PARCO EOLICO "ROSAMARINA"

A.5 - Studio Anemologico

Lavello (Potenza)

Settembre 2019

Version: B

ORDINE DEGLI ARCHITETTI PIANIFICATORI PAESAGGISTI E CONSERVATORI
PROVINCIA DI POTENZA
Donata Maria Rosaria
Margiotta
architetto
420 sez. A

EDP Renewables Italia Holding S.r.l.

Via Lepetit 8/10

20124 - Milano

MARGIOTTA ASSOCIATI

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85100 Potenza

P.IVA: 01108480763

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INDICE

INTRODUZIONE

Il presente documento è stato redatto al fine di stimare la producibilità dell'impianto eolico di Lavello (PZ) denominato "Rosamarina" di proprietà di EDP Renewables Holding Italia Srl, con sede legale a Milano in Via R. Lepetit 8/10, leader globale nel settore delle energie rinnovabili e rappresenta il quarto produttore al mondo di energia eolica.

Sul sito è stata installata una torre anemometrica di riferimento, in località Bosco delle Rose, lo studio anemologico che segue.

Lo scenario studiato nell'ambito della presente analisi è un layout di 7 aerogeneratori con potenza unitaria di 5,3 MW, pari a 37.1 MW di potenza globale, con altezza del mozzo di 121 m.

1. CARATTERISTICHE DEL PARCO EOLICO

Il parco, ubicato a nord-est dell'abitato di Lavello da cui dista circa otto Km ricadente in della frazione di Gaudiano si svilupperà in parte lungo la dorsale del "Monte Quercia" (WTG 1, WTG 2 e WTG 3) e in parte sull'altopiano immediatamente a valle del crinale verso nord-est, a sud della località la Signorella ed a nord della masseria Rosamarina (WTG 4, WTG 5 e WTG 6, e WTG 7).

Le caratteristiche del Parco eolico in esame sono le seguenti:

Scenario del progetto	**7 x GE158 5.3MW @121m**
Modello delle turbine	**GE158**
Altezza mozzo (m)	**121**
turbina (MW)	**5.3**
Numero di turbine	**7**
Capacità (MW)	**37.1**

Tabella 1– Caratteristiche del parco eolico "Rosamarina"

La dislocazione degli aerogeneratori sul territorio è scaturita da un'attenta analisi della morfologia del territorio, da una serie di rilievi sul campo, da studi anemometrici e da una serie di elaborazioni e simulazioni informatizzate finalizzate a:

- minimizzare l'impatto visivo;

- ottemperare alle prescrizioni delle competenti autorità;
- ottimizzare la viabilità di servizio dedicata e la produzione energetica

Nella tabella sottostante si riportano le coordinate degli aerogeneratori di progetto nel sistema di coordinate UTM WGS 1984 fuso 33W.

AEROGENERATORE	EST	NORD
WTG 1	574399	4546704
WTG 2	575499	4547317
WTG 3	575215	4546780
WTG 4	579877	4550531
WTG 5	579018	4550604
WTG 6	578131	4550234
WTG 7	578264	4550852

Tabella 2 - Coordinate aerogeneratori

Si riporta nell'immagine sottostante una rappresentazione della distribuzione sul territorio (Comune di Lavello) delle 7 turbine costituenti il parco eolico.

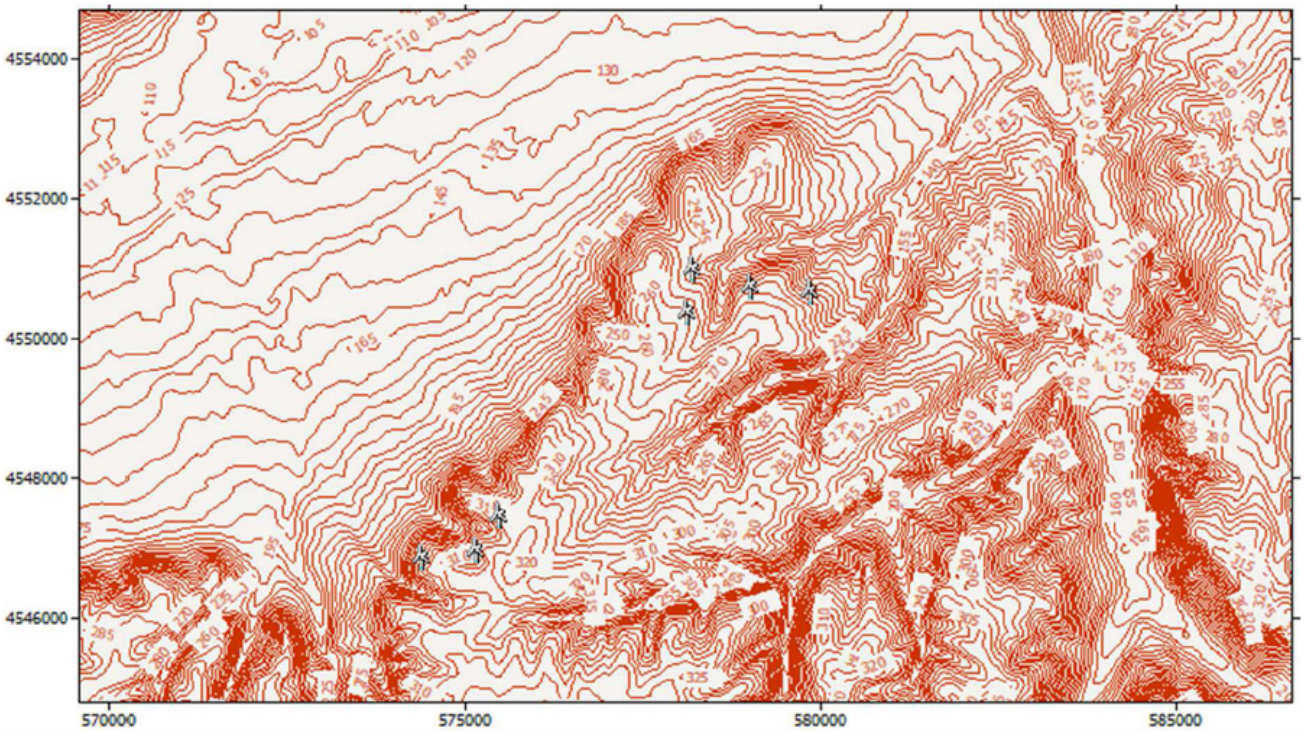


Figura 1: localizzazione delle turbine costituenti il parco eolico "Rosamarina"

2. TORRI DI MISURA INSTALLATE NELL'AREA

Per lo studio anemologico dell'area in cui localizzare l'impianto sono stati utilizzati i dati rilevati dalla torre anemometrica della società Tivano srl, proprietà controllata dalla Società EDP, ubicata in località Sterpara sul terreno identificato catastalmente al Fg. N. 65 p.lle 47 e 82 del comune di Lavello ed autorizzata con permesso a costruire n.6 del 2017 che si allega alla presente relazione.

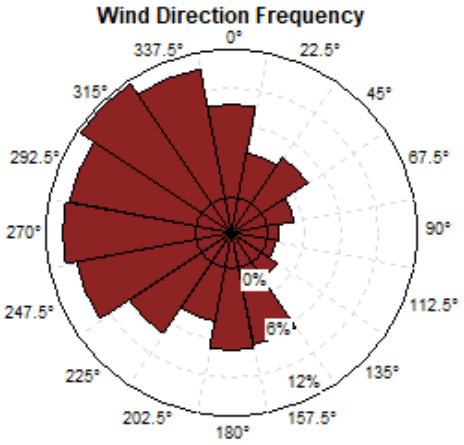
Di seguito si riportano le coordinate dell' anemometro utilizzato nel sistema di coordinate Gauss Boaga Roma 40 fuso est.

Località	Coordinate GAUSS BOAGA - ROMA 40 (m)		Data di installazione
	est	nord	
Sterpara	2586731	4542051	05/2017

Tabella 3 – Ubicazione anemometro

Il periodo di riferimento dei dati utilizzati và da maggio 2018 ad agosto 2019 come mostrato nelle tabelle allegate alla presente relazione.

Dalla campagna anemologica effettuata, sono stati ricavati i dati della velocità e direzione predominante dei venti rappresentati dalla Rosa dei Venti di seguito riportata:



3. CURVA DI POTENZA

La curva di potenza considerata nella presente analisi, corrispondente ad una densità dell'aria di 1,17 kg/m^3, è la seguente:

WGT	**GE 158 5.3 MW 1,17 Kg/m^3**
VELOCITA' (m/s)	POTENZA (KW)
0	0
1	0
2	0
3	68
4	277
5	603
6	1081
7	1747
8	2618
9	3574
10	4403
11	5032
12	5292
13	5300
14	5300
15	5300
16	5300
17	5300
18	5300
19	5300
20	5300
21	5300
22	5300

Tabella 4 – Curva di potenza considerata nella presente analisi

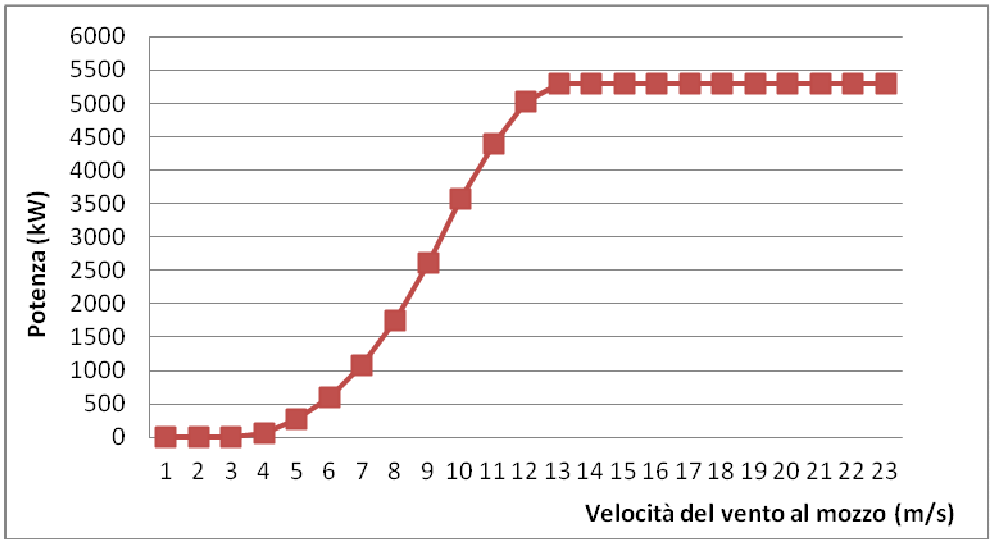


Figura 2: Curva di potenza

La Società EDPR, contestualmente alla realizzazione del parco, ha intenzione di istallare un ulteriore torre anemometrica in Località Coppa Fenocchio, a circa 420,00 metri dalla WTG06 e a circa 660,00 metri dalla WTG07.

Località	**Coordinate UTM – WGS84 33T (m)**		**Data di installazione**
	est	nord	
Coppa Fenocchio	577780	4550434	**In fase esecutiva**

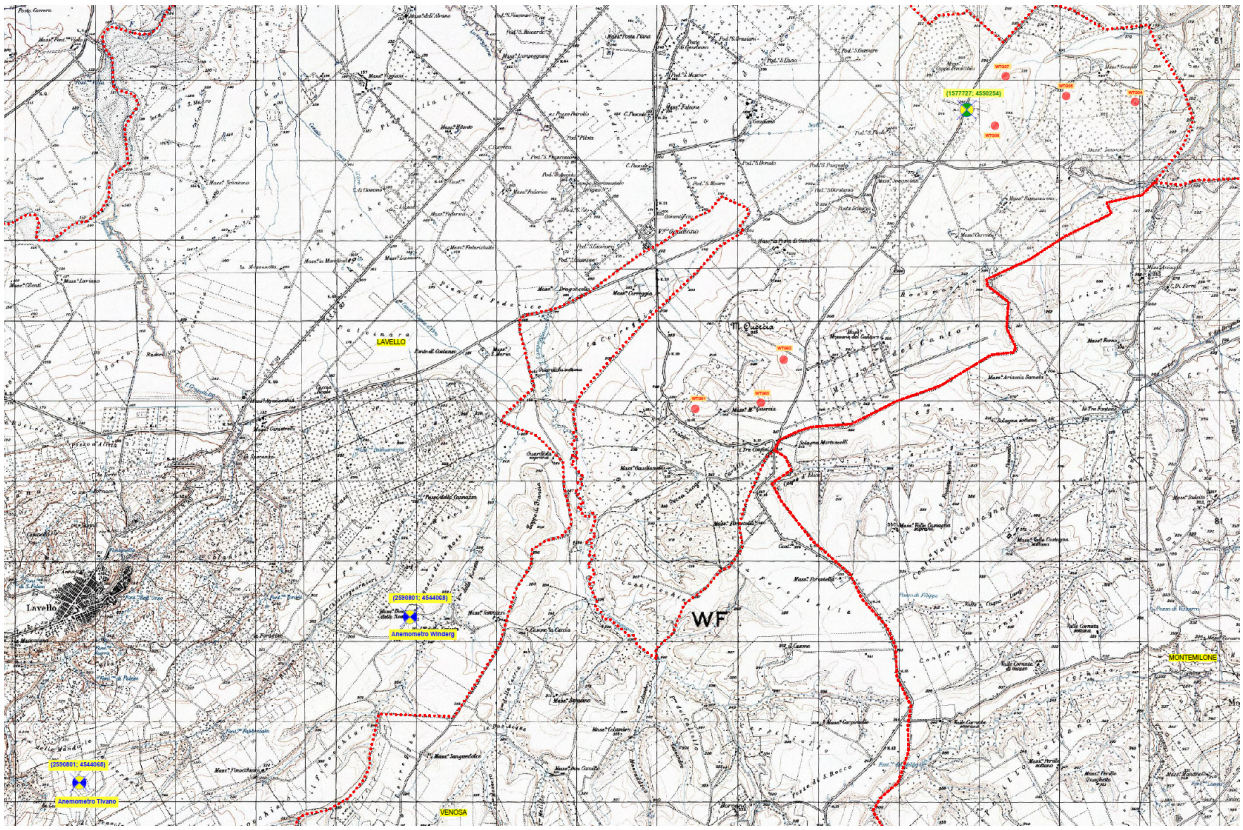


Figura 3: Localizzazione degli anemometri (rif. El.A.16.a.6)

4. DENSITA' VOLUMENTRICA

La produzione annuale stimata per il parco eolico di Lavello "Rosamarina" è di **100.361MWh**.

Per il calcolo della densità volumetrica di energia annua unitaria si ha:

$$Ev = \frac{E}{18D^2H}$$

dove D e H rappresentano rispettivamente il diametro del rotore e l'altezza totale dell'aerogeneratore (somma del raggio del rotore e dell'altezza da terra del mozzo) espressi in metri, mentre E rappresenta l'energia prodotta dalla turbina (espressa in kWh/anno).

Nel caso in esame, considerando un aerogeneratore avente un rotore di diametro pari a 158 m ed altezza totale di 199.90 m risulta:

***Ev** = (100.360.000/7)/18x158^{2}x199.9= 0.16 (KWh/(anno*m^3)*

Nella seguente tabella si riportano i dati della producibilità e della densità volumetrica dei singoli aerogeneratori.

Aerogeneratore	Gross	Ore	Densità volumetrica
1	15 030	2 591	0,167
2	14 784	2 549	0,165
3	14 268	2 460	0,159
4	13 904	2 397	0,155
5	14 331	2 471	0,159
6	14 147	2 439	0,157
7	13 897	2 396	0,155
Producibilità totale Mwh	**100 361**	**Densità volumetrica media**	**0,160**

5. DOCUMENTAZIONE DI INSTALLAZIONE E CALIBRAZIONE DELL'ANEMOMETRO DI RIFERIMENTO

Document Type: Technical Report	Document Code: TCRP-EU/E&CMM-METST-000055
COMMISSIONING AND RECEPTION REPORT MET MAST TIVANO WIND FARM	

Version Control			
Version #	Date	Content	Distribution List
0	2018-04-05	Initial Version	<> <>

Prepared by:	Reviewed by:	Approved by:	Approved by (option):
<Name> Title: <> Dpt.: <> Date: 05-04-2018	<Name> Title: <> Dpt.: <> Date: DD-MM-YYYY	<Name> Title: <> Dpt.: <> Date: DD-MM-YYYY	<Name> Title:<> Dpt.:<> Date: DD-MM-YYYY

Contents

1 OBJECT

The purpose of this document is to describe the installation and commissioning of the permanent met mast in the Tivano Wind Farm in Italy.

All met mast specifications and equipment information will be included in this report.

2 SCOPE

This document is applied to each new met mast installed in Wind Farms in Europe and Brazil, property of EDP Renewables.

3 APPLICABLE DOCUMENTS

This section presents the documents of this sort that are related to met mast installation and commissioning in the Tivano Wind Farm:

- Met mast structure: technical specifications.
- Met mast equipment: technical specifications.
- Installation report.
- Report installation
–Fall arrest system.
- Sensors datasheets.
- Calibration certificates.
- SCADA data.

4 TIVANO MET MAST INFORMATION

4.1 General Information

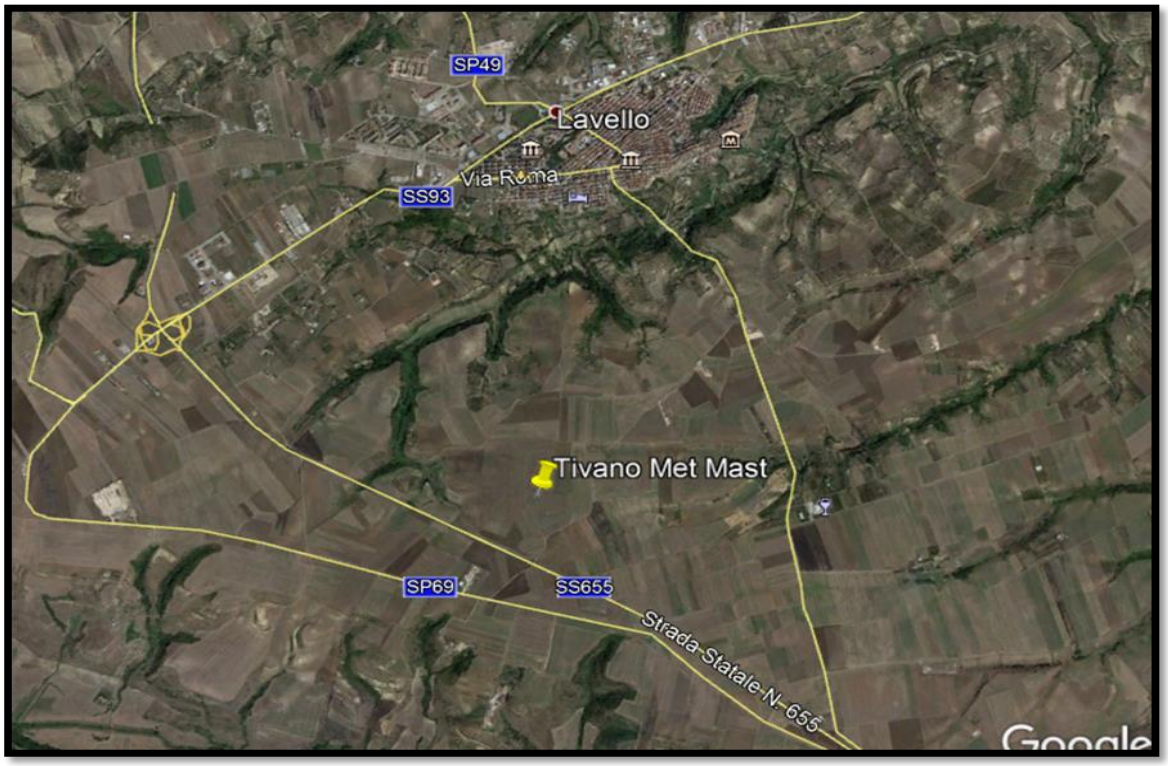
Wind Farm	Tivano WF				
Station name	Tivano Met Mast				
Site	Basilicata, Italy				
Met mast srtucture	Self Standing TV95		Met mast height	92,5 + 2,5	
Datalogger	Campbell CR3000		Communication System	GSM/SCADA	
Coordenates	Zone	X	Y	Altitude	Map Datum
	33T	566726	4542042	354	WWGS84

Met Mast Equipment						
Equipment	Type	Serial Number	Channel number	Height	Boom Orientation (0º/N)	Comments
Anemometer 1 (A1)	VectorA100M	3884		TOP	-	The anemometer 1 belongs to the consultant, when the PCV finalize , the EDPR sensor will be installed.
Anemometer 2 (A2)	VectorA100M	3886		89,5	14	
Anemometer 3 (A3)	VectorA100M	3889		45	10	
Wind Vane 1 (V1)	VectorW200P	61927		89,5	194	
Wind Vane 2 (V2)	VectorW200P	61928		45	190	
Temperature and humidity sensor (T1)	Vaisala HMP155A	M2430127		89,5	130	
Rain detector 1	Vaisala DRD11A	M044028		5	-	
Pressure sensor (B)	Vaisala PTB210	L2630181		1,5	-	
Datalogger (DAT)	Campbell CR3000	10639		1,5	-	
Beacon	1x2000+3x32cd			92,5-45		

4.2 Location.

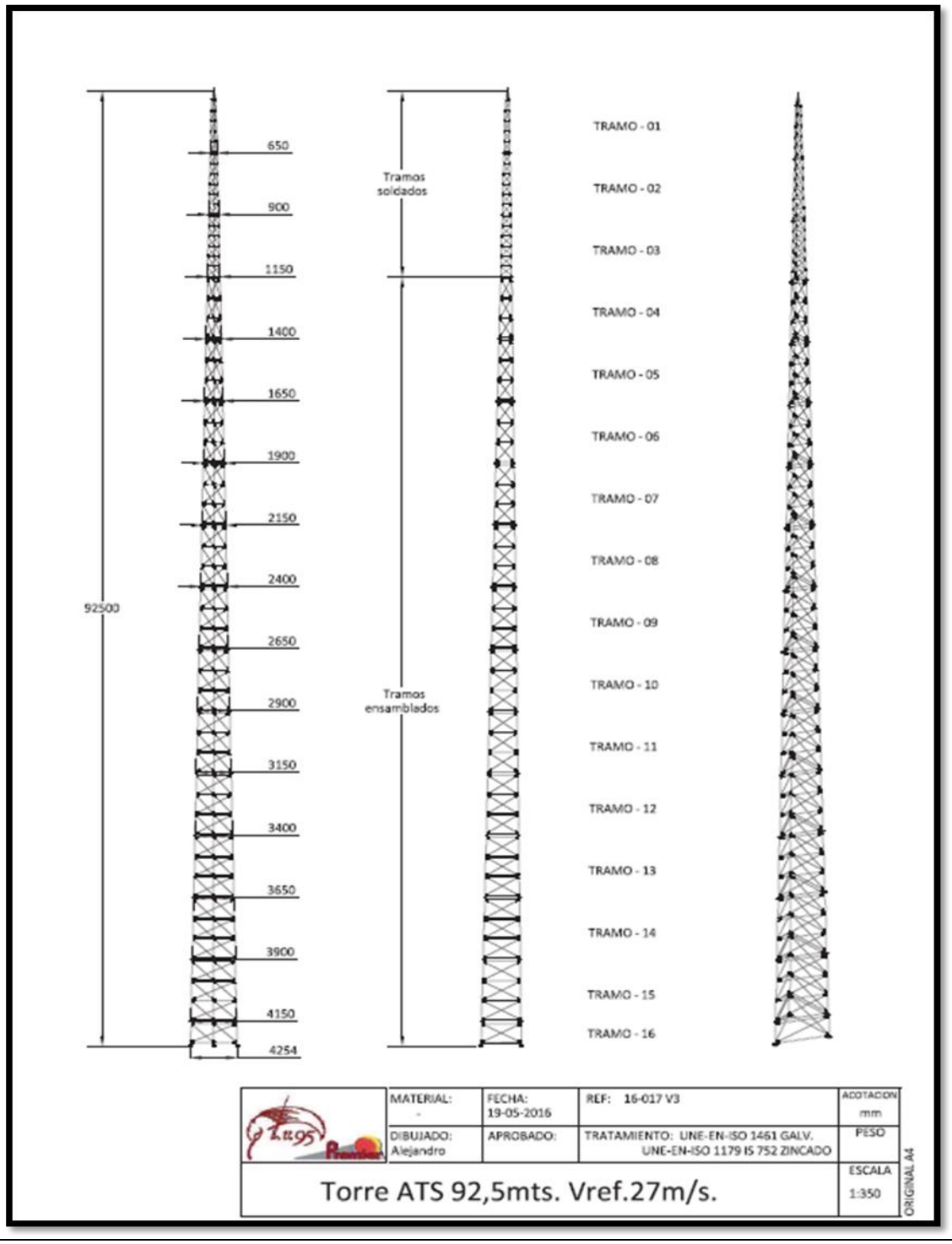
Location:

Access:



4.3 Structure Documentation

General drawings:



Technical Introduction

Torre autosoportada de 92,5 para V_{ref} =27 m/s

1. Alcance y ubicación

En la presente documento se describen las cargas consideradas así como los materiales utilizados en la construcción de una torre de 92,5 metros de altura.

Se ha calculado una configuración de torre autosoportada con la ayuda del programa de cálculo por elementos finitos SAP2000. Los cálculos se han llevado a cabo bajo hipótesis de casos de cargas estáticos, o sostenidas en el tiempo y considerando la no linealidad geométrica de los efectos P-Delta con teoría de grandes desplazamientos. Considerar los casos de carga de viento como casos estáticos, en lugar de casos dinámicos con una determinada duración de ráfaga, resta del lado de la seguridad, al mismo tiempo que reduce considerablemente el tiempo de computación del cálculo.

2. Descripción y despiece

La estructura se beneficia del sistema de construcción modular de TV 95 basado en tramos de 6 m longitud, excepto el tramo inferior de la torre (tramo 16) que es de 2,5 m . Estos tramos son de fabricación estándar y con su combinación se consigue una estructura a medida de las necesidades del cliente.

Los tramos son de planta triangular formados por tres montantes y una celosía que los une. El material utilizado es:

- Para todos los montantes y para los tubos de la celosía del tramo 16, acero S355.
- Para la varilla de la celosía, acero S235 (tramos soldados: tramos 1,2 y 3).
- Para los tubos de la celosía, acero S275 (tramos atornillados: tramos del 4 al 15).

3. Cargas consideradas

Se ha tenido en cuenta una velocidad básica del viento ($V_{b,0}$) de 27 m/s, lo que representa una velocidad de referencia (V_{ref}) de 27 m/s, que equivale a una velocidad media en punta (V_m) de 38,6 m/s. Todo ello equivale a una velocidad de supervivencia de 55,8 m/s.

Asimismo también se tiene en cuenta el efecto de la temperatura dentro de un rango que va desde los -15°C hasta los 45°C.

No se ha considerado una sobrecarga debida a la acumulación de hielo.

Composition of the tower

Tramo	Cota [m]	Longitud [m]	Sección inferior [mm]	Sección superior [mm]	Montante	Celosía
16	2,5	2,5	4.254	4.150	120	80x6
15	8,5	6	4.150	3.900	110	76x6
14	14,5	6	3.900	3.650	105	76x6
13	20,5	6	3.650	3.400	100	76x5
12	26,5	6	3.400	3.150	100	76x5
11	32,5	6	3.150	2.900	95	60x6
10	38,5	6	2.900	2.650	90	60x5
9	44,5	6	2.650	2.400	85	60x4
8	50,5	6	2.400	2.150	80	60x3
7	56,5	6	2.150	1.900	75	50x4
6	62,5	6	1.900	1.650	70	50x3
5	68,5	6	1.650	1.400	65	42x3
4	74,5	6	1.400	1.150	60	42x3
3	80,5	6	1.150	900	35	20
2	86,5	6	900	650	30	20
1	92,5	6	650	-	30	16

Standar Foundations:

Torre autosoportada de 92,5 para V_{ref} =27 m/s

Para el cálculo de la zapata cuadrada de dimensiones mínimas (a) x (a) x (h) se ha considerado un hormigón H25. La zapata estará situada a cota -1,5 metros, considerándose la capa de 1,5 metros por encima de la zapata igual que el terreno colindante.

Caso 1: no existe nivel freático; el peso específico del suelo (seco) es 15 kN/m^3 y la tensión admisible del terreno son 0,30 MPa.

Dimensiones zapata para el caso 1 :

a (m)	h(m)
10,0	1,0

Caso 2: no existe nivel freático; el peso específico del suelo (seco) es 23 kN/m^3 y la tensión admisible del terreno son 0,30 MPa.

Dimensiones zapata para el caso 2 :

a (m)	h(m)
10,2	1,0

Caso 3: existe nivel freático; el peso específico del suelo (sumergido) es 9 kN/m^3 y la tensión admisible del terreno son 0,18 MPa.

Dimensiones zapata para el caso 3 :

a (m)	h(m)
10,4	1,0

Caso 4: existe nivel freático; el peso específico del suelo (sumergido) es 11 kN/m^3 y la tensión admisible del terreno son 0,18 MPa.

Dimensiones zapata para el caso 4 :

a (m)	h(m)
10,3	1,0

NOTA: Estos valores son aproximados y deberán verificarse con el estudio geotécnico correspondiente al emplazamiento exacto de la torre.

4.4 Fall Arrest System

CE Declaración de conformidad

TRACTEL Greifzug GmbH

Scheidtbachstraße 19-21 • 51469 Bergisch Gladbach • Alemania

Declaramos, bajo nuestra propia responsabilidad como fabricantes,

para el producto abajo descrito:

Equipo de protección personal contra caídas • FABA™

Sistema de protección de ascenso con guía fija

Sistema A12

1. El producto arriba indicado coincide con los modelos que se sometieron a la comprobación de modelo homologado.

Certificación de modelo homologado N°: ZP/B106/12

2. Los modelos de construcción homologados cumplen con las exigencias de EN 353-1, edición de marzo de 2002, los ensayos adicional CNB/P/11.073 (13.10.2010) y concuerdan con las disposiciones de la Directiva Europea 89/686/EWG, edición de diciembre de 1989.

3. Expedidora del certificado sobre la homologación del modelo de construcción y del control de la producción en serie:

DEKRA EXAM GmbH,
Dinnendahlstraße 9, 44809 Bochum, Alemania,
notificada y registrada bajo el N° 0158 a la Comisión de la Comunidad Europea.

Firma autorizada:

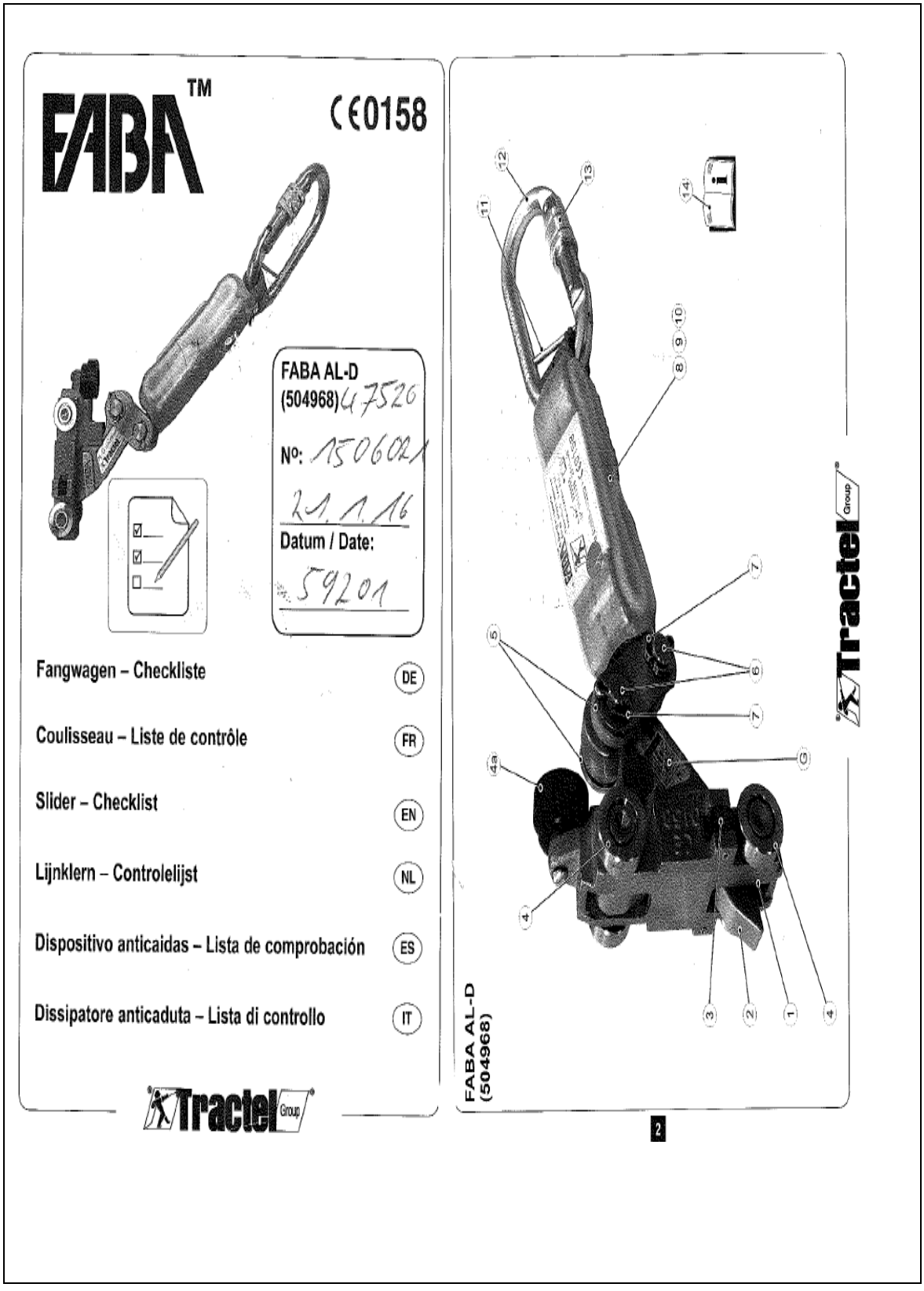
Dipl.-Ing. Denis Pradon, Gerente

Bergisch Gladbach, 24.04.2012

Unterschrift

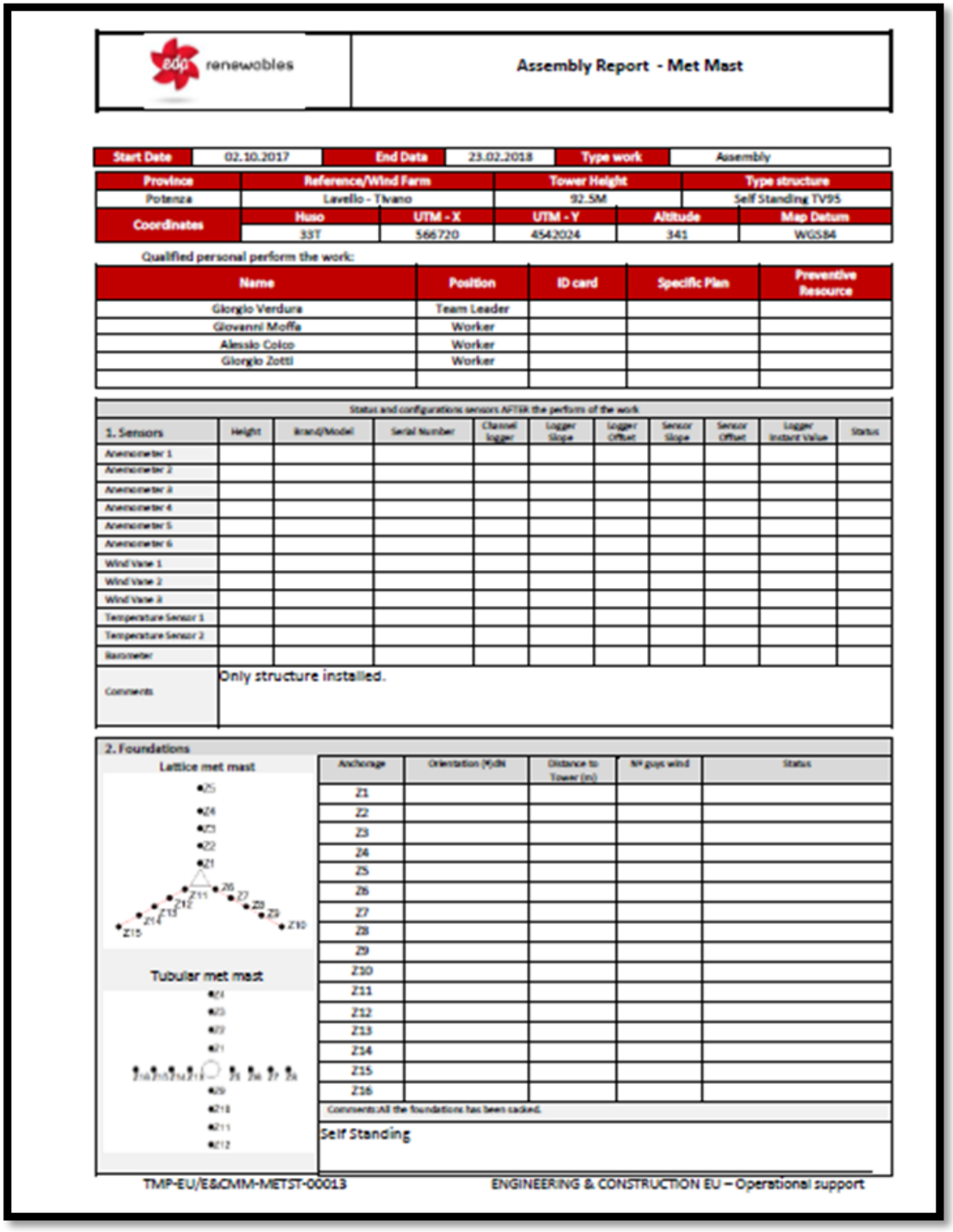
G0788-00_CE_FABA_A12_ES.DOC

FABA™ Tractel Group


FABA™
CE0158
FABA AL-D
(504968) 47520
Nº: 150602
21.1.16
Datum / Date:
59201
Fangwagen – Checkliste DE
Coulisseau – Liste de contrôle FR
Slider – Checklist EN
Lijnklern – Controlelijst NL
Dispositivo anticaidas – Lista de comprobación ES
Dissipatore anticaduta – Lista di controllo IT
Tractel Group
FABA AL-D
(504968)
Tractel Group
2

4.5 Installation Report (Contractor)

Structure: TV95 (92,5m)



renewables

Assembly Report - Met Mast

Start Date	02.10.2017	End Date	23.02.2018	Type work	Assembly

Province	Reference/Wind Farm	Tower Height	Type structure
Potenza	Lavello - Tivano	92.5M	Self Standing TV95

Coordinates	Huso	UTM - X	UTM - Y	Altitude	Map Datum
	33T	566720	4542024	341	WGS84

Qualified personal perform the work:

Name	Position	ID card	Specific Plan	Preventive Resource
Giorgio Verdura	Team Leader			
Giovanni Moffa	Worker			
Alessio Colco	Worker			
Giorgio Zotti	Worker			

Status and configurations sensors AFTER the perform of the work

1. Sensors	Height	Brand/Model	Serial Number	Channel logger	Logger Slope	Logger Offset	Sensor Slope	Sensor Offset	Logger Instant Value	Status
Anemometer 1										
Anemometer 2										
Anemometer 3										
Anemometer 4										
Anemometer 5										
Anemometer 6										
Wind Vane 1										
Wind Vane 2										
Wind Vane 3										
Temperature Sensor 1										
Temperature Sensor 2										
Barometer										
Comments	Only structure installed.									

2. Foundations

Lattice met mast

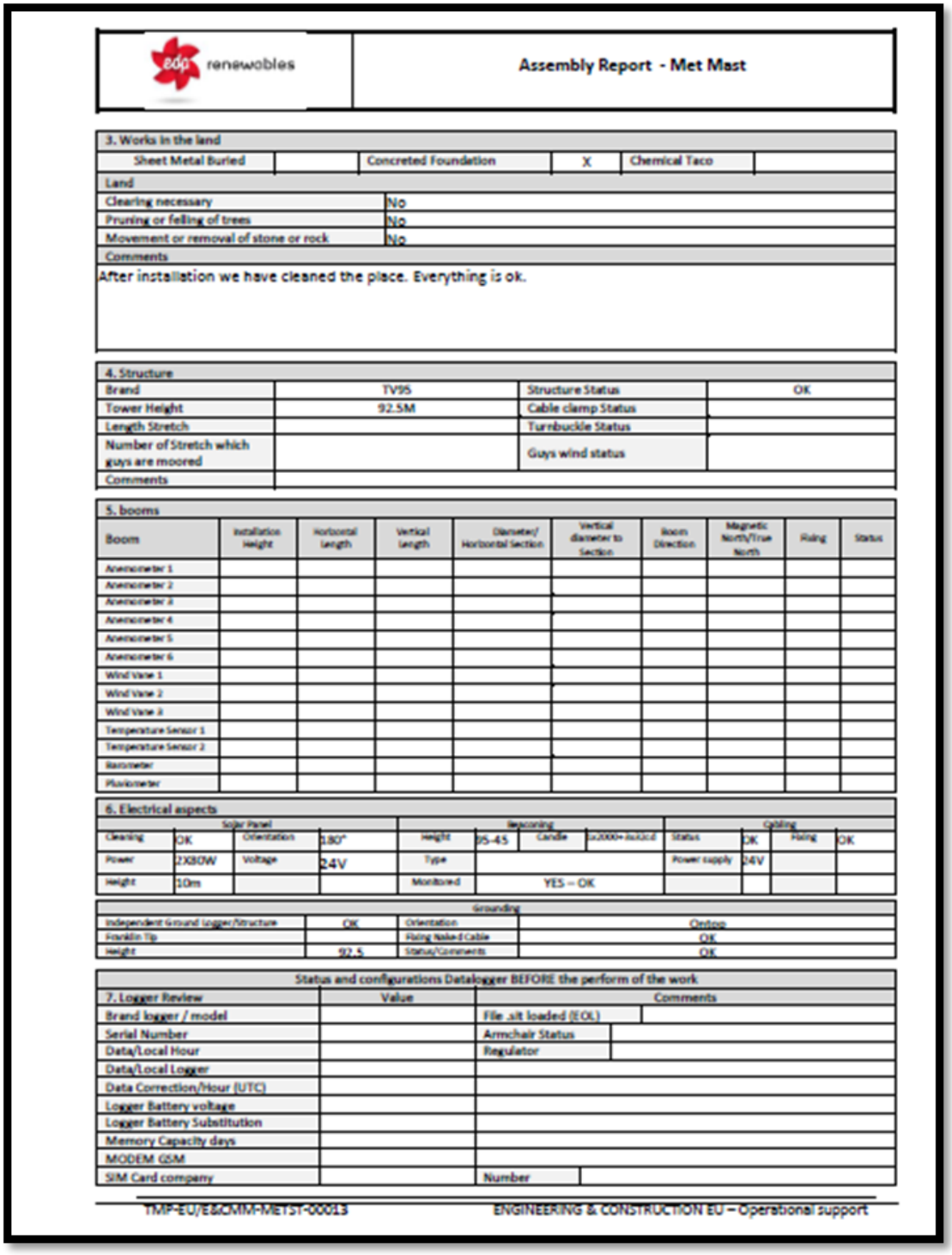
Tubular met mast

Anchorage	Orientation (X)dN	Distance to Tower (m)	Nº guys wind	Status
Z1				
Z2				
Z3				
Z4				
Z5				
Z6				
Z7				
Z8				
Z9				
Z10				
Z11				
Z12				
Z13				
Z14				
Z15				
Z16				

Comments:All the foundations has been casked.

Self Standing

TMP-EU/E&CMM-METST-00013 ENGINEERING & CONSTRUCTION EU – Operational support



renewables

Assembly Report - Met Mast

3. Works in the land					
Sheet Metal Buried		Concreted Foundation	X	Chemical Taco	

Land	
Clearing necessary	No
Pruning or felling of trees	No
Movement or removal of stone or rock	No
Comments	

After installation we have cleaned the place. Everything is ok.

4. Structure			
Brand	TV95	Structure Status	OK
Tower Height	92.5M	Cable clamp Status	
Length Stretch		Turnbuckle Status	
Number of Stretch which guys are moored		Guys wind status	
Comments			

5. booms									
Boom	Installation Height	Horizontal Length	Vertical Length	Diameter/ Horizontal Section	Vertical diameter to Section	Boom Direction	Magnetic North/True North	Fixing	Status
Anemometer 1									
Anemometer 2									
Anemometer 3									
Anemometer 4									
Anemometer 5									
Anemometer 6									
Wind Vane 1									
Wind Vane 2									
Wind Vane 3									
Temperature Sensor 1									
Temperature Sensor 2									
Barometer									
Pluviometer									

6. Electrical aspects											
Solar Panel				Beaconing				Cabling			
Cleaning	OK	Orientation	180°	Height	65-45	Candle	1x2000-3x3000	Status	OK	Fixing	OK
Power	2X80W	Voltage	24V	Type				Power supply	24V		
Height	10m			Monitored	YES – OK						

Grounding			
Independent Ground Logger/Structure	OK	Orientation	Ostop
Franklin Tip		Fixing Naked Cable	OK
Height	92.5	Status/Comments	OK

Status and configurations Datalogger BEFORE the perform of the work			
7. Logger Review	Value	Comments	
Brand logger / model		File .slt loaded (EOL)	
Serial Number		Armchair Status	
Data/Local Hour		Regulator	
Data/Local Logger			
Data Correction/Hour (UTC)			
Logger Battery voltage			
Logger Battery Substitution			
Memory Capacity days			
MODEM GSM			
SIM Card company		Number	

TMP-EU/E&CMM-METST-00013 ENGINEERING & CONSTRUCTION EU – Operational support

renewables

Assembly Report - Met Mast

List of Photographs

Elements	Photographs	Comments
Structure	1	
Anchors	2	
Foundations	3	
Datalogger	4	
Sensors	5	
Lifeline	6-7	
Lighting Rod		
Grounding	8	
Access	9	
Points cardinals	10-11-12-13-14	
Site after the works		
Other representatives photographs		

Photographs


1


2


3


4


5


6

TMP-EU/E&CMM-METST-00013 ENGINEERING & CONSTRUCTION EU – Operational support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Assembly Report - Met Mast
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ENGINEERING & CONSTRUCTION EU – Operational support

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Assembly Report - Met Mast

Start Date	02.10.2017	End Data	23.02.2018	Type work	Assembly

Province	Reference/Wind Farm		Tower Height		Type structure
Potenza	Lavello - Tivano		92.5M		Self Standing TV95
Coordinates	**Huso**	**UTM - X**	**UTM - Y**	**Altitude**	**Map Datum**
	33T	566720	4542024	341	WGS84

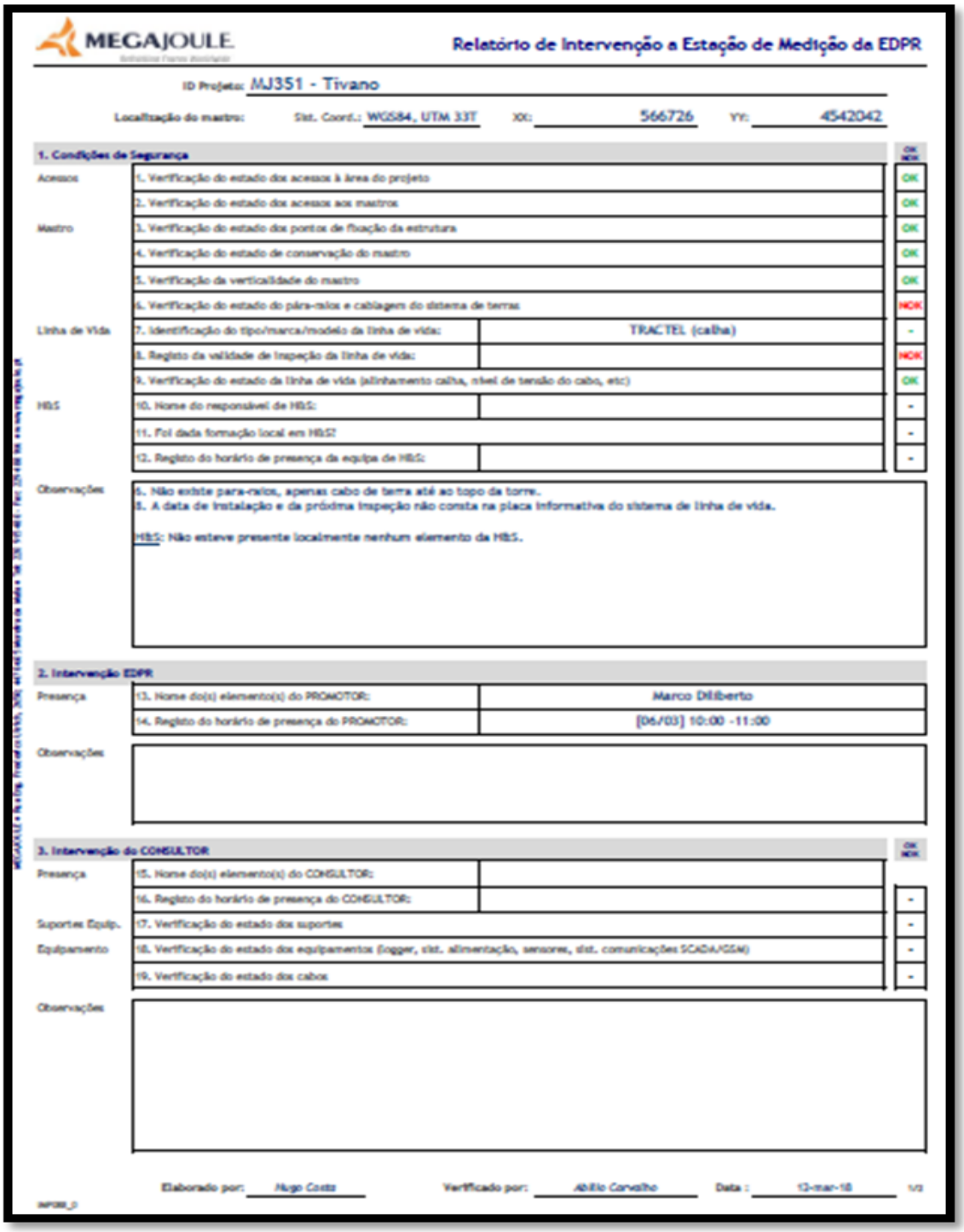
Annex IV. Pre-works security inspection

	NOK	OK	Comments
The worker knows and is able to interpret the document "E.T. Tubular guyed Meteorological Mast. Security instructions"	☐	X	
The worker knows and is able to interpret the document "E.T. Lattice guyed Meteorological Mast. Security instructions".	☐	X	
The worker knows and is able to interpret the document "Wind farm Meteorological Mast maintenance. Security instructions".	☐	X	
The station is straight without winding.	☐	X	
The junctions between sections are in good conditions	☐	X	
All guy wires are fixed to the anchors	☐	X	
The guys have the tension recommended by the manufacturer	☐	X	
Anchors state	☐	X	
The anchors excess guy are clean up	☐	X	
The wire-line anchors are in good conditions	☐	X	
The crease of the guy in the anchor project over the ground	☐	X	
The fastening ring project over the ground	☐	X	
The sensor cabling are securely fastened to the station	☐	X	
The supports are securely fastened to the structure	☐	X	
The lightning rod is upright	☐	X	
Upper part station absorber inspection (*).	☐	X	
Fall arrest system fastening to the station inspection (*).	☐	X	
Descent of the fall arrest system inspection (*).	☐	X	
Fastening inspection in order to avoid fall arrest system movements (*).	☐	X	
Datalogger Ground	☐	X	
Station doublé-sink Ground (MT and Datalogger)	☐	X	
If a "NOK" is indicated during the Check-List, the EDPR responsible shall be called in order to notify it and proceed as indicated			
Comments:			

(*) The fall arrest system inspection and maintenance shall be carried out in the semiannual maintenance operations/ sensor change interventions / station tensioning operations (Lattice stations).

Qualified Technician who performed the inspection:	Sign:
Company:IDNAMIC Name: GIORGIO VERDURA Date:23.02.2018	

Instrumentation: Megajoule (22/02/2018)



MEGAJOULE

Relatório de Intervenção a Estação de Medição da EDPR

ID Projeto: MJ351 - Tivano

Localização do mastro: Sist. Coord.: WGS84, UTM 33T XX: 566726 YY: 4542042

1. Condições de Segurança

			OK/NOK
Acessos	1. Verificação do estado dos acessos à área do projeto		OK
	2. Verificação do estado dos acessos aos mastros		OK
Mastro	3. Verificação do estado dos pontos de fixação da estrutura		OK
	4. Verificação do estado de conservação do mastro		OK
	5. Verificação da verticalidade do mastro		OK
	6. Verificação do estado do pára-raios e cablagem do sistema de terras		NOK
Linha de Vida	7. Identificação do tipo/marca/modelo da linha de vida:	TRACTEL (calha)	-
	8. Registo da validade de inspeção da linha de vida:		NOK
	9. Verificação do estado da linha de vida (alinhamento calha, nível de tensão do cabo, etc)		OK
HSS	10. Nome do responsável de HSS:		-
	11. Foi dada formação local em HSS?		-
	12. Registo do horário de presença da equipa de HSS:		-

Observações:

6. Não existe para-raios, apenas cabo de terra até ao topo da torre.
8. A data de instalação e da próxima inspeção não consta na placa informativa do sistema de linha de vida.

HSS: Não esteve presente localmente nenhum elemento da HSS.

2. Intervenção EDPR

Presença	13. Nome do(s) elemento(s) do PROMOTOR:	Marco DiBerto
	14. Registo do horário de presença do PROMOTOR:	[06/03] 10:00 -11:00

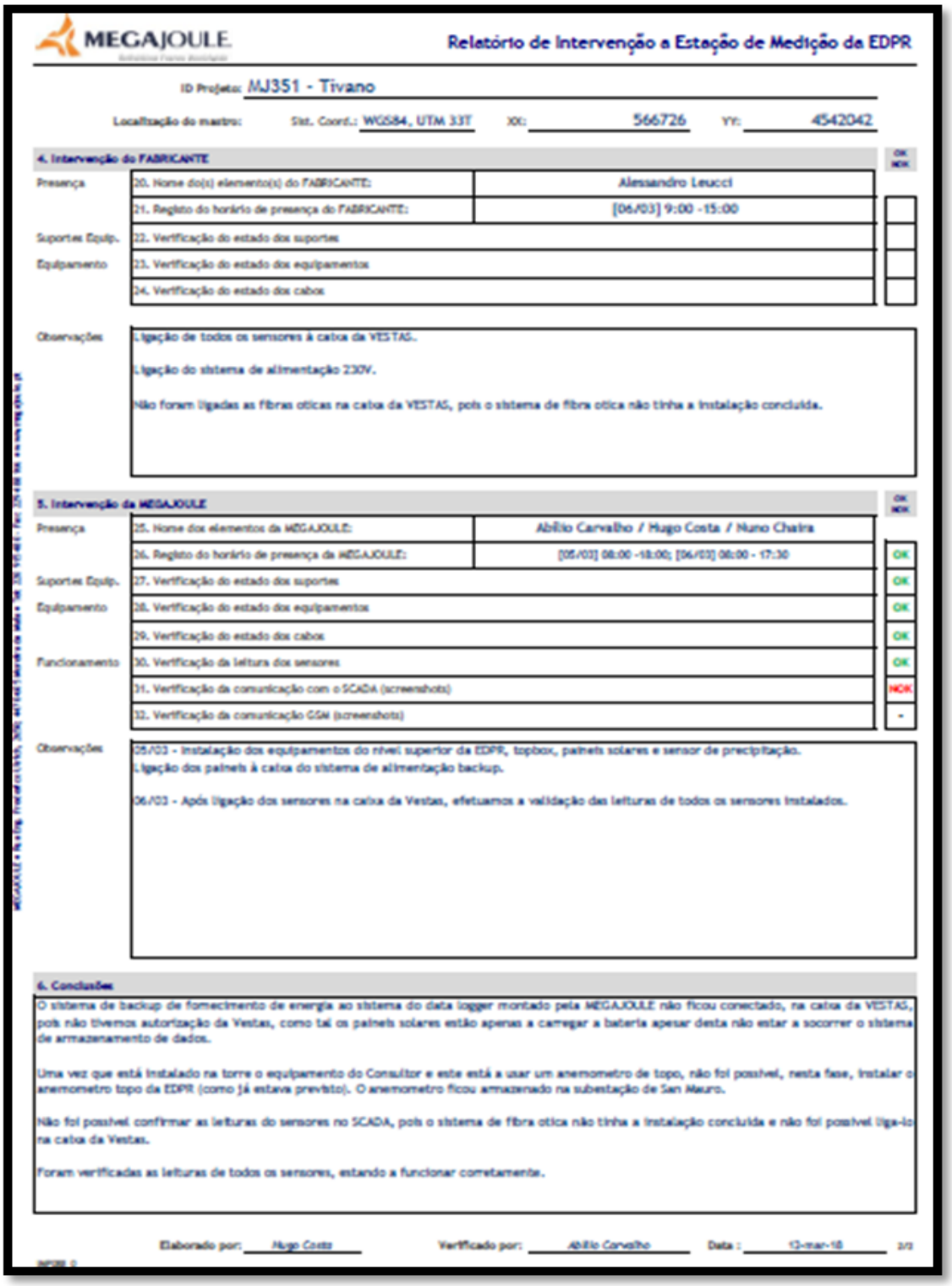
Observações:

3. Intervenção do CONSULTOR

			OK/NOK
Presença	15. Nome do(s) elemento(s) do CONSULTOR:		
	16. Registo do horário de presença do CONSULTOR:		-
Suportes Equip.	17. Verificação do estado dos suportes		-
Equipamento	18. Verificação do estado dos equipamentos (logger, sist. alimentação, sensores, sist. comunicações SCADA/GSM)		-
	19. Verificação do estado dos cabos		-

Observações:

Elaborado por: Hugo Costa Verificado por: Abílio Carvalho Data : 12-mar-18 1/2



MEGAJOULE

Relatório de Intervenção a Estação de Medição da EDPR

ID Projeto: MJ351 - Tivano

Localização do mastro: Sist. Coord.: WGS84, UTM 33T XX: 566726 YY: 4542042

4. Intervenção do FABRICANTE

			OK / NOK
Presença	20. Nome do(s) elemento(s) do FABRICANTE:	Alessandro Leucci	
	21. Registo do horário de presença do FABRICANTE:	[06/03] 9:00 -15:00	
Suportes Equip.	22. Verificação do estado dos suportes		
Equipamento	23. Verificação do estado dos equipamentos		
	24. Verificação do estado dos cabos		

Observações:

Ligação de todos os sensores à caixa da VESTAS.

Ligação do sistema de alimentação 230V.

Não foram ligadas as fibras oticas na caixa da VESTAS, pois o sistema de fibra ótica não tinha a instalação concluída.

5. Intervenção da MEGAJOULE

			OK / NOK
Presença	25. Nome dos elementos da MEGAJOULE:	Abílio Carvalho / Hugo Costa / Nuno Chaira	
	26. Registo do horário de presença da MEGAJOULE:	[05/03] 08:00 -18:00; [06/03] 08:00 - 17:30	OK
Suportes Equip.	27. Verificação do estado dos suportes		OK
Equipamento	28. Verificação do estado dos equipamentos		OK
	29. Verificação do estado dos cabos		OK
Funcionamento	30. Verificação da leitura dos sensores		OK
	31. Verificação da comunicação com o SCADA (screenshots)		NOK
	32. Verificação da comunicação GSM (screenshots)		-

Observações:

05/03 - Instalação dos equipamentos do nível superior da EDPR, topbox, painels solares e sensor de precipitação.
Ligação dos painels à caixa do sistema de alimentação backup.

06/03 - Após ligação dos sensores na caixa da Vestas, efetuamos a validação das leituras de todos os sensores instalados.

6. Conclusão:

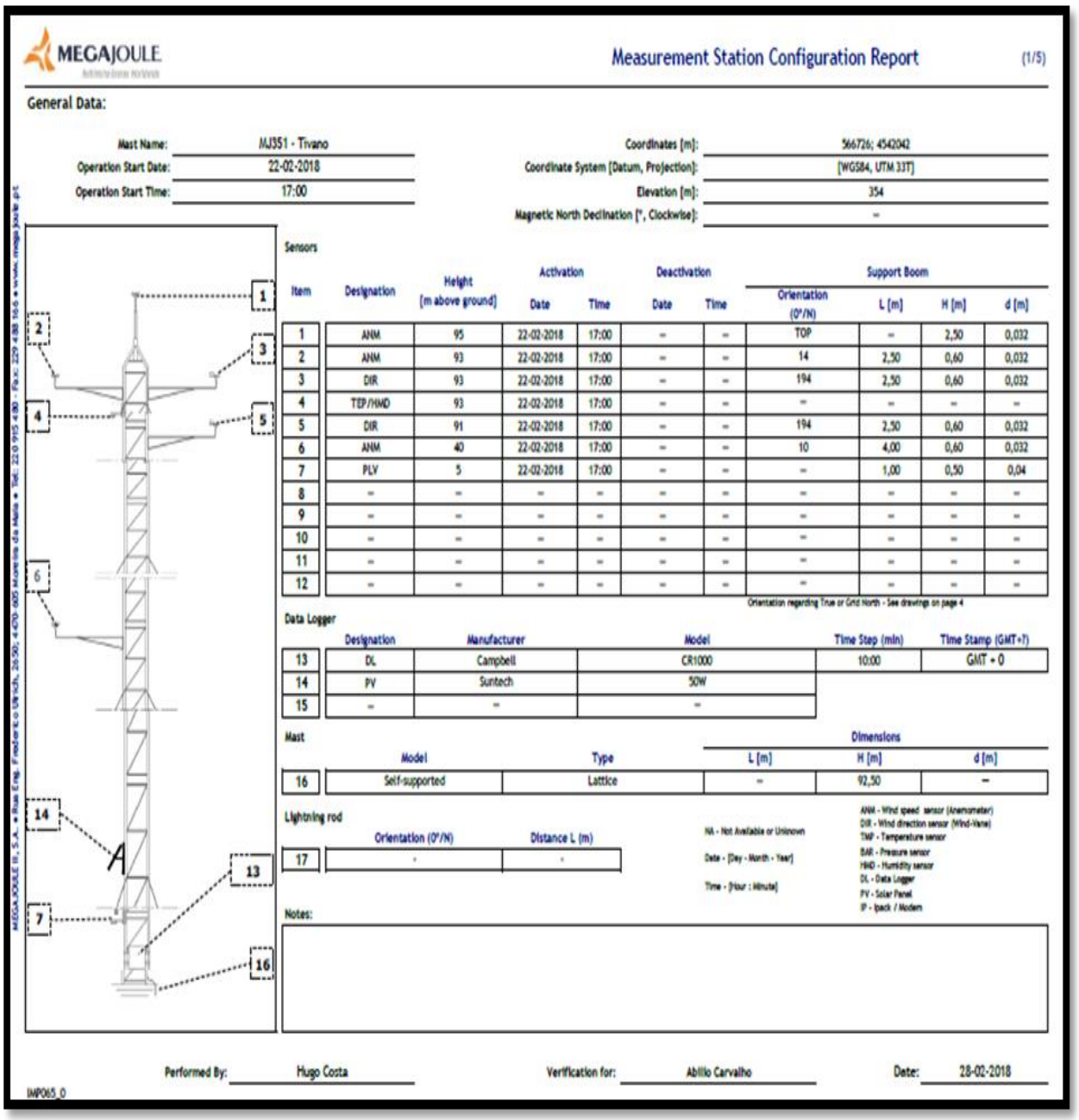
O sistema de backup de fornecimento de energia ao sistema do data logger montado pela MEGAJOULE não ficou conectado, na caixa da VESTAS, pois não tivemos autorização da Vestas, como tal os painels solares estão apenas a carregar a bateria apesar desta não estar a socorrer o sistema de armazenamento de dados.

Uma vez que está instalado na torre o equipamento do Consultor e este está a usar um anemometro de topo, não foi possível, nesta fase, instalar o anemometro topo da EDPR (como já estava previsto). O anemometro ficou armazenado na subestação de San Mauro.

Não foi possível confirmar as leituras do sensores no SCADA, pois o sistema de fibra ótica não tinha a instalação concluída e não foi possível liga-lo na caixa da Vestas.

Foram verificadas as leituras de todos os sensores, estando a funcionar corretamente.

Elaborado por: Hugo Costa Verificado por: Abílio Carvalho Data : 12-mar-18 2/2



MEGAJOULE

Measurement Station Configuration Report (1/5)

General Data:

Mast Name:	MJ351 - Tivano	Coordinates [m]:	566726; 4542042
Operation Start Date:	22-02-2018	Coordinate System [Datum, Projection]:	[WGS84, UTM 33T]
Operation Start Time:	17:00	Elevation [m]:	354
		Magnetic North Declination [°, Clockwise]:	-

Sensors

Item	Designation	Height [m above ground]	Activation Date	Activation Time	Deactivation Date	Deactivation Time	Support Boom Orientation (0°/N)	Support Boom L [m]	Support Boom H [m]	Support Boom d [m]
1	ANM	95	22-02-2018	17:00	-	-	TOP	-	2,50	0,032
2	ANM	93	22-02-2018	17:00	-	-	14	2,50	0,60	0,032
3	DIR	93	22-02-2018	17:00	-	-	194	2,50	0,60	0,032
4	TEP/HMD	93	22-02-2018	17:00	-	-	-	-	-	-
5	DIR	91	22-02-2018	17:00	-	-	194	2,50	0,60	0,032
6	ANM	40	22-02-2018	17:00	-	-	10	4,00	0,60	0,032
7	PLV	5	22-02-2018	17:00	-	-	-	1,00	0,50	0,04
8	-	-	-	-	-	-	-	-	-	-
9	-	-	-	-	-	-	-	-	-	-
10	-	-	-	-	-	-	-	-	-	-
11	-	-	-	-	-	-	-	-	-	-
12	-	-	-	-	-	-	-	-	-	-

Orientation regarding True or Grid North - See drawings on page 4

Data Logger

	Designation	Manufacturer	Model	Time Step (min)	Time Stamp (GMT+?)
13	DL	Campbell	CR1000	10:00	GMT + 0
14	PV	Suntech	50W		
15	-	-	-		

Mast

	Model	Type	Dimensions L [m]	Dimensions H [m]	Dimensions d [m]
16	Self-supported	Lattice	-	92,50	-

Lightning rod

	Orientation (0°/N)	Distance L (m)
17	-	-

NA - Not Available or Unknown

Date - [Day - Month - Year]

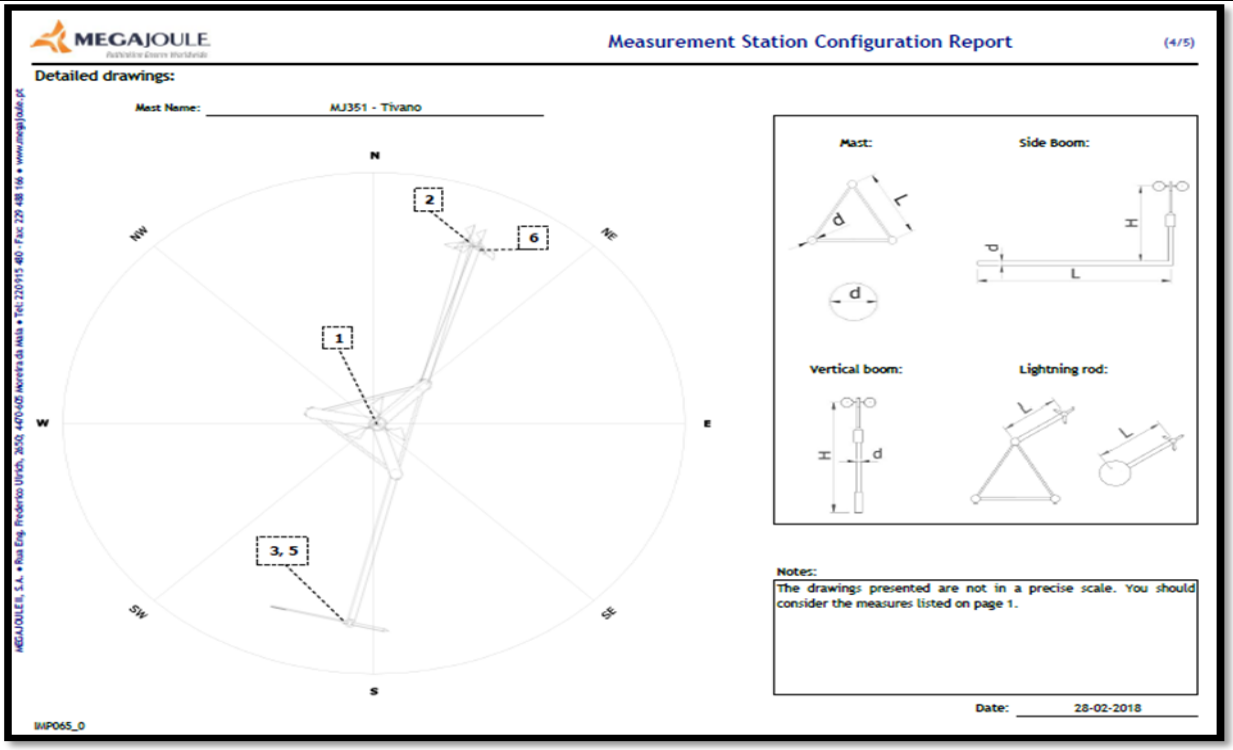
Time - [Hour : Minute]

ANM - Wind speed sensor (Anemometer)
DIR - Wind direction sensor (Wind-Vane)
TMP - Temperature sensor
BAR - Pressure sensor
HMD - Humidity sensor
DL - Data Logger
PV - Solar Panel
IP - Ipack / Modem

Notes:

Performed By: Hugo Costa Verification for: Abílio Carvalho Date: 28-02-2018

IMP065_0



MEGAJOULE

Measurement Station Configuration Report (4/5)

Detailed drawings:

Mast Name: MJ351 - Tivano

Mast:

Side Boom:

Vertical boom:

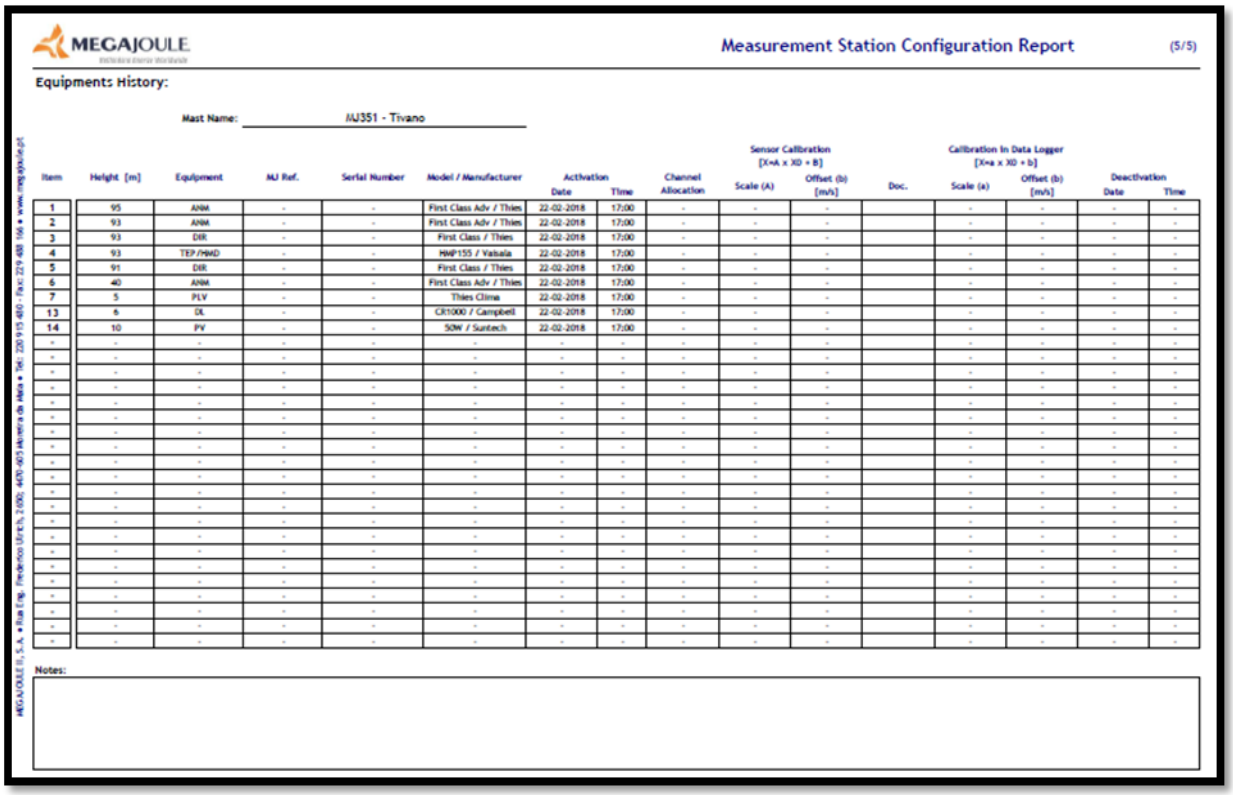
Lightning rod:

Notes:

The drawings presented are not in a precise scale. You should consider the measures listed on page 1.

Date: 28-02-2018

IMP065_0



MEGAJOULE

Measurement Station Configuration Report (5/5)

Equipments History:

Mast Name: MJ351 - Tivano

Item	Height [m]	Equipment	MJ Ref.	Serial Number	Model / Manufacturer	Activation Date	Activation Time	Channel Allocation	Sensor Calibration [X=A x XD + B] Scale (A)	Sensor Calibration [X=A x XD + B] Offset (b) [m/s]	Doc.	Calibration in Data Logger [X=a x XD + b] Scale (a)	Calibration in Data Logger [X=a x XD + b] Offset (b) [m/s]	Deactivation Date	Deactivation Time
1	95	ANM	-	-	First Class Adv / Thies	22-02-2018	17:00	-	-	-		-	-	-	-
2	93	ANM	-	-	First Class Adv / Thies	22-02-2018	17:00	-	-	-		-	-	-	-
3	93	DIR	-	-	First Class / Thies	22-02-2018	17:00	-	-	-		-	-	-	-
4	93	TEP/MHD	-	-	MHP155 / Vaisala	22-02-2018	17:00	-	-	-		-	-	-	-
5	91	DIR	-	-	First Class / Thies	22-02-2018	17:00	-	-	-		-	-	-	-
6	40	ANM	-	-	First Class Adv / Thies	22-02-2018	17:00	-	-	-		-	-	-	-
7	5	PLV	-	-	Thies Clima	22-02-2018	17:00	-	-	-		-	-	-	-
13	6	DL	-	-	CR1000 / Campbell	22-02-2018	17:00	-	-	-		-	-	-	-
14	10	PV	-	-	50W / Suntech	22-02-2018	17:00	-	-	-		-	-	-	-

Notes:

4.6 Met Mast Photos

Figure 1. Met Mast Structure

Figure 2. Met Mast Structure

Figure 4 Fall Arrest System Plate

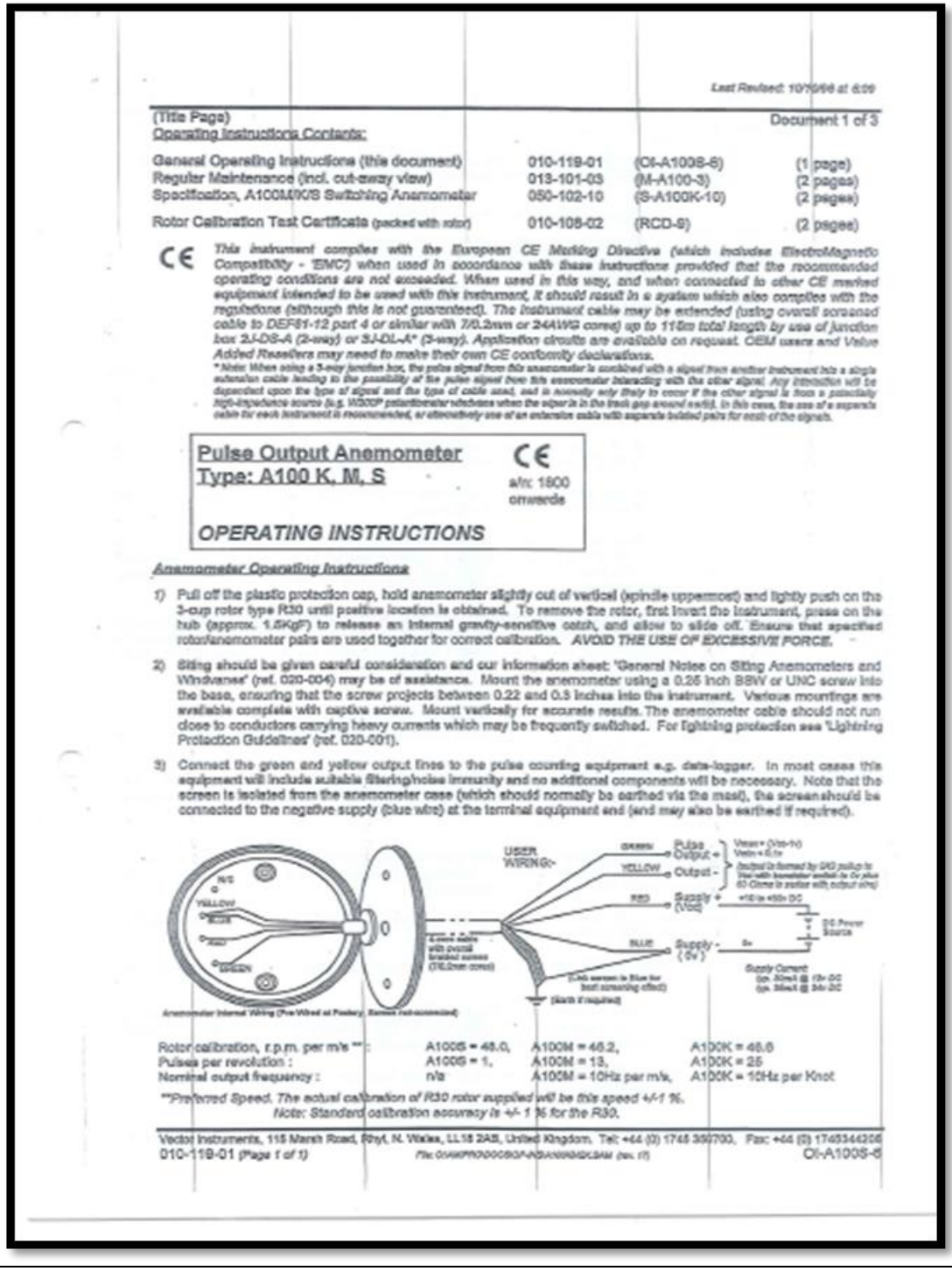
Figure 5. Anti-climb fence

Figure 6. Fall arrest system

Figure 7. Electrical box

4.7 Sensors Datasheets

Anemometer Datasheet: VectorA100M



Last Revised: 10/10/96 at 6:09

(Title Page) Document 1 of 3

Operating Instructions Contents:

General Operating Instructions (this document)	010-119-01	(OI-A100S-6)	(1 page)
Regular Maintenance (incl. cut-away view)	013-101-03	(M-A100-3)	(2 pages)
Specification, A100M/K/S Switching Anemometer	050-102-10	(S-A100K-10)	(2 pages)
Rotor Calibration Test Certificate (packed with rotor)	010-108-02	(RCD-6)	(2 pages)

CE This instrument complies with the European CE Marking Directive (which includes Electromagnetic Compatibility - 'EMC') when used in accordance with these instructions provided that the recommended operating conditions are not exceeded. When used in this way, and when connected to other CE marked equipment intended to be used with this instrument, it should result in a system which also complies with the regulations (although this is not guaranteed). The instrument cable may be extended (using overall screened cable to DEF81-12 part 4 or similar with 7/0.2mm or 24AWG cores) up to 115m total length by use of junction box JJ-DS-A (2-way) or JJ-DL-A* (3-way). Application circuits are available on request. OEM users and Value Added Resellers may need to make their own CE conformity declarations.

* Note: When using a 3-way junction box, the pulse signal from this anemometer is combined with a signal from another instrument into a single extension cable leading to the possibility of the pulse signal from this anemometer interacting with the other signal. Any interaction will be dependent upon the type of signal and the type of cable used, and is normally only likely to occur if the other signal is from a potentially high-impedance source (e.g. W200P potentiometer windvane) when the signal is in the mid-gap around north). In this case, the use of a separate cable for each instrument is recommended, or alternatively use of an extension cable with separate twisted pairs for each of the signals.

Pulse Output Anemometer
Type: A100 K, M, S
CE a/fc 1600 onwards

OPERATING INSTRUCTIONS

Anemometer Operating Instructions

1) Pull off the plastic protection cap, hold anemometer slightly out of vertical (spindle uppermost) and lightly push on the 3-cup rotor type R30 until positive location is obtained. To remove the rotor, first invert the instrument, press on the hub (approx. 1.5KgF) to release an internal gravity-sensitive catch, and allow to slide off. Ensure that specified rotor/anemometer pairs are used together for correct calibration. *AVOID THE USE OF EXCESSIVE FORCE.*

2) Siting should be given careful consideration and our information sheet: 'General Notes on Siting Anemometers and Windvanes' (ref. 020-004) may be of assistance. Mount the anemometer using a 0.25 inch BSW or UNC screw into the base, ensuring that the screw projects between 0.22 and 0.3 inches into the instrument. Various mountings are available complete with captive screw. Mount vertically for accurate results. The anemometer cable should not run close to conductors carrying heavy currents which may be frequently switched. For lightning protection see 'Lightning Protection Guidelines' (ref. 020-001).

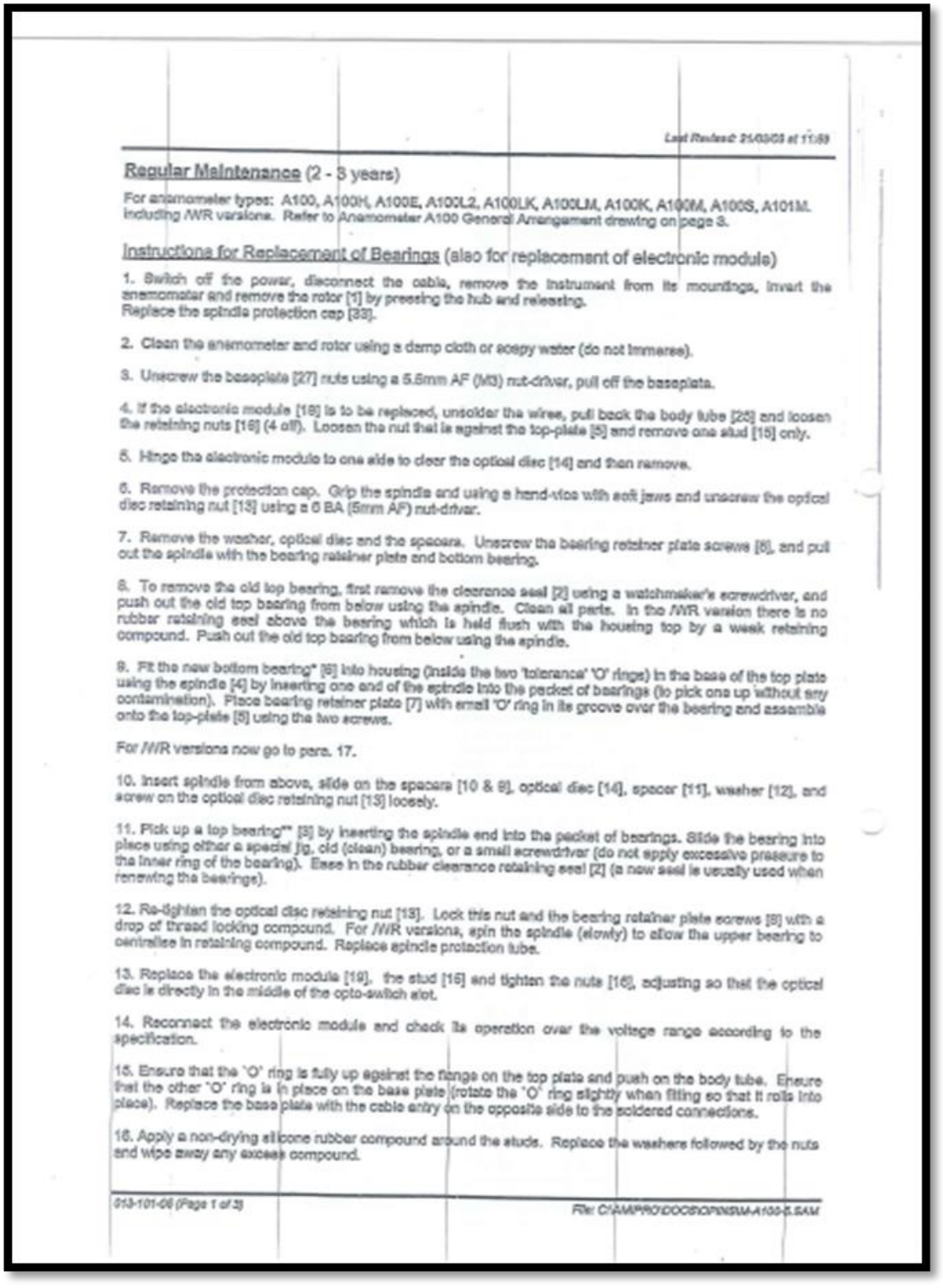
3) Connect the green and yellow output lines to the pulse counting equipment e.g. data-logger. In most cases this equipment will include suitable filtering/noise immunity and no additional components will be necessary. Note that the screen is isolated from the anemometer case (which should normally be earthed via the mast), the screen should be connected to the negative supply (blue wire) at the terminal equipment end (and may also be earthed if required).

Rotor calibration, r.p.m. per m/s **:	A100S = 48.0,	A100M = 48.2,	A100K = 48.6
Pulses per revolution :	A100S = 1,	A100M = 13,	A100K = 25
Nominal output frequency :	n/a	A100M = 10Hz per m/s,	A100K = 10Hz per Knot

**Preferred Speed. The actual calibration of R30 rotor supplied will be this speed +/-1 %.
Note: Standard calibration accuracy is +/- 1 % for the R30.

Vector Instruments, 118 Marsh Road, Rhyl, N. Wales, LL18 2AB, United Kingdom. Tel: +44 (0) 1745 360700. Fax: +44 (0) 1745344206

010-119-01 (Page 1 of 1) OI-A100S-6



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Regular Maintenance (2 - 3 years)

For anemometer types: A100, A100H, A100E, A100L2, A100LK, A100LM, A100K, A100M, A100S, A101M. including /WR versions. Refer to Anemometer A100 General Arrangement drawing on page 3.

Instructions for Replacement of Bearings (also for replacement of electronic module)

1. Switch off the power, disconnect the cable, remove the instrument from its mountings, invert the anemometer and remove the rotor [1] by pressing the hub and releasing. Replace the spindle protection cap [33].

2. Clean the anemometer and rotor using a damp cloth or soapy water (do not immerse).

3. Unscrew the baseplate [27] nuts using a 5.5mm AF (M3) nut-driver, pull off the baseplate.

4. If the electronic module [18] is to be replaced, unsolder the wires, pull back the body tube [25] and loosen the retaining nuts [16] (4 off). Loosen the nut that is against the top-plate [5] and remove one stud [15] only.

5. Hinge the electronic module to one side to clear the optical disc [14] and then remove.

6. Remove the protection cap. Grip the spindle and using a hand-vice with soft jaws and unscrew the optical disc retaining nut [13] using a 6 BA (5mm AF) nut-driver.

7. Remove the washer, optical disc and the spacers. Unscrew the bearing retainer plate screws [8], and pull out the spindle with the bearing retainer plate and bottom bearing.

8. To remove the old top bearing, first remove the clearance seal [2] using a watchmaker's screwdriver, and push out the old top bearing from below using the spindle. Clean all parts. In the /WR version there is no rubber retaining seal above the bearing which is held flush with the housing top by a weak retaining compound. Push out the old top bearing from below using the spindle.

9. Fit the new bottom bearing** [6] into housing (inside the two 'tolerance' 'O' rings) in the base of the top plate using the spindle [4] by inserting one end of the spindle into the packet of bearings (to pick one up without any contamination). Place bearing retainer plate [7] with small 'O' ring in its groove over the bearing and assemble onto the top-plate [5] using the two screws.

For /WR versions now go to para. 17.

10. Insert spindle from above, slide on the spacers [10 & 9], optical disc [14], spacer [11], washer [12], and screw on the optical disc retaining nut [13] loosely.

11. Pick up a top bearing** [3] by inserting the spindle end into the packet of bearings. Slide the bearing into place using either a special jig, old (clean) bearing, or a small screwdriver (do not apply excessive pressure to the inner ring of the bearing). Ease in the rubber clearance retaining seal [2] (a new seal is usually used when renewing the bearings).

12. Re-tighten the optical disc retaining nut [13]. Lock this nut and the bearing retainer plate screws [8] with a drop of thread locking compound. For /WR versions, spin the spindle (slowly) to allow the upper bearing to centralise in retaining compound. Replace spindle protection tube.

13. Replace the electronic module [18], the stud [15] and tighten the nuts [16], adjusting so that the optical disc is directly in the middle of the opto-switch slot.

14. Reconnect the electronic module and check its operation over the voltage range according to the specification.

15. Ensure that the 'O' ring is fully up against the flange on the top plate and push on the body tube. Ensure that the other 'O' ring is in place on the base plate (rotate the 'O' ring slightly when fitting so that it rolls into place). Replace the base plate with the cable entry on the opposite side to the soldered connections.

16. Apply a non-drying silicone rubber compound around the studs. Replace the washers followed by the nuts and wipe away any excess compound.

013-101-06 (Page 1 of 3) *File: C:\AMPRO\DOCS\OPINSTM\A100-S.6AM*

IWR Versions Only:

17. Insert the small 'O'-ring into the bottom corner of the recess for the top bearing.

18. Apply a thin film of retaining compound using a small screwdriver or other pointed tool where bearing outer ring is to fit above the 'O' ring indicated by cross-hatched area on drawing (figure 1).

19. Apply thin film of retaining compound on spindle, as indicated by cross-hatched area on drawing.

20. Pick up a sealed top bearing*** [S8] so that the sealed side is uppermost by inserting the spindle end into the packet of bearings. Slide the bearing onto the compound and up to the shoulder of the spindle. Hold the upper end of the spindle so that the bearing cannot slide back and insert the assembly into the extension tube so that the bearing finishes flush with the tube end.

21. Slide on the spacers [10 & 9], optical disc [14], spacer [11], washer [12], and screw on the optical disc retaining nut [13] loosely, being careful not to push the spindle up again and spoil the seal.

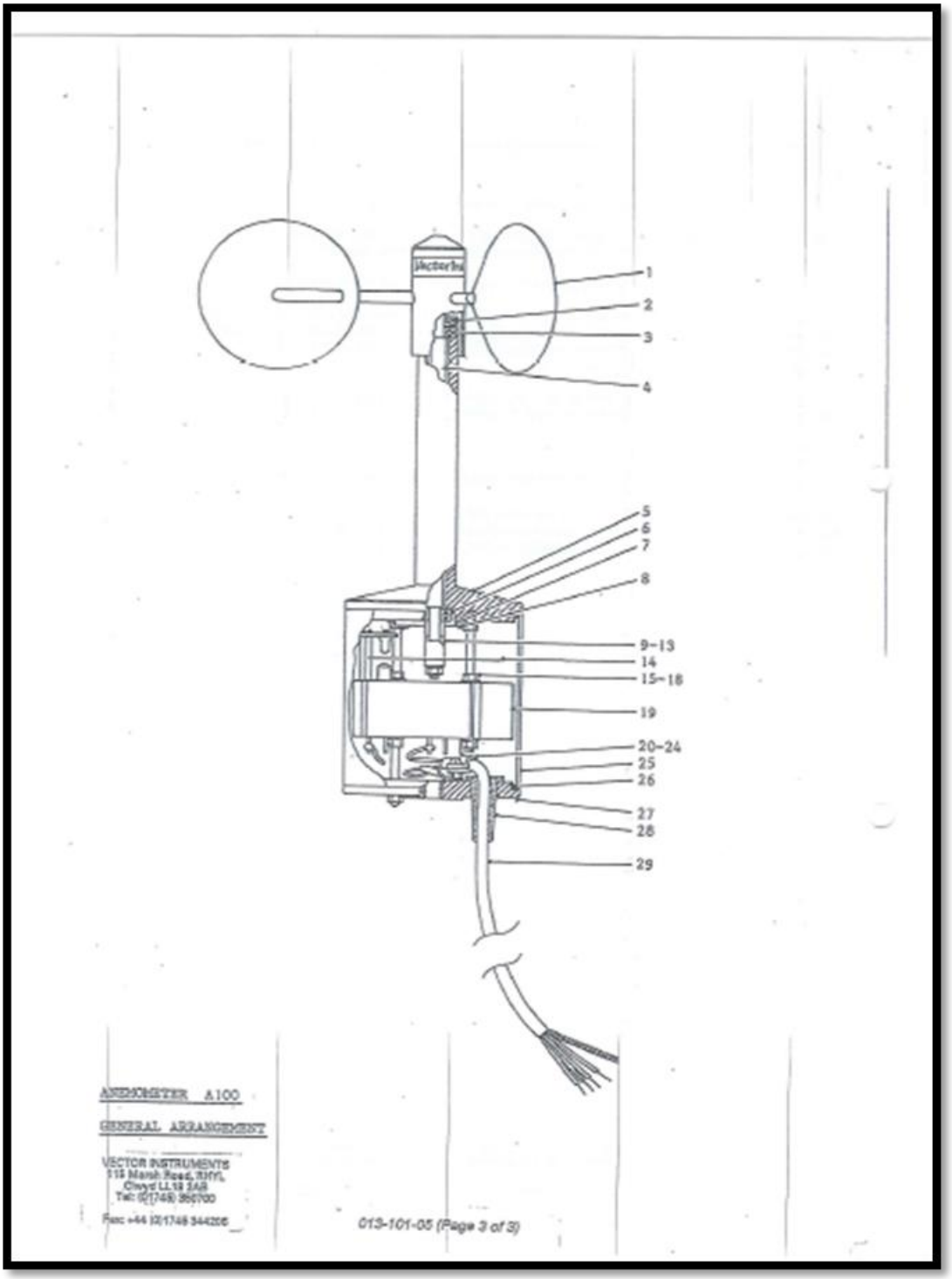
Now continue as para. 12 above.

Do not lubricate the bearings as they are pre-lubricated during manufacture.

*The bottom bearing is unshielded, the ball-cage being visible from both sides.
**The standard top bearing can be identified by the stainless steel shields which cover the ball-cage.
***The sealed bearing has a pre-loaded ptfe plastic touching seal on one side only.

Figure 1:

Vector Instruments (Windspeed Ltd), 116 Marsh Rd., Rhyl, Denbs., LL18 2AB, United Kingdom, Tel: (01745) 360700, Fax: (01745) 344238, International Fax: +44 (0) 1745 344238, e-mail: sales@windspeed.co.uk, website: www.windspeed.co.uk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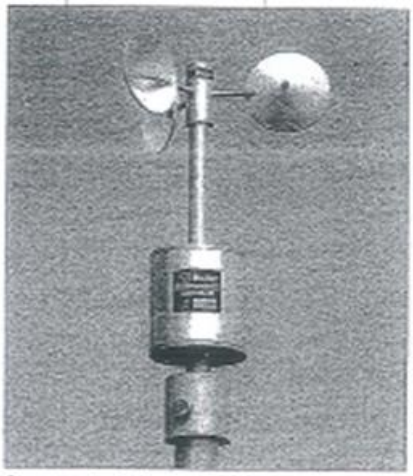
ANEMOMETER A100
GENERAL ARRANGEMENT
VECTOR INSTRUMENTS
013-101-05 (Page 3 of 3)

PULSE OUTPUT ANEMOMETERS

A100K
A100M
A100S



In these anemometers the rotor spindle turns a multi-slotted disc, interrupting the beam from a light-emitting diode. The output is obtained by amplification of the signal from an opto-electronic sensor in the path of the light beam.

All rotors are tested by comparison with a pre-calibrated rotor, traceable to the NPL standard, and individual calibration data provided.

The small size and light weight of the A100 series anemometers together with the patented gravity-sensitive fastener for the rotor facilitate use in portable applications, and although built to withstand hurricane force winds, the balanced 3-cup rotor also offers unsurpassed sensitivity and accuracy at low wind speeds.

The three versions offered provide for a range of resolutions according to type of application, two of which allow direct readout of wind speed in Knots or m/s using standard electronic counter/timers.

Construction is in anodised aluminium alloys, stainless steel and weather resisting plastics for all exposed parts, and the bearings (stainless steel shaft running in two precision corrosion-resistant ball-races) are protected from the entry of moisture droplets and dust, resulting in an instrument suitable for permanent exposure to the weather including marine environments. A touching shaft-seal can be fitted for extra protection as an alternative to the standard non-contact seal, with a small increase in threshold speed.

The wide range of operating temperatures allows use at any latitude, and an anti-icing heater can be fitted if required.

Performance

Windspeed range:	0 to 75 m/s
Threshold:	0.15 m/s (0.7 m/s with touching shaft seal).
Independent Linearity:	2% (0.7% up to 55 m/s)
Accuracy:	1% of reading (10 to 55 m/s)
	0.1 m/s (0.1 to 10 m/s)
Distance constant:	2.3 m

Electrical

Supply voltage:	10 to 30 volts D.C.
Supply current:	30 mA (typical) at 12V supply.
Output voltage:	+0.1 to +12V square wave with 12V supply.
Output resistance:	3.3 K ohms
Temperature range:	-50 to +70°C
Connections:	4-wire system (or 3-wire with short lines).

Vector Instruments

A100K/M/S

Output

Pulse-rate and resolution:

INSTRUMENT VERSION	Nominal pulse Rate (± 2%)	Pulses / Wind-run	Resolution (cm)	Duty Cycle
A100K	10Hz per Knot	10 pulses Per 1.69 ft	5.15	50% ± 20%
A100M	10Hz per m/s	10 pulses Per metre	10	50% ± 10%
A100S	0.8Hz per m/s	1 pulse Per 1.25m	125	50% ± 5%

Mechanical

Fixing: ¼ in. UNC / BSW thread (standard tripod screw)

Weight: 350g. Net., including 3m cable

Packing details: Weight: 700g

(One instrument c/w rotor) Dimensions: 25 x 16 x 16 cm

Cable: 3m, 4 core screened as standard

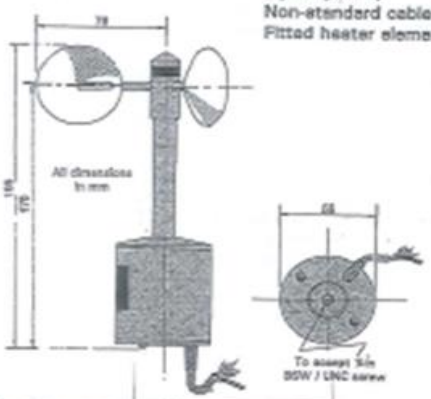
Options

K, M or S version

Marine version includes touching shaft seal (specify /WR)

Non-standard cable length

Fitted heater element HE-1 (12V 6W)
HE-2 (24V 6W)



Vector Instruments

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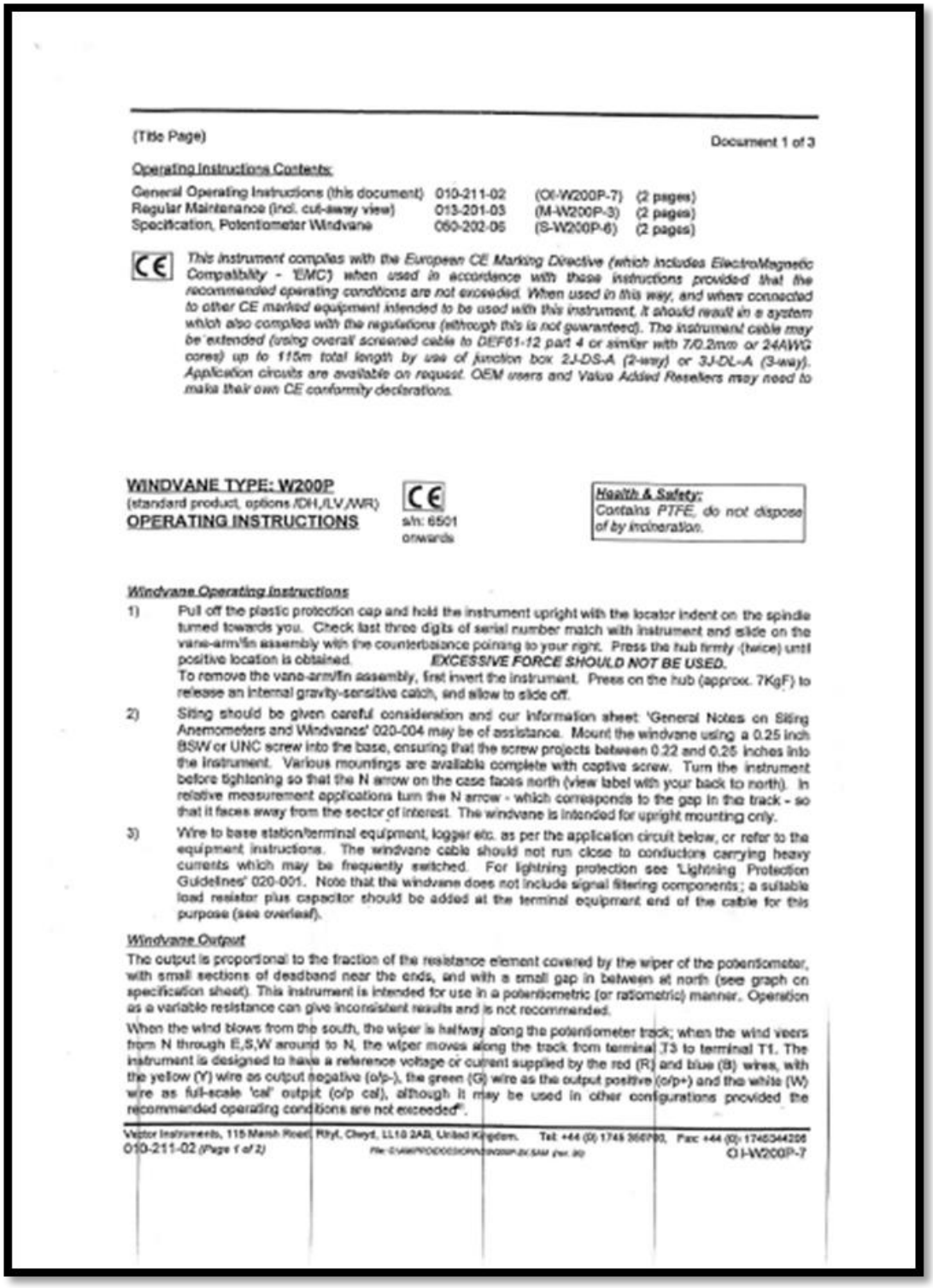
Agent/Distributor:

CE

060-102-11

B-A100K-11

Wind Vane Datasheet: Vector W200P



(Title Page) Document 1 of 3

Operating Instructions Contents:

General Operating Instructions (this document)	010-211-02	(OI-W200P-7)	(2 pages)
Regular Maintenance (incl. cut-away view)	013-201-03	(M-W200P-3)	(2 pages)
Specification, Potentiometer Windvane	060-202-05	(S-W200P-6)	(2 pages)

CE *This instrument complies with the European CE Marking Directive (which includes ElectroMagnetic Compatibility - 'EMC') when used in accordance with these instructions provided that the recommended operating conditions are not exceeded. When used in this way, and where connected to other CE marked equipment intended to be used with this instrument, it should result in a system which also complies with the regulations (although this is not guaranteed). The instrument cable may be extended (using overall screened cable to DEF61-12 part 4 or similar with 7/0.2mm or 24AWG cores) up to 115m total length by use of junction box 2J-DS-A (2-way) or 3J-DL-A (3-way). Application circuits are available on request. OEM users and Value Added Resellers may need to make their own CE conformity declarations.*

WINDVANE TYPE: W200P
(standard product, options /DH,/LV,/WR)
OPERATING INSTRUCTIONS

CE s/n: 6501 onwards

Health & Safety:
Contains PTFE, do not dispose of by incineration.

Windvane Operating Instructions

1) Pull off the plastic protection cap and hold the instrument upright with the locator indent on the spindle turned towards you. Check last three digits of serial number match with instrument and slide on the vane-arm/fin assembly with the counterbalance pointing to your right. Press the hub firmly (twice) until positive location is obtained. ***EXCESSIVE FORCE SHOULD NOT BE USED.***
To remove the vane-arm/fin assembly, first invert the instrument. Press on the hub (approx. 7KgF) to release an internal gravity-sensitive catch, and allow to slide off.

2) Siting should be given careful consideration and our information sheet 'General Notes on Siting Anemometers and Windvanes' 020-004 may be of assistance. Mount the windvane using a 0.25 inch BSW or UNC screw into the base, ensuring that the screw projects between 0.22 and 0.25 inches into the instrument. Various mountings are available complete with captive screw. Turn the instrument before tightening so that the N arrow on the case faces north (view label with your back to north). In relative measurement applications turn the N arrow - which corresponds to the gap in the track - so that it faces away from the sector of interest. The windvane is intended for upright mounting only.

3) Wire to base station/terminal equipment, logger etc. as per the application circuit below, or refer to the equipment instructions. The windvane cable should not run close to conductors carrying heavy currents which may be frequently switched. For lightning protection see 'Lightning Protection Guidelines' 020-001. Note that the windvane does not include signal filtering components; a suitable load resistor plus capacitor should be added at the terminal equipment end of the cable for this purpose (see overleaf).

Windvane Output

The output is proportional to the fraction of the resistance element covered by the wiper of the potentiometer, with small sections of deadband near the ends, and with a small gap in between at north (see graph on specification sheet). This instrument is intended for use in a potentiometric (or ratiometric) manner. Operation as a variable resistance can give inconsistent results and is not recommended.

When the wind blows from the south, the wiper is halfway along the potentiometer track; when the wind veers from N through E,S,W around to N, the wiper moves along the track from terminal T3 to terminal T1. The instrument is designed to have a reference voltage or current supplied by the red (R) and blue (B) wires, with the yellow (Y) wire as output negative (o/p-), the green (G) wire as the output positive (o/p+) and the white (W) wire as full-scale 'cal' output (o/p cal), although it may be used in other configurations provided the recommended operating conditions are not exceeded.

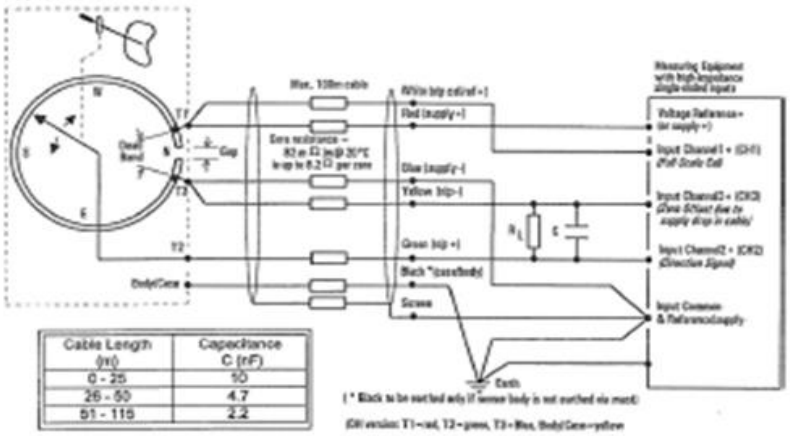
Vector Instruments, 115 Marsh Road, Rhyl, Clwyd, LL18 2AB, United Kingdom. Tel: +44 (0) 1745 366000, Fax: +44 (0) 1745344206
010-211-02 (Page 1 of 2) OI-W200P-7

Output Loading

The output will need to be loaded (R_L) to some degree in order to avoid spurious signals when the wiper is in the gap. This loading will add a non-linearity error, the maximum occurs at 240° and is 0.53° using a 100KΩ load (0.11° with a minimum recommended load of 470KΩ). This contribution to error can be corrected if required while logging or subsequent data processing according to the formula below.

A suitable capacitor should be added to the o/p+ (= pot. wiper =green wire) line at the terminal equipment end of the cable. This will reduce possible interference pick-up, especially when the wiper is in the gap. However, the value of R_L x C should not be too large or there will be significant sampling errors when the average wind direction is near north (wiper frequently crossing the gap). To minimise this source of error, it is best to use a relatively low value of load resistance, and apply the correction as the formula below. The table shows suitable values of C for various cable lengths.

Application Circuit [#1]



Cable Length (m)	Capacitance C (nF)
0 - 25	10
26 - 50	4.7
51 - 115	2.2

(* Black to be earthed only if sensor body is not earthed via mast)

(UK version: T1=red, T2=green, T3=Blue, Body/Case=yellow

Formulae

The wind direction can be calculated according to the following formulae which can correct for non-linearity due to loading, voltage drops in the cables and potentiometer tolerances[#2].

Corrected Direction (degrees), $\theta = (360 - D)x_c + \frac{D}{2}$

Where, Corrected Potentiometer Output*, $x_c = x\left\{1 + \frac{R}{R_L}\left(x - x^2\right)\right\}$

* *This correction is for the non-linearity due to loading, provided R_L is large compared to the pot. resistance R and the cable core resistance. Set $x_c = x$ if linearity correction is not required.*

and, fraction of full potentiometer output, $x = (CH2 - CH3) \div (CH1 - CH3)$

and, R = potentiometer resistance[#3], R_L = load resistance, D = Deadband (in degrees)[#3]

and, CH1, CH2 and CH3 are measurement channel values.

Notes

[#1] See the paragraph on CE Marking overleaf. It is possible to use this instrument up to the absolute max. ratings in the spec. without damage or degradation of performance, however this is not covered by our declaration of compliance with the CE marking regulations.

[#2] In some applications there may not be sufficient channels available to measure the three values required. In this case the measurements can be simplified (with an accompanying potential loss of accuracy) as follows:-

i) If the Voltage Reference (V_{REF}) is known (and sufficiently stable), then it need not be measured. The voltage drop in the red wire can also be assumed equal to that in the blue, permitting measurement of only two channels, CH2(potentiometer voltage) and CH3 (voltage drop / zero offset). Thus the formula for x becomes: $x = (CH2 - CH3) \div (V_{REF} - 2.CH3)$

ii) If short cables are in use, then the voltage drop in both the red and blue wires is small and may be assumed to be zero (it can be further reduced by paralleling the red+white and blue+yellow wire pairs). If V_{REF} is known (as above) then only CH2 need be measured and the formula for x becomes simply: $x = CH2 \div V_{REF}$.

iii) If short cables are in use, the voltage drop in the blue wire is small and may be assumed to be zero (it can be further reduced by paralleling the blue+yellow wire pairs), but if V_{REF} is not known (or not stable over time/temperature etc.) and both CH1 (i.e. V_{REF}) and CH2 are measured, then the formula for x becomes simply: $x = CH2 \div CH1$.

[#3] Refer to specification sheet for nominal Deadband and Potentiometer Resistance figures. Data for individual instruments is available on request. Instruments are set up so that south corresponds to the mid point of the potentiometer resistance.

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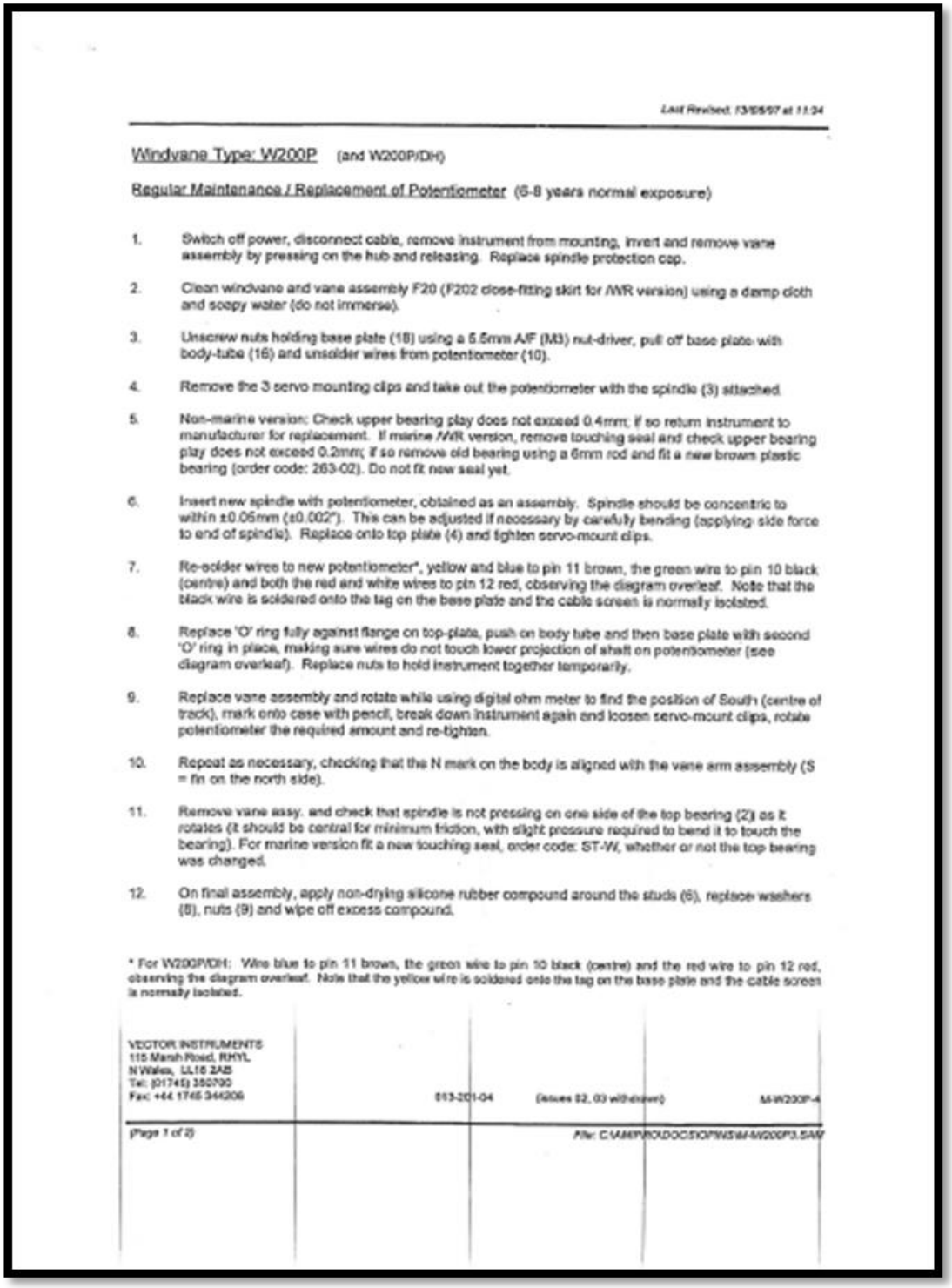
010-211-02 (Page 2 of 2) OI-W200P-7



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Windvane Type: W200P (and W200P/DH)

Regular Maintenance / Replacement of Potentiometer (6-8 years normal exposure)

1. Switch off power, disconnect cable, remove instrument from mounting, invert and remove vane assembly by pressing on the hub and releasing. Replace spindle protection cap.
2. Clean windvane and vane assembly F20 (F202 close-fitting skirt for /WR version) using a damp cloth and soapy water (do not immerse).
3. Unscrew nuts holding base plate (18) using a 6.5mm A/F (M3) nut-driver, pull off base plate with body-tube (16) and unsolder wires from potentiometer (10).
4. Remove the 3 servo mounting clips and take out the potentiometer with the spindle (3) attached.
5. Non-marine version: Check upper bearing play does not exceed 0.4mm; if so return instrument to manufacturer for replacement. If marine /WR version, remove touching seal and check upper bearing play does not exceed 0.2mm; if so remove old bearing using a 6mm rod and fit a new brown plastic bearing (order code: 263-02). Do not fit new seal yet.
6. Insert new spindle with potentiometer, obtained as an assembly. Spindle should be concentric to within ±0.05mm (±0.002"). This can be adjusted if necessary by carefully bending (applying side force to end of spindle). Replace onto top plate (4) and tighten servo-mount clips.
7. Re-solder wires to new potentiometer*, yellow and blue to pin 11 brown, the green wire to pin 10 black (centre) and both the red and white wires to pin 12 red, observing the diagram overleaf. Note that the black wire is soldered onto the tag on the base plate and the cable screen is normally isolated.
8. Replace 'O' ring fully against flange on top-plate, push on body tube and then base plate with second 'O' ring in place, making sure wires do not touch lower projection of shaft on potentiometer (see diagram overleaf). Replace nuts to hold instrument together temporarily.
9. Replace vane assembly and rotate while using digital ohm meter to find the position of South (centre of track), mark onto case with pencil, break down instrument again and loosen servo-mount clips, rotate potentiometer the required amount and re-tighten.
10. Repeat as necessary, checking that the N mark on the body is aligned with the vane arm assembly (S = fin on the north side).
11. Remove vane assy. and check that spindle is not pressing on one side of the top bearing (2) as it rotates (it should be central for minimum friction, with slight pressure required to bend it to touch the bearing). For marine version fit a new touching seal, order code: ST-W, whether or not the top bearing was changed.
12. On final assembly, apply non-drying silicone rubber compound around the studs (6), replace washers (8), nuts (9) and wipe off excess compound.

* For W200P/DH: Wire blue to pin 11 brown, the green wire to pin 10 black (centre) and the red wire to pin 12 red, observing the diagram overleaf. Note that the yellow wire is soldered onto the tag on the base plate and the cable screen is normally isolated.

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013-201-04 (issues 02, 03 withdrawn) M-W200P-4

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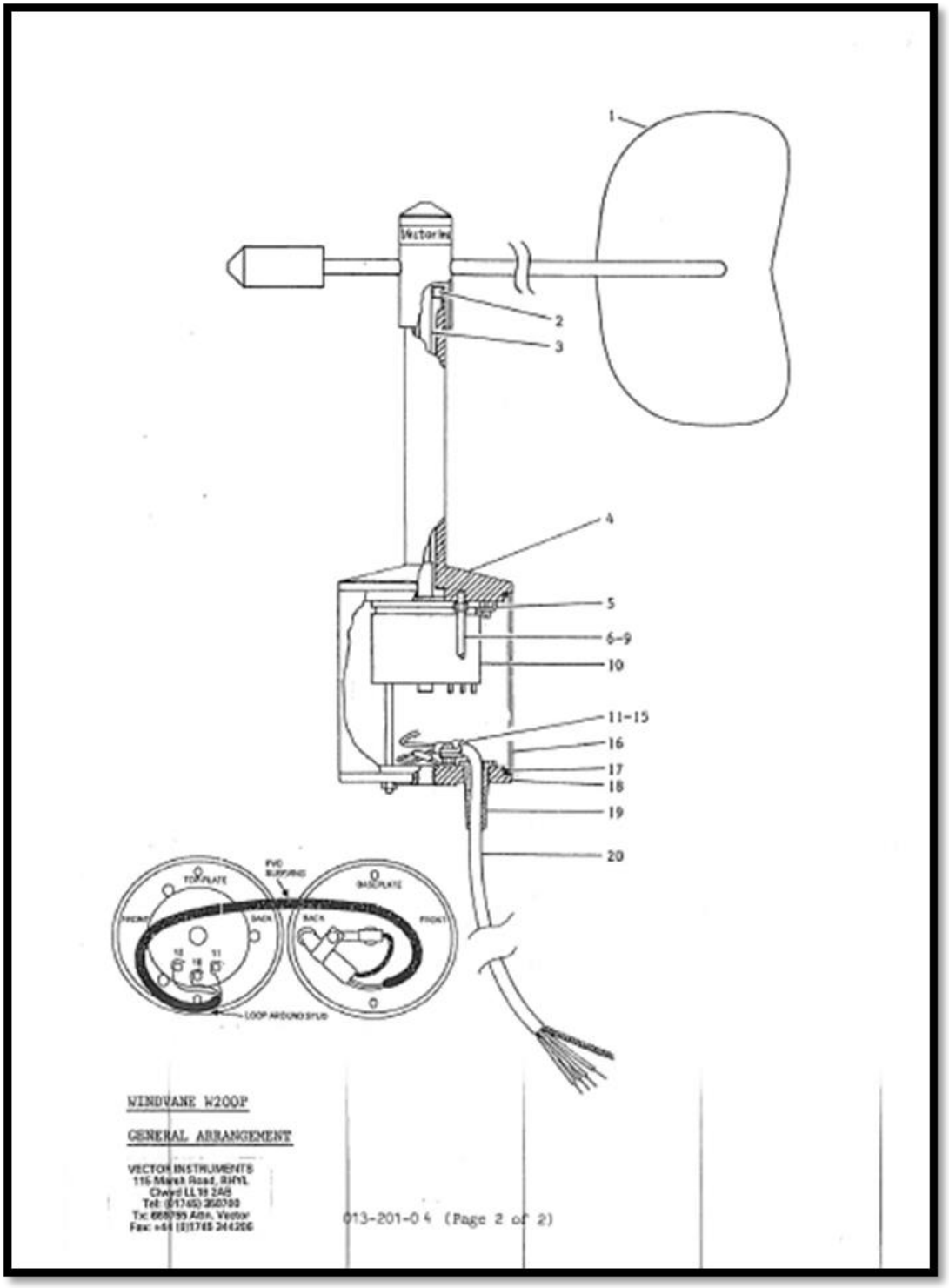

1
2
3
4
5
6-9
10
11-15
16
17
18
19
20
TOP PLATE
BASE PLATE
FRONT
BACK
LOOP AROUND STUD
WINDVANE W200P
GENERAL ARRANGEMENT
VECTOR INSTRUMENTS
013-201-04 (Page 2 of 2)

POTENTIOMETER WINDVANE W200P

This instrument incorporates a precision wire-wound potentiometer as shaft angle transducer, enabling wind direction to be accurately determined when used in suitable electronic circuits. The potentiometer has the lowest possible torque consistent with long life and reliability, the small gap at north being filled with an insulating material to ensure smooth operation over the full 360°. The vane-arm assembly is attached by the unique Porton™ gravity fastener, allowing rapid attachment and release; thus improving portability.

Construction is from anodised aluminium alloys and stainless steels for exposed parts. Combined with the hard plastic (upper) plain bearing and precision ball races, the result is an instrument with a long service interval which is suitable for permanent exposure to the weather.

In the marine version,[#1] body/fin sealing is enhanced and a touching shaft-seal is fitted above the upper (replaceable) bearing for extra protection.

For applications where improved sensitivity is required, a larger vane version [#2] is available.

An anti-icing heater can also be fitted to extend operation by removing hoare frost around the upper bearing.

Range of Operation

Maximum Wind Speed:	Over 75m/s (150Knots, 170mph) [60m/s][#2]
Range:	360° mechanical angle, full-circle continuous rotation allowed.
Temperature range:	-50 to +70°C

Performance

Threshold:	0.6m/s (1.2Knot, 1.4mph) [0.75m/s][#1] [0.5m/s][#2] (the vane will commence movement when aligned at 45° to the flow).
Response:	Damped natural Wavelength: 3.4m [3.6m][#2] Damping Ratio: 0.2m [0.24m][#2] Recovery distance: 0.51m [0.54m][#2] Distance constant: 2.3m [2.4m][#2]
Repeatability:	±0.5° vane removed and replaced (no measurable backlash movement during use).
Life of potentiometer:	5×10^7 cycles (10 years typical exposure).
Service Interval:	4 to 5 years.
Accuracy:	±3° in steady winds >5m/s [6m/s][#1] [3.5m/s][#2] (±2° obtainable following calibration).

Electrical

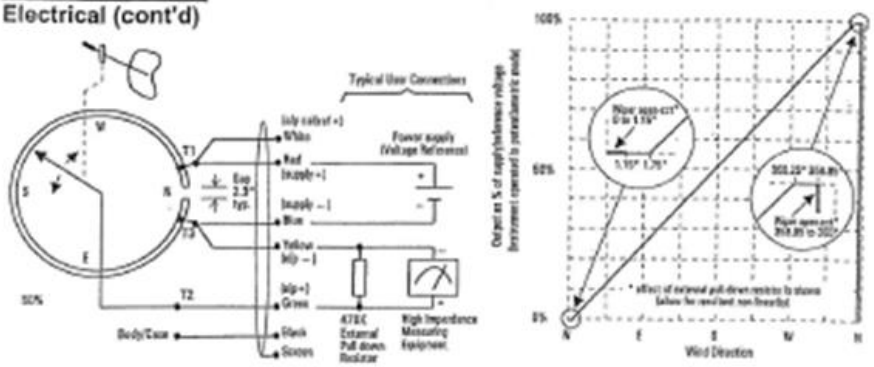
Potentiometer resistance:	1000 Ω ±10%
Maximum dissipation:	0.5W, -50 to +20°C (de-rate linearly to 0.25W at 70°C)
Maximum wiper current:	50μA*, (20mA absolute max.)
Supply voltage:	1 to 5V*, (20V absolute max.) across terminals 1 & 3.
Case to pot. voltage:	72V max. (case or screen to any terminal on pot.)
Insulation resistance:	>50MΩ
Temperature coefficient of resistance:	±50 x 10^{-6}/°C
Electrical continuity angle:	357.7 ±1.5° (2.3° gap at north)
Electrical variation angle:	356.5 ±1.5° (3.5° dead-band)
Resolution:	±0.2°
Independent non-linearity:	±0.25% (unloaded)

*Notes: Figures marked * refer to recommended operating conditions.*
Bracketed figures marked [#1,#2] refer to parameters changed when options are fitted, (see options section overleaf).

Vector Instruments

W200P

Electrical (cont'd)



Terminations: 3 metres of 6-wire cable with overall screen: 7 x 0.2mm (≈24AWG) overall tinned copper wire braid screen and black pvc outer. Alternative standard lengths: 6m, 10m, 15m. (where extended, max. recommended overall length: 100m)

Connections: Red, White: Terminal T1. Green (wiper): Terminal T2. Blue, Yellow: Terminal T3. Black: Sensor body. Screen: Isolated.

Rotation sense: Direction changes from N through E,S,W to N cause the wiper to move along the track from terminal T3 to terminal T1. Note: Wind direction is North when wind is coming from the North.

Mechanical

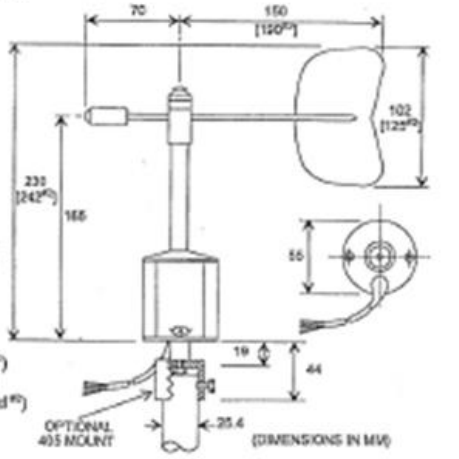
Net weight: 310g. [350g][1]

Packed weight: 700g. [780g][2]

Packed dimensions: 250 x 160 x 160mm [230 x 180 x 170mm][2] (one instrument c/w fin)

Fixing: 0.25 inch UNC/BSW screw into base, or optional mast adapter (type 405 shown). Taper fitting also available.

Materials: Anodised aluminium alloys and stainless steels for exposed parts.



Options

/WR:- Marine version (see bracketed figures marked [1])

/LV:- The standard F20 vane-arm/fin can be replaced with a larger F20/LV type (see bracketed figures marked [2])

/HE-1, /HE-2:- Anti-icing heaters, 6W (12V, 24V resp.)

Also available is a selection of mounting brackets and arms, mast adaptors and spare parts; including vane, bearing, potentiometer/spindle assy. & overhaul kit.

CE

Vector Instruments

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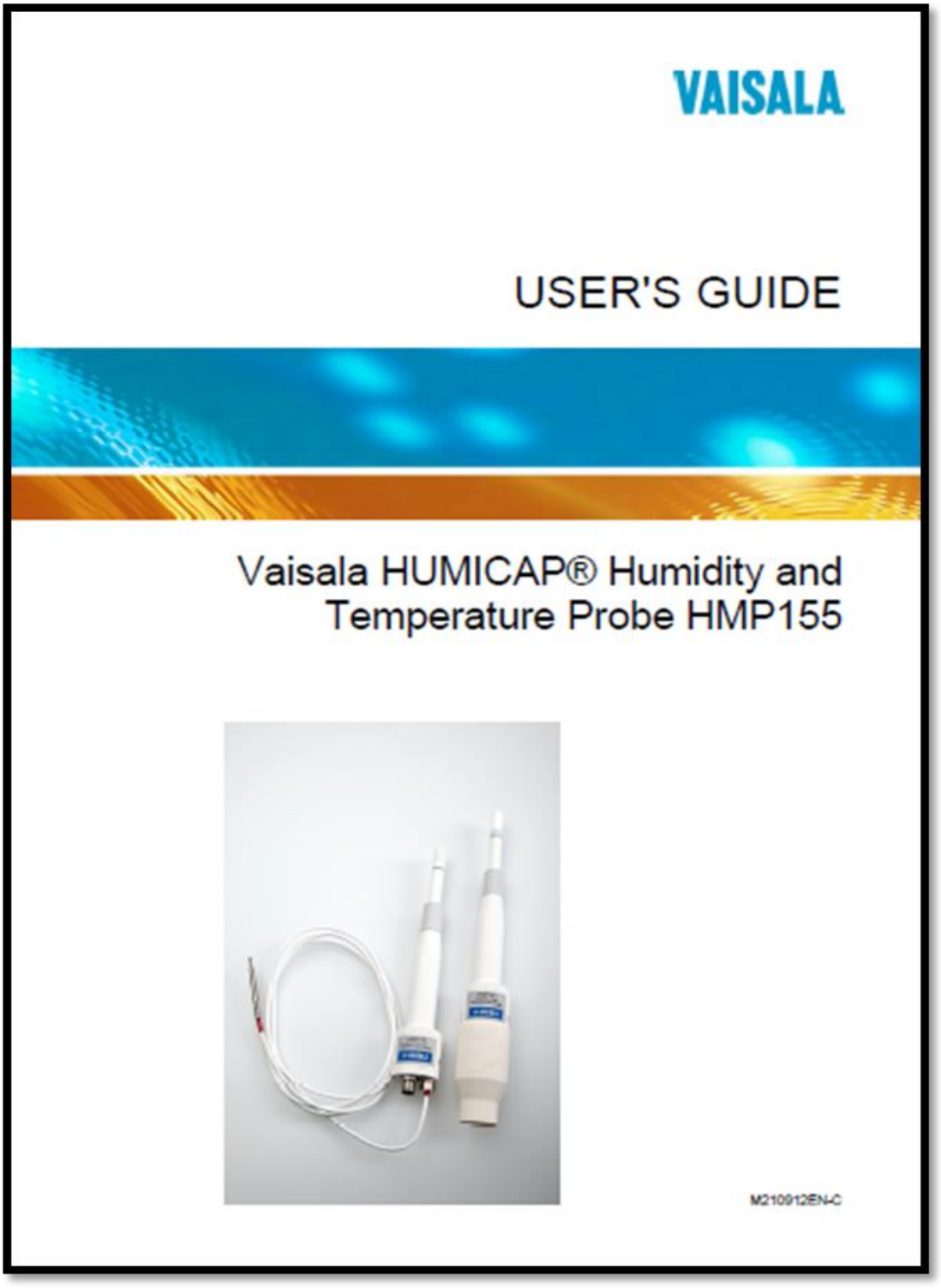
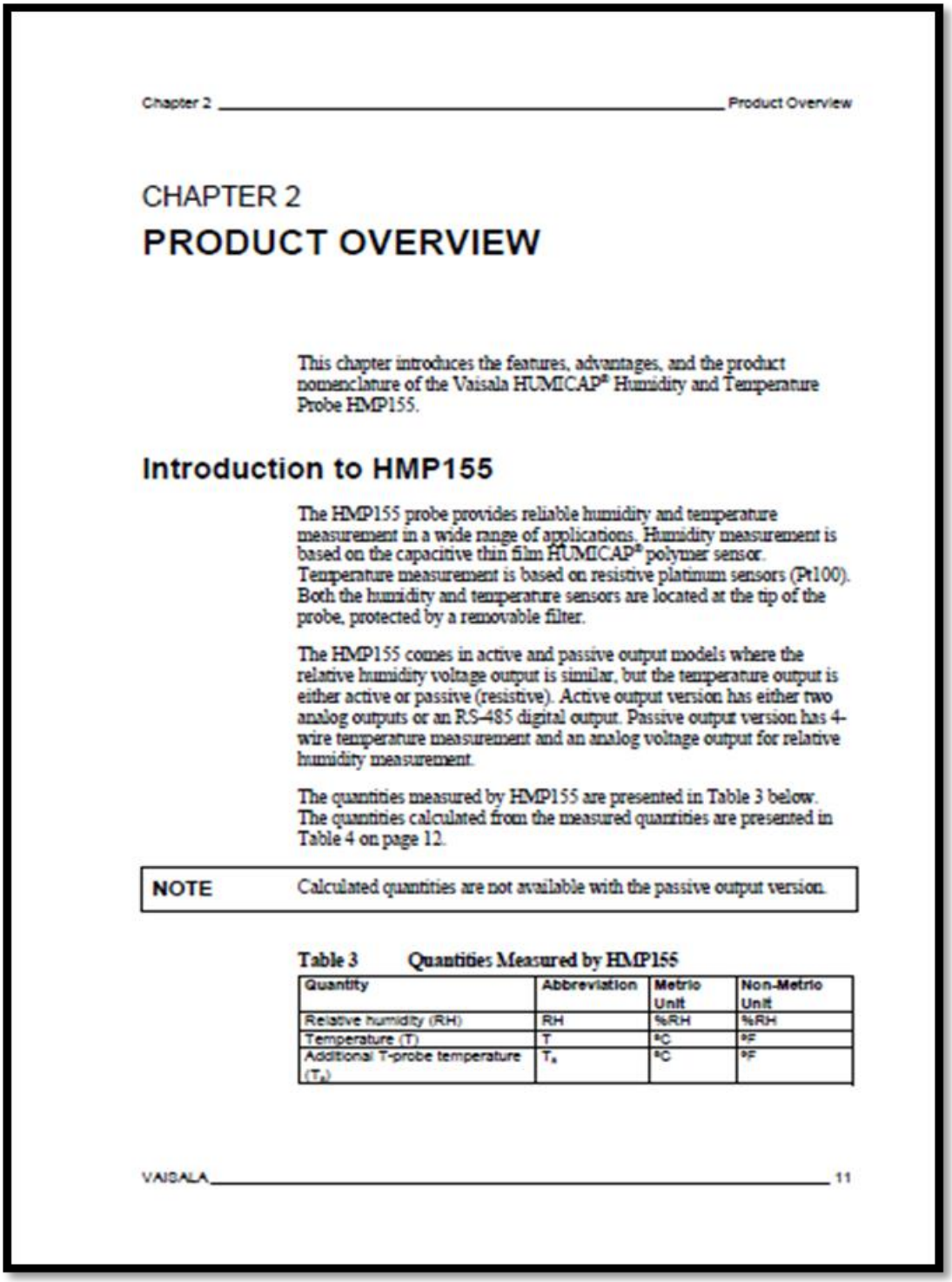
050-202-06

Vector Instrument's policy of continuous development means that this specification may be altered without notice, however new product will wherever possible remain compatible with that previously supplied.

Termohygrometer Datasheet: Vaisala HMP155A





Chapter 2 Product Overview

CHAPTER 2

PRODUCT OVERVIEW

This chapter introduces the features, advantages, and the product nomenclature of the Vaisala HUMICAP® Humidity and Temperature Probe HMP155.

Introduction to HMP155

The HMP155 probe provides reliable humidity and temperature measurement in a wide range of applications. Humidity measurement is based on the capacitive thin film HUMICAP® polymer sensor. Temperature measurement is based on resistive platinum sensors (Pt100). Both the humidity and temperature sensors are located at the tip of the probe, protected by a removable filter.

The HMP155 comes in active and passive output models where the relative humidity voltage output is similar, but the temperature output is either active or passive (resistive). Active output version has either two analog outputs or an RS-485 digital output. Passive output version has 4-wire temperature measurement and an analog voltage output for relative humidity measurement.

The quantities measured by HMP155 are presented in Table 3 below. The quantities calculated from the measured quantities are presented in Table 4 on page 12.

NOTE Calculated quantities are not available with the passive output version.

Table 3 Quantities Measured by HMP155

Quantity	Abbreviation	Metric Unit	Non-Metric Unit
Relative humidity (RH)	RH	%RH	%RH
Temperature (T)	T	°C	°F
Additional T-probe temperature (T_a)	T_a	°C	°F

VAISALA 11

Table 4 Quantities Calculated by HMP155

Quantity	Abbreviation	Metric Unit	Non-Metric Unit
Dew point / Frost point Temperature (T_{df})	TDF	°C	°F
Dew point Temperature (T_d)	TD	°C	°F
Mixing ratio (x)	X	g/kg	gr/lb
Wetbulb temperature (T_w)	TW	°C	°F

Basic Features and Options

- Can be used to replace HMP45A/D, also in radiation shields
- Improved performance with the HUMICAP®180R sensor and alternatively the HUMICAP®180RC sensor. Also available with the HUMICAP®180 sensor.
- Warmed humidity probe for improved performance in constant high humidity (active output version).
- Different voltage ranges possible: 0...1 V, 0…5 V, 0…10 V (active and passive output versions).
- Different T-output scales possible: -40…+60°C, -20…+40°C, -80…+60°C (active output version)
- Chemical purge option for applications where interfering chemicals in the measuring environment pose a risk (active output version).
- Additional temperature probe (T-probe) with fast response (active output version).
- USB connectivity for service connections via the optional USB-M12 cable.
- Installation kits for an additional T-probe into DTR13 and DTR502 radiation shields.
- Installation kit for Stevenson screen (active and passive output version, both with and without additional T-probe).
- MI70 connectivity for field checking and calibration.
- Optional connection cover for additional protection in wet environments.

Structure of the HMP155

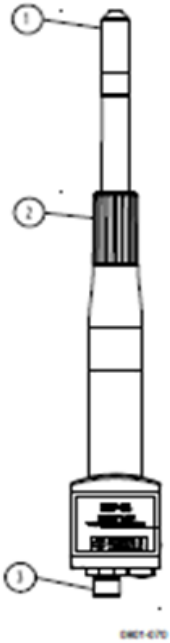


Figure 1 HMP155 Probe

The numbers refer to Figure 1 above.

1 = Filter
2 = Protective cover
3 = 8-Pin male connector (M12)

Additional Temperature Probe Option

Figure 2 HMP155 with Additional T-probe

The active output version of HMP155 can be ordered with an additional temperature probe option, see Figure 2 above. When the additional T-probe is in use, the relative humidity value is calculated based on the T_d (dew point) value obtained from the humidity probe and the T, value obtained from the T-probe.

When installing HMP155 with T-probe, it is important to make sure that the humidity probe and the T-probe are installed in the same conditions in order to get accurate readings. Even a slight difference in temperature conditions between the T-probe and the humidity probe will result in false RH readings. The two probes need to be installed so that the humidity probe does not heat the T-probe, but is close enough for the probes to share the same environment conditions. When the RH reading is required, always install the T-probe in the place where you need the reading from.

Warmed Probe Option

In changing temperature conditions with high humidity, the probe temperature can lag behind the temperature of the surrounding air and this can cause a risk of condensation on the sensor. A wet probe cannot observe the actual humidity in the ambient air. If the condensed water is contaminated, the life span of the probe may shorten and the calibration may change.

The HMP155 warmed probe is heated continuously so that its temperature is always higher than that of the environment. This prevents condensation on the probe. With the additional temperature probe it is possible to calculate the true RH based on the non-heated (ambient) temperature information. If the warming is selected but the additional temperature probe is not present, HMP155 only produces dew point and mixing ratio output.

Connection Cover Option

Figure 3 HMP155 with Optional Connection Cover

An optional connection cover is available for enhanced protection in wet environments such as coasts or rainforests.

Barometer Datasheet: Vaisala PTB210

VAISALA www.vaisala.com

PTB210 Digital Barometer

The Vaisala BAROCAP® Digital Barometer PTB210 is a reliable outdoor barometer that withstands harsh conditions.

The PTB210 paired with the SPH10 Static Pressure Head.

For Harsh Environments

The Vaisala BAROCAP® Digital Barometer PTB210 is ideal for outdoor installations and harsh environments. The barometers are designed to operate in a wide temperature range, and the electronics housing provides IP65 (NEMA 4) standardized protection against sprayed water.

Features/Benefits

- 500 ... 1100 hPa or 50 ... 1100 hPa pressure ranges with serial output
- Different scalings between 500 ... 1100 hPa with analog output
- Electronics housing IP65 protected against sprayed water
- Accurate and stable measurement
- NIST traceable (certificate included)

The PTB210 barometers are ideal for use in applications such as weather stations, data buoys and ships, airports, and agrology. They are also an excellent solution for monitoring barometric pressure in industrial equipment such as laser interferometers and engine test benches.

Several Pressure Ranges

The PTB210 barometers are designed for various pressure ranges. They are available in two basic configurations: serial output for 500 ... 1100 hPa and 50 ... 1100 hPa and analog output with different scalings between 500 ... 1100 hPa.

Accurate and Stable Measurement

All the PTB210 barometers are digitally adjusted and calibrated by using electronic working standards. A higher accuracy barometer, that is fine-tuned and calibrated against a High Precision Pressure Calibrator, is available for the 500 ... 1100 hPa pressure range.

In addition, the PTB210 integrates directly with Vaisala Static Pressure Head Series SPH10/20. This pairing offers accurate measurement in all wind conditions.

Vaisala BAROCAP® Technology

The PTB210 barometers use the Vaisala BAROCAP® Sensor, a silicon capacitive absolute pressure sensor developed by Vaisala for barometric pressure applications. The Vaisala BAROCAP® Sensor provides excellent hysteresis and repeatability characteristics and outstanding temperature and long-term stability. All PTB210 barometers are delivered with a factory calibration certificate which is NIST traceable.

Technical Data

Operating Range (1hPa=1mbar)

Pressure range (order specified)	
serial output	500 ... 1100 hPa
	50 ... 1100 hPa
analog output	500 ... 1100 hPa
	600 ... 1060 hPa
	800 ... 1060 hPa
	900 ... 1100 hPa
Operating temperature range	-40 ... +60 °C (-40 ... +140 °F)
Humidity range	non-condensing

Accuracy

SERIAL OUTPUT (units in hPa)

Pressure range	500 ... 1100 Class A	500 ... 1100 Class B	50 ... 1100
Non linearity*	±0.10	±0.15	±0.20
Hysteresis*	±0.05	±0.05	±0.10
Repeatability*	±0.05	±0.05	±0.10
Calibration uncertainty**	±0.07	±0.15	±0.20
Accuracy at +20 °C (+68 °F)***	±0.15	±0.20	±0.35
Temperature dependence****	±0.20	±0.20	±0.40
Total accuracy*** -40 ... +60 °C (-40 ... +140 °F)	±0.25	±0.30	±0.50
Long term stability (hPa/year)	±0.10	±0.10	±0.20

ANALOG OUTPUT

Non linearity*	±0.20 hPa
Hysteresis*	±0.05 hPa
Repeatability*	±0.05 hPa
Calibration uncertainty**	±0.15 hPa
Accuracy at +20 °C (+68 °F)***	±0.30 hPa
Temperature dependence****	±0.50 hPa
Total accuracy*** -40 ... +60 °C (-40 ... +140 °F)	±0.60 hPa
Long term stability	±0.10 hPa/year

* Defined as the ±2 standard deviation limits of end point non-linearity, hysteresis error or repeatability error.
** Defined as ±2 standard deviation limits of inaccuracy of the working standard including traceability to NIST.
*** Defined as the root sum of the squares (RSS) of end point non-linearity, hysteresis error, repeatability error and calibration uncertainty at room temperature.
**** Defined as ±2 standard deviation limits of temperature dependence over the operating temperature range.

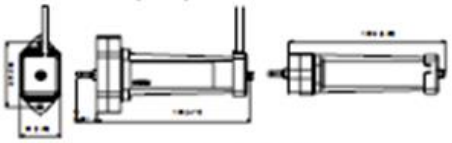
General

(= Factory setting)

SERIAL OUTPUT	
Current consumption	
normal mode	< 15 mA=
power down mode	< 0.8 mA
shutdown mode	0.2 mA
Shutdown	ON/OFF
Settling time at power up	2 s
Serial I/O (factory setting=)	RS232C
	RS232C /TTL (optional)
	RS485, non isolated (optional)
parity	none, even=, odd
data bits	7=, 8
stop bits	1=, 2
Baud rate	1200, 2400, 4800, 9600=, 19200
Response time	1 s=
Resolution	0.01 hPa (1 measurement/s)
	0.03 hPa (10 measurements/s)
ANALOG OUTPUT	
Outputs	0 ... 5 VDC, 0 ... 2.5 VDC (order specified)
Current consumption	
normal mode	< 8 mA
shutdown mode	0.2 mA
Shutdown	ON/OFF
Response time	500 ms
Resolution	300 µV
Measurement rate	3 measurements/s
ALL MODELS	
Supply voltage (reverse polarity protected)	
with RS232/TTL output	5 ... 28 VDC
with RS485 or analog output	8 ... 18 VDC
Max. pressure	5 000 hPa abs.
Pressure connector	M5 (10-32) internal thread
Pressure fitting	barbed fitting for 1/8" I.D. tubing
Housing	
electronics	IP65 (NEMA 4)
sensor	IP53
Housing material	PC plastic
Supply/output cable length	1, 2, 3, 5 or 10 m
Instrument	110 g
Cable	28 g/m
Electromagnetic compatibility	Complies with EMC standard EN61326-1, Generic Environment

Dimensions

Dimensions in mm (inches)



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VAISALA

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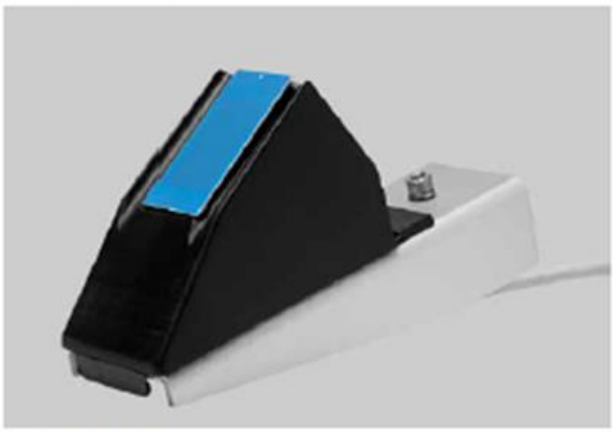
www.vaisala.com

CE

Rain detector/Pluviometer Datasheet:Vaisala DRD11A

VAISALA www.vaisala.com

DRD11A Rain Detector



Vaisala DRD11A Rain Detector

Features/Benefits

- Fast and accurate precipitation detection (ON/OFF)
- Rain intensity measurement with processing unit
- Maintenance free
- Heating element for keeping sensor free of snow and condensed moisture, and for quick drying

Rain and snow are quickly and accurately detected with the DRD11A Rain Detector. The DRD11A operates via droplet detection rather than by signal level threshold.

A special delay circuitry allows about two-minute interval between raindrops before assuming an OFF (no rain) position. This enables the sensor to accurately distinguish between rain cessation and light rain.

The DRD11A also features an analog Rain Signal for estimating rain intensity. Since this signal is proportional to the percentage of moist or wet area on the sensor plate, rain intensity has a direct impact on the amplitude and variation of this analog signal.

The DRD11A sensor is positioned at a 30° angle. This design, together with the internal heating element, ensures that the surface dries quickly, an essential factor in calculating intensity. The same heating element also protects the surface from fog and condensed moisture, and is activated at low temperatures in order to melt snow, thus allowing snow detection. Sensor performance is not affected by reasonable amounts of dirt and dust due to droplet detection.

The DRD11L is a low heating power model of the DRD11A. It is intended to be used in areas with only rain or wet/moist snow precipitation.

Technical Data

Sensor

Capacitive principle, thick layer sensor
RainCap™ with a thin glass shield. Integrated heater element.

Sensitivity of Rain Detection

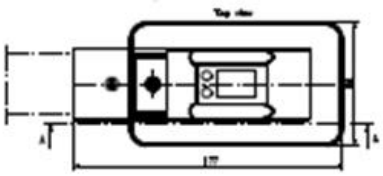
Minimum wet area	0.05 cm²
OFF-delay (active)	< 5 min

Physical

Sensor plate	
Sensing area	7.2 cm²
Angle	30°
Housing material	Polypropylene
Windshield and support bracket	Aluminum
Moisture shield	Polyurethane
Dimensions	(h x w x l)
With wind shield	110 x 80 x 175 mm
Without wind shield	90 x 46 x 157 mm
Weight	500 g
Cable length	4 m

Electrical

Supply voltage	12 VDC ± 10 %
Supply current	
Typical less than	150 mA
Maximum	260 mA
Heater OFF	25 mA
Sensor plate	
Heating power	0.5 ... 2.3 W



Output

Rain ON/OFF
Open collector, active low signal corresponds to rain

Maximum voltage	15 V
Maximum current	50 mA
Analog output	1...3 V (wet...dry)
Frequency output	1500...6000 Hz, non-calibrated

Input

Control to switch heater OFF
Open circuit input enables the heater.
Connection to GND disables the heater.

Contact rating min.	15 V, 2 mA

Ground Wiring

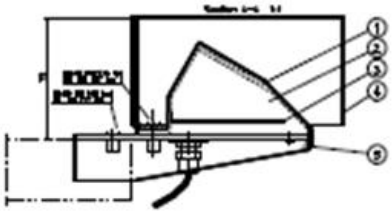
Separate ground wires for signal and heater

Temperature Range

Operating	-55...+55 °C (-65...+131 °F)
Storage	-40...+65 °C (-40...+149 °F)

Mounting

By one screw (M5 x 20 mm) to sensor arm



1. *Sensor, RainCap™*
2. *Polyurethane moisture shield*
3. *Component assembly*
4. *Wind shield*
5. *Mounting plate*

VAISALA

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CE

4.8 Calibration Certificates.

Anemometer 1 (TOP) Serial Number 3844:

2 (3884

Deutsche WindGuard
Wind Tunnel Services GmbH, Varel

DEUTSCHE WINDGUARD

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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

Calibration mark
Kalibrierzeichen

1615032
D-K-15140-01-00
09/2016

Object *Gegenstand*	Cup Anemometer
Manufacturer *Hersteller*	Windspeed LTD Denbighshire LL18 2AB
Type *Typ*	A100M
Serial number *Fabrikat/Serien-Nr.*	3884 FHRZ
Customer *Auftraggeber*	Vestas Manufacturing A/S
Order No. *Auftragsnummer*	A13797
Project No. *Projektnummer*	VT160906
Number of pages *Anzahl der Seiten*	4
Date of Calibration *Datum der Kalibrierung*	28.09.2016

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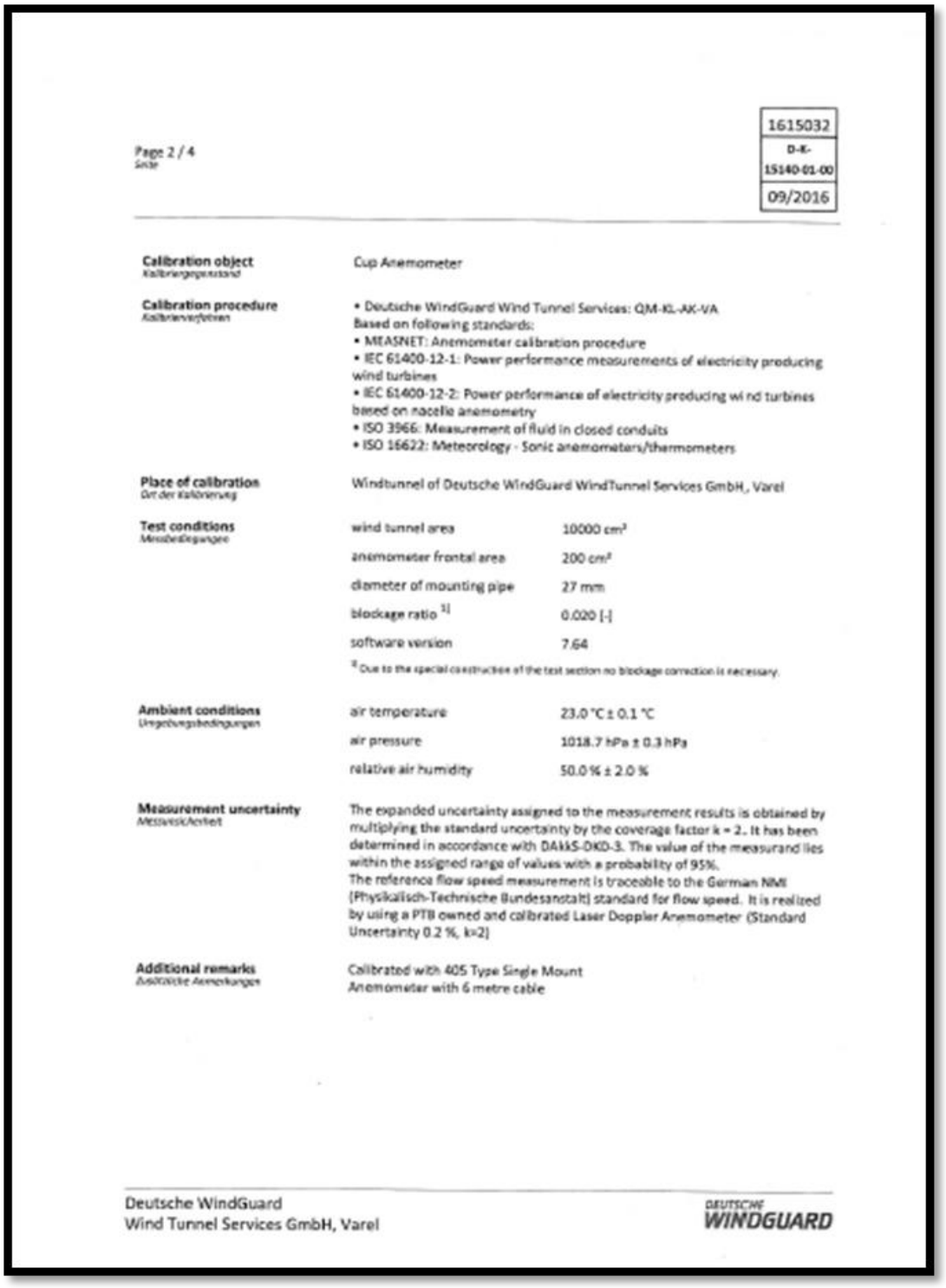
Date *Datum*	Head of the calibration laboratory *Leiter des Kalibrierlaboratoriums*	Person in charge *Bearbeiter*
28.09.2016	Dipl. Phys. Dieter Westermann	Techniker Dirk Henningsen



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09/2016

Calibration object
Kalibriergegenstand

Cup Anemometer

Calibration procedure
Kalibrierverfahren

- Deutsche WindGuard Wind Tunnel Services: QM-KL-AK-VA

Based on following standards:
- MEASNET: Anemometer calibration procedure
- IEC 61400-12-1: Power performance measurements of electricity producing wind turbines
- IEC 61400-12-2: Power performance of electricity producing wind turbines based on nacelle anemometry
- ISO 3966: Measurement of fluid in closed conduits
- ISO 16622: Meteorology - Sonic anemometers/thermometers

Place of calibration
Ort der Kalibrierung

Windtunnel of Deutsche WindGuard WindTunnel Services GmbH, Varel

Test conditions
Messbedingungen

wind tunnel area	10000 cm²
anemometer frontal area	200 cm²
diameter of mounting pipe	27 mm
blockage ratio [1]	0.020 [-]
software version	7.64

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

Ambient conditions
Umgebungsbedingungen

air temperature	23.0 °C ± 0.1 °C
air pressure	1018.7 hPa ± 0.3 hPa
relative air humidity	50.0 % ± 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

Calibrated with 405 Type Single Mount Anemometer with 6 metre cable

Deutsche WindGuard
Wind Tunnel Services GmbH, Varel

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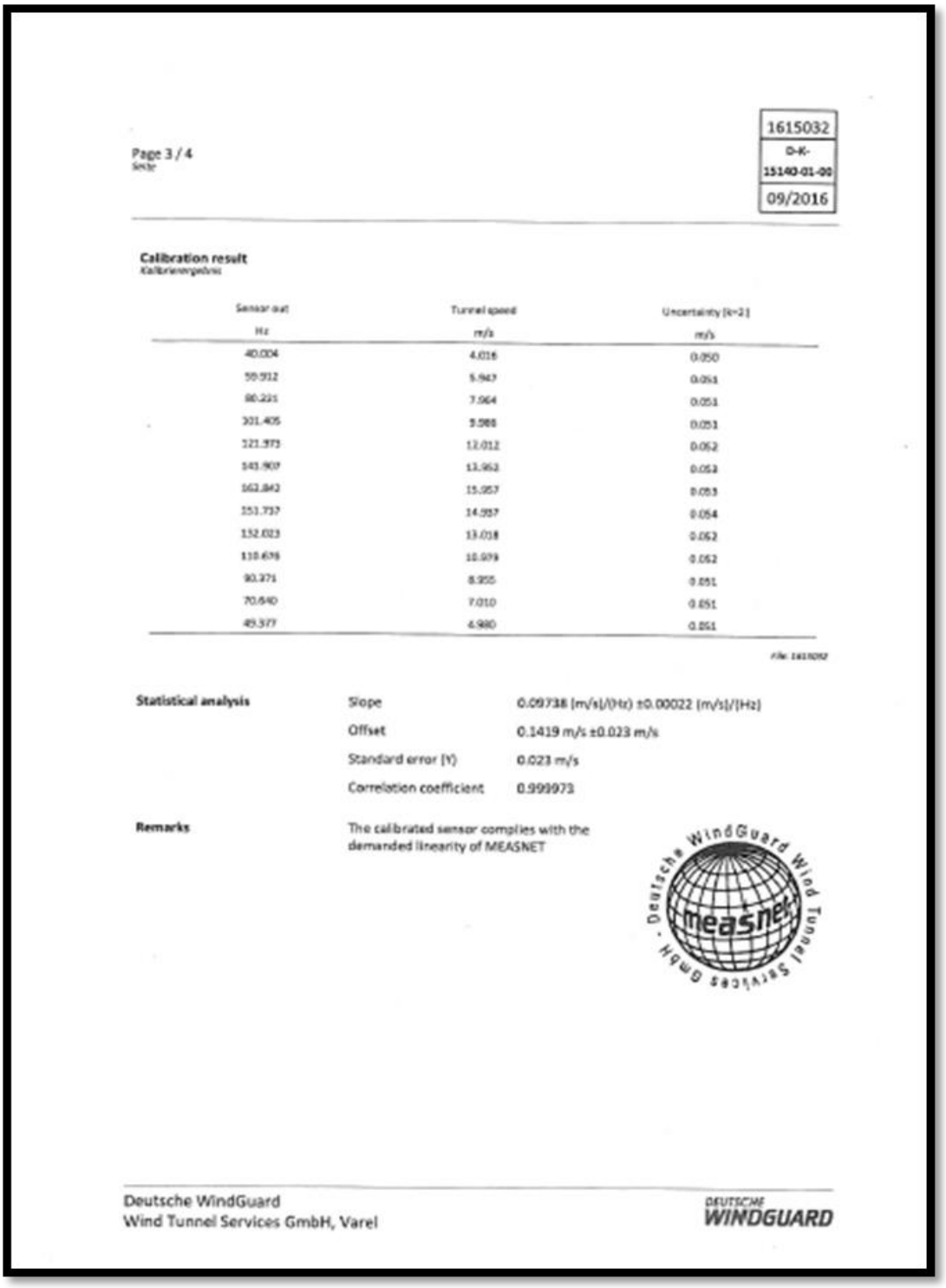

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09/2016

Calibration result
Kalibrierergebnis

Sensor out Hz	Tunnel speed m/s	Uncertainty [k=2] m/s
40.004	4.016	0.050
59.912	5.947	0.051
80.221	7.964	0.051
101.405	9.988	0.051
121.373	12.012	0.052
143.907	13.963	0.053
163.842	15.957	0.053
151.737	14.957	0.054
132.023	13.018	0.052
110.639	10.979	0.052
90.371	8.955	0.051
70.640	7.010	0.051
49.377	4.980	0.051

File: 1615032

Statistical analysis

Slope	0.09738 [m/s]/[Hz] ±0.00022 [m/s]/[Hz]
Offset	0.1419 m/s ±0.023 m/s
Standard error (Y)	0.023 m/s
Correlation coefficient	0.999973

Remarks

The calibrated sensor complies with the demanded linearity of MEASNET

Deutsche WindGuard Wind Tunnel Services GmbH

Deutsche WindGuard
Wind Tunnel Services GmbH, Varel

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D-E-15140-01-00
09/2016

Graphical representation of the result
Grafische Darstellung des Ergebnisses

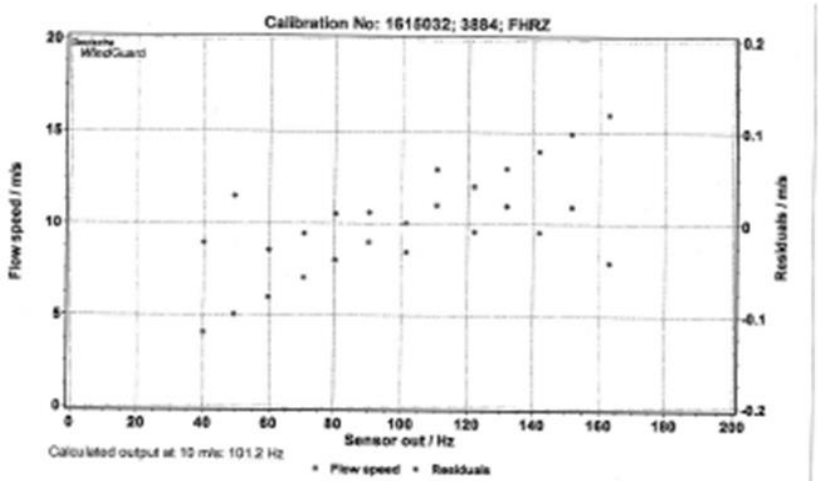
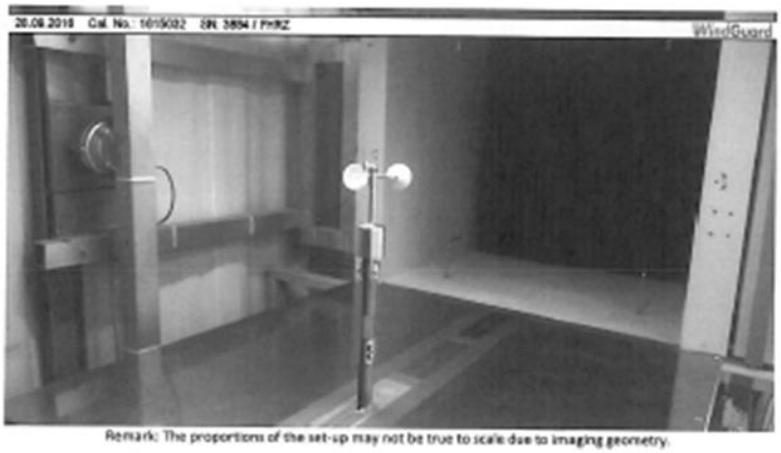


Photo of the measurement setup
Foto des Messaufbaus



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

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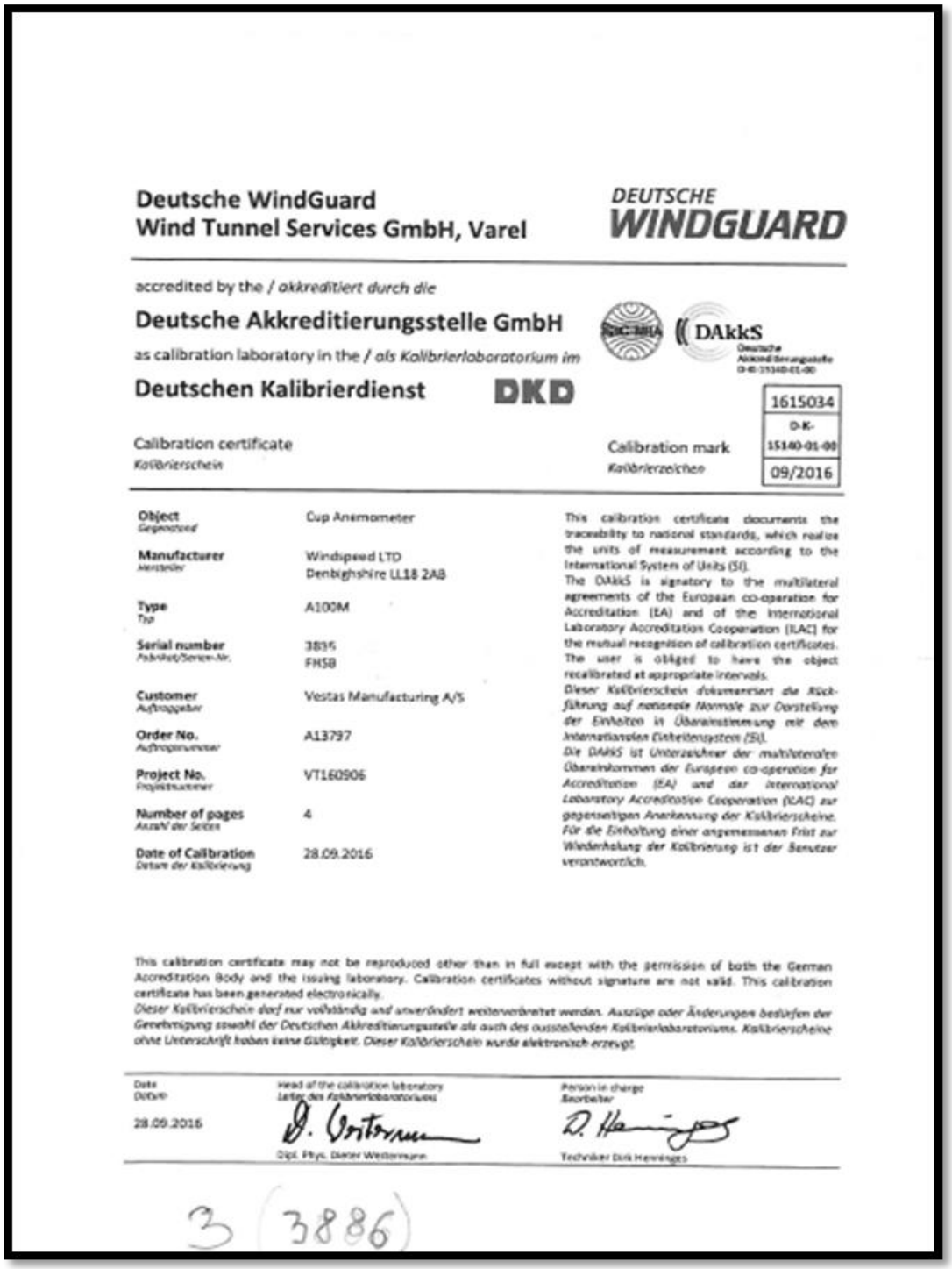
Anemometer 2 (89,5m) Serial Number 3886:



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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

1615034
D-K-15140-01-00
09/2016

Object *Gegenstand*	Cup Anemometer
Manufacturer *Hersteller*	Windspeed LTD Denbighshire LL18 2AB
Type *Typ*	A100M
Serial number *Fabrikat/Serien-Nr.*	3886 FHSB
Customer *Auftraggeber*	Vestas Manufacturing A/S
Order No. *Auftragsnummer*	A13797
Project No. *Projektnummer*	VT160906
Number of pages *Anzahl der Seiten*	4
Date of Calibration *Datum der Kalibrierung*	28.09.2016

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Date *Datum*	Head of the calibration laboratory *Leiter des Kalibrierlaboratoriums*	Person in charge *Bearbeiter*
28.09.2016	Dipl. Phys. Dieter Westermann	Techniker Dirk Hennings

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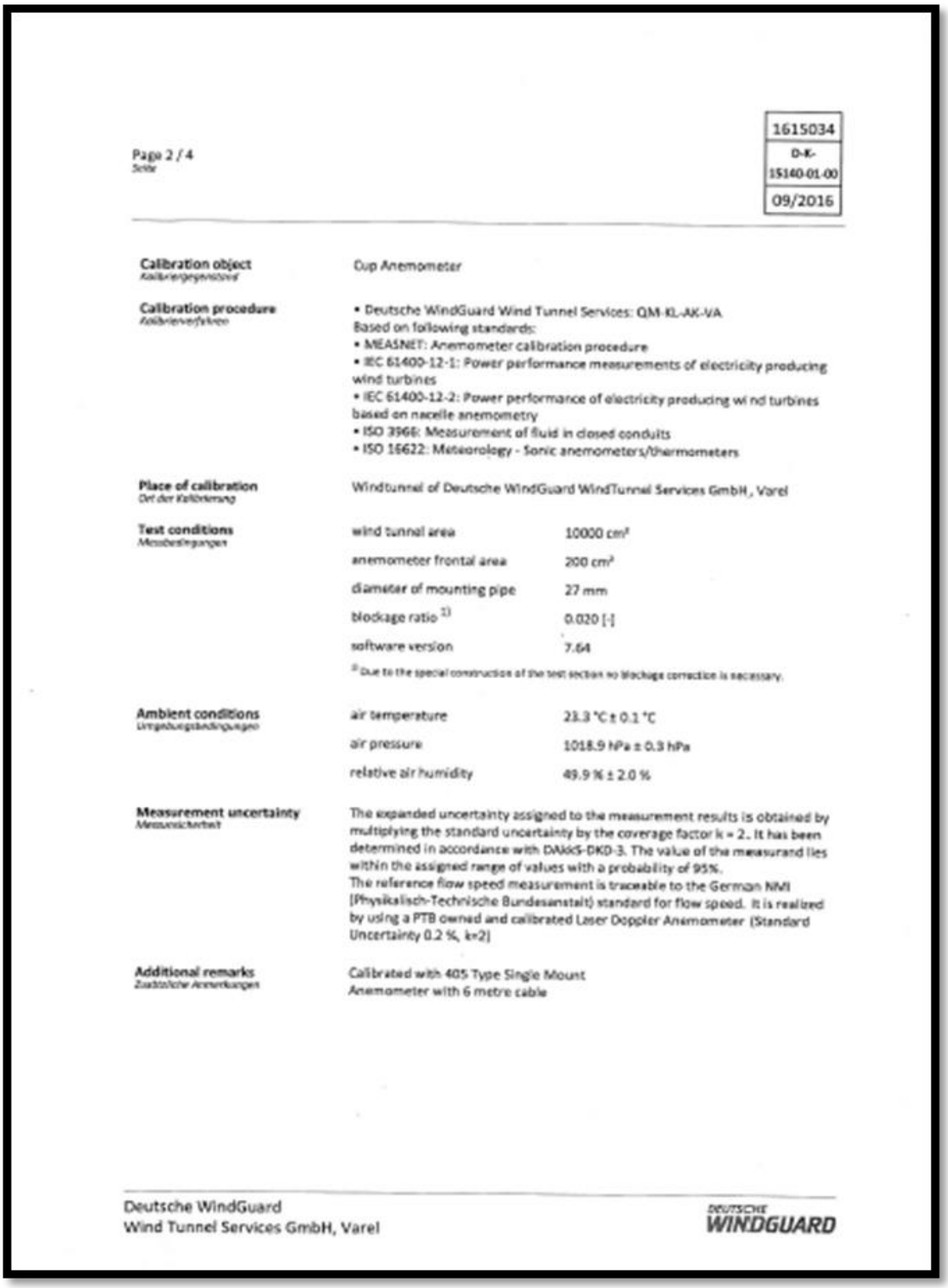

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Calibration object
Kalibriergegenstand

Cup Anemometer

Calibration procedure
Kalibrierverfahren

- Deutsche WindGuard Wind Tunnel Services: QM-KL-AK-VA

Based on following standards:
- MEASNET: Anemometer calibration procedure
- IEC 61400-12-1: Power performance measurements of electricity producing wind turbines
- IEC 61400-12-2: Power performance of electricity producing wind turbines based on nacelle anemometry
- ISO 3966: Measurement of fluid in closed conduits
- ISO 16622: Meteorology - Sonic anemometers/thermometers

Place of calibration
Ort der Kalibrierung

Windtunnel of Deutsche WindGuard WindTunnel Services GmbH, Varel

Test conditions
Messbedingungen

wind tunnel area	10000 cm²
anemometer frontal area	200 cm²
diameter of mounting pipe	27 mm
blockage ratio [1]	0.020 [-]
software version	7.64

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

Ambient conditions
Umgebungsbedingungen

air temperature	23.3 °C ± 0.1 °C
air pressure	1018.9 hPa ± 0.3 hPa
relative air humidity	49.9 % ± 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

Calibrated with 405 Type Single Mount Anemometer with 6 metre cable

Deutsche WindGuard
Wind Tunnel Services GmbH, Varel

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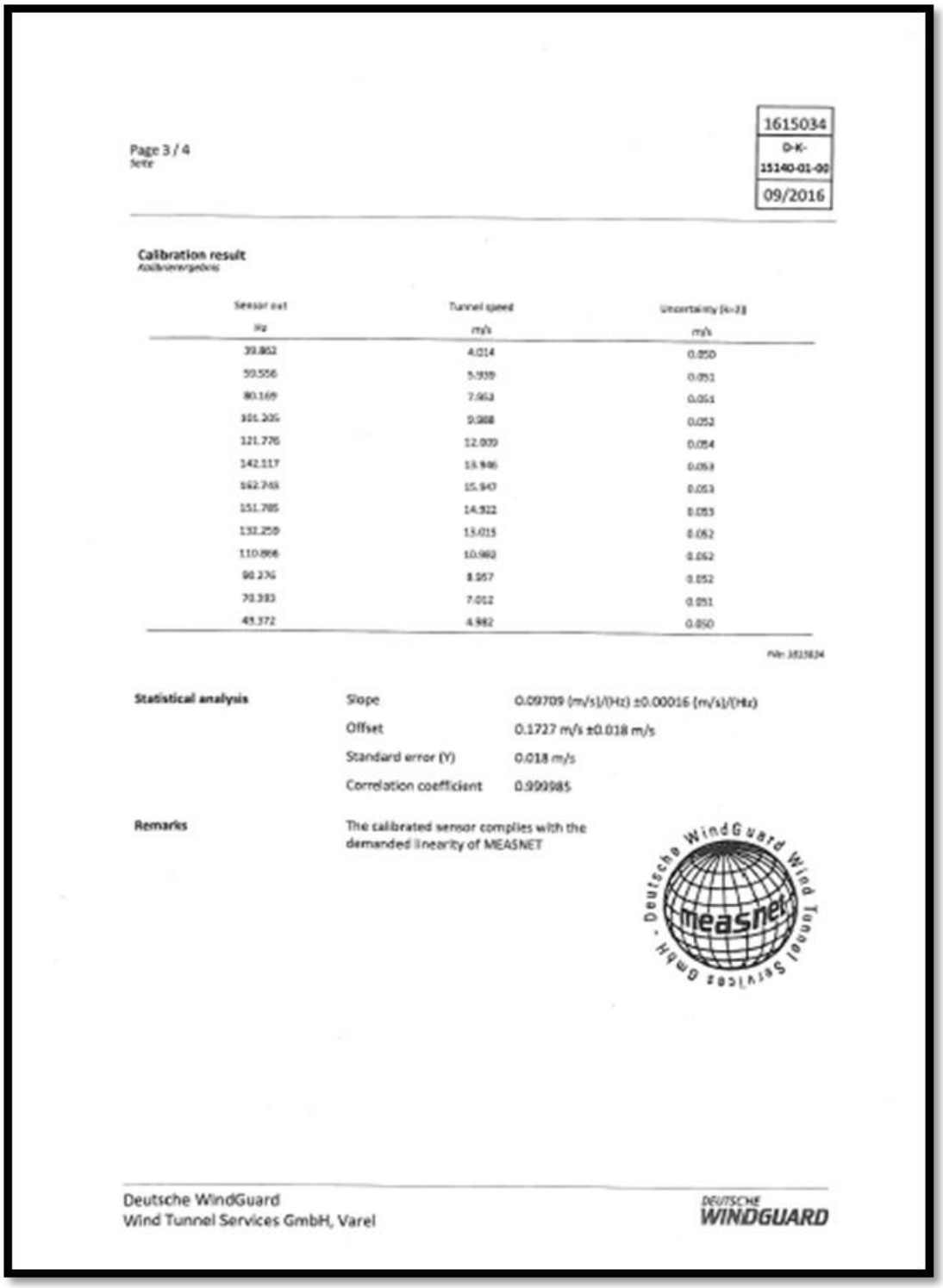

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15140-01-00
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Calibration result
Kalibrierergebnis

Sensor out Hz	Tunnel speed m/s	Uncertainty (k=2) m/s
39.862	4.014	0.050
50.556	5.939	0.051
80.169	7.963	0.051
101.205	9.988	0.052
121.776	12.009	0.054
142.117	13.946	0.053
162.743	15.947	0.053
151.785	14.922	0.053
132.259	13.015	0.052
110.866	10.980	0.052
90.276	8.957	0.052
70.393	7.012	0.051
49.372	4.982	0.050

File: 1615034

Statistical analysis

Slope	0.09709 (m/s)/(Hz) ±0.00016 (m/s)/(Hz)
Offset	0.1727 m/s ±0.018 m/s
Standard error (Y)	0.018 m/s
Correlation coefficient	0.999985

Remarks

The calibrated sensor complies with the demanded linearity of MEASNET

Deutsche WindGuard Wind Tunnel Services GmbH

measnet

Deutsche WindGuard
Wind Tunnel Services GmbH, Varel

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D-IE-15140-01-00
09/2016

Graphical representation of the result
Grafische Darstellung des Ergebnisses

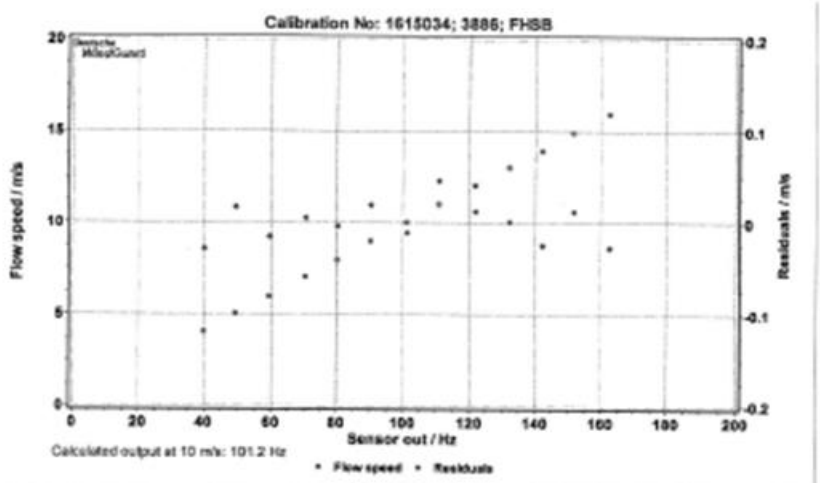

Photo of the measurement setup
Foto des Messaufbaus

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

Deutsche WindGuard
Wind Tunnel Services GmbH, Varel

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Anemometer 3 (45m) Serial Number 3889:

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Deutschen Kalibrierdienst DKD

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

Calibration certificate
Kalibrierschein

Calibration mark
Kalibrierzeichen

1615038
D-K-15140-01-00
09/2016

Object *Gegenstand*	Cup Anemometer
Manufacturer *Hersteller*	Windspeed LTD Denbighshire LL18 2AB
Type *Typ*	A100M
Serial number *Fabrikat/Serien Nr.*	3889 FHUA
Customer *Auftraggeber*	Vestas Manufacturing A/S
Order No. *Auftragsnummer*	A13799
Project No. *Projektnummer*	VT160908
Number of pages *Anzahl der Seiten*	4
Date of Calibration *Datum der Kalibrierung*	28.09.2016

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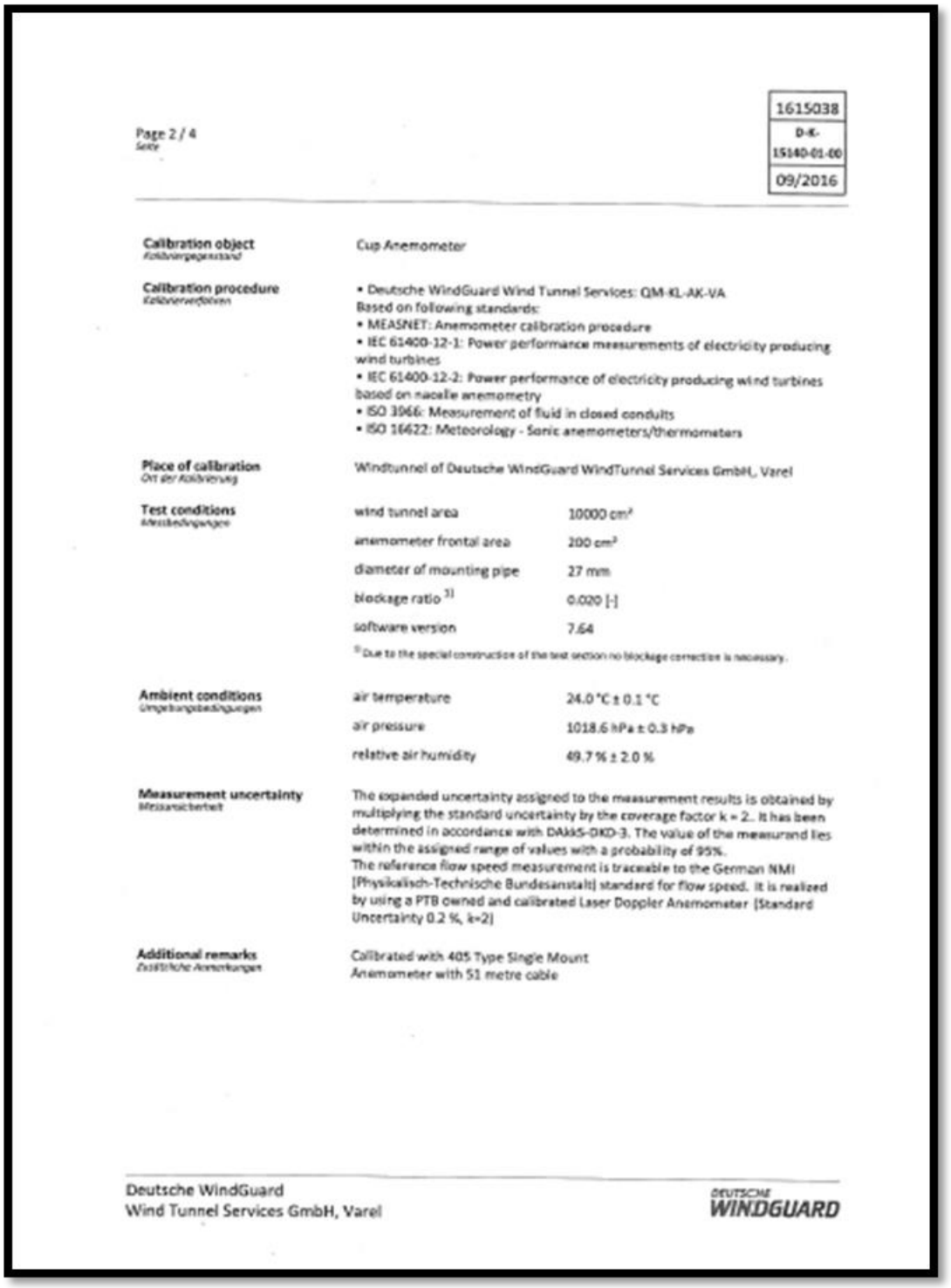
Date *Datum*	Head of the calibration laboratory *Leiter des Kalibrierlaboratoriums*	Person in charge *Bearbeiter*
28.09.2016	Dipl. Phys. Dieter Westermann	Techniker Dirk Hennigs



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Calibration object
Kalibriergegenstand

Cup Anemometer

Calibration procedure
Kalibrierverfahren

- Deutsche WindGuard Wind Tunnel Services: QM-KL-AK-VA

Based on following standards:

- MEASNET: Anemometer calibration procedure
- IEC 61400-12-1: Power performance measurements of electricity producing wind turbines
- IEC 61400-12-2: Power performance of electricity producing wind turbines based on nacelle anemometry
- ISO 3966: Measurement of fluid in closed conduits
- ISO 16622: Meteorology - Sonic anemometers/thermometers

Place of calibration
Ort der Kalibrierung

Windtunnel of Deutsche WindGuard WindTunnel Services GmbH, Varel

Test conditions
Messbedingungen

wind tunnel area	10000 cm²
anemometer frontal area	200 cm²
diameter of mounting pipe	27 mm
blockage ratio [3]	0.020 [-]
software version	7.64

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

Ambient conditions
Umgebungsbedingungen

air temperature	24.0 °C ± 0.1 °C
air pressure	1018.6 hPa ± 0.3 hPa
relative air humidity	49.7 % ± 2.0 %

Measurement uncertainty
Messunsicherheit

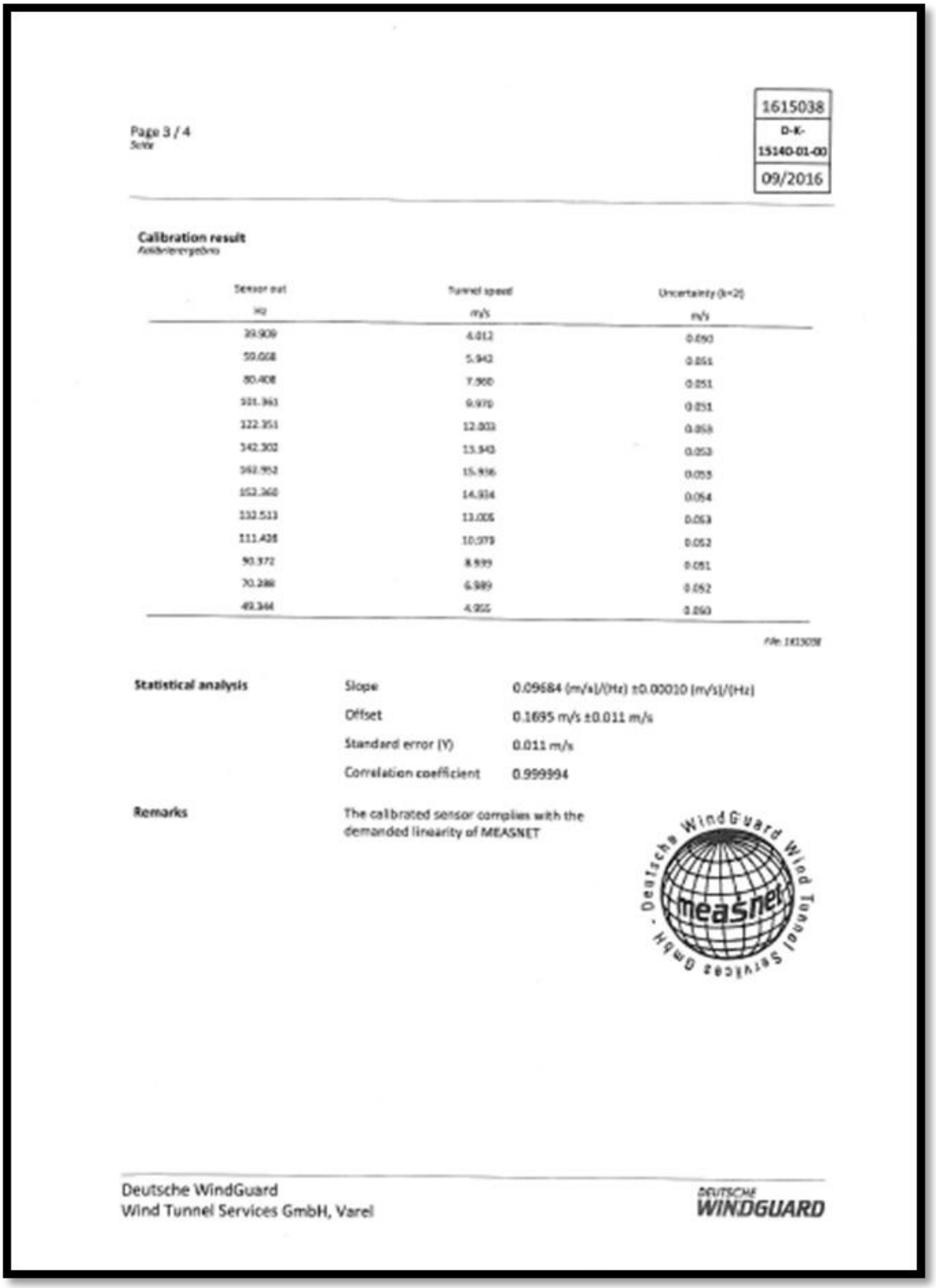
The expanded uncertainty assigned to the measurement results is obtained by multiplying the standard uncertainty by the coverage factor k = 2.. It has been determined in accordance with DAkkS-DKD-3. The value of the measurand lies within the assigned range of values with a probability of 95%.
The reference 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

Calibrated with 405 Type Single Mount Anemometer with 51 metre cable

Deutsche WindGuard
Wind Tunnel Services GmbH, Varel

DEUTSCHE WINDGUARD



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Seite

1615038
D-K-15140-01-00
09/2016

Calibration result
Kalibrierergebnis

Sensor out Hz	Tunnel speed m/s	Uncertainty (k=2) m/s
39.909	4.012	0.050
59.008	5.942	0.051
80.408	7.960	0.051
101.361	9.970	0.051
122.351	12.001	0.053
142.302	13.943	0.053
162.952	15.936	0.055
152.360	14.934	0.054
132.513	13.005	0.053
111.428	10.979	0.052
90.372	8.939	0.051
70.286	6.989	0.052
49.344	4.955	0.050

File: 1615038

Statistical analysis

Slope	0.09684 (m/s)/(Hz) ±0.00010 (m/s)/(Hz)
Offset	0.1695 m/s ±0.011 m/s
Standard error (Y)	0.011 m/s
Correlation coefficient	0.999994

Remarks

The calibrated sensor complies with the demanded linearity of MEASNET

Deutsche WindGuard Wind Tunnel Service GmbH - measnet

Deutsche WindGuard
Wind Tunnel Services GmbH, Varel

DEUTSCHE WINDGUARD

1615038
D-K-15140-01-00
09/2016

Graphical representation of the result
Graphische Darstellung des Ergebnisses

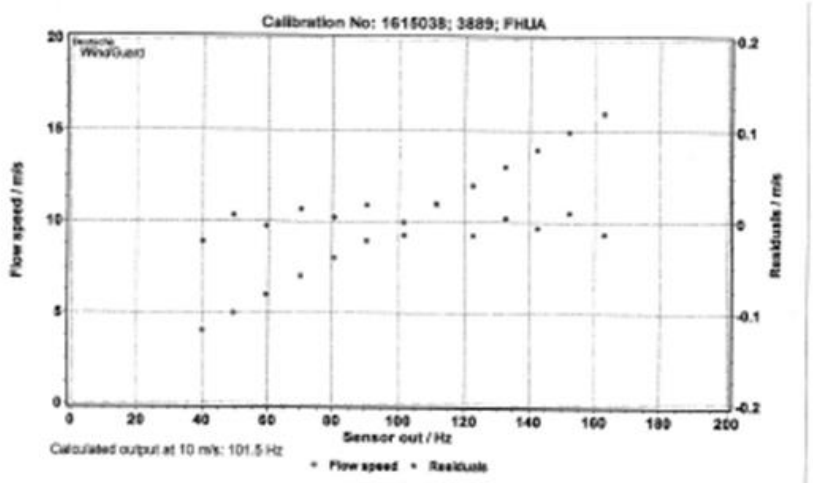


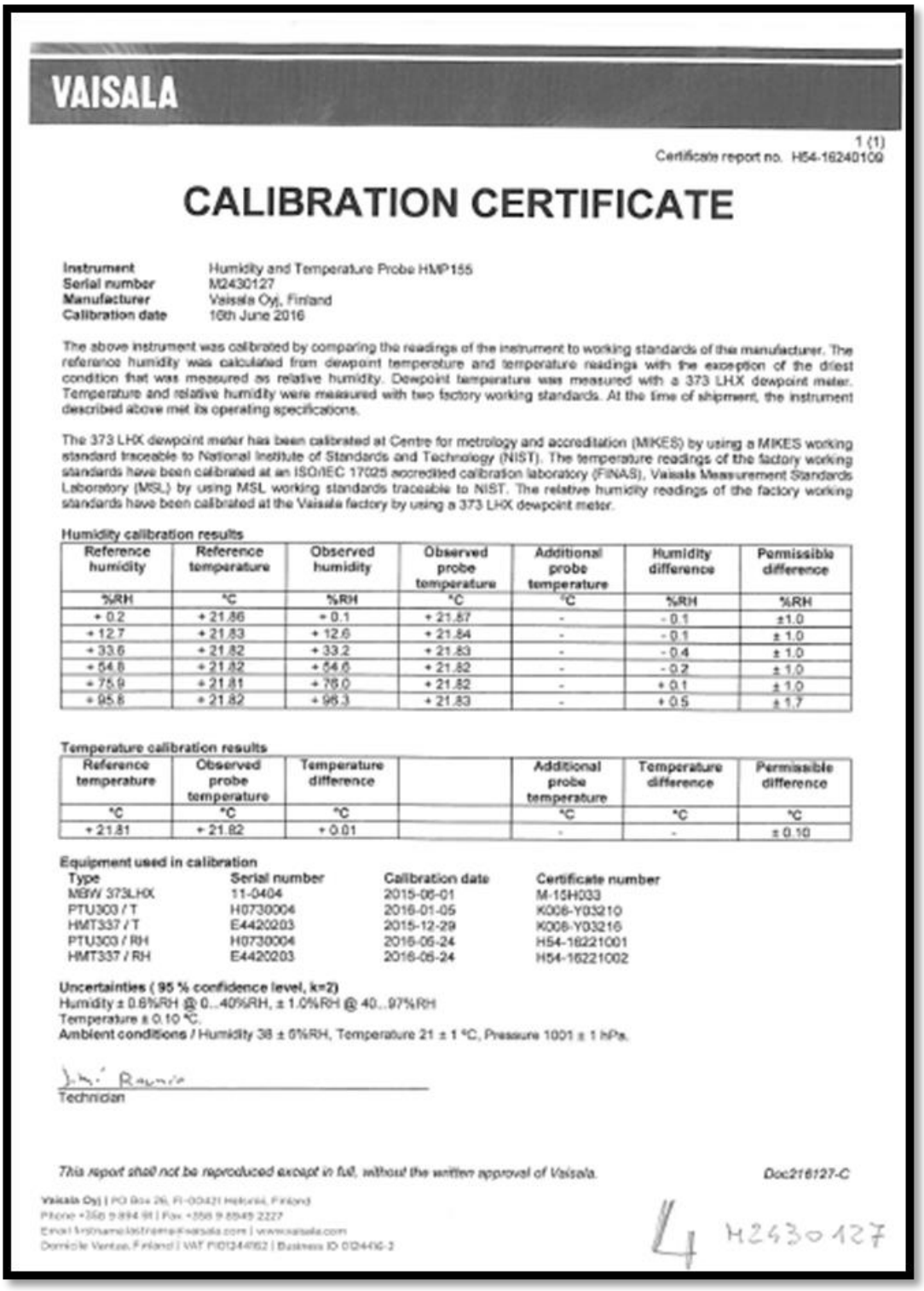
Photo of the measurement setup
Foto des Messaufbaus

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

Deutsche WindGuard
Wind Tunnel Services GmbH, Varel

DEUTSCHE WINDGUARD

Humidity and temperature VAISALA. Serial number: M2430127:



VAISALA

1 (1)
Certificate report no. H54-16240109

CALIBRATION CERTIFICATE

Instrument	Humidity and Temperature Probe HMP155
Serial number	M2430127
Manufacturer	Vaisala Oyj, Finland
Calibration date	10th June 2016

The above instrument was calibrated by comparing the readings of the instrument to working standards of the manufacturer. The reference humidity was calculated from dewpoint temperature and temperature readings with the exception of the driest condition that was measured as relative humidity. Dewpoint temperature was measured with a 373 LHX dewpoint meter. Temperature and relative humidity were measured with two factory working standards. At the time of shipment, the instrument described above met its operating specifications.

The 373 LHX dewpoint meter has been calibrated at Centre for metrology and accreditation (MIKES) by using a MIKES working standard traceable to National Institute of Standards and Technology (NIST). The temperature readings of the factory working standards have been calibrated at an ISO/IEC 17025 accredited calibration laboratory (FINAS), Vaisala Measurement Standards Laboratory (MSL) by using MSL working standards traceable to NIST. The relative humidity readings of the factory working standards have been calibrated at the Vaisala factory by using a 373 LHX dewpoint meter.

Humidity calibration results

Reference humidity	Reference temperature	Observed humidity	Observed probe temperature	Additional probe temperature	Humidity difference	Permissible difference
%RH	°C	%RH	°C	°C	%RH	%RH
+ 0.2	+ 21.86	+ 0.1	+ 21.87	-	- 0.1	±1.0
+ 12.7	+ 21.83	+ 12.6	+ 21.84	-	- 0.1	± 1.0
+ 33.6	+ 21.82	+ 33.2	+ 21.83	-	- 0.4	± 1.0
+ 54.8	+ 21.82	+ 54.6	+ 21.82	-	- 0.2	± 1.0
+ 75.9	+ 21.81	+ 76.0	+ 21.82	-	+ 0.1	± 1.0
+ 95.8	+ 21.82	+ 96.3	+ 21.83	-	+ 0.5	± 1.7

Temperature calibration results

Reference temperature	Observed probe temperature	Temperature difference		Additional probe temperature	Temperature difference	Permissible difference
°C	°C	°C		°C	°C	°C
+ 21.81	+ 21.82	+ 0.01		-	-	± 0.10

Equipment used in calibration

Type	Serial number	Calibration date	Certificate number
MBW 373LHX	11-0404	2015-06-01	M-15H033
PTU303 / T	H0730004	2016-01-05	K008-Y03210
HMT337 / T	E4420203	2015-12-29	K008-Y03216
PTU303 / RH	H0730004	2016-06-24	H54-16221001
HMT337 / RH	E4420203	2016-06-24	H54-16221002

Uncertainties (95 % confidence level, k=2)
Humidity ± 0.6%RH @ 0...40%RH, ± 1.0%RH @ 40...97%RH
Temperature ± 0.10 °C.
Ambient conditions / Humidity 38 ± 6%RH, Temperature 21 ± 1 °C, Pressure 1001 ± 1 hPa.

Technician

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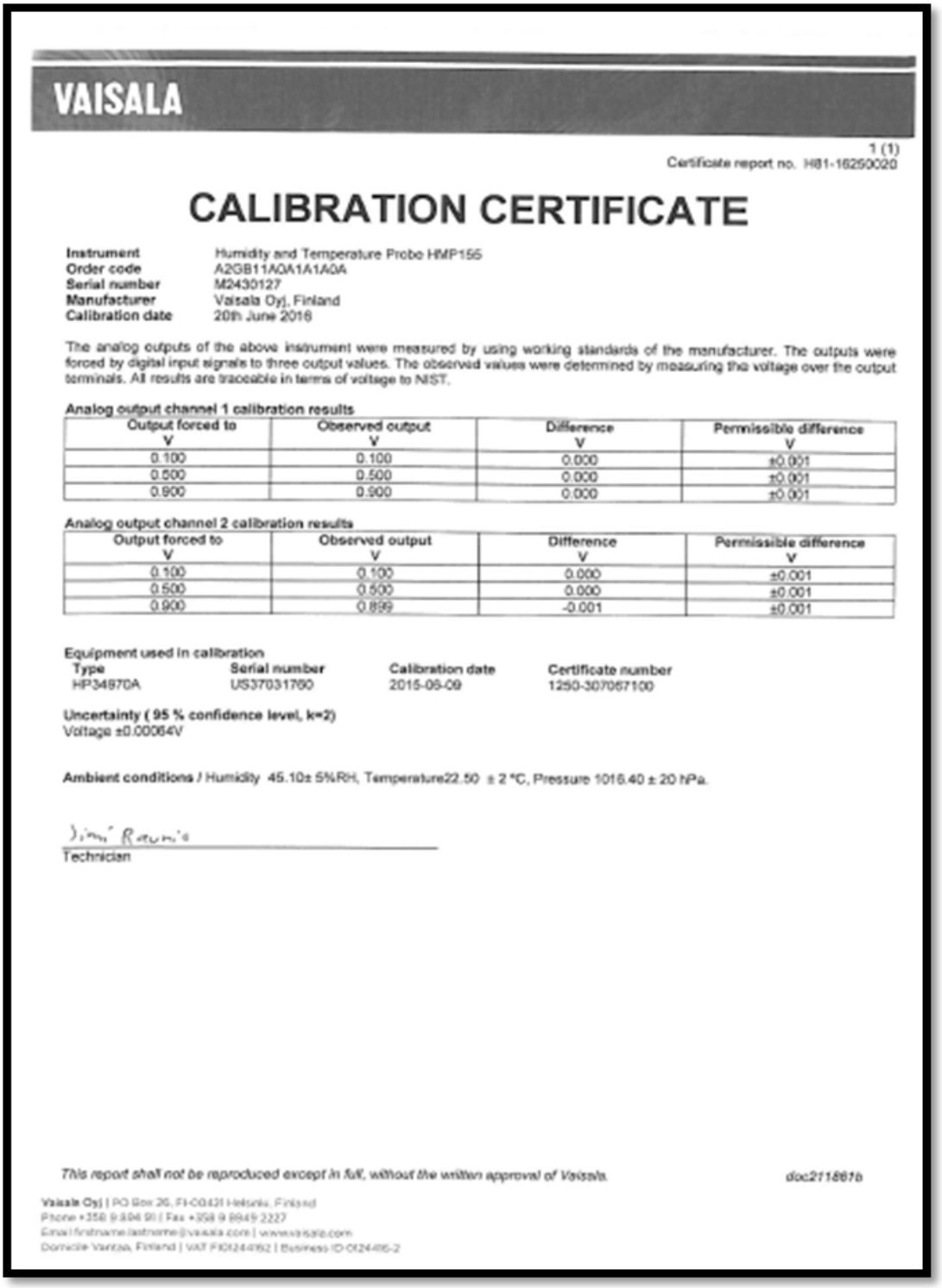
Domicile Vantaa, Finland | VAT FI01244152 | Business ID 0124452-3

H2430127



VAISALA

1 (1)
Certificate report no. H81-16250020

CALIBRATION CERTIFICATE

Instrument	Humidity and Temperature Probe HMP155
Order code	A2GB11A0A1A1A0A
Serial number	M2430127
Manufacturer	Vaisala Oyj, Finland
Calibration date	20th June 2016

The analog outputs of the above instrument were measured by using working standards of the manufacturer. The outputs were forced by digital input signals to three output values. The observed values were determined by measuring the voltage over the output terminals. All results are traceable in terms of voltage to NIST.

Analog output channel 1 calibration results

Output forced to V	Observed output V	Difference V	Permissible difference V
0.100	0.100	0.000	±0.001
0.500	0.500	0.000	±0.001
0.900	0.900	0.000	±0.001

Analog output channel 2 calibration results

Output forced to V	Observed output V	Difference V	Permissible difference V
0.100	0.100	0.000	±0.001
0.500	0.500	0.000	±0.001
0.900	0.899	-0.001	±0.001

Equipment used in calibration

Type	Serial number	Calibration date	Certificate number
HP34970A	US37031760	2015-05-09	1250-307067100

Uncertainty (95 % confidence level, k=2)
Voltage ±0.00064V

Ambient conditions / Humidity 45.10± 5%RH, Temperature22.50 ± 2 °C, Pressure 1016.40 ± 20 hPa

Technician

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Barometer VAISALA. Serial number: L2630181:

VAISALA

1 (1)
Certificate report no. H11-15250004

CALIBRATION CERTIFICATE

Instrument	PTB210 Class C digital barometer
Serial number	L2630181
Manufacturer	Vaisala Oyj, Finland
Calibration date	25th June 2015

The above instrument was calibrated by comparing the readings of the instrument to the factory working standard of Vaisala.

The pressure readings of the factory working standard have been calibrated at an ISO/IEC 17025 accredited calibration laboratory (FINAS), Vaisala Measurement Standards Laboratory (MSL), by using MSL working standards traceable to NIST.

Calibration results

Reference hPa	Observed hPa	Correction* hPa	Acceptance limit hPa
510.05	510.05	0.00	± 0.1
610.05	610.05	0.00	± 0.1
710.16	710.16	0.00	± 0.1
803.11	803.12	-0.01	± 0.1
899.99	900.00	-0.01	± 0.1
960.08	960.10	-0.02	± 0.1
1000.02	1000.03	-0.01	± 0.1
1068.01	1068.01	0.00	± 0.1

*To obtain the true pressure, add the correction to the barometer reading.
Interpolated corrections may be used at intermediate readings of the scale of the barometer.

Equipment used in calibration

Type	Serial number	Calibration date	Certificate number
PTB220	E1050002	2015-04-14	K008-Y00677
HP34970A	US37008315	2015-02-06	1250-307063762

Uncertainty (95 % confidence level, k=2)
Pressure 0.15hpa

Ambient Conditions

Humidity	35 %RH ± 5 %RH
Temperature	23 °C ± 1 °C
Pressure	1008 hPa ± 1 hPa

Technician

Pos 9

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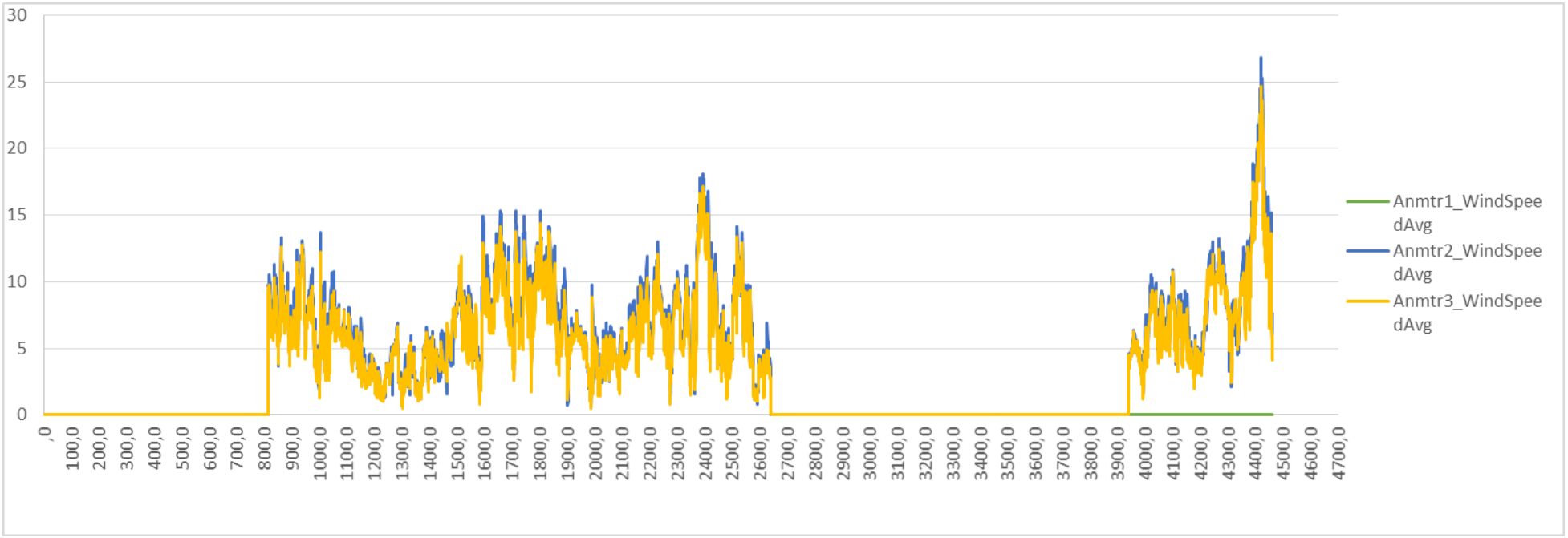
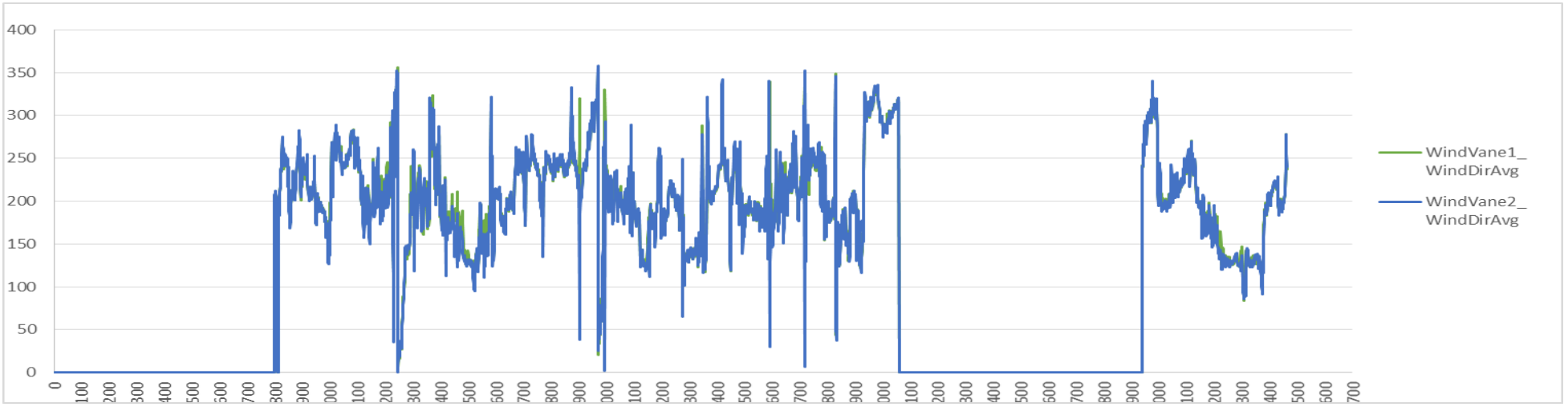
4.9 Graphic Summary Report

Start date: 01/03/2018: 00:00 End date:31/03/2018 : 23:50

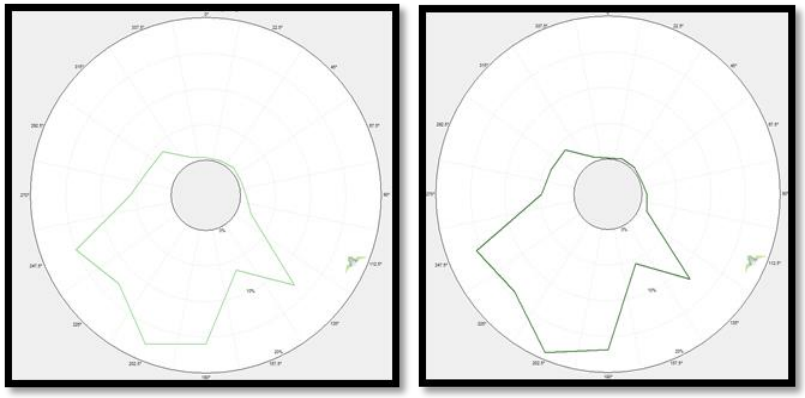
Avg Ane1: 0m/s	Avg Ane 2: 6,00m/s	Avg Ane 5,55: m/s



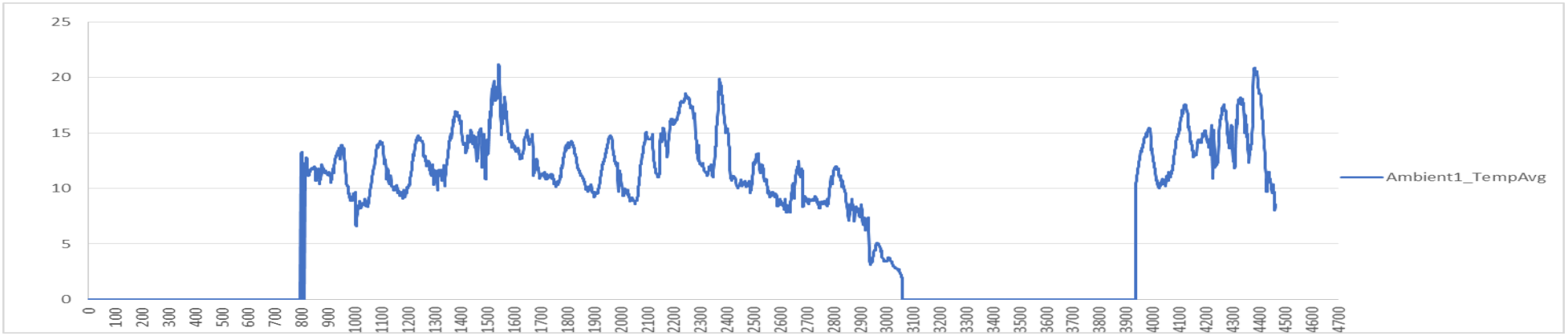
Wind Direction:



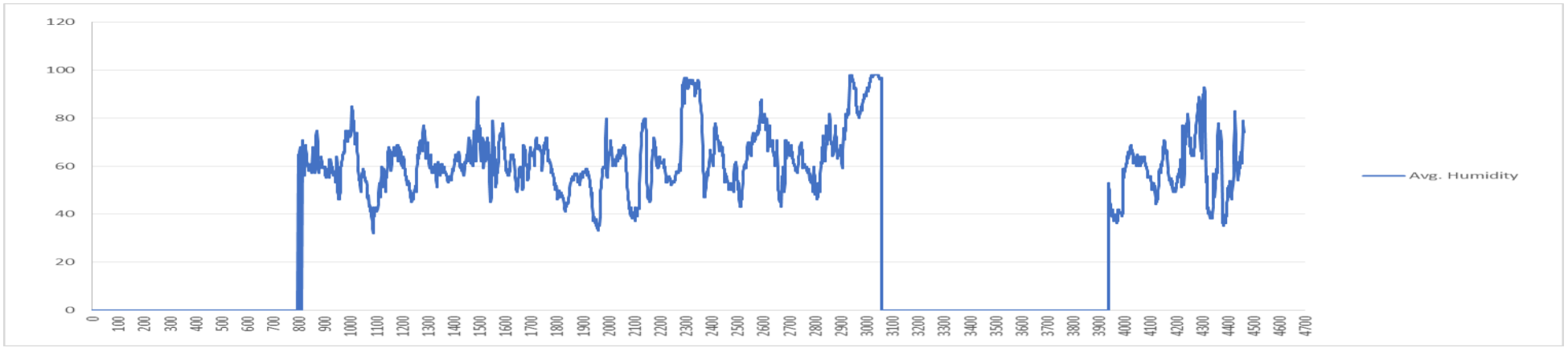
Wind roses:



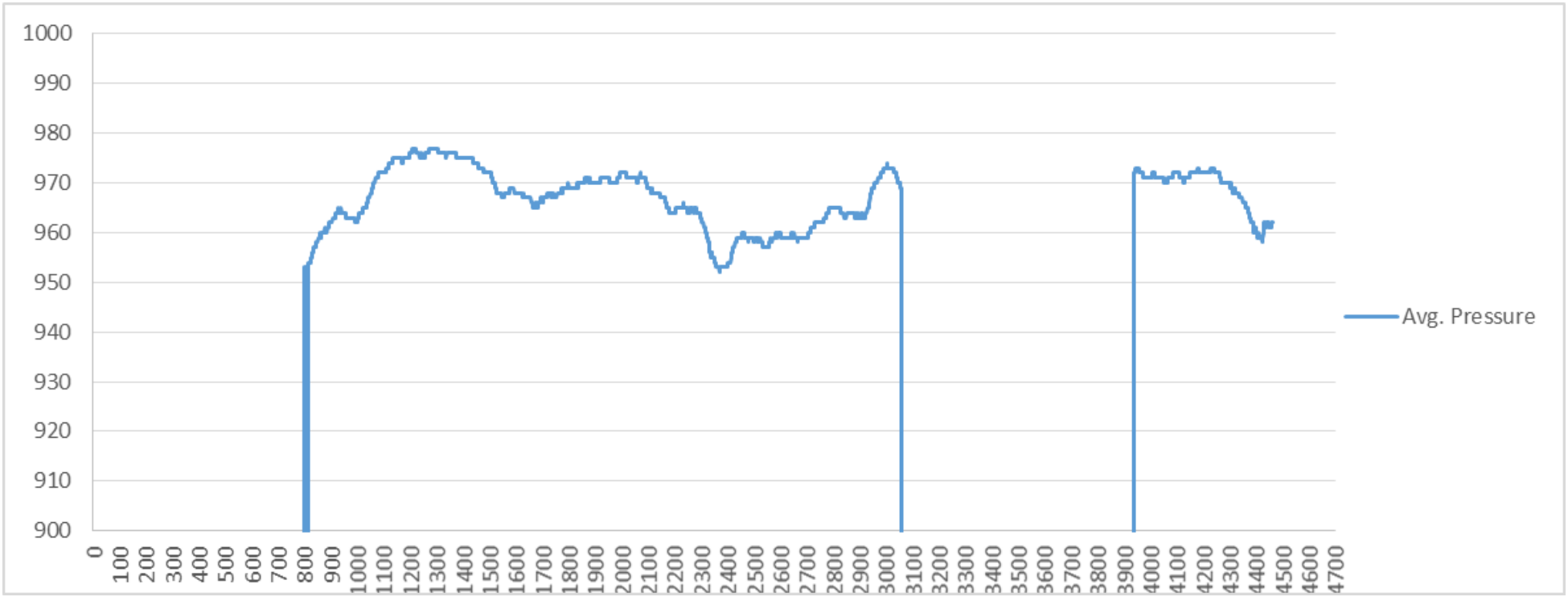
Avg Temperature: 12,04ºC



Avg Humidity: 62.28%



Avg Pressure:967,04 mb



4.10 Status Sensors

TM TIVANO				
SENSORES	**OK**	**NO OK**	**N/A**	**Comments**
Anemometer 1		X		The sensor appears like "0" because the anemometer is from the consultant.
Anemometer 2	X			
Anemometer 3	X			
Wind Vane 1	X			
Wind Vane 2	X			
Temperature Sensor 1	X			
Humidity sensor 1	X			
Rain detection	X			This sensor only perform a signal when it´s raining.
Barometer	X			

4.11 Conclusions and pending issues

Conclusions and pending issues

Revision	Date	Pending issues
0	24/04/2018	1. The consultant windspeed sensor (TOP) It will be replaced by an EDRP windspeed sensor when the PCV finalize. 2. The off-grid PV system is installed in the mast but it wasn´t connected due the possibility of losing Vestas warranty, so is expected to be installed after warranty of one year coverage.

6. PERMESSO A COSTRUIRE DELL'ANEMOMETRO DI RIFERIMENTO

CITTA' DI LAVELLO

Provincia di Potenza

SETTORE IV – SERVIZI AL TERRITORIO

Bollo assolto virtualmente ai sensi degli artt. 46 e 47 del D.P.R. n.445/2000

Marca da bollo €. 16,00 n. 01161176481242 del 12/04/2017

Permesso a costruire n° 006 del 2017

IL RESPONSABILE DEL IV SETTORE SERVIZI AL TERRITORIO E LAVORI PUBBLICI

VISTA la richiesta del Sig. **VENERONI Gianluca** nato a Milano (MI) l'8 maggio 1963 ed ivi residente alla via R. Lepetit n.8/10, in qualità di amministratore delegato della società Tivano srl con sede in Milano alla via R. Lepetit - P.IVA 08637370969, tendente ad ottenere il permesso a costruire relativo all'installazione di una torre anemometrica su terreno sito in loc. Sterpara del comune di Lavello, identificato catastalmente al Fg. n.65 p.lle 47 e 82 ricadente in Zona agricola del R.U. vigente, presentata in data 30/01/2017 prot. 1259 ed integrata in data 13/04/2017 e 08/05/2017;

VISTA la comunicazione del Dipartimento Infrastrutture e Mobilità, Ufficio Difesa del Suolo della Regione Basilicata, di **avvenuto deposito** relativamente alla Denuncia dei lavori per deposito (art.2 L.R. 38/97 e artt. 93 e 94 del DPR 380/2001). **Rif. Fascicolo n. 7911 prot. n. 30671 del 21/02/2017**;

VISTO il D.P.R n. 380/2001 e succ. mm. e ii.;

VISTO il Regolamento Urbanistico ed il Regolamento Edilizio Comunale vigenti;

VISTO il Decreto 10 settembre 2010 del Ministero dello Sviluppo Economico "Linee guida per l'autorizzazione degli impianti alimentati da fonti rinnovabili".

DATO ATTO che ai fini del rilascio del presente permesso, il richiedente ha versato:

- la somma di € 61,00 per diritti di segreteria;

RILASCIA IL PERMESSO A COSTRUIRE

Al Sig. **VENERONI Gianluca** C.F. **VNRGLC63E08F205I**

relativo all'installazione di una torre anemometrica su terreno sito in loc. Sterpara del comune di Lavello, identificato catastalmente al Fg. n.65 p.lle 47 e 82 ricadente in Zona agricola del R.U. vigente, sotto l'osservanza delle vigenti disposizioni in materia edilizia, di igiene e di polizia locale in conformità al progetto presentato e secondo la perfetta regola d'arte, perché riesca solida, igienica, decorosa ed atta alla sua destinazione, tanto per i materiali usati quanto per il sistema costruttivo adottato, nonché sotto l'osservanza delle prescrizioni appresso riportate.

Dato atto che l'intervento è autorizzato ai sensi di quanto riportato nel Decreto 10 settembre 2010, al termine della sua funzione a servizio del parco eolico "Il Finocchiario" a cui è connesso, è prescritta la dismissione ed il ripristino dello stato dei luoghi prevedendo la rimozione di tutte le opere fuori terra.

I lavori dovranno iniziare entro un anno dalla data di rilascio e terminare entro tre anni dalla predetta data (art. 15 D.P.R. 06 Giugno 2001 n. 380) .

PRESCRIZIONI GENERALI

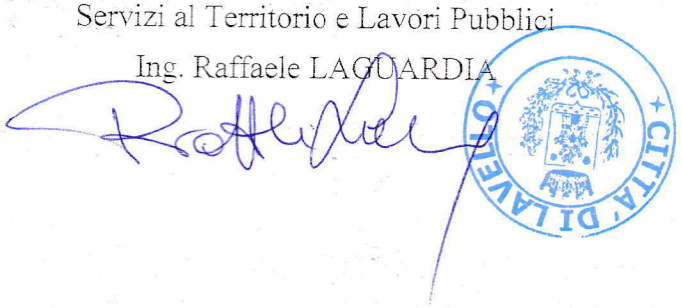
1) Dovranno trovare applicazione tutte le norme sulla prevenzione degli infortuni sul lavoro;
2) I diritti dei terzi debbono essere salvi, riservati e rispettati in ogni fase dell'esecuzione dei lavori;
3) Deve evitarsi in ogni caso di ingombrare le vie e gli spazi pubblici adiacenti e debbono essere adottate tutte le cautele atte a rimuovere ogni pericolo di danno a persone o cose;
4) Il luogo destinato alla costruzione di che trattasi deve essere chiuso con assito lungo i lati prospicienti le vie, le aree o spazi pubblici;
5) Per eventuale occupazione di aree e spazi pubblici si deve ottenere apposita autorizzazione dell'Ufficio Tributi Comunale. Le aree e spazi così occupati debbono essere restituiti nel pristino stato, a lavoro ultimato o anche prima su richiesta dell'Ufficio Tecnico Comunale, nel caso che la costruzione venisse abbandonata o sospesa oltre un certo tempo;
6) Per manomettere il suolo pubblico il costruttore dovrà munirsi di speciale autorizzazione dell'Ente Competente;
7) Gli assiti di cui al paragrafo 3 od altri ripari debbono essere imbiancati agli angoli salienti a tutta altezza e muniti di lanterna a luce rossa da mantenersi accese dal tramonto al levar del sole, secondo l'intero orario della pubblica illuminazione stradale;
8) Gli Uffici Comunali si riservano la riscossione delle tasse speciali e degli eventuali canoni, precari ecc... che risultassero applicabili ad opere ultimate a tenore dei relativi regolamenti;
9) L'allineamento stradale e degli altri eventuali rilievi riguardanti il nuovo fabbricato, verranno dati da un funzionario dell'Ufficio Tecnico previo sopralluogo da effettuarsi a richiesta e in presenza del Direttore dei Lavori;
10) E' assolutamente vietato apportare modifiche di qualsiasi genere a progetto approvato, pena i provvedimenti sanciti dai regolamenti in vigore e l'applicazione delle sanzioni comminate dalla Legge;
11) Dovranno, infine, essere osservate le norme e disposizioni di cui alla Legge 5 novembre 1971 n° 1086, sulle opere in conglomerato cementizio normale e precompresso ed a struttura metallica, nonché le prescrizioni costruttive di cui alla Legge 25 novembre 1962 n° 1684, avente per oggetto "Provvedimenti per l'edilizia, con particolari prescrizioni per le zone sismiche";
12) Il titolare della concessione, il direttore dei lavori e l'assuntore dei lavori sono responsabili di ogni inosservanza così delle norme generali di legge e di regolamento, come delle modalità esecutive fissate nella presente concessione;
13) Per le costruzioni eseguite in difformità della concessione si applicano le sanzioni amministrative di cui all'art. 15 della legge 28.1.1977 n° 10, nonché quelle penali di cui al successivo art. 17.

Il rilascio del permesso di costruire non vincola il Comune in ordine a lavori che il Comune stesso intendesse eseguire per migliorare i propri servizi (Viabilità, illuminazione, fognatura, impianto idrico, ecc...) in conseguenza dei quali non potranno essere pretesi compensi o indennità salvo quanto previsto da leggi e regolamenti.

ALL'INIZIO dei lavori dovrà essere collocata, all'esterno del cantiere, ben visibile al pubblico, una tabella con le seguenti indicazioni: Ditta proprietaria, Impresa, Progettista, Direttore dei lavori, Estremi del presente permesso.

Dalla Residenza Municipale, 12 maggio 2017

IL RESPONSABILE DEL SETTORE IV
Servizi al Territorio e Lavori Pubblici
Ing. Raffaele LAGUARDIA



7. TABELLE DISPONIBILITA' DATI DI VENTO

DISPONIBILITA' DEI DATI RELATIVA AL PERIODO: 01/05/2018 - 31/07/2019

X	DISPONIBILITA' DATO (100%)
+	DISPONIBILITA' DATO (parziale)
-	DATI NON DISPONIBILI

MAGGIO 2018	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
VELOCITA' 95M	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
VELOCITA' 89.5M	X	X	X	X	X	X	X	X	X	X	X	X	-	+	+	X	+	X	X	X	X	X	X	+	+	+	+	X	X	X	X
VELOCITA' 45M	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
DIREZIONE 89.5M	X	X	X	X	X	X	X	X	X	X	X	+	-	+	+	X	+	X	X	X	X	X	+	+	+	+	+	X	X	X	X
DIREZIONE 45M	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

GIUGNO 2018	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
VELOCITA' 95M	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
VELOCITA' 89.5M	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
VELOCITA' 45M	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
DIREZIONE 89.5M	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
DIREZIONE 45M	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

LUGLIO 2018	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
VELOCITA' 95M	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
VELOCITA' 89.5M	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
VELOCITA' 45M	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
DIREZIONE 89.5M	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	+	X	X	X	X	X	X	X	X	X	X	X	X	X
DIREZIONE 45M	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

AGOSTO 2018	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
VELOCITA' 95M	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
VELOCITA' 89.5M	+	X	+	+	+	+	+	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
VELOCITA' 45M	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
DIREZIONE 89.5M	+	X	+	+	+	+	+	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
DIREZIONE 45M	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

SETTEMBRE 2018	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
VELOCITA' 95M	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
VELOCITA' 89.5M	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
VELOCITA' 45M	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
DIREZIONE 89.5M	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	+
DIREZIONE 45M	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

OTTOBRE 2018	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
VELOCITA' 95M	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
VELOCITA' 89.5M	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
VELOCITA' 45M	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
DIREZIONE 89.5M	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
DIREZIONE 45M	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

NOVEMBRE 2018	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
VELOCITA' 95M	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	X	X	X	X	X	X	X
VELOCITA' 89.5M	-	-	-	-	-	-	-	+	X	X	+	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
VELOCITA' 45M	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
DIREZIONE 89.5M	X	X	X	X	X	X	X	+	X	X	+	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
DIREZIONE 45M	-	-	-	-	-	-	-	+	X	X	+	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

DICEMBRE 2018	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
VELOCITA' 95M	X	X	X	X	X	X	X	X	X	X	+	X	X	X	X	+	+	X	+	X	X	X	X	X	X	X	X	+	+	X	X
VELOCITA' 89.5M	X	X	X	X	X	X	X	X	X	X	+	X	X	X	X	+	+	X	+	X	X	X	X	X	X	X	X	+	+	X	X
VELOCITA' 45M	X	X	X	X	X	X	X	X	X	X	+	X	X	X	X	+	+	X	+	X	X	X	X	X	X	X	X	+	+	X	X
DIREZIONE 89.5M	X	X	X	X	X	X	X	X	X	X	+	X	X	X	X	+	+	X	+	X	X	X	X	X	X	X	X	+	+	X	X
DIREZIONE 45M	X	X	X	X	X	X	X	X	X	X	+	X	X	X	X	+	+	X	+	X	X	X	X	X	X	X	X	+	+	X	X

GENNAIO 2019	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
VELOCITA' 95M	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
VELOCITA' 89.5M	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
VELOCITA' 45M	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
DIREZIONE 89.5M	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
DIREZIONE 45M	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

FEBBRAIO 2019	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28
VELOCITA' 95M	X	X	X	X	X	X	+	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
VELOCITA' 89.5M	X	X	X	X	X	X	+	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
VELOCITA' 45M	X	X	X	X	X	X	+	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
DIREZIONE 89.5M	X	X	X	X	X	X	+	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
DIREZIONE 45M	X	X	X	X	X	X	+	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

MARZO 2019	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
VELOCITA' 95M	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
VELOCITA' 89.5M	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
VELOCITA' 45M	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
DIREZIONE 89.5M	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
DIREZIONE 45M	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

APRILE 2019	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
VELOCITA' 95M	X	X	X	X	X	+	X	X	X	X	X	X	X	X	X	X	X	X	X	X	+	X	X	X	X	+	X	X	X	X
VELOCITA' 89.5M	X	X	X	X	X	+	X	X	X	X	X	X	X	X	X	X	X	X	X	X	+	X	X	X	X	+	X	X	X	X
VELOCITA' 45M	X	X	X	X	X	+	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	+	X	X	X	X
DIREZIONE 89.5M	X	X	X	X	X	+	X	X	X	X	X	X	X	X	X	X	X	X	X	X	+	X	X	X	X	+	X	X	X	X
DIREZIONE 45M	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	+	X	X	X	X

MAGGIO 2019	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
VELOCITA' 95M	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	+	X	X	X	X	X	X	X	X	X	X	X	X	X	X
VELOCITA' 89.5M	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	+	X	X	+	X	X	X	X	X	X	X	X	X	X	X
VELOCITA' 45M	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	+	X	X	X	X	X	X	X	X	X	X	X
DIREZIONE 89.5M	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	+	X	X	+	X	X	X	X	X	X	X	X	X	X	X
DIREZIONE 45M	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	+	X	X	X	X	X	X	X	X	X	X	X

GIUGNO 2019	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
VELOCITA' 95M	X	X	X	X	X	X	X	X	X	+	X	X	X	X	X	X	X	X	X	X	X	X	X	+	+	X	X	X	X	X
VELOCITA' 89.5M	X	X	X	X	X	+	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	+	+	X	X	X	X	X
VELOCITA' 45M	X	X	X	X	X	+	+	X	X	+	X	X	X	X	X	X	X	X	X	X	X	X	X	+	+	X	X	X	X	X
DIREZIONE 89.5M	X	X	X	X	X	+	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	+	+	X	X	X	X	X
DIREZIONE 45M	X	X	X	X	X	+	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	+	+	X	X	X	X	X

LUGLIO 2019	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
VELOCITA' 95M	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
VELOCITA' 89.5M	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
VELOCITA' 45M	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
DIREZIONE 89.5M	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
DIREZIONE 45M	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X