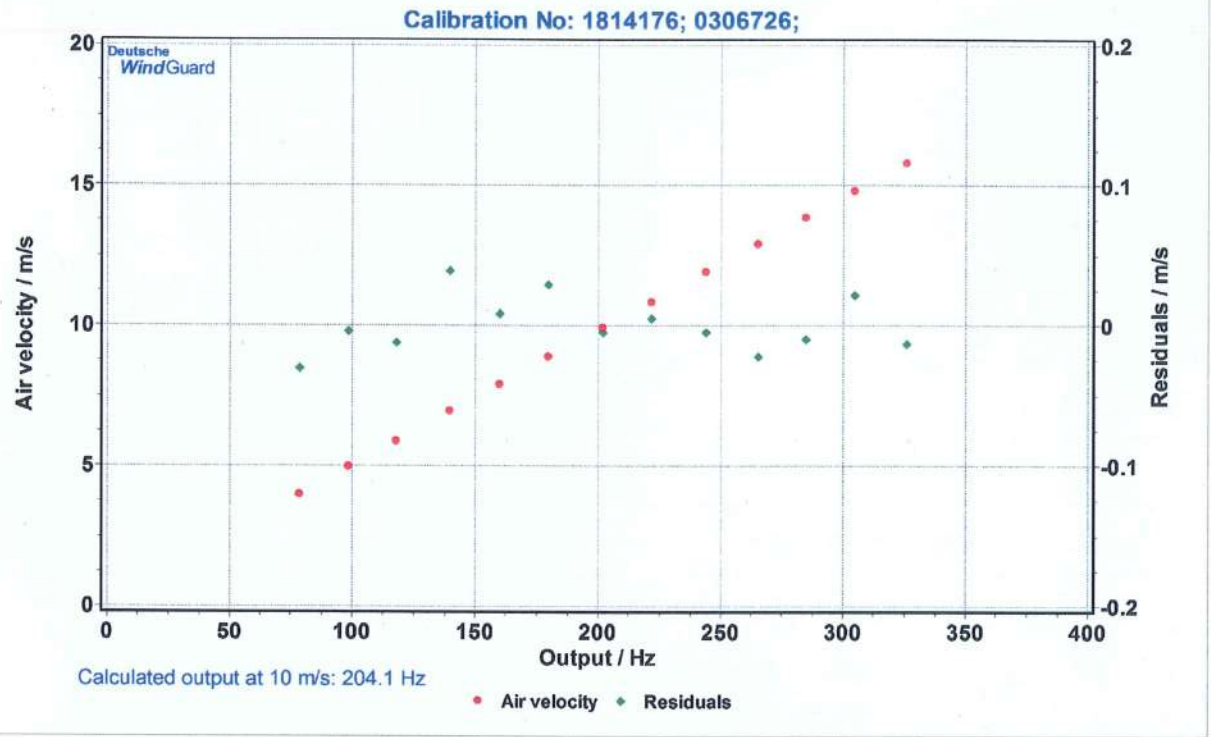

Photo of the measurement setup
Foto des Messaufbaus

Remark: The proportions of the set-up may not be true to scale due to imaging geometry.

DEUTSCHE
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Deutsche Akkreditierungsstelle GmbH

as calibration laboratory in the / *als Kalibrierlaboratorium im*

Deutschen Kalibrierdienst

DKD

DAkkS Deutsche Akkreditierungsstelle D-K-15140-01-00

Calibration certificate *Kalibrierschein*	1814185
Calibration mark *Kalibrierzeichen*	D-K-15140-01-00 10/2018

Object *Gegenstand*	Cup Anemometer
Manufacturer *Hersteller*	Thies Clima D-37083 Göttingen
Type *Typ*	4.3350.10.000
Serial number *Fabrikat/Serien-Nr.*	0306716
Customer *Auftraggeber*	IDNAMIC ITALIA S.r.L IT-82020 Pietrelcina (BN)
Order No. *Auftragsnummer*	A18/111
Project No. *Projektnummer*	VT181008
Number of pages *Anzahl der Seiten*	4
Date of Calibration *Datum der Kalibrierung*	24.10.2018

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Für die Einhaltung einer angemessenen Frist zur Wiederholung der Kalibrierung ist der Benutzer verantwortlich.

Date *Datum*	Head of the calibration laboratory *Leiter des Kalibrierlaboratoriums*	Person in charge *Bearbeiter*
24.10.2018	Dipl. Phys. Dieter Westermann	Jens-Martin Herold, B. Eng.

1814185
D-K-15140-01-00
10/2018

Calibration object
Kalibriergegenstand

Cup Anemometer

Calibration procedure
Kalibrierverfahren

IEC 61400-12-1:2017

Place of calibration
Ort der Kalibrierung

Wind tunnel of Deutsche WindGuard WindTunnel Services GmbH, Varel

Test conditions
Messbedingungen

wind tunnel area	10000 cm²
anemometer frontal area	230 cm²
diameter of mounting pipe	33.7 mm EN 10217
blockage ratio [1)]	0.023 [-]
software version	P_7.8.07

[1)] Due to the special construction of the test section no blockage correction is necessary.

Ambient conditions
Umgebungsbedingungen

air temperature	22.7 °C ± 0.1 °C
air pressure	1020.0 hPa ± 0.3 hPa
relative air humidity	45.9 % ± 2.0 %

Measurement uncertainty
Messunsicherheit

The expanded 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 DAkkS-DKD-3. The value of the measurand lies within the assigned range of values with a probability of 95%.
The reference flow speed measurement is traceable to the German NMI (Physikalisch-Technische Bundesanstalt) standard for flow speed. It is realized by using a PTB owned and calibrated Laser Doppler Anemometer (Standard Uncertainty 0.2 %, k=2)

Additional remarks
Zusätzliche Anmerkungen

-

1814185
D-K-15140-01-00
10/2018

Calibration result
Kalibrierergebnis

Reference Air velocity m/s	Reference Unc m/s	Test item Output Hz
3.967	0.05	78.921
5.869	0.05	117.935
7.868	0.05	159.558
9.894	0.05	201.929
11.900	0.05	243.967
13.843	0.05	284.987
15.807	0.05	325.214
14.810	0.05	305.110
12.906	0.05	264.794
10.855	0.05	221.481
8.874	0.05	180.057
6.918	0.05	139.295
4.913	0.05	97.807

Statistical analysis

Slope	0.04787 (m/s)/(Hz) ±0.00008 (m/s)/(Hz)
Offset	0.2278 m/s ±0.016 m/s
Standard error (Y)	0.016 m/s
Correlation coefficient	0.999986

Remarks

The calibrated sensor complies with the demanded linearity of MEASNET

1814185
D-K-15140-01-00
10/2018

Graphical representation of the result
Grafische Darstellung des Ergebnisses

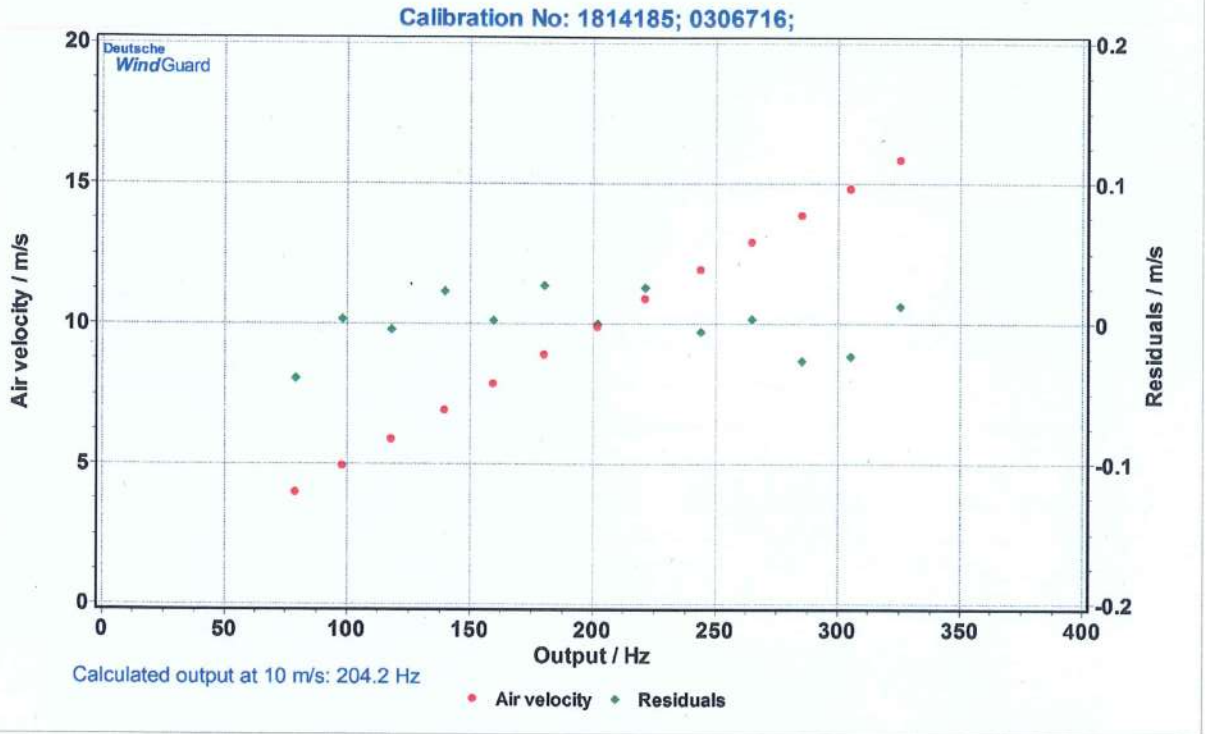

Photo of the measurement setup
Foto des Messaufbaus

Remark: The proportions of the set-up may not be true to scale due to imaging geometry.

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Deutschen Kalibrierdienst DKD

DAkkS Deutsche Akkreditierungsstelle D-K-15140-01-00

Calibration certificate *Kalibrierschein*	1814183
Calibration mark *Kalibrierzeichen*	D-K-15140-01-00 10/2018

Object *Gegenstand*	Cup Anemometer
Manufacturer *Hersteller*	Thies Clima D-37083 Göttingen
Type *Typ*	4.3350.10.000
Serial number *Fabrikat/Serien-Nr.*	0306715
Customer *Auftraggeber*	IDNAMIC ITALIA S.r.L IT-82020 Pietrelcina (BN)
Order No. *Auftragsnummer*	A18/111
Project No. *Projektnummer*	VT181008
Number of pages *Anzahl der Seiten*	4
Date of Calibration *Datum der Kalibrierung*	24.10.2018

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Für die Einhaltung einer angemessenen Frist zur Wiederholung der Kalibrierung ist der Benutzer verantwortlich.

Date *Datum*	Head of the calibration laboratory *Leiter des Kalibrierlaboratoriums*	Person in charge *Bearbeiter*
24.10.2018	Dipl. Phys. Dieter Westermann	Jens-Martin Herold, B. Eng.

1814183
D-K-15140-01-00
10/2018

Calibration object
Kalibriergegenstand

Cup Anemometer

Calibration procedure
Kalibrierverfahren

IEC 61400-12-1:2017

Place of calibration
Ort der Kalibrierung

Wind tunnel of Deutsche WindGuard WindTunnel Services GmbH, Varel

Test conditions
Messbedingungen

wind tunnel area	10000 cm²
anemometer frontal area	230 cm²
diameter of mounting pipe	33.7 mm EN 10217
blockage ratio [1)]	0.023 [-]
software version	P_7.8.07

[1)] Due to the special construction of the test section no blockage correction is necessary.

Ambient conditions
Umgebungsbedingungen

air temperature	22.6 °C ± 0.1 °C
air pressure	1020.5 hPa ± 0.3 hPa
relative air humidity	45.9 % ± 2.0 %

Measurement uncertainty
Messunsicherheit

The expanded 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 DAkkS-DKD-3. The value of the measurand lies within the assigned range of values with a probability of 95%.
The reference flow speed measurement is traceable to the German NMI (Physikalisch-Technische Bundesanstalt) standard for flow speed. It is realized by using a PTB owned and calibrated Laser Doppler Anemometer (Standard Uncertainty 0.2 %, k=2)

Additional remarks
Zusätzliche Anmerkungen

-

1814183
D-K-15140-01-00
10/2018

Calibration result
Kalibrierergebnis

Reference Air velocity m/s	Reference Unc m/s	Test item Output Hz
3.960	0.05	78.799
5.892	0.05	118.660
7.879	0.05	160.163
9.907	0.05	202.116
11.905	0.05	243.572
13.839	0.05	284.818
15.803	0.05	326.439
14.801	0.05	305.046
12.897	0.05	264.819
10.866	0.05	221.908
8.875	0.05	179.996
6.930	0.05	140.219
4.925	0.05	98.330

Statistical analysis		
	Slope	0.04783 (m/s)/(Hz) ±0.00009 (m/s)/(Hz)
	Offset	0.2249 m/s ±0.019 m/s
	Standard error (Y)	0.019 m/s
	Correlation coefficient	0.999982

Remarks

The calibrated sensor complies with the demanded linearity of MEASNET

1814183
D-K-15140-01-00
10/2018

Graphical representation of the result
Grafische Darstellung des Ergebnisses

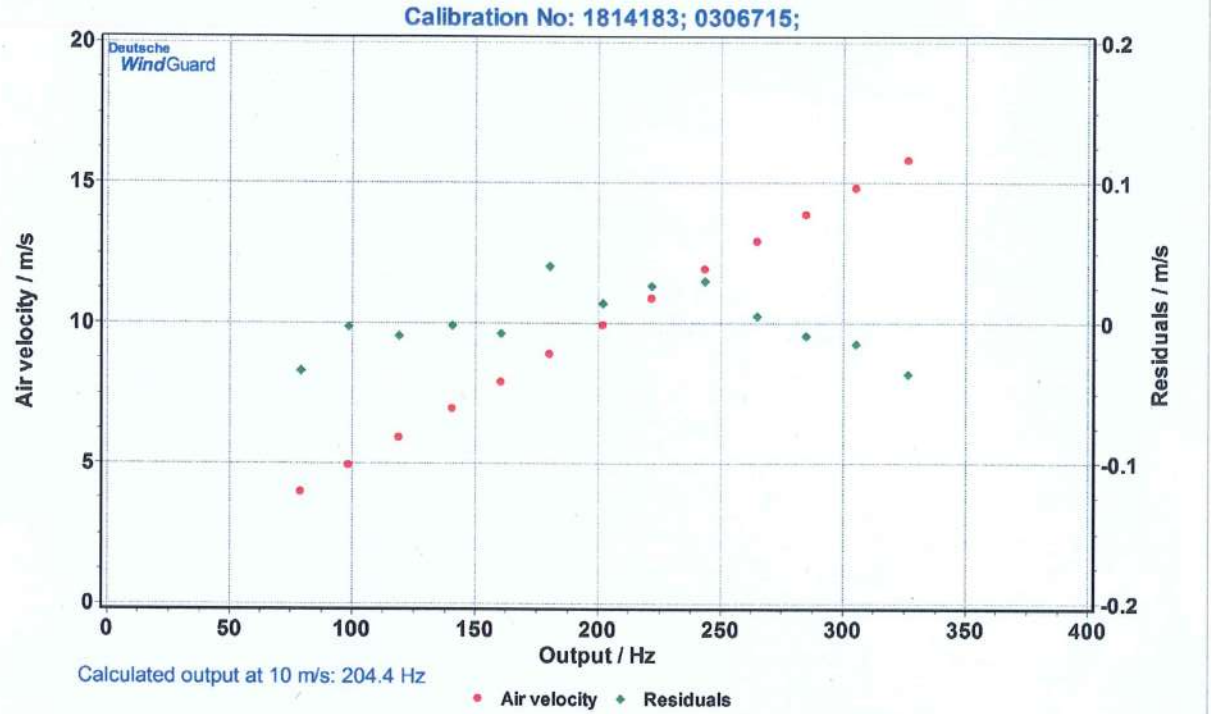
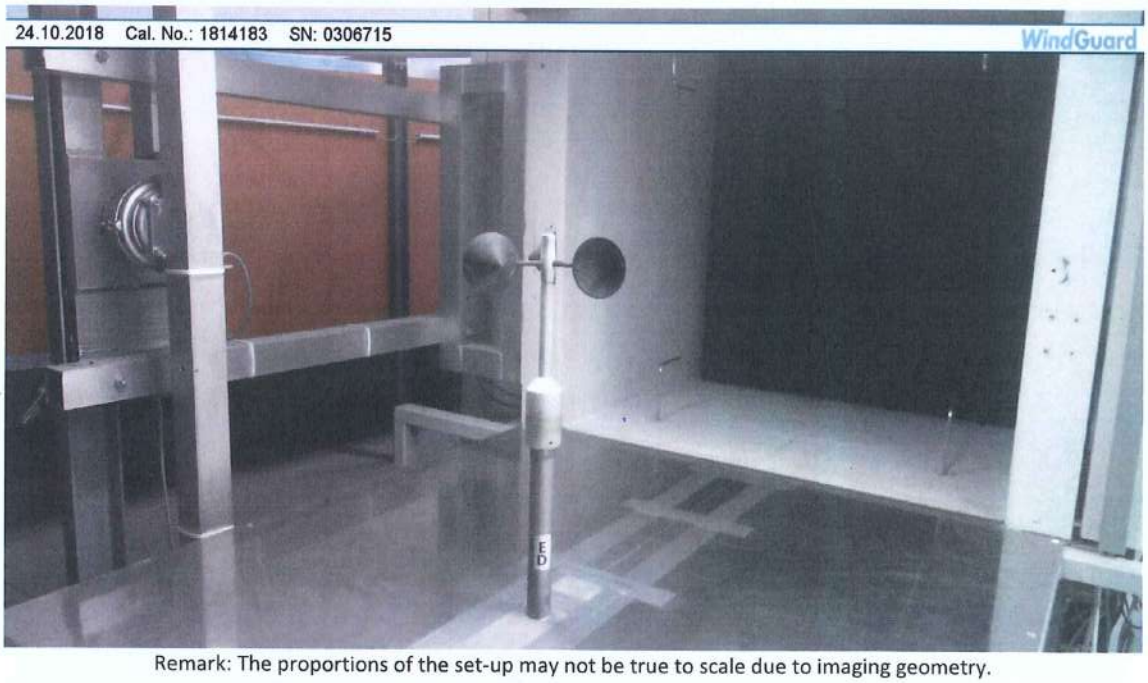


Photo of the measurement setup
Foto des Messaufbaus



Remark: The proportions of the set-up may not be true to scale due to imaging geometry.

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Wind Tunnel Services GmbH

IECRE and MEASNET approved test laboratory

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Deutsche Akkreditierungsstelle GmbH

as calibration laboratory in the / *als Kalibrierlaboratorium im*

Deutschen Kalibrierdienst

DAkkS Deutsche Akkreditierungsstelle D-K-15140-01-00

Calibration certificate *Kalibrierschein*	1814171
Calibration mark *Kalibrierzeichen*	D-K-15140-01-00 10/2018

Object *Gegenstand*	Cup Anemometer
Manufacturer *Hersteller*	WindSensor DK-4000 Roskilde
Type *Typ*	P2546A
Serial number *Fabrikat/Serien-Nr.*	7329
Customer *Auftraggeber*	IDNAMIC ITALIA S.r.L IT-82020 Pietrelcina (BN)
Order No. *Auftragsnummer*	A18/111
Project No. *Projektnummer*	VT181008
Number of pages *Anzahl der Seiten*	4
Date of Calibration *Datum der Kalibrierung*	24.10.2018

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Für die Einhaltung einer angemessenen Frist zur Wiederholung der Kalibrierung ist der Benutzer verantwortlich.

Date *Datum*	Head of the calibration laboratory *Leiter des Kalibrierlaboratoriums*	Person in charge *Bearbeiter*
24.10.2018	Dipl. Phys. Dieter Westermann	Techniker Dirk Henninges

1814171
D-K-15140-01-00
10/2018

Calibration object
Kalibriergegenstand

Cup Anemometer

Calibration procedure
Kalibrierverfahren

IEC 61400-12-1:2017

Place of calibration
Ort der Kalibrierung

Wind tunnel of Deutsche WindGuard WindTunnel Services GmbH, Varel

Test conditions
Messbedingungen

wind tunnel area	10000 cm²
anemometer frontal area	220 cm²
diameter of mounting pipe	25.0 mm
blockage ratio [1)]	0.022 [-]
software version	P_7.8.07

[1)] Due to the special construction of the test section no blockage correction is necessary.

Ambient conditions
Umgebungsbedingungen

air temperature	21.4 °C ± 0.1 °C
air pressure	1018.4 hPa ± 0.3 hPa
relative air humidity	46.8 % ± 2.0 %

Measurement uncertainty
Messunsicherheit

The expanded 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 DAkkS-DKD-3. The value of the measurand lies within the assigned range of values with a probability of 95%.
The reference flow speed measurement is traceable to the German NMI (Physikalisch-Technische Bundesanstalt) standard for flow speed. It is realized by using a PTB owned and calibrated Laser Doppler Anemometer (Standard Uncertainty 0.2 %, k=2)

Additional remarks
Zusätzliche Anmerkungen

-

1814171
D-K-15140-01-00
10/2018

Calibration result
Kalibrierergebnis

Reference Air velocity m/s	Reference Unc m/s	Test item Output Hz
3.952	0.05	6.091
5.885	0.05	9.223
7.875	0.05	12.396
9.907	0.05	15.728
11.918	0.05	18.975
13.855	0.05	22.128
15.812	0.05	25.310
14.826	0.05	23.688
12.910	0.05	20.596
10.869	0.05	17.243
8.873	0.05	14.024
6.940	0.05	10.887
4.924	0.05	7.635

Statistical analysis

Slope	0.61680 (m/s)/(Hz) ±0.00059 (m/s)/(Hz)
Offset	0.2127 m/s ±0.010 m/s
Standard error (Y)	0.010 m/s
Correlation coefficient	0.999995

Remarks

The calibrated sensor complies with the demanded linearity of MEASNET

1814171
D-K-15140-01-00
10/2018

Graphical representation of the result
Grafische Darstellung des Ergebnisses

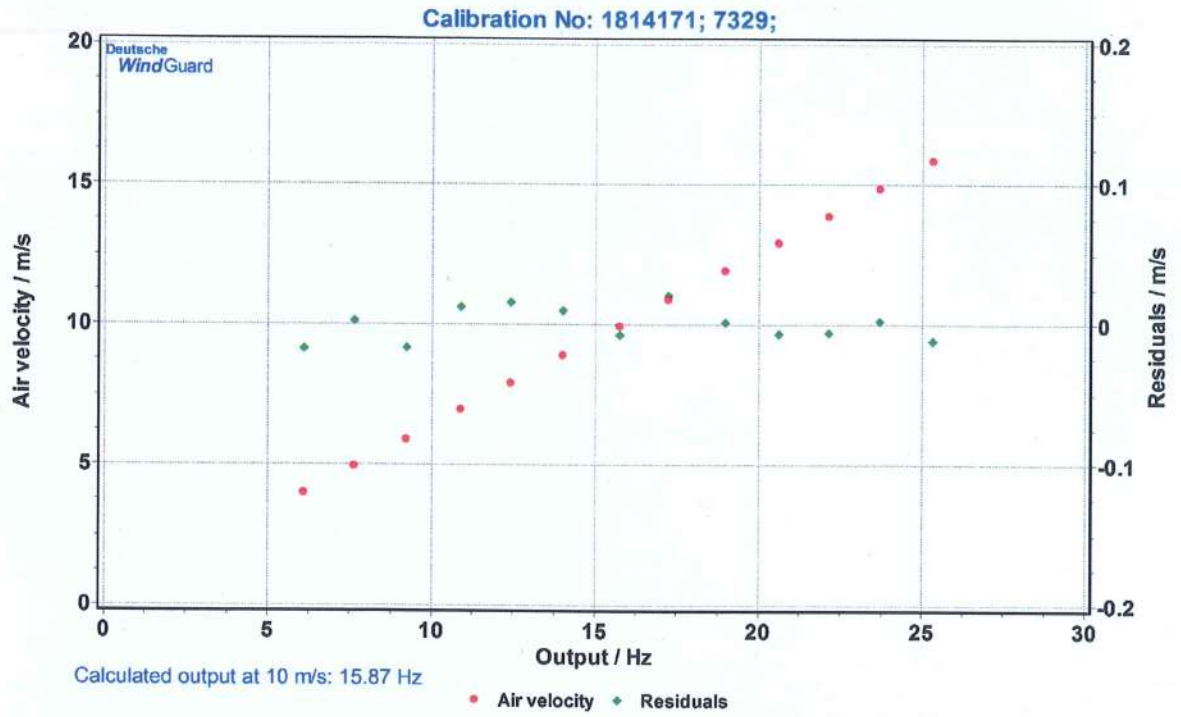

Photo of the measurement setup
Foto des Messaufbaus

Remark: The proportions of the set-up may not be true to scale due to imaging geometry.

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Wind Tunnel Services GmbH

IECRE and MEASNET approved test laboratory

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as calibration laboratory in the / *als Kalibrierlaboratorium im*

Deutschen Kalibrierdienst DKD

DAkkS Deutsche Akkreditierungsstelle D-K-15140-01-00

1814172
D-K-15140-01-00
10/2018

Calibration certificate
Kalibrierschein

Calibration mark
Kalibrierzeichen

Object *Gegenstand*	Cup Anemometer
Manufacturer *Hersteller*	WindSensor DK-4000 Roskilde
Type *Typ*	P2546A
Serial number *Fabrikat/Serien-Nr.*	7328
Customer *Auftraggeber*	IDNAMIC ITALIA S.r.L IT-82020 Pietrelcina (BN)
Order No. *Auftragsnummer*	A18/111
Project No. *Projektnummer*	VT181008
Number of pages *Anzahl der Seiten*	4
Date of Calibration *Datum der Kalibrierung*	24.10.2018

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Date *Datum*	Head of the calibration laboratory *Leiter des Kalibrierlaboratoriums*	Person in charge *Bearbeiter*
24.10.2018	Dipl. Phys. Dieter Westermann	Techniker Dirk Henninges

1814172
D-K- 15140-01-00
10/2018

Calibration object
Kalibriergegenstand

Cup Anemometer

Calibration procedure
Kalibrierverfahren

IEC 61400-12-1:2017

Place of calibration
Ort der Kalibrierung

Wind tunnel of Deutsche WindGuard WindTunnel Services GmbH, Varel

Test conditions
Messbedingungen

wind tunnel area	10000 cm²
anemometer frontal area	220 cm²
diameter of mounting pipe	25.0 mm
blockage ratio [1)]	0.022 [-]
software version	P_7.8.07

[1)] Due to the special construction of the test section no blockage correction is necessary.

Ambient conditions
Umgebungsbedingungen

air temperature	21.5 °C ± 0.1 °C
air pressure	1018.6 hPa ± 0.3 hPa
relative air humidity	46.6 % ± 2.0 %

Measurement uncertainty
Messunsicherheit

The expanded 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 DAkkS-DKD-3. The value of the measurand lies within the assigned range of values with a probability of 95%.
The reference flow speed measurement is traceable to the German NMI (Physikalisch-Technische Bundesanstalt) standard for flow speed. It is realized by using a PTB owned and calibrated Laser Doppler Anemometer (Standard Uncertainty 0.2 %, k=2)

Additional remarks
Zusätzliche Anmerkungen

-

1814172
D-K-15140-01-00
10/2018

Calibration result
Kalibrierergebnis

Reference Air velocity m/s	Reference Unc m/s	Test item Output Hz
3.959	0.05	6.094
5.883	0.05	9.172
7.870	0.05	12.385
9.899	0.05	15.663
11.913	0.05	18.937
13.843	0.05	22.067
15.798	0.05	25.259
14.818	0.05	23.632
12.907	0.05	20.509
10.849	0.05	17.199
8.884	0.05	13.950
6.934	0.05	10.851
4.923	0.05	7.571

Statistical analysis

Slope	0.61709 (m/s)/(Hz) ±0.00092 (m/s)/(Hz)
Offset	0.2331 m/s ±0.015 m/s
Standard error (Y)	0.016 m/s
Correlation coefficient	0.999988

Remarks

The calibrated sensor complies with the demanded linearity of MEASNET

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Graphical representation of the result
Grafische Darstellung des Ergebnisses

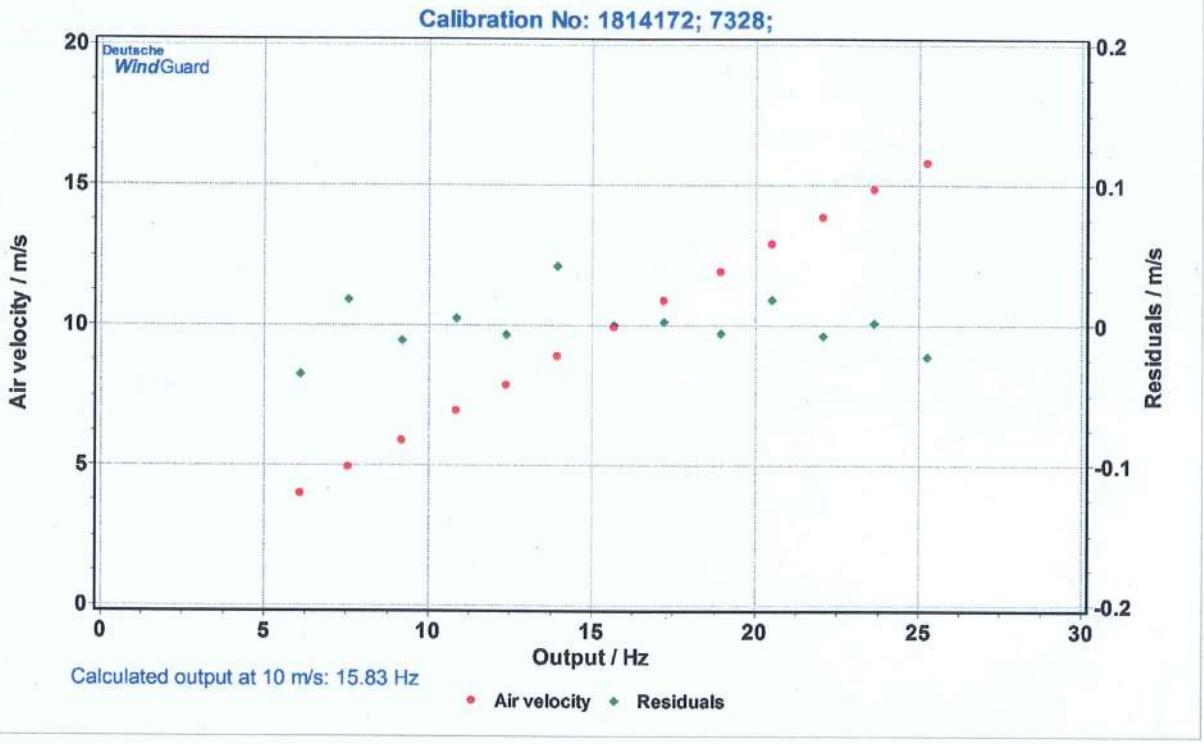
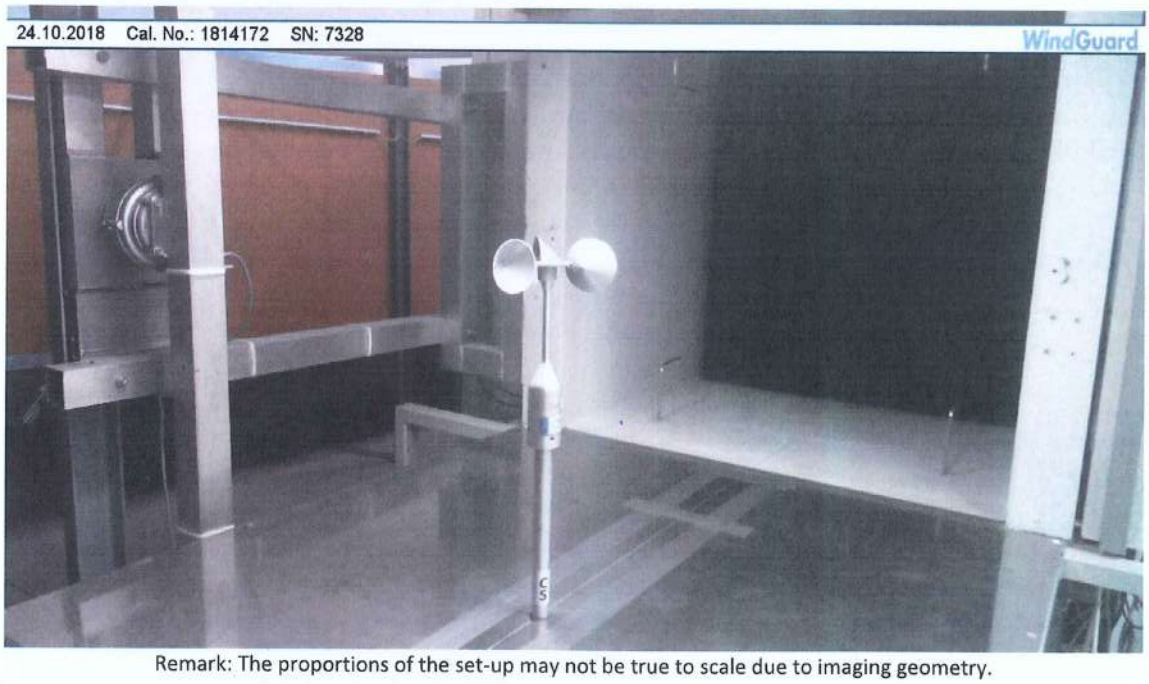


Photo of the measurement setup
Foto des Messaufbaus



Remark: The proportions of the set-up may not be true to scale due to imaging geometry.

DEUTSCHE
WINDGUARD

Deutsche WindGuard
Wind Tunnel Services GmbH

IECRE and MEASNET approved test laboratory

accredited by the / *akkreditiert durch die*

Deutsche Akkreditierungsstelle GmbH

as calibration laboratory in the / *als Kalibrierlaboratorium im*

Deutschen Kalibrierdienst DKD

DAkkS Deutsche Akkreditierungsstelle D-K-15140-01-00

Calibration certificate *Kalibrierschein*	Calibration mark *Kalibrierzeichen*
	1814174
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Object *Gegenstand*	Cup Anemometer
Manufacturer *Hersteller*	WindSensor DK-4000 Roskilde
Type *Typ*	P2546A
Serial number *Fabrikat/Serien-Nr.*	6031
Customer *Auftraggeber*	IDNAMIC ITALIA S.r.L IT-82020 Pietrelcina (BN)
Order No. *Auftragsnummer*	A18/111
Project No. *Projektnummer*	VT181008
Number of pages *Anzahl der Seiten*	4
Date of Calibration *Datum der Kalibrierung*	24.10.2018

This calibration certificate documents the 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 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*	Head of the calibration laboratory *Leiter des Kalibrierlaboratoriums*	Person in charge *Bearbeiter*
24.10.2018	Dipl. Phys. Dieter Westermann	Techniker Dirk Henninges

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Calibration object
Kalibriergegenstand
Cup Anemometer

Calibration procedure
Kalibrierverfahren
IEC 61400-12-1:2017

Place of calibration
Ort der Kalibrierung
Wind tunnel of Deutsche WindGuard WindTunnel Services GmbH, Varel

Test conditions
Messbedingungen

wind tunnel area	10000 cm²
anemometer frontal area	220 cm²
diameter of mounting pipe	25.0 mm
blockage ratio [1)]	0.022 [-]
software version	P_7.8.07

[1)] Due to the special construction of the test section no blockage correction is necessary.

Ambient conditions
Umgebungsbedingungen

air temperature	21.8 °C ± 0.1 °C
air pressure	1019.1 hPa ± 0.3 hPa
relative air humidity	46.3 % ± 2.0 %

Measurement uncertainty
Messunsicherheit
The expanded 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 DAkkS-DKD-3. The value of the measurand lies within the assigned range of values with a probability of 95%.
The reference flow speed measurement is traceable to the German NMI (Physikalisch-Technische Bundesanstalt) standard for flow speed. It is realized by using a PTB owned and calibrated Laser Doppler Anemometer (Standard Uncertainty 0.2 %, k=2)

Additional remarks
Zusätzliche Anmerkungen
-

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Calibration result
Kalibrierergebnis

Reference Air velocity m/s	Reference Unc m/s	Test item Output Hz
3.953	0.05	6.067
5.881	0.05	9.163
7.889	0.05	12.378
9.898	0.05	15.619
11.899	0.05	18.818
13.845	0.05	21.982
15.809	0.05	25.104
14.813	0.05	23.533
12.901	0.05	20.448
10.853	0.05	17.145
8.877	0.05	13.934
6.929	0.05	10.762
4.918	0.05	7.542

Statistical analysis		
	Slope	0.62070 (m/s)/(Hz) ±0.00085 (m/s)/(Hz)
	Offset	0.2135 m/s ±0.014 m/s
	Standard error (Y)	0.014 m/s
	Correlation coefficient	0.999990

Remarks

The calibrated sensor complies with the demanded linearity of MEASNET

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Graphical representation of the result
Grafische Darstellung des Ergebnisses

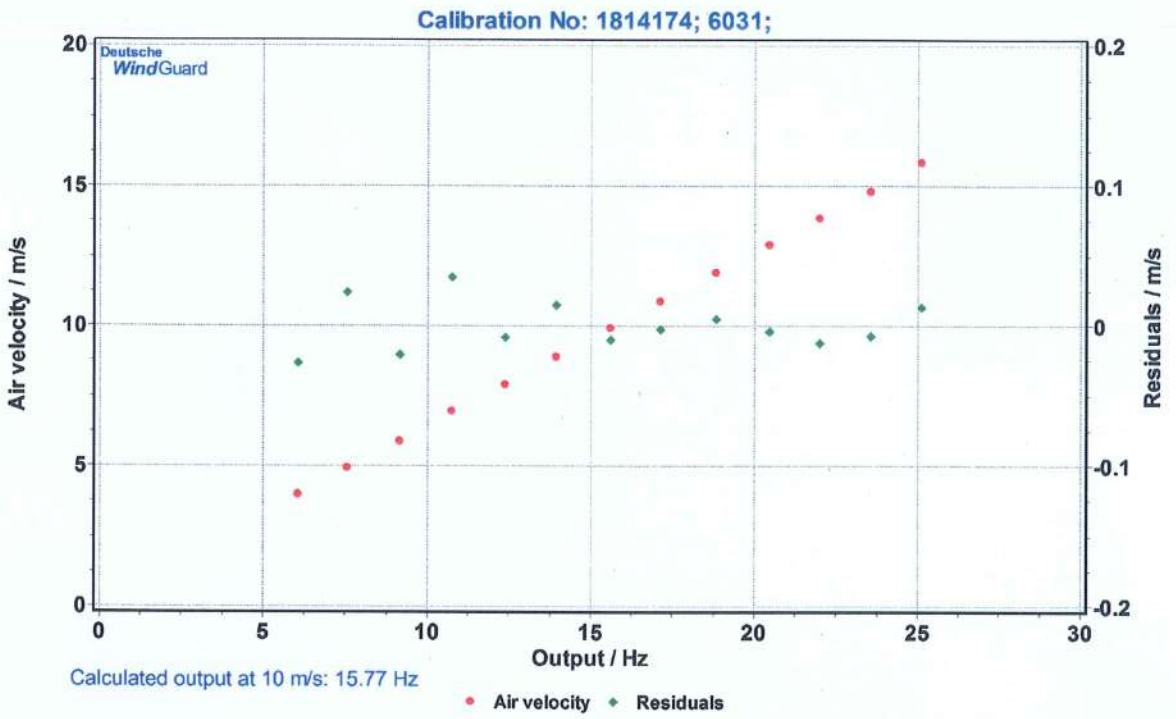

Photo of the measurement setup
Foto des Messaufbaus

Remark: The proportions of the set-up may not be true to scale due to imaging geometry.