

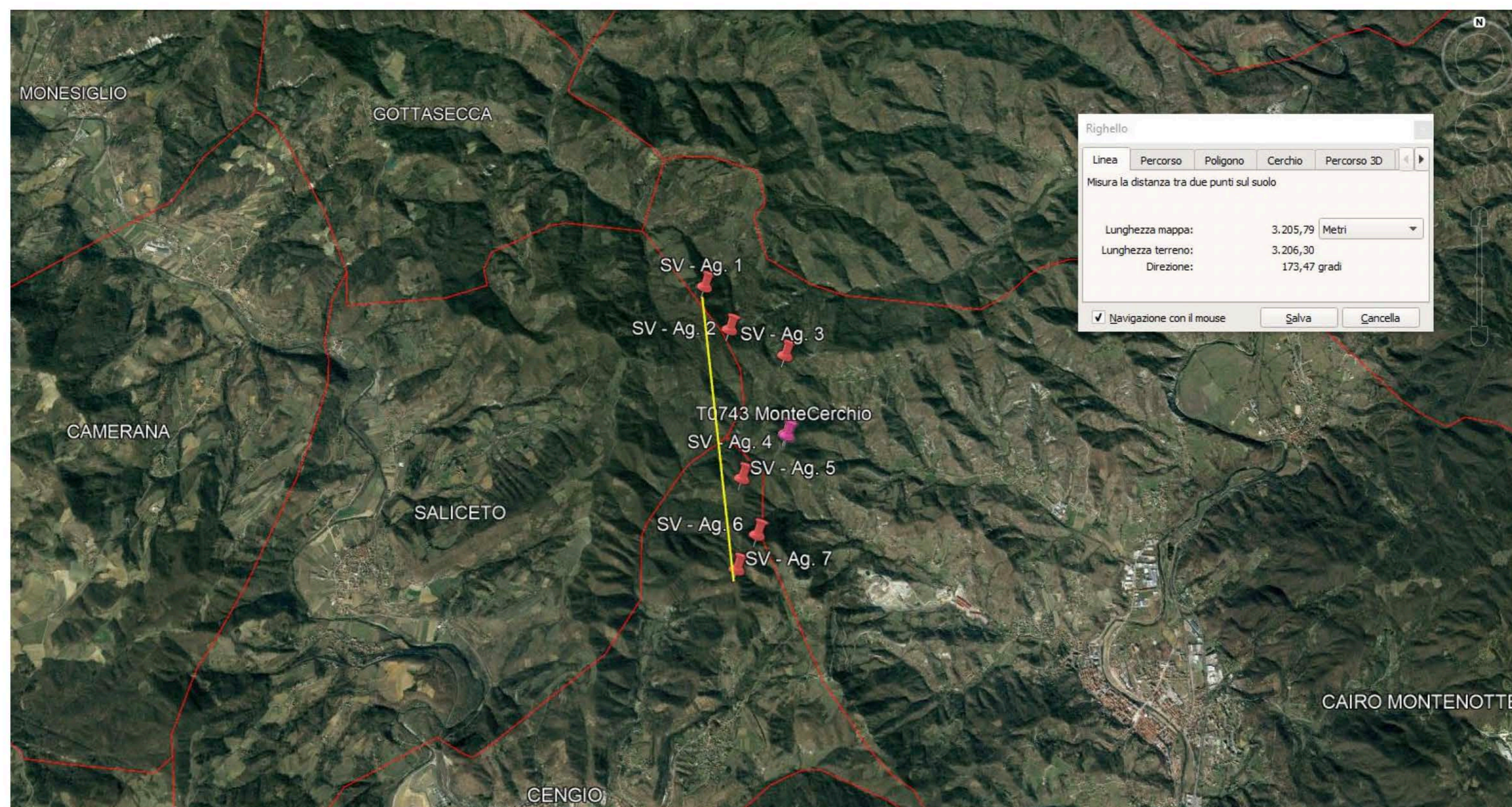
# Impianto eolico nei Comuni di Cairo Montenotte e Cengio (SV)

## Regione Liguria

**Tavola di Valutazione preliminare della Producibilità Eolica fluidodinamica ed al netto delle perdite generali e da interferenza a seguito della raccolta dati svolta in sito con la stazione anemometrica descritta in Allegato A**

CLIENTE	REVISIONE				REDAZIONE
	N°	MESE	ANNO	LUOGO	C. Gaioni
	00	Maggio	2023	GARDONE VAL TROMPIA	 <b>APPROVAZIONE</b>
					C. Mazzarella
ORDINE RIF.	Accettazione ns. Offerta 161_BS_2023 del 05/05/2023				





**LAYOUT IMPIANTO CON POSIZIONI AEROGENERATORI E STAZIONE ANEMOMETRICA**

**Sedi operative:**

- Via Matteotti, 311 – SCALA P – Int.10 – 25063 Gardone Val Trompia (BS)  
 Tel. 030 2056980 – Fax 030 831100

E-mail: [info@tecnogaia.it](mailto:info@tecnogaia.it)  
 E-mail PEC [info@pec.tecnogaia.com](mailto:info@pec.tecnogaia.com)

**Sede Legale:**

Via Matteotti, 311 – 25063 Gardone Val Trompia (BS)

Cod. Fisc. & P. IVA 13029730150  
 Cap. Soc. € 119.000,00 interamente versato  
 Iscrizione nel Registro Imprese Brescia N° REA 496849



**IMPIANTO EOLICO NEI COMUNI DI CAIRO MONTENOTTE E CENGIO (SV) – REGIONE LIGURIA**

 Aerogeneratore: **Vestas V162-6.2 MW** Potenza nominale: **6.2 MW** Diametro Rotore: **162.0 m** Altezza di mozzo: **125.0 m**

AG / RIF.	Coordinate WGS84 - Fuso 32		Base macchina (m s.l.m.)	Dati al mozzo Stima svolta con WASP							
	Longitudine	Latitudine		H mozzo (m)	V (m/s)	P Lorda (MWh/a)	P Lorda netto scie (MWh/a)	Perdite per scia (%)	Perdite stimate	P Netta P50% (MWh/a)	Ore equiv. (MWh/MW)
SV AG1	437.593	4.921.053	737	125,0							
SV AG2	437.871	4.920.538	770	125,0							
SV AG3	438.479	4.920.260	682	125,0							
SV AG4	438.479	4.919.379	664	125,0							
SV AG5	437.995	4.918.881	668	125,0							
SV AG6	438.155	4.918.260	680	125,0							
SV AG7	437.936	4.917.888	690	125,0							

<b>MEDIE</b>	<b>699</b>	<b>125,0</b>								
<b>TOTALI</b>										

Note:

- 1) Producibilità lorda calcolata con curva di potenza alla densità dell'aria di 1.225 kg/m<sup>3</sup>, corrispondente alla quota del mare
- 2) Perdite per densità dell'aria, incluse nelle stimate, calcolate sulla base della curva di potenza alla densità di 1.120 kg/m<sup>3</sup>

**Vestas**<sup>®</sup>

# EnVentus<sup>™</sup> Platform

**Wind.** It means the world to us.<sup>™</sup>



# The **foundation** for the future of wind

We are pioneers. We keep moving and improving. It's what Vestas does. EnVentus™ is the next phase of this journey. By connecting heritage with innovation, Vestas creates solutions that responsibly address tomorrow's energy challenges.

## **Market opportunities**

Our customers are demanding ever more advanced wind turbines, enabling profitable project realisation in increasingly challenging locations as the renewable energy landscape expands and diversifies; larger, more powerful turbines responsive to evolving grid requirements.

## **Customised to maximise**

EnVentus™ represents the next generation in the evolution of wind turbines. Designed to encompass a wide range of turbine configurations, system designs apply modularity to meet customisation and market demands more efficiently. Combined with the extensive Vestas portfolio of solutions, EnVentus™ variants can maximise the potential of each unique wind site.

## **On the shoulders of giants**

EnVentus™ is the realisation of a vision to connect the best engineering from Vestas. Building on more than 151 GW of tried and tested technology, EnVentus™ aims to ensure continued leadership. Using technology and experience from both on- and offshore, the EnVentus™ platform architecture combines advanced proven system designs that deliver innovation.





**+157 GW**

By connecting advanced modular design with more than 157 GW of tried and tested technology, EnVentus™ aims to ensure continued technology leadership.





**Vestas**®

# 40 years of experience

The EnVentus™ platform architecture connects proven system designs from the 2 MW platform, 4 MW platform, and 9 MW platform.



# Connecting certainty with innovation

The EnVentus™ platform is the result of meticulous and careful evaluation of an unbroken line of Vestas technology solutions. With more than 157 GW of wind turbine capacity installed and 40 years of experience in relentlessly pursuing better performance through technology and service, EnVentus™ is Vestas' next generation in the evolution of wind turbines.

## Proven technology

The EnVentus™ platform architecture connects proven system designs from the 2 MW platform, 4 MW platform and 9 MW platform turbine technology. The result is one versatile platform that delivers a higher level of robustness and performance with the ability to meet varying grid compliance requirements around the world.

## System efficiency

The EnVentus™ platform architecture features a full-scale converter, proven from the 4 MW platform, capable of meeting complex and differing grid requirements in local markets. The full-scale converter is matched by a permanent magnet generator for maximum system efficiency and balanced by a medium-speed drivetrain. Known from the 9 MW platform, the EnVentus™ powertrain is optimised to reduce structural loads and has been chosen for reasons of mechanical robustness and flexibility. Combined with advanced load management strategies, the EnVentus™ platform enables siting at increasingly complex project conditions.

## Latest solutions

The EnVentus™ platform architecture benefits from the latest developments in control systems, applying the Vestas Control System 8000 also operating on the 4 MW platform. Similarly, the portfolio of standard towers are based on Tubular Steel Tower (TST), High Tubular Steel Tower (HTST), Concrete Hybrid Towers (CHT), or Large Diameter Steel Tower (LDST) technology, reaching hub heights of up to 169m.

V150-6.0 MW™, V162-6.2 MW™, V162-7.2 MW™ and V172-7.2 MW™ turbine blades are the result of incremental

improvements to proven technical solutions. All EnVentus™ turbines feature slender profile and pre-bent blades, optimised for weight through application of carbon pultrusion material and a structural shell blade design, enabling the optimisation of the structural loads while increasing the rotor sizes. Vestas' most advanced aerofoil design ensures high aerodynamic performance and excellent sound power levels.

## Tested to the limit

By applying reusable modules, versatility in offering can be achieved while adhering to Vestas' rigorous testing standards. The Vestas Test Centre is unrivalled in the wind industry. We test nacelle components using accelerated life testing under mixed and aggregated environmental conditions. For critical components, Highly Accelerated Life Testing (HALT) identifies potential failure modes and mechanisms. Specialised test rigs ensure strength and robustness for the gearbox, generator, yaw and pitch system, lubrication system and accumulators. Our quality control system ensures that each component is manufactured to design specifications and performs at site. We systematically monitor measurement trends that are critical to quality, locating defects before they occur.

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## We know wind

Vestas is the right partner to help you realise the full potential of your wind site. We have the largest installed capacity in the industry and currently monitor over 48,000 turbines across the globe: Tangible proof of our commitment to making renewable energy solutions that are productive, reliable and economical.

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# Maximised site potential

The Vestas EnVentus™ platform adds four new variants to the wide range of existing Vestas turbines, providing the ability to create an even more finely matched combination of turbines to harness available wind energy in any specific location.

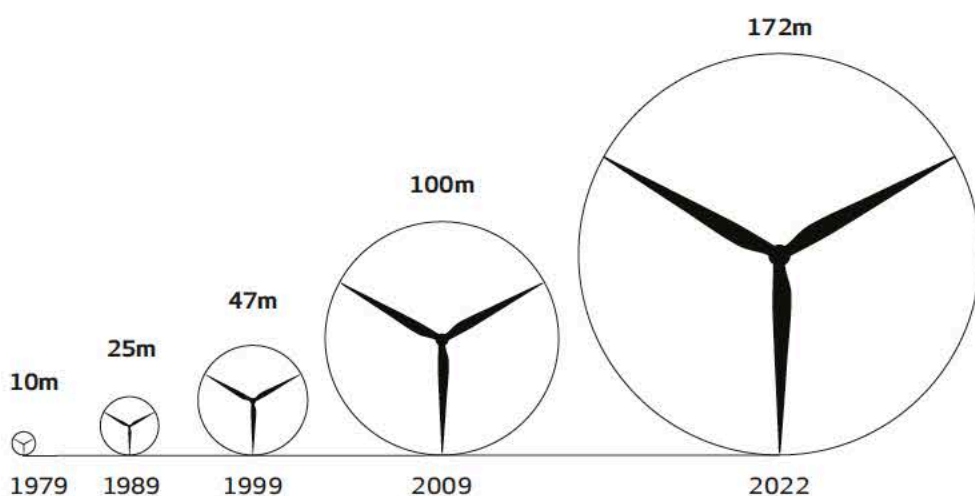
## Versatility at the core

Through advanced modularity in design, EnVentus™ aims to meet customisation needs more efficiently combining reusable modules depending on unique market and project conditions. Designed with global applicability in mind, EnVentus™ based variants benefit from a full-scale converter enabling compliance with varying market-specific grid code requirements. The wide range of standard hub heights, options, and modes of operation contribute to the ability to meet specific requirements.

## Business case flexibility

The relationship between rotor size and rating help maximise turbine level production. This makes the variants especially suitable for projects limited by the number of wind turbines installed. Combining double-digit\* annual energy production improvements in low, medium and high wind speeds, the EnVentus turbines are ready to secure project realisation in auction and permit-based environments.

## Rotor size development



\*Depending on site specific conditions.

## V150-6.0 MW™

The V150-6.0 MW™ lifts the larger rotor introduced with V150-4.2 MW™ into stronger wind speeds. Combined with its higher generator rating, it increases the production potential at WTG level by more than 20 percent compared to V136-4.2 MW™ in medium wind speed conditions. Applying Vestas' most advanced aerofoil blade design combined with lower rotational speeds of the EnVentus™ drivetrain, means realisation of power production potential at very low sound power levels. A comprehensive portfolio of standard and site-specific towers allow for application in tip height constraint markets, varying from 180m to 244m.

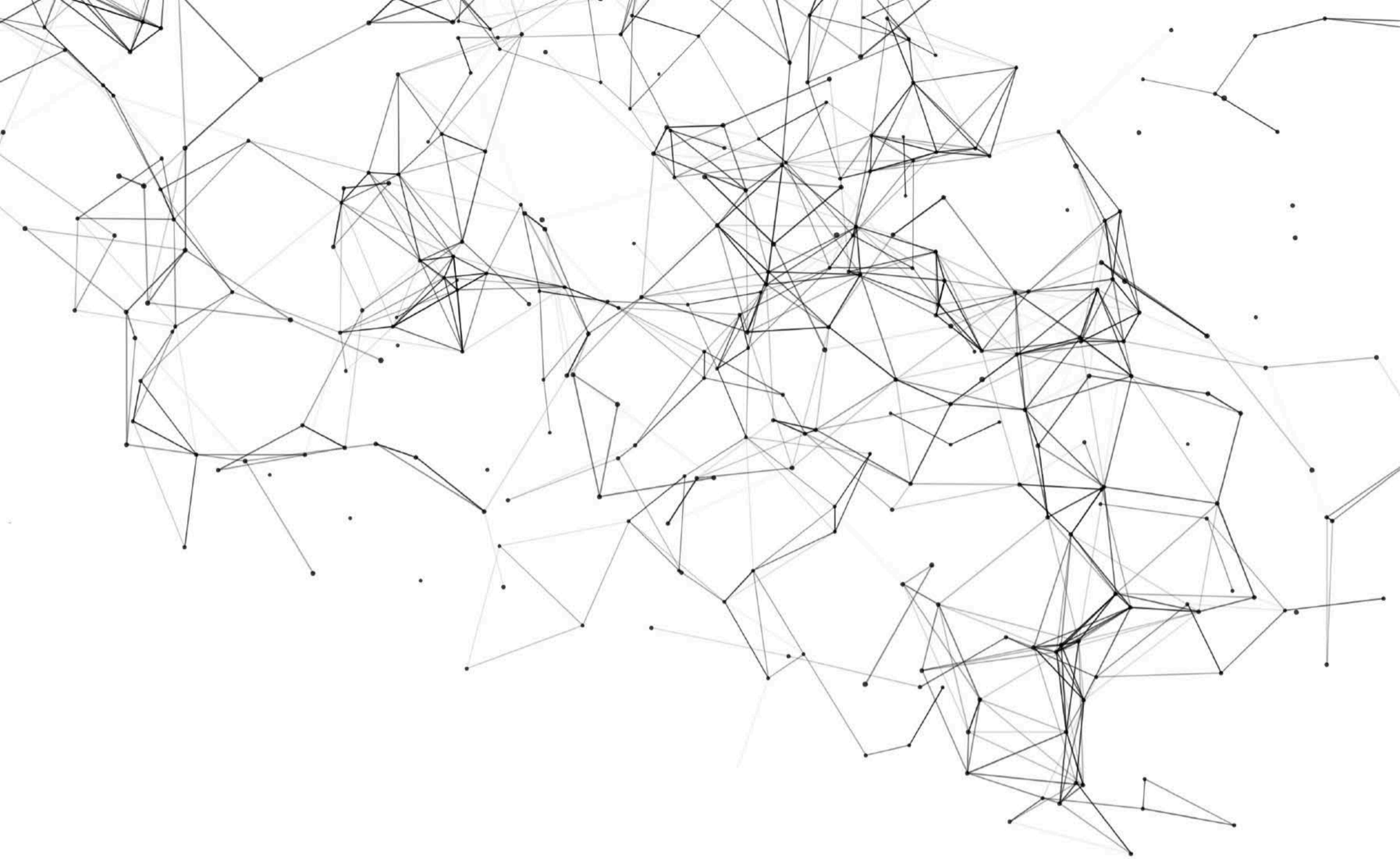
## V162-6.2 MW™

With a swept area of over 20,000m<sup>2</sup>, the V162-6.2 MW™ applies a larger rotor to achieve higher energy production paired with a high capacity factor. Due to the large operational envelope, the V162-6.2 MW™ has great relative siteability on both turbulence and average wind speeds. With a maximum Sound Power Level of 104.8dB(A), the V162-6.2 MW™ delivers over 30 percent higher energy production than the V150-4.2 MW™.

## V162-7.2 MW™ & V172-7.2 MW™

With flexible ratings of 6.5 MW, 6.8 MW and 7.2 MW, the V162-7.2 MW™ and V172-7.2 MW™ improve annual energy production through enhancements in powertrain and power conversion systems. Improved siteability in hot climates is enabled through the optional larger CoolerTop. The modularised nacelle design improves transportability of the nacelle unit and provides flexibility to service and upgrades over the turbine's operational lifetime. The V172-7.2 MW™ is designed for low to medium average wind conditions, whereas the V162-7.2 MW™ caters more for applications in medium to high wind segments, especially where tip height restrictions may apply.





## WIND CLASSES

Turbine type	Low wind speeds	Medium wind speeds	High wind speeds
EnVentus™ turbines			
V150-6.0 MW™		[Blue bar spanning Medium and High wind speeds]	
V162-6.2 MW™		[Blue bar spanning Medium and High wind speeds]	
V162-7.2 MW™		[Blue bar spanning Medium and High wind speeds]	
V172-7.2 MW™	[Blue bar spanning Low, Medium, and High wind speeds]		

### All of Vestas

As part of the suite of Vestas offerings, the EnVentus turbines can be combined with an extensive list of technology options to create customised solutions to suit the needs of each unique project. By adding options to the standard turbine, we can enhance the performance and adaptability of the wind power project and facilitate a shorter permitting cycle at restricted sites. These options can be a decisive factor in realising your specific project and the business case certainty of your investments. Additionally, the well-established Vestas manufacturing and global supply chain setup ensure the ability to deliver, while supporting local requirement.

### Options available for the EnVentus™ platform:

- Additional operating modes
- Aviation Markings on the Blades
- Vestas Bat Protection System
- Aviation Lights
- Condition Monitoring Solution
- Fire Suppression
- Lightning detection
- Load Optimised Modes
- Low Temperature Operation to -30°C
- Oil Debris Monitoring System
- Vestas Shadow Flicker Control System
- Service Personnel Lift
- Vestas Ice Detection™
- Vestas Anti-Icing System™



# The knowledge to control

## **Knowledge about wind project planning is key**

When planning a wind power plant, there are a broad range of factors over its entire lifecycle that will impact its success in the long-term. These range from financing and siting, to grid requirements and the regulatory framework. One of the first and most important steps is to identify the most suitable location for your wind power plant. Vestas' siting capabilities cover all the steps from finding a site, until delivering a fully optimised power plant set up.

Using the largest weather library in the industry, site-specific met mast campaigns and advanced analytical tools, Vestas examines a broad spectrum of wind and weather data to evaluate potential sites and establish which of them can provide optimum conditions for your project. In addition, Vestas can optimise the layout of your wind power plant and the technology selection with high accuracy by implementing detailed simulations of the conditions on site and analyse their effects over the whole

operating life of the plant. Put simply, it finds the optimal balance between the estimated ratio of annual revenue to operating costs over the lifetime of your plant, to determine your project's true potential and provide a firm basis for your investment decision.

The complexity and specific requirements of grid connections vary considerably across the globe, making the optimal design of electrical components for your wind power plant essential. By identifying grid codes early in the project phase and simulating extreme operating conditions, Vestas' Electrical PreDesign provides you with an ideal way to build a grid compliant, productive and highly profitable wind power plant. It allows customised collector network cabling, substation protection and reactive power compensation, which boost the cost efficiency of your business.





### **Advanced monitoring and real-time plant control**

All our wind turbines can benefit from VestasOnline® Business, the latest Supervisory Control and Data Acquisition (SCADA) system for wind power plants.

This flexible system includes an extensive range of monitoring and management functions to control your wind power plant. VestasOnline® Business enables you to optimise production levels, monitor performance and produce detailed, tailored reports from anywhere in the world. The VestasOnline® Power Plant Controller offers scalability and fast, reliable real-time control and features customisable configuration, allowing you to implement any control concept needed to meet local grid requirements.

### **Condition monitoring and maintenance**

Operating a large wind power plant calls for efficient management strategies to minimise downtime and operational expenses. Vestas offers 24/7 monitoring, performance reporting and predictive maintenance solutions to improve turbine performance and availability.

Vestas Condition Monitoring Solution (CMS) enables to predict the failure of components by analysing vibration signals, preventing major equipment damages and enabling to optimise the service planning according to the energy production and weather conditions. Additionally, Vestas' Active Output Management® (AOM) provides detailed plans and long-term agreements for maintenance, online monitoring, optimisation and troubleshooting. It is possible to get a full scope contract, combining turbine technology with guaranteed time or energy-based availability performance targets, thereby creating a solid base for your power plant investment.



An aerial photograph showing a long, white wind turbine blade being hoisted by a green crane. The blade extends from the right side of the frame towards the center. Below the blade, a yellow support structure is visible. The background consists of a vast, flat landscape with green fields, patches of trees, and a distant horizon under a clear sky. The lighting suggests late afternoon or early morning.

# Vestas' transparency towards **Sustainability**

## **Vestas Sustainability**

In 2020, we introduced our sustainability strategy, Sustainability in Everything We Do. At Vestas we are working to improve our own environmental performance, create value for local communities, promote a safe, diverse, and inclusive workplace, while leading the transition to a world powered by sustainable energy. We believe these efforts will help to elevate the standards of our industry as a whole. Read more about Vestas sustainability strategy at [www.vestas.com/en/sustainability](http://www.vestas.com/en/sustainability).

## **Life Cycle Assessments (LCA)**

Since 1999, we have been developing wind turbine LCAs to give 'cradle-to-grave' evaluations of the environmental impact of our products and solutions. These evaluations concentrate on two key actions: documenting the environmental performance

of Vestas wind turbines and analysing the results to reduce the environmental impact of our turbines. The LCAs provide environmental impact transparency to help customers achieve their own sustainability ambitions. To view our current portfolio of Life Cycle Assessments visit the following page: [www.vestas.com/en/sustainability/reports-and-ratings](http://www.vestas.com/en/sustainability/reports-and-ratings).

As part of our commitment to customers, we also offer customised wind power plant LCAs, called Vestas® SiteLCA™. These assessments determine key indicators of environmental performance, taking the wind turbine type, site specific conditions and production supply chain into consideration. SiteLCA™ provides customers or project developers with transparent environmental facts for a specific wind power plant.



g/kWh

**5.6-7.6**



**1086**



CO<sub>2</sub> comparison between the EnVentus platform and a coal power plant

Energy neutral

**6-7**

months of operation

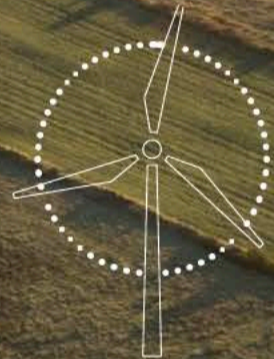


Energy return

**34 -**

**42**

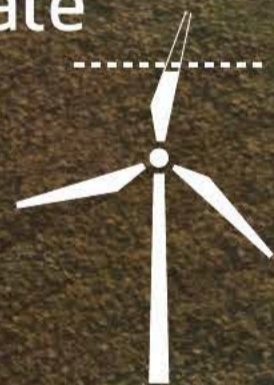
times



Recyclability rate

**86%-**

**89%**



**Vestas**

Sustainability metrics depending on project and site specific conditions



# V150-6.0 MW™ IEC S

## Facts & figures

**POWER REGULATION** Pitch regulated with variable speed

### OPERATING DATA

Rated power 6,000kW  
 Cut-in wind speed 3m/s  
 Cut-out wind speed\* 25m/s  
 Wind class IEC S  
 Standard operating temperature range from -20°C to +45°C  
 \*High Wind Operation available as standard

### SOUND POWER

Maximum 104.9dB(A)\*  
 \*Sound Optimised Modes available dependent on site and country

### ROTOR

Rotor diameter 150m  
 Swept area 17,672m<sup>2</sup>  
 Aerodynamic brake full blade feathering with 3 pitch cylinders

### ELECTRICAL

Frequency 50/60Hz  
 Converter full scale

### GEARBOX

Type two planetary stages

### TOWER

Hub height 105m (IEC S)  
 125m (IEC S/DIBt S)  
 148m (DIBt S)  
 155m (IEC S)  
 166m (DIBt S)  
 169m (DIBt S)

### TURBINE OPTIONS

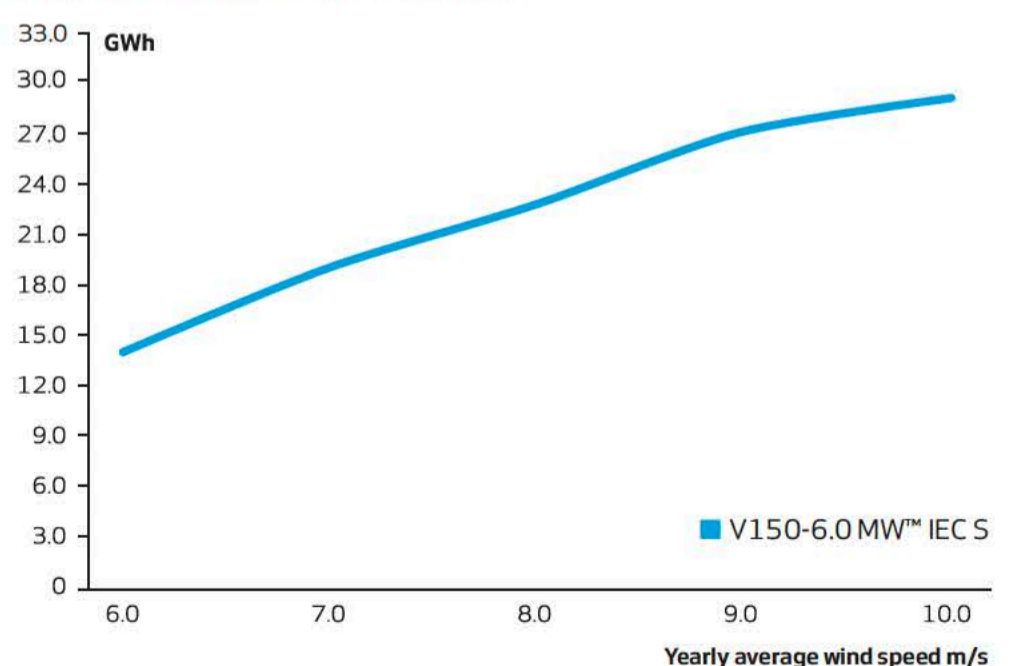
- Condition Monitoring System
- Oil Debris Monitoring System
- Service Personnel Lift
- Low Temperature Operation to -30°C
- Vestas Ice Detection™
- Vestas Anti-Icing System™
- Vestas Shadow Flicker Control System
- Aviation Lights
- Aviation Markings
- Fire Suppression System
- Vestas Bat Protection System
- Lightning Detection System
- Power Optimised Modes

### SUSTAINABILITY

Carbon Footprint 7.6g CO<sub>2</sub>e/kWh  
 Return on energy break-even 6 months  
 Lifetime return on energy 42 times  
 Recyclability rate 89%

Configuration: HH=166m, Vavg=8.5m/s, k=2.22. Depending on site-specific conditions. Metrics are based on a preliminary stream-lined analysis. An externally-verified Lifecycle Assessment will be made publicly available on vestas.com once finalised.

### ANNUAL ENERGY PRODUCTION



**Assumptions**  
 One wind turbine, 100% availability, 0% losses, k factor =2,  
 Standard air density = 1.225, wind speed at hub height



# V162-6.2 MW™ IECS

## Facts & figures

**POWER REGULATION** Pitch regulated with variable speed

### OPERATING DATA

Rated power 6,200kW  
 Cut-in wind speed 3m/s  
 Cut-out wind speed\* 25m/s  
 Wind class IECS  
 Standard operating temperature range from -20°C to +45°C  
 \*High Wind Operation available as standard

### SOUND POWER

Maximum 104.8dB(A)\*  
 \*Sound Optimised Modes available dependent on site and country

### ROTOR

Rotor diameter 162m  
 Swept area 20,612m<sup>2</sup>  
 Aerodynamic brake full blade feathering with 3 pitch cylinders

### ELECTRICAL

Frequency 50/60Hz  
 Converter full scale

### GEARBOX

Type two planetary stages

### TOWER

Hub height 119m (IECS/DIBt S)  
 125m (IECS)  
 166m (IECS/DiBt S)  
 169m (DIBt S)

### TURBINE OPTIONS

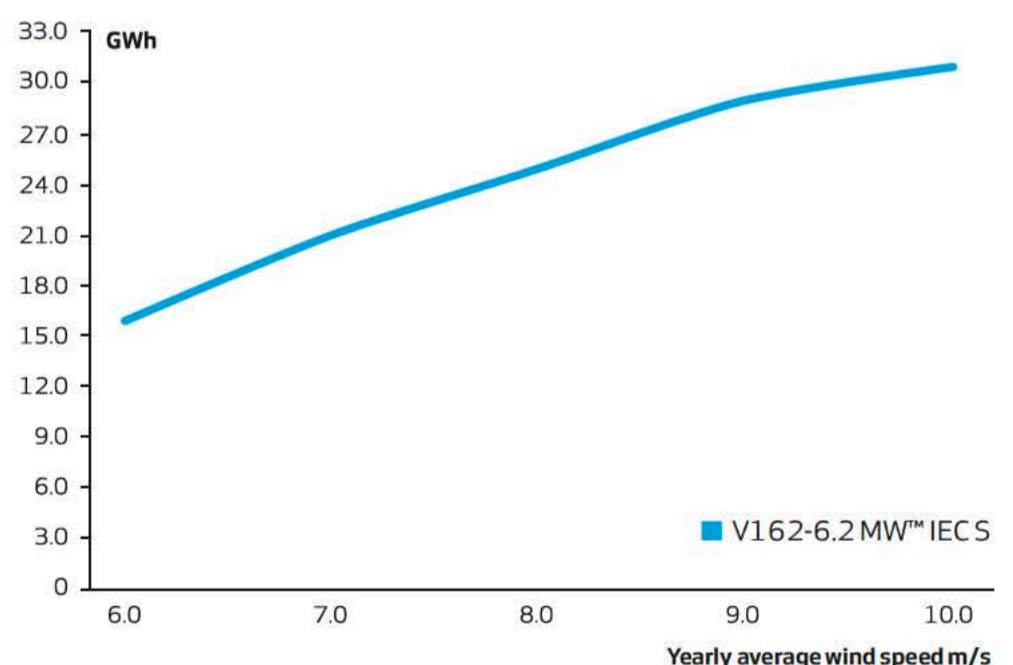
- Condition Monitoring System
- Oil Debris Monitoring System
- Service Personnel Lift
- Low Temperature Operation to -30°C
- Vestas Ice Detection™
- Vestas Anti-Icing System™
- Vestas Shadow Flicker Control System
- Aviation Lights
- Aviation Markings
- Fire Suppression System
- Vestas Bat Protection System
- Lightning Detection System
- Power Optimised Modes

### SUSTAINABILITY

Carbon Footprint 6.1g CO<sub>2</sub>e/kWh  
 Return on energy break-even 6 months  
 Lifetime return on energy 39 times  
 Recyclability rate 88%

Configuration: HH=166m, Vavg=8.5m/s, k=2.48. Depending on site-specific conditions. Metrics are based on a preliminary stream-lined analysis. An externally-verified Lifecycle Assessment will be made publicly available on vestas.com once finalised.

### ANNUAL ENERGY PRODUCTION



**Assumptions**  
 One wind turbine, 100% availability, 0% losses, k factor =2,  
 Standard air density = 1.225, wind speed at hub height



# V162-7.2 MW™ IEC S

## Facts & figures

**POWER REGULATION** Pitch regulated with variable speed

### OPERATING DATA

Standard rated power 7,200kW  
 Cut-in wind speed 3m/s  
 Cut-out wind speed\* 25m/s  
 Wind class IEC S  
 Standard operating temperature range from -20°C to +45°C  
 \*High Wind Operation available as standard

### SOUND POWER

Maximum 105.5dB(A)\*  
 \*Sound Optimised Modes available dependent on site and country

### ROTOR

Rotor diameter 162m  
 Swept area 20,612m<sup>2</sup>  
 Aerodynamic brake full blade feathering with 3 pitch cylinders

### ELECTRICAL

Frequency 50/60Hz  
 Converter full scale

### GEARBOX

Type two planetary stages

### TOWER

Hub height 119m (IEC S/DIBt S)  
 169m (IEC S)\*  
 169m ((DIBt S))

\*Includes 3m raised foundation

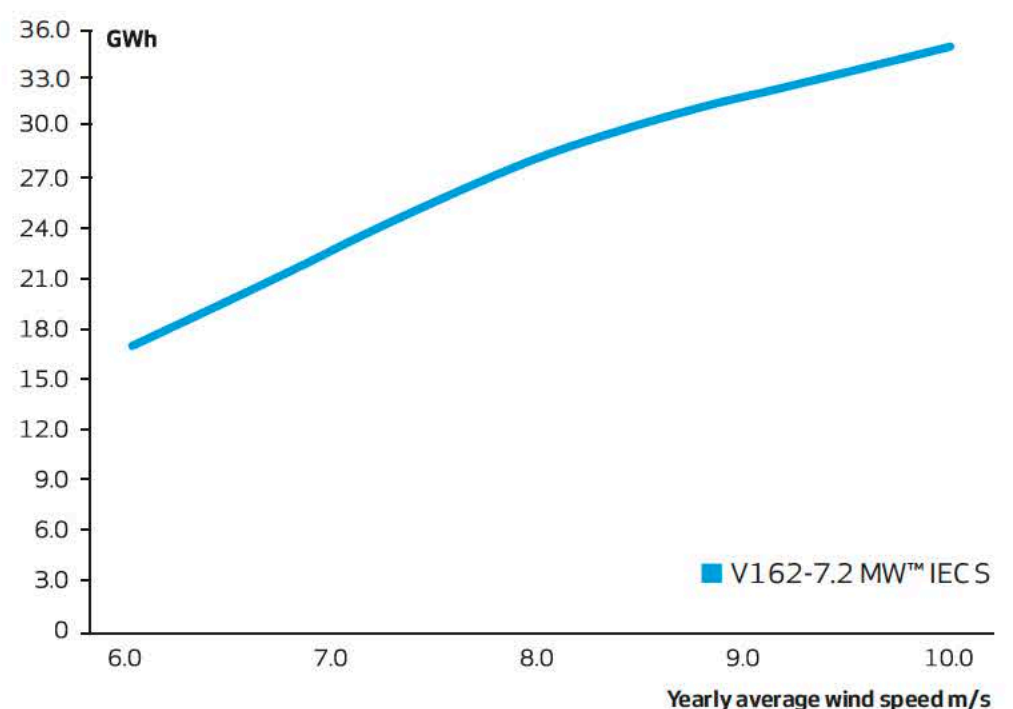
### TURBINE OPTIONS

- 6.5 MW Operational Mode
- 6.8 MW Operational Mode
- Oil Debris Monitoring System
- High Temperature Cooler Top
- Service Personnel Lift
- Low Temperature Operation to -30°C
- Vestas Ice Detection™
- Vestas Anti-Icing System™
- Vestas Shadow Flicker Control System
- Aviation Lights
- Aviation Markings
- Fire Suppression System
- Vestas Bat Protection System
- Lightning Detection System

### SUSTAINABILITY

Carbon Footprint 5.8g CO<sub>2</sub>e/kWh  
 Return on energy break-even 6 months  
 Lifetime return on energy 41 times  
 Recyclability rate 86-87%  
 Configuration: HH=166m, Vavg=8.5m/s, k=2.48. Depending on site-specific conditions. Metrics are based on a preliminary stream-lined analysis. An externally-verified Lifecycle Assessment will be made publicly available on vestas.com once finalised.

### ANNUAL ENERGY PRODUCTION



**Assumptions**  
 One WTG, 100% availability, 0% losses, k factor = 2,  
 Standard density = 1.225



# V172-7.2 MW™ IECS

## Facts & figures

**POWER REGULATION** Pitch regulated with variable speed

### OPERATING DATA

Standard rated power 7,200kW  
 Cut-in wind speed 3m/s  
 Cut-out wind speed\* 25m/s  
 Wind class IECS  
 Standard operating temperature range from -20°C to +45°C  
 \*High Wind Operation available as standard

### SOUND POWER

Maximum 106.9dB(A)\*  
 \*Sound Optimised Modes available dependent on site and country

### ROTOR

Rotor diameter 172m  
 Swept area 23,235m<sup>2</sup>  
 Aerodynamic brake full blade feathering with 3 pitch cylinders

### ELECTRICAL

Frequency 50/60Hz  
 Converter full scale

### GEARBOX

Type two planetary stages

### TOWER

Hub height\* 112m (IECS)\*\*  
 117m (IECS)\*\*  
 150m (IECS)\*\*  
 164m (DIBt)  
 166m (IECS)  
 175m (DIBt)

\*Site specific towers available on request

\*\*Preliminary

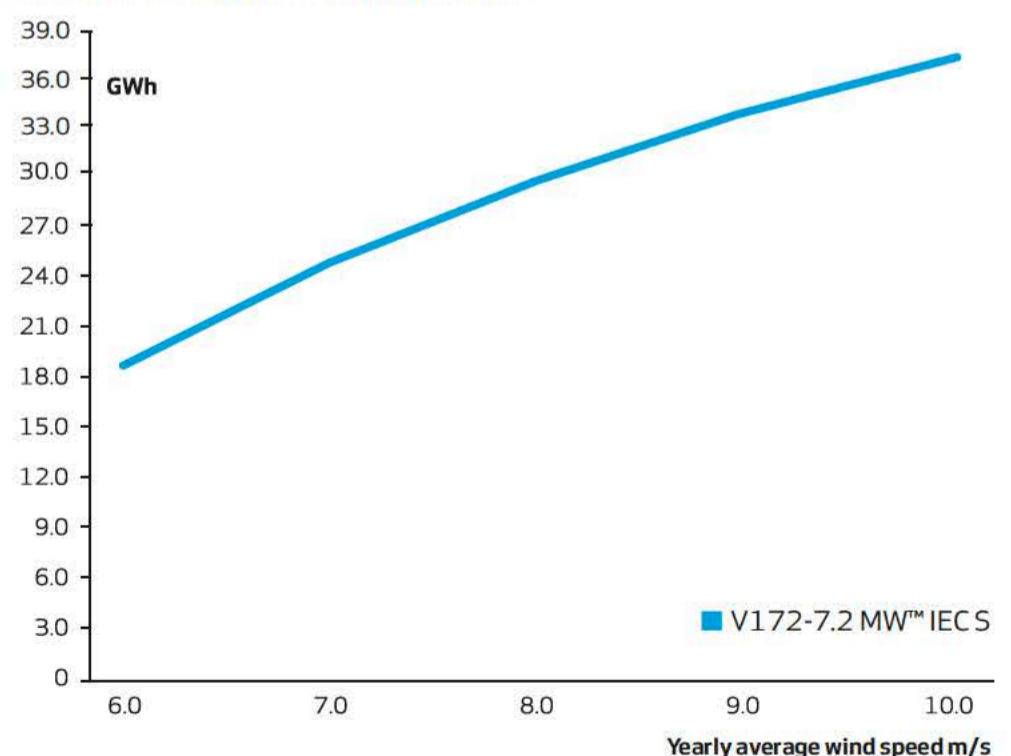
### TURBINE OPTIONS

- 6.5 MW Operational Mode
- 6.8 MW Operational Mode
- Oil Debris Monitoring System
- High Temperature Cooler Top
- Service Personnel Lift
- Low Temperature Operation to -30°C
- Vestas Ice Detection™
- Vestas Anti-Icing System™
- Vestas Shadow Flicker Control System
- Aviation Lights
- Aviation Markings
- Fire Suppression System
- Vestas Bat Protection System
- Lightning Detection System

### SUSTAINABILITY

Carbon Footprint 6.2g CO<sub>2</sub>e/kWh  
 Return on energy break-even 7 months  
 Lifetime return on energy 34-35 times  
 Recyclability rate 87%  
 Configuration: HH=166m, Vavg=7.5m/s, k=2.48. Depending on site-specific conditions. Metrics are based on a preliminary stream-lined analysis. An externally-verified Lifecycle Assessment will be made publicly available on vestas.com once finalised.

### ANNUAL ENERGY PRODUCTION



**Assumptions**  
 One WTG, 100% availability, 0% losses, k factor = 2,  
 Standard density = 1.225



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vestas@vestas.com . [vestas.com](https://www.vestas.com)

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*ALLEGATO A:*

*Relazione d'installazione stazione  
anemometrica Monte Cerchio*

*Cod. T0743*

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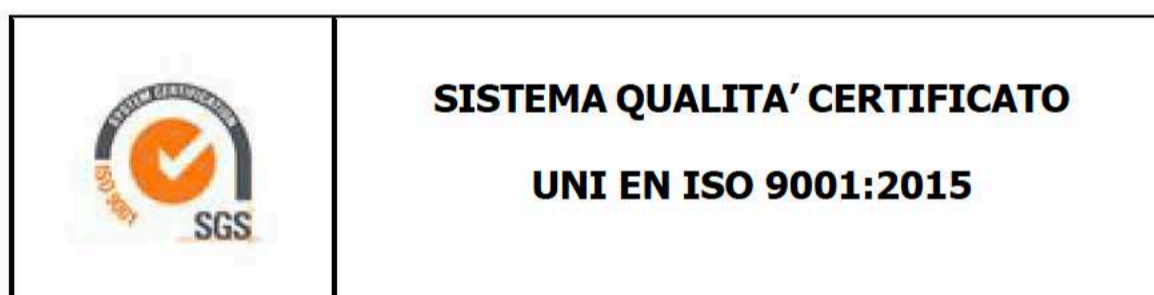
## Resoconto sull'installazione della stazione anemometrica denominata Monte Cerchio ricadente nel Comune di Cairo Montenotte (SV)

CLIENTE	REVISIONE				REDAZIONE
<b>Deca Service</b> S.r.l.	N°	MESE	ANNO	LUOGO	C. GAIONI
	0	Novembre	2022	GARDONE VAL TROMPIA	<i>Carlo Sironi</i> <b>APPROVAZIONE</b> C. MAZZARELLA <i>C. Mazzarella</i>
	<b>ORDINE RIF.</b> Accettazione Ns. Offerta nr. 202_BS_2022 del 13/10/2022				



**IL PRESENTE DOCUMENTO È AD USO ESCLUSIVO DEL COMMITTENTE.**

**L'USO IMPROPRIO DA PARTE DI TERZI DI INFORMAZIONI, DATI, ELABORATI,  
IMMAGINI IVI CONTENUTI È SANZIONABILE NEI TERMINI DI LEGGE.**



**Sedi operative:**

- Via Matteotti, 311 – SCALA P – Int.10 – 25063 **Gardone V.T. (BS)**  
Tel. 030 2056980 – Fax 030 831100

E-mail: [info@tecnogaia.it](mailto:info@tecnogaia.it)  
E-mail PEC [info@pec.tecnogaia.com](mailto:info@pec.tecnogaia.com)

**Sede Legale:**

Via Matteotti, 311 – 2506 **Gardone Val Trompia (BS)**  
Tel. 030 2056980 – Fax 030 831100

N° Iscriz. Registro Imprese Brescia  
Cod. Fisc. & P. IVA 13029730150  
N° REA 496849

Cap. Soc. € 119.000,00 interamente versato



## 1. Premessa

Nell'ambito dell'incarico ricevuto Deca Service S.r.l. per l'espletamento di attività di monitoraggio eolico, nel mese di Novembre 2022, è stata effettuata l'installazione di una stazione anemometrica ricadente nel territorio della Provincia di Savona. La presente relazione riporta il resoconto degli interventi effettuati.

Costituiscono parte integrante del documento gli allegati contenenti:

- le planimetrie con l'ubicazione del punto di installazione;
- le schede con le informazioni rilevate durante l'attività in sito;
- le prove di registrazione dopo l'installazione;
- le riprese fotografiche effettuate al termine delle attività in sito.

La relazione stessa è altresì resa disponibile anche su supporto magnetico con formato compatibile con l'ambiente Windows.

## 2. Installazione della stazione anemometrica Monte Cerchio – Cairo Montenotte (SV)

In data 29/11/2022 è stata completata l'installazione nel territorio comunale di Cairo Montenotte (SV) di una stazione anemometrica da 40 metri denominata "Monte Cerchio", in località omonima, a cui è stato assegnato il codice stazione 0743.

Sul sostegno sono stati installati, oltre al sistema di acquisizione dati munito del kit di telegestione, due sensori di velocità FIRST CLASS a 40 e 30 metri dal suolo. L'allestimento della stazione è completato con due sensori di direzione a banderuola a 40 e 30m dal suolo e con un sensore di temperatura a 3,5 m dal suolo.



La scelta del punto di installazione è scaturita, ad opera del Committente ed a seguito di sopralluoghi mirati in sito, dall'individuazione di un punto ben rappresentativo di un'area più ampia che risulta interessata da buona ventosità.

L'ubicazione della stazione è riportata sulla planimetria nella **Tavola 1** (cartografia stradale 1:200.000) e, con maggior dettaglio, nella **Tavola 2** (stralcio cartografia IGMI 1:25.000).

La **Scheda A** "Qualificazione dei dati anemologici di un sito – Scheda della stazione anemometrica" contiene i dati identificativi della stazione e delle apparecchiature installate, nonché i dati relativi alla localizzazione della stazione e al sito circostante il punto di installazione.

Prima dell'installazione è stata effettuata in laboratorio una verifica di funzionamento delle apparecchiature da utilizzare, i cui risultati sono riportati nella **Scheda B** "Qualificazione dei dati anemologici di un sito – Scheda di verifica in laboratorio delle apparecchiature da utilizzare".

La **Scheda C** "Qualificazione dei dati anemologici di un sito – Rapporto sul sopralluogo effettuato nel sito per la scelta del punto di installazione della stazione anemometrica" fornisce i dati relativi all'accessibilità ed alcuni dati utili per il montaggio della stazione ricavati dal sopralluogo effettuato prima dell'installazione.

La **Scheda D** "Qualificazione dei dati anemologici di un sito – Configurazione acquirente dati dei canali acquirente" è una rappresentazione fotografica, tratta dall'ambiente web di configurazione del data logger Ammonit METEO 40M installato, delle impostazioni inserite nell'acquirente dati relative ai sensori presenti sulla stazione anemometrica.

Negli allegati denominati "Report di calibrazione dell'anemometro" sono riportati:

- Nell' **Allegato 1a** i risultati di una prova di calibrazione in camera a vento, eseguita dall'istituto riconosciuto Measnet Deutsche WindGuard Wind Tunnel Services, sul sensore di velocità THIES First Class N° calibrazione 2214409 che è stato installato con apposita mensola sulla sommità del sostegno a 40 m dal suolo.
- Nell' **Allegato 1b** i risultati di una prova di calibrazione in camera a vento, eseguita dall'istituto riconosciuto Measnet Deutsche WindGuard Wind Tunnel Services, sul sensore di velocità THIES First Class N° calibrazione 2214410 che è stato installato con apposita mensola a 30 m dal suolo.



[www.tecnogaia.it](http://www.tecnogaia.it)

Resoconto sull'installazione della stazione anemometrica denominata Monte Cerchio ricadente nel Comune di Cairo Montenotte (SV) - Autore: C. Gaioni

Al fine di verificare il funzionamento dell'acquisitore dati, al termine dell'installazione è stata effettuata una prova di funzionamento, i cui risultati sono riportati nell'**Allegato 2** "Prova di registrazione dopo l'installazione" e su supporto magnetico con nome-file MonteCerchio.xls, che è stata trascodificata al rientro in sede.

Completano le informazioni raccolte per questa installazione le **riprese fotografiche** della postazione anemometrica, effettuate dalla stazione e verso la stazione da una distanza di qualche decina di metri, in direzione dei punti cardinali.

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# SITO EOLICO DI MONTE CERCHIO

Comune di CAIRO MONTENOTTE (SV)

Ubicazione geografica del sito



Scala 1:200.000



 Sito eolico



Regione: LIGURIA

Cartina di base: Atlante stradale d'Italia, Volume NORD 1:200.000, Ediz. TCI, Milano 2004.

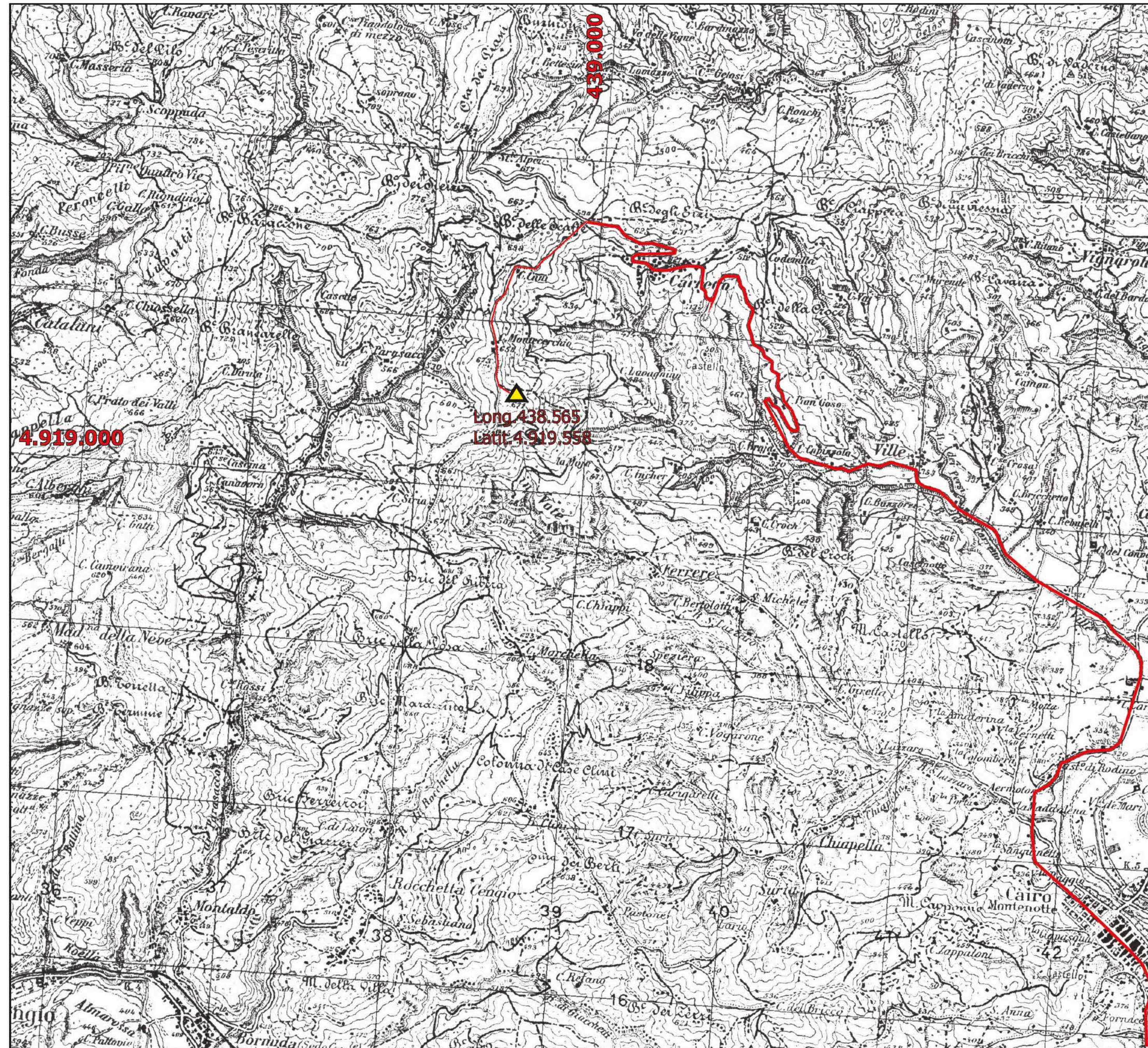




# SITO EOLICO DI MONTE CERCHIO

Comune di CAIRO MONTENOTTE (SV)

Ubicazione della stazione anemometrica e accessibilità



## LEGENDA

- Viabilità principale
- Viabilità accesso al sito

- Confini regionali
- Confini provinciali
- Confini comunali

Stazione anemometrica Monte Cerchio

Cartina di base IGMI, serie 25:  
DEGO 81 II NO

Scala 1:25.000



Regione: LIGURIA

TecnoGaia s.r.l.



**QUALIFICAZIONE DEI DATI ANEMOLOGICI DI UN SITO**

Scheda della stazione anemometrica



**Sito: Monte Cerchio**

**Fornitore: Tecnogaia**

Data

Codifica documento

Archivio

Compilato da

**Sezione A ) – Dati identificativi della stazione anemometrica**

Nome stazione (max 16 car.): **Monte Cerchio** Codice: **0743**

Comune di: **Cairo Montenotte** Provincia: **SV** Regione: **Liguria**

Tavoletta IGMI: **Deگو** Foglio n°: **81 II NO**

Sezione B ) – Dati identificativi delle apparecchiature

**SENSORI DIGITALI**

<i>N</i>	<i>Tipo</i>	<i>h dal suolo(m)</i>	<i>Marca</i>	<i>modello</i>	<i>Matricola</i>	<i>n° inventario</i>	<i>Orientamento mensole</i>
<b>A</b>	<b>Velocità</b>	<b>40</b>	<b>THIES</b>	<b>FC ADVANCED II</b>	<b>09223131</b>	<b>TG22-3411</b>	<b>175°</b>
<b>B</b>	<b>Velocità</b>	<b>30</b>	<b>THIES</b>	<b>FC ADVANCED II</b>	<b>09223132</b>	<b>TG22-3412</b>	<b>175°</b>
<b>C</b>							
<b>D</b>							
<b>E</b>							
<b>F</b>							

**SENSORI ANALOGICI**

<i>N</i>	<i>Tipo</i>	<i>h dal suolo(m)</i>	<i>Marca</i>	<i>modello</i>	<i>n° matricola</i>	<i>n° inventario</i>	<i>Orient. Sensore</i>	<i>Rotaz. Positiva verso</i>
<b>A</b>	<b>Direzione</b>	<b>40</b>	<b>NRG</b>	<b>200M</b>	<b>1007000020552</b>	<b>TG22/3356</b>	<b>355°</b>	<b>Sud</b>
<b>B</b>	<b>Direzione</b>	<b>30</b>	<b>NRG</b>	<b>200M</b>	<b>1007000022612</b>	<b>TG22/3357</b>	<b>355°</b>	<b>Sud</b>
<b>C</b>	<b>Temp.</b>	<b>3,5</b>	<b>NRG</b>	<b>T60</b>	<b>9400004999</b>	<b>TG22/3368</b>	<b>0°</b>	
<b>D</b>								
<b>E</b>								
<b>F</b>								

**ACQUISITORE**

Ammonit

**METEO – 40M**

**D223209**

**TG22/3394**

ACCESSORI:  
**ROUTER**

**SOSTEGNO**      **40**

**Contenitore apparecchiature**

Quadro Tais Cube  
IP66-4

**Sezione C ) – Dati relativi alla localizzazione della stazione anemometrica ed al sito**

Coordinate chilometriche **UTM ED50**: long. **438 565** - latit. **4 919 558** - Fuso **32**

Coordinate chilometriche **UTM WGS84**: long. **438 484** - latit. **4 919 359** - Fuso **32**

Altitudine in metri s.l.m.: **664**

Caratteristiche orografiche: **Crinale**

Utilizzo del terreno: **Incolto**

Dimensioni dell'area interessata: 1 (kmq)

Accessibilità: **Buona**

Presenza linee elettriche:

**Note :**

**Sezione D ) – Procedura di gestione della stazione e cambio cartuccia**

Sarà effettuata da: **Tecnogaia**

per conto di: **Deca Service S.r.l.**



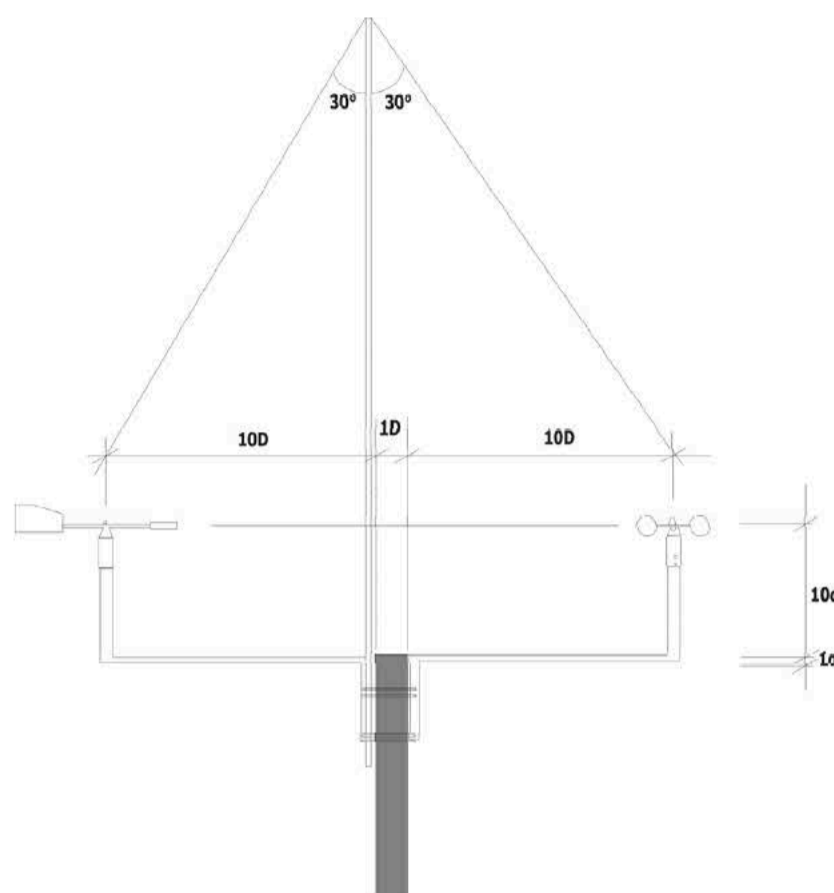
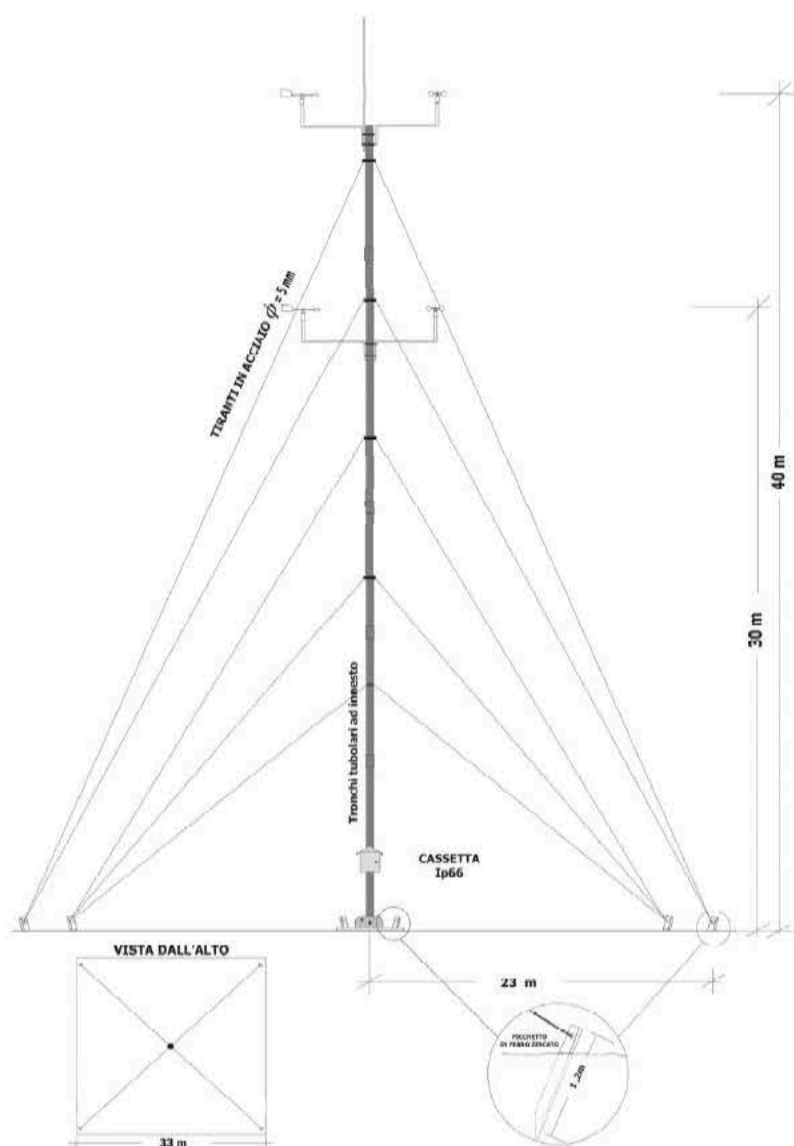
Sito: Monte Cerchio

Stazione: Monte Cerchio

**Sezione E) – Caratteristiche del sostegno e disposizione dei sensori**

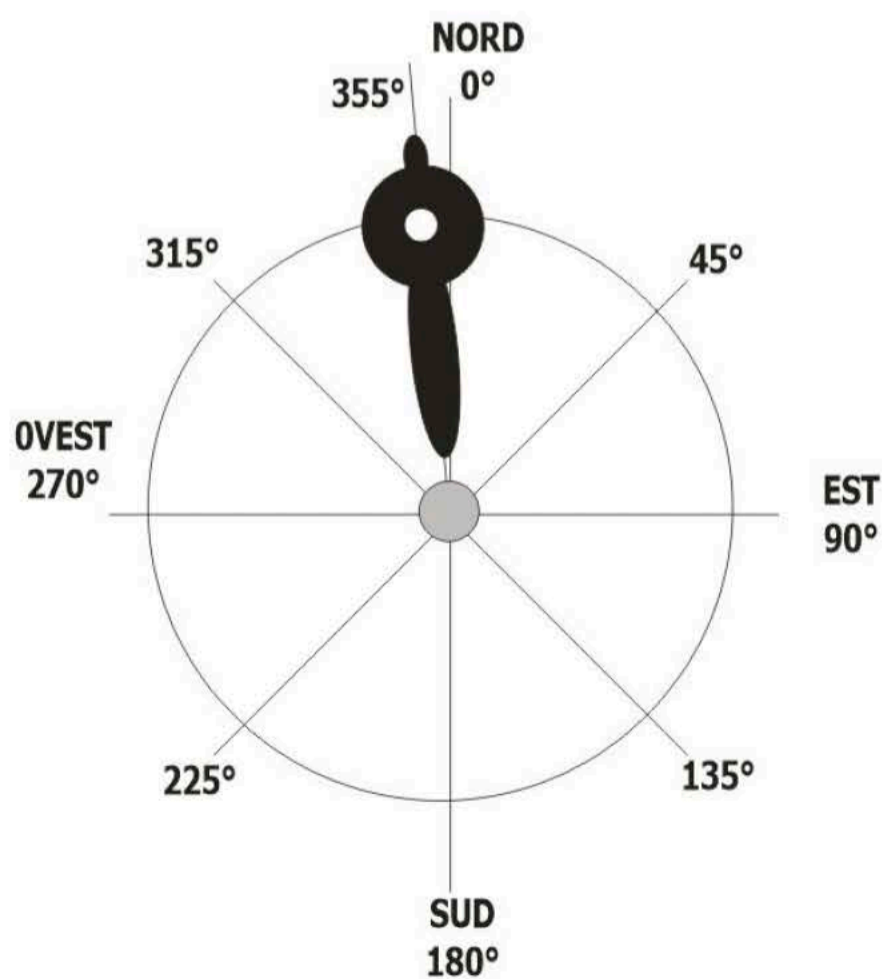
**STAZIONE ANEMOMETRICA**

**MENSOLE ANEMOMETRI E PARAFULMINE**

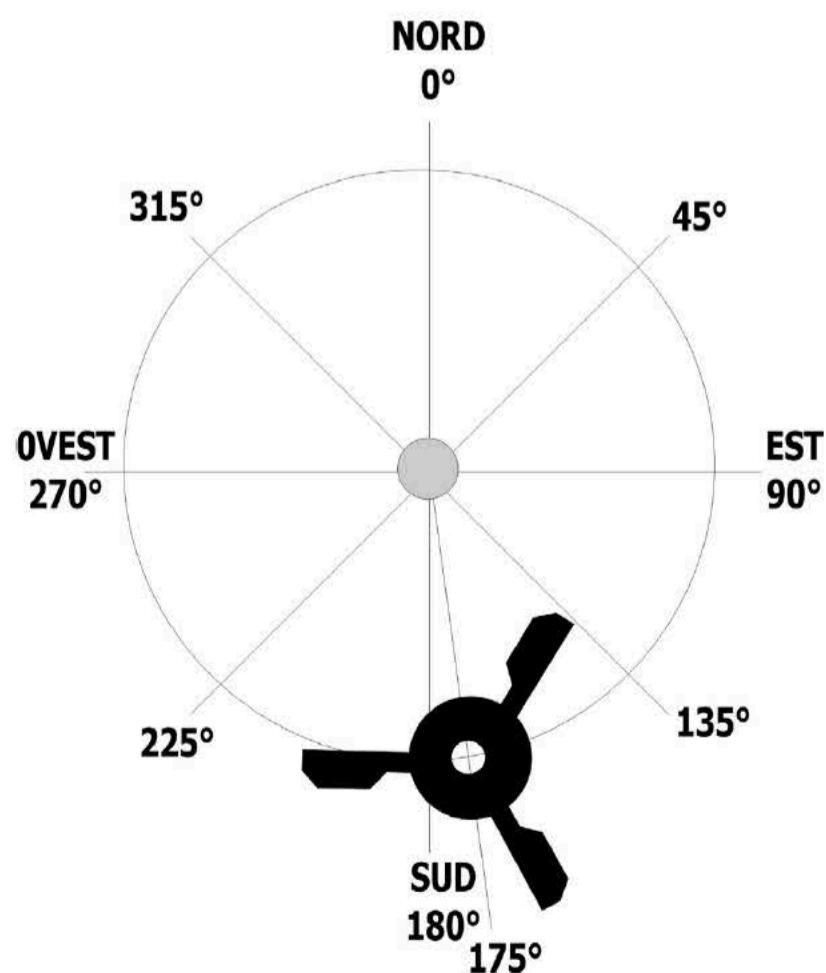


**ORIENTAMENTO MENSOLE:**

**SENSORI DI DIREZIONE**



**SENSORI DI VELOCITA'**



Stazione anemometrica installata da: **Bonsi E.**

**data: 29/11/2022**



**QUALIFICAZIONE DEI DATI ANEMOLOGICI DI UN SITO**

Scheda di verifica in laboratorio delle apparecchiature da utilizzare

**Committente: Deca Service Srl****Staz. prev. Di installaz.: 40m\_11\_22**

Data

Codifica documento

Archivio

Compilato da

**Sezione A) – Dati identificativi delle apparecchiature****SENSORI VELOCITÀ****(A):** h dal suolo **40** (m) Tipo **THIES** mod.**FC Advanced II** n°calibr. **2214409** n° inven. **TG22/3411****(B):** h dal suolo **30** (m) Tipo **THIES** mod.**FC Advanced II** n°calibr. **2214410** n° inven. **TG22/3412****SENSORI DIREZIONE****(A):** h dal suolo **40** (m) Tipo **NRG** mod. **200M** n° matr. **1007000020552** n° inven. **TG22/3356****(B):** h dal suolo **30** (m) Tipo **NRG** mod. **200M** n° matr. **1007000022612** n° inven. **TG22/3357****ACQUISITORE:** Tipo **AMMONIT** mod. **METEO-40M** n°matr. **D223209** n°invent. **TG22/3394****Sezione B) – Prova di funzionamento dei sensori****SENSORE DI VELOCITA' (A)****SENSORE DI VELOCITA' (B)**

VELOCITA' DI ROTAZIONE IMPOSTATO (giri/min)	FREQUENZA IN USCITA DAL SENSORE (Hz)	VALORE DI VELOCITA' RICONTRATO (m/s)	VELOCITA' DI ROTAZIONE IMPOSTATO (giri/min)	FREQUENZA IN USCITA DAL SENSORE (Hz)	VALORE DI VELOCITA' RICONTRATO (m/s)
<b>144</b>	90	<b>4,5</b>	<b>144</b>	90	<b>4,4</b>
<b>287</b>	180	<b>8,6</b>	<b>286</b>	180	<b>8,5</b>
<b>558</b>	360	<b>16,8</b>	<b>556</b>	360	<b>16,9</b>

**SENSORE DI DIREZIONE (A)****SENSORE DI DIREZIONE (B)**

POSIZIONE DELLA BANDERUOLA (° Sess.)	VALORE DI DIREZIONE ATTESO (°Sess.)	VALORE DI DIREZIONE RICONTRATO (°Sess.)	POSIZIONE DELLA BANDERUOLA (° Sess.)	VALORE DI DIREZIONE ATTESO (°Sess.)	VALORE DI DIREZIONE RICONTRATO (°Sess.)
<b>EST</b>	90	<b>90</b>	<b>EST</b>	90	<b>90</b>
<b>SUD</b>	180	<b>180</b>	<b>SUD</b>	180	<b>180</b>
<b>OVEST</b>	270	<b>270</b>	<b>OVEST</b>	270	<b>270</b>

**Sezione C) – Prova di registrazione**Data: **26-10-2022** dalle:**10:00** alle: **12:00** Nome file: **261022.xls**Esito della verifica: **POSITIVO**

Note : \_\_\_\_\_

Verifica effettuata da :**Antonijevic**Data : **26-10-2022**



**QUALIFICAZIONE DEI DATI ANEMOLOGICI DI UN SITO**  
Rapporto sul sopralluogo effettuato nel sito per la scelta del punto di  
installazione della stazione anemometrica



**Sito: Monte Cerchio**

**Fornitore: Tecnogaia**

Data

Codifica documento

Archivio

Compilato da

**Sezione A ) – Dati dimensionali della stazione anemometrica**

Sostegno da  50 m  40 m  30 m  20 m  15 m  Altro .. m

**Sezione B ) – Dati identificativi del sito**

Nome del sito: **Monte Cerchio**

Località: **Monte Cerchio**

Comune di : **Cairo Montenotte** Provincia : **SV**

Coordinate UTM: **ED50** Long. **438 565** - Latit. **4 919 558** - Fuso **32**

Coordinate UTM: **WGS84** Long. **438 484** - Latit. **4 919 359** - Fuso **32**

Tavoletta IGMI: **Dego** Foglio n° : **81 II NO**

Segni particolari che identificano il punto di installazione:

Abitato più vicino al sito:

**Sezione C ) – Dati relativi alle caratteristiche del sito e accessibilità**

Tipo di terreno:  Smosso (arato)  Compatto (pascolo)

Roccioso misto

Bosco

Recinzione:  Si per pascolo equini o bovini  Si per richiesta specifica  NO

Abitato dal quale parte la strada migliore per accedere al sito:

Descrizione del percorso e dei segni che identificano il percorso per raggiungere il sito:

**Dalla E80 prendere l'uscita di Savona per E717/A6 per Torino. Continuare su E717 per 14,4 km poi prendere l'uscita per Altare su SP429. Svoltare leggermente a destra, poi, alla rotonda, prendere la prima uscita su NSA338. Dopo 4,5 km, alla rotonda, prendere la prima uscita su SP29 e proseguire per 2,9 km. Prendere l'uscita per Cairo Montenotte Centro e continuare sulla strada imboccando la SP9. Dopo 5,7 km, superato l'abitato di Carretto, svoltare a sinistra sulla Strada Statale Colle di Cadibona. Dopo 1,4 km sulla sinistra il punto d'installazione si troverà a 100 m dall'accesso al prato.**

Mezzi:  Furgone  Auto  Fuoristrada per metri 500 m  Trattore per gli ultimi 200m

Piedi per metri

Riferimento per procurarsi un trattore:

Presenza cancelli  SI  NO

Problemi di percorrenza con pioggia (fondo strada non drenante):  SI  NO

**Scheda compilata da:** Zanoletti N.

**data:** 11/08/22



Sito: Monte Cerchio

Fornitore: TecnoGaia

### Configurazione acquirente

Configuration for M.Cerchio 0743 (D223209)

#### Configuration

Name M.Cerchio 0743  
Type Meteo-40M  
Timezone UTC+01:00  
File entry statistic period 10 minutes  
File period 24 hours  
Calibration CS1 199.88  $\mu$ A  
Calibration CS2 200.00  $\mu$ A  
Firmware 2.1.5+13-1

#### Communication

CECS power permanent off  
Modem permanent on (Switch S1)  
Ethernet permanent off

#### Evaluations

	Type	Height	Unit	Statistics						Parameters			
				Avg	Min	Max	Median	StdDev	Sum	Count	Val		
Anemometer30m	wind_speed	30.0	m/s	✓	✓	✓	✓	✓	✓	slope=0.0457	offset=0.2476	minimal_value=0.2476	period=1
Anemometer40m	wind_speed	40.0	m/s	✓	✓	✓	✓	✓	✓	slope=0.04587	offset=0.2192	minimal_value=0.2192	period=1
Temp3m	temperature	3.0	°C	✓	✓	✓	✓	✓	✓	slope=44.74364	offset=-40.85555		
WindVane30m	wind_direction	30.0	°	✓				✓	✓	slope=147.9	offset=356		
WindVane40m	wind_direction	40.0	°	✓				✓	✓	slope=147.9	offset=356		

#### Channels

##### System channels

	Unit	Rate	Statistics						Range
			Avg	Min	Max	Median	StdDev	Sum	
A1	V	1.0 s	✓	✓	✓	✓	✓	✓	10 V
A2	V	1.0 s	✓	✓	✓	✓	✓	✓	10 V
A3	V	1.0 s	✓	✓	✓	✓	✓	✓	10 V
C1	I	1.0 s	✓	✓	✓	✓	✓	✓	
C2	I	1.0 s	✓	✓	✓	✓	✓	✓	
T	°C		✓						
I	mA		✓	✓	✓				
V	V		✓	✓	✓				



## Calibration Certificate / Kalibrierschein

issued by the calibration laboratory / erstellt durch das Kalibrierlaboratorium

**Deutsche WindGuard  
Wind Tunnel Services GmbH**



Member of / Mitglied im

**Deutschen Kalibrierdienst**



accredited to / akkreditiert nach  
**DIN EN ISO/IEC 17025:2018**

Calibration mark  
Kalibrierzeichen

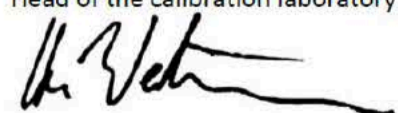
2214409
D-K-
15140-01-00
10/2022


<b>Object</b> <i>Gegenstand</i>	Cup Anemometer
<b>Manufacturer</b> <i>Hersteller</i>	Thies Clima D-37083 Göttingen
<b>Type</b> <i>Typ</i>	4.3352.00.000
<b>Serial number</b> <i>Fabrikat/Serien-Nr.</i>	09223131
<b>Customer</b> <i>Auftraggeber</i>	TecnoGaia S.r.l. I-25063 Gardone Val Trompia (Brescia)
<b>Order No.</b> <i>Auftragsnummer</i>	Email 2022-09-27, Bonsi
<b>Project No.</b> <i>Projektnummer</i>	VT220924
<b>Number of pages</b> <i>Anzahl der Seiten</i>	5
<b>Date of Calibration</b> <i>Datum der Kalibrierung</i>	10.10.2022

This calibration certificate documents the traceability to national standards, which realize the units of measurement according to the International System of Units (SI).  
The DAkKS is signatory to the multilateral agreements of the European co-operation for Accreditation (EA) and of the International Laboratory Accreditation Cooperation (ILAC) for the mutual recognition of calibration certificates. The presented results relate only to the calibrated object. The user is obliged to have the object recalibrated at appropriate intervals.  
*Dieser Kalibrierschein dokumentiert die Rückführung auf nationale Normale zur Darstellung der Einheiten in Übereinstimmung mit dem Internationalen Einheitensystem (SI). Die DAkKS ist Unterzeichner der multilateralen Übereinkommen der European co-operation for Accreditation (EA) und der International Laboratory Accreditation Cooperation (ILAC) zur gegenseitigen Anerkennung der Kalibrierscheine. Die dargestellten Ergebnisse beziehen sich nur auf den kalibrierten Gegenstand. Für die Einhaltung einer angemessenen Frist zur Wiederholung der Kalibrierung ist der Benutzer verantwortlich.*


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*Dieser Kalibrierschein darf nur vollständig und unverändert weiterverbreitet werden. Auszüge oder Änderungen bedürfen der Genehmigung des ausstellenden Kalibrierlaboratoriums. Kalibrierscheine ohne Unterschrift haben keine Gültigkeit. Dieser Kalibrierschein wurde elektronisch erzeugt.*

Date  
*Datum*  
  
10.10.2022

Freigegeben durch / Approval by  
Head of the calibration laboratory  
  
  
Heiko Westermann, B. Sc.

Person in charge  
*Bearbeiter*  
  
  
Techniker Dirk Henniges



<b>Calibration object</b> <i>Kalibriergegenstand</i>	Cup Anemometer										
<b>Calibration procedure</b> <i>Kalibrierverfahren</i>	IEC 61400-12-1:2017										
<b>Place of calibration</b> <i>Ort der Kalibrierung</i>	Wind tunnel 1 of Deutsche WindGuard Wind Tunnel Services GmbH, Varel										
<b>Test conditions</b> <i>Messbedingungen</i>	<table><tr><td>wind tunnel area</td><td>10000 cm<sup>2</sup></td></tr><tr><td>DUT frontal area</td><td>230 cm<sup>2</sup></td></tr><tr><td>diameter of mounting pipe</td><td>33.7 mm EN 10217</td></tr><tr><td>blockage ratio <sup>1)</sup></td><td>0.023 [-]</td></tr><tr><td>software version</td><td>P_9.1.0_CAN_NI</td></tr></table> <p><sup>1)</sup> Due to the special construction of the test section no blockage correction is necessary.</p>	wind tunnel area	10000 cm <sup>2</sup>	DUT frontal area	230 cm <sup>2</sup>	diameter of mounting pipe	33.7 mm EN 10217	blockage ratio <sup>1)</sup>	0.023 [-]	software version	P_9.1.0_CAN_NI
wind tunnel area	10000 cm <sup>2</sup>										
DUT frontal area	230 cm <sup>2</sup>										
diameter of mounting pipe	33.7 mm EN 10217										
blockage ratio <sup>1)</sup>	0.023 [-]										
software version	P_9.1.0_CAN_NI										
<b>Ambient conditions</b> <i>Umgebungsbedingungen</i>	<table><tr><td>air temperature</td><td>(20.1 ± 0.4) °C – (20.5 ± 0.4) °C</td></tr><tr><td>air pressure</td><td>(1012.4 ± 0.4) hPa – (1012.5 ± 0.4) hPa</td></tr><tr><td>relative air humidity</td><td>(45.1 ± 6.0) % – (45.9 ± 6.0) %</td></tr></table>	air temperature	(20.1 ± 0.4) °C – (20.5 ± 0.4) °C	air pressure	(1012.4 ± 0.4) hPa – (1012.5 ± 0.4) hPa	relative air humidity	(45.1 ± 6.0) % – (45.9 ± 6.0) %				
air temperature	(20.1 ± 0.4) °C – (20.5 ± 0.4) °C										
air pressure	(1012.4 ± 0.4) hPa – (1012.5 ± 0.4) hPa										
relative air humidity	(45.1 ± 6.0) % – (45.9 ± 6.0) %										
<b>Measurement uncertainty</b> <i>Messunsicherheit</i>	<p>The expanded uncertainty assigned to the measurement results is obtained by multiplying the standard uncertainty by the coverage factor <math>k=2</math>. It has been determined in accordance with EA-4/02 M: 2013. The value of the measurand lies within the assigned range of values with a probability of 95%.</p> <p>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 (Expanded uncertainty 0.2 %, <math>k=2</math>)</p>										
<b>Certificate ID</b> <i>Zertifikat ID</i>	ABcjnPB2ZbR7vT2Y49Zwtr 										
<b>Additional remarks</b> <i>Zusätzliche Anmerkungen</i>	-										
<b>Revision</b> <i>Revision</i>	0										

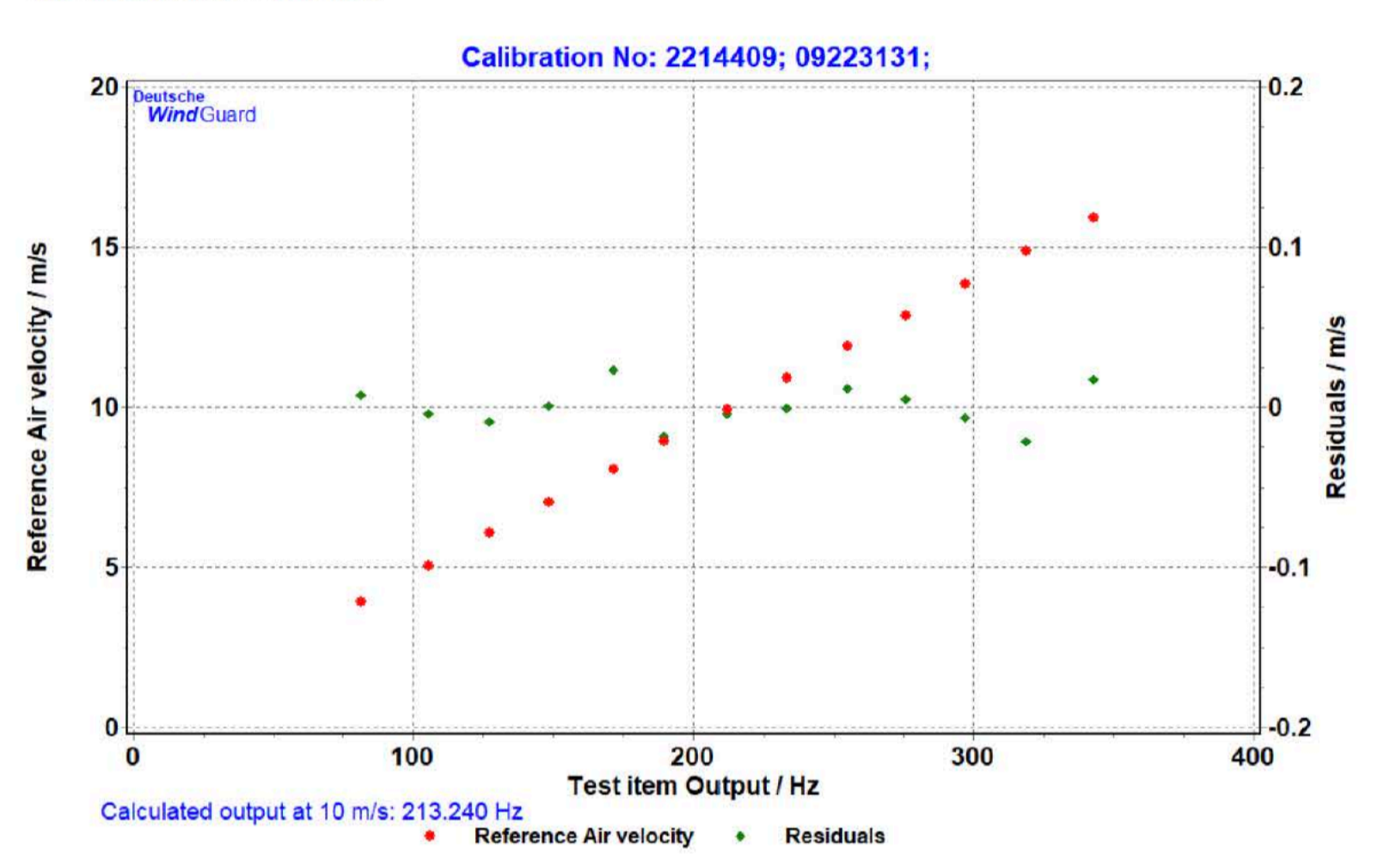


**Calibration result**  
*Kalibrierergebnis*

Reference	Combined	Test item
Air velocity	Unc	Output
m/s	m/s	Hz
3.940	0.050	81.279
6.061	0.051	127.167
8.075	0.051	171.782
9.937	0.056	211.789
11.894	0.067	254.783
13.844	0.077	296.912
15.915	0.089	342.576
14.865	0.083	318.835
12.853	0.072	275.560
10.905	0.061	232.964
8.934	0.051	189.600
7.025	0.051	148.407
5.051	0.050	105.255



**Graphical representation of the result**  
*Grafische Darstellung des Ergebnisses*



<b>Statistical analysis</b>	Slope $m$	0.04587 (m/s)/(Hz) $\pm$ 0.00005 (m/s)/(Hz)
	Offset $b$	0.2192 m/s $\pm$ 0.011 m/s
	Standard error (Y) / RSD	0.0136 m/s
	Correlation coefficient $R$	0.999994

**Remarks**      The calibrated sensor complies with the demanded linearity of MEASNET





**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.

- End of document / Ende des Dokuments -





Test Report issued under the responsibility of:

**DEUTSCHE  
WINDGUARD**

**TEST REPORT  
IEC 61400-12-1 Annex F  
Anemometer Calibration Certificate**

IECRE Report Number. .... :	IECRE.WE.TR.AC.22-32923-R0
RETL Calibration Certificate. .... :	2214409
Date of issue ..... :	10.10.2022
RE Testing Laboratory..... : (Name & Address)	Deutsche WindGuard Wind Tunnel Services GmbH D-26316 Varel
Applicant ..... : (Name & Address)	TecnoGaia S.r.l. I-25063 Gardone Val Trompia (Brescia)
Test item description ..... :	Cup Anemometer
Manufacturer..... :	Thies Clima
Model/Type reference ..... :	4.3352.00.000
Ratings / Serial number ..... :	09223131

Tested by (name, function, signature) .....	Printed name/function	Signature
	Techniker Dirk Henniges Operator	
Approved by (name, function, signature) .....	Printed name/function	Signature
	Heiko Westermann, B. Sc. Head of calibration laboratory	

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**Calibration Certificate / Kalibrierschein**issued by the calibration laboratory / *erstellt durch das Kalibrierlaboratorium***Deutsche WindGuard  
Wind Tunnel Services GmbH**Deutsche  
Akkreditierungsstelle  
D-K-15140-01-00Member of / *Mitglied im***Deutschen Kalibrierdienst**accredited to / *akkreditiert nach*  
**DIN EN ISO/IEC 17025:2018***Calibration mark*  
*Kalibrierzeichen*

2214410
D-K-
15140-01-00
10/2022

<b>Object</b> <i>Gegenstand</i>	Cup Anemometer
<b>Manufacturer</b> <i>Hersteller</i>	Thies Clima D-37083 Göttingen
<b>Type</b> <i>Typ</i>	4.3352.00.000
<b>Serial number</b> <i>Fabrikat/Serien-Nr.</i>	09223132
<b>Customer</b> <i>Auftraggeber</i>	TecnoGaia S.r.l. I-25063 Gardone Val Trompia (Brescia)
<b>Order No.</b> <i>Auftragsnummer</i>	Email 2022-09-27, Bonsi
<b>Project No.</b> <i>Projektnummer</i>	VT220924
<b>Number of pages</b> <i>Anzahl der Seiten</i>	5
<b>Date of Calibration</b> <i>Datum der Kalibrierung</i>	10.10.2022

This calibration certificate documents the traceability to national standards, which realize the units of measurement according to the International System of Units (SI).

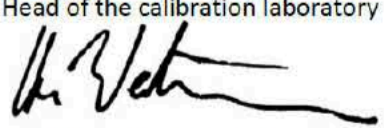
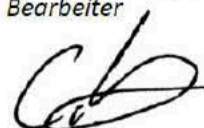
The DAkkS is signatory to the multilateral agreements of the European co-operation for Accreditation (EA) and of the International Laboratory Accreditation Cooperation (ILAC) for the mutual recognition of calibration certificates. The presented results relate only to the calibrated object. The user is obliged to have the object recalibrated at appropriate intervals.

*Dieser Kalibrierschein dokumentiert die Rückführung auf nationale Normale zur Darstellung der Einheiten in Übereinstimmung mit dem Internationalen Einheitensystem (SI).*


*Die DAkkS ist Unterzeichner der multilateralen Übereinkommen der European co-operation for Accreditation (EA) und der International Laboratory Accreditation Cooperation (ILAC) zur gegenseitigen Anerkennung der Kalibrierscheine. Die dargestellten Ergebnisse beziehen sich nur auf den kalibrierten Gegenstand. Für die Einhaltung einer angemessenen Frist zur Wiederholung der Kalibrierung ist der Benutzer verantwortlich.*

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Date <i>Datum</i>	Freigegeben durch / <i>Approval by</i> Head of the calibration laboratory	Person in charge <i>Bearbeiter</i>
10.10.2022	 Heiko Westermann, B. Sc.	 Chè Krüger



<b>Calibration object</b> <i>Kalibriergegenstand</i>	Cup Anemometer										
<b>Calibration procedure</b> <i>Kalibrierverfahren</i>	IEC 61400-12-1:2017										
<b>Place of calibration</b> <i>Ort der Kalibrierung</i>	Wind tunnel 1 of Deutsche WindGuard Wind Tunnel Services GmbH, Varel										
<b>Test conditions</b> <i>Messbedingungen</i>	<table><tr><td>wind tunnel area</td><td>10000 cm<sup>2</sup></td></tr><tr><td>DUT frontal area</td><td>230 cm<sup>2</sup></td></tr><tr><td>diameter of mounting pipe</td><td>33.7 mm EN 10217</td></tr><tr><td>blockage ratio <sup>1)</sup></td><td>0.023 [-]</td></tr><tr><td>software version</td><td>P_9.1.0_CAN_NI</td></tr></table> <p><sup>1)</sup> Due to the special construction of the test section no blockage correction is necessary.</p>	wind tunnel area	10000 cm <sup>2</sup>	DUT frontal area	230 cm <sup>2</sup>	diameter of mounting pipe	33.7 mm EN 10217	blockage ratio <sup>1)</sup>	0.023 [-]	software version	P_9.1.0_CAN_NI
wind tunnel area	10000 cm <sup>2</sup>										
DUT frontal area	230 cm <sup>2</sup>										
diameter of mounting pipe	33.7 mm EN 10217										
blockage ratio <sup>1)</sup>	0.023 [-]										
software version	P_9.1.0_CAN_NI										
<b>Ambient conditions</b> <i>Umgebungsbedingungen</i>	<table><tr><td>air temperature</td><td>(20.3 ± 0.4) °C – (20.6 ± 0.4) °C</td></tr><tr><td>air pressure</td><td>(1012.5 ± 0.4) hPa – (1012.5 ± 0.4) hPa</td></tr><tr><td>relative air humidity</td><td>(45.0 ± 6.0) % – (45.8 ± 6.0) %</td></tr></table>	air temperature	(20.3 ± 0.4) °C – (20.6 ± 0.4) °C	air pressure	(1012.5 ± 0.4) hPa – (1012.5 ± 0.4) hPa	relative air humidity	(45.0 ± 6.0) % – (45.8 ± 6.0) %				
air temperature	(20.3 ± 0.4) °C – (20.6 ± 0.4) °C										
air pressure	(1012.5 ± 0.4) hPa – (1012.5 ± 0.4) hPa										
relative air humidity	(45.0 ± 6.0) % – (45.8 ± 6.0) %										
<b>Measurement uncertainty</b> <i>Messunsicherheit</i>	<p>The expanded uncertainty assigned to the measurement results is obtained by multiplying the standard uncertainty by the coverage factor <math>k=2</math>. It has been determined in accordance with EA-4/02 M: 2013. 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 (Expanded uncertainty 0.2 %, <math>k=2</math>)</p>										
<b>Certificate ID</b> <i>Zertifikat ID</i>	4oRJgfqZVUwkYnVrN73WiB 										
<b>Additional remarks</b> <i>Zusätzliche Anmerkungen</i>	-										
<b>Revision</b> <i>Revision</i>	0										

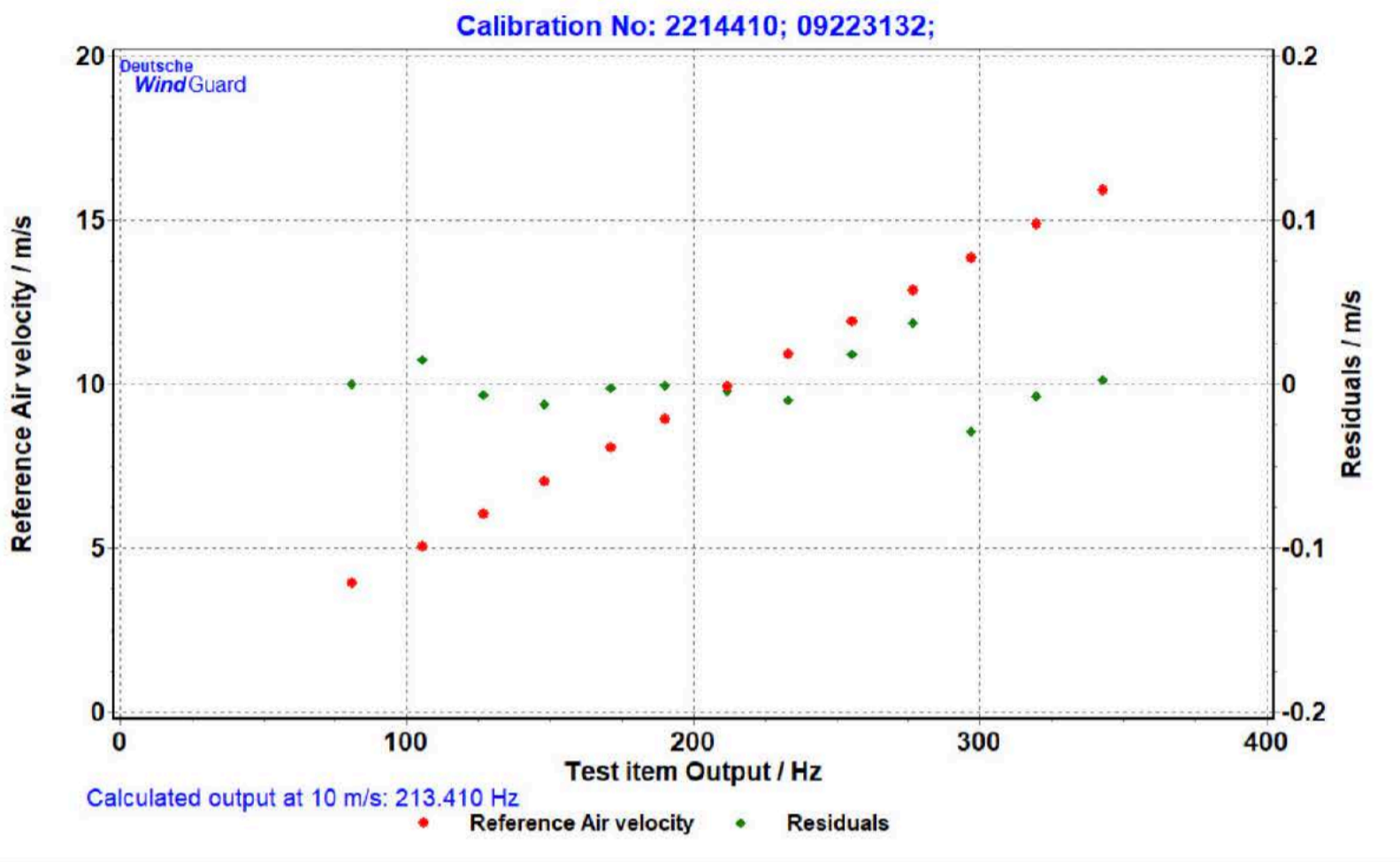


**Calibration result**  
*Kalibrierergebnis*

Reference	Combined	Test item
Air velocity	Unc	Output
m/s	m/s	Hz
3.935	0.050	80.692
6.051	0.051	126.834
8.063	0.051	170.964
9.934	0.056	211.882
11.896	0.067	255.303
13.838	0.078	296.764
15.910	0.089	342.797
14.863	0.083	319.679
12.855	0.072	276.701
10.905	0.061	233.013
8.938	0.051	190.142
7.026	0.051	148.061
5.043	0.050	105.257



**Graphical representation of the result**  
Grafische Darstellung des Ergebnisses



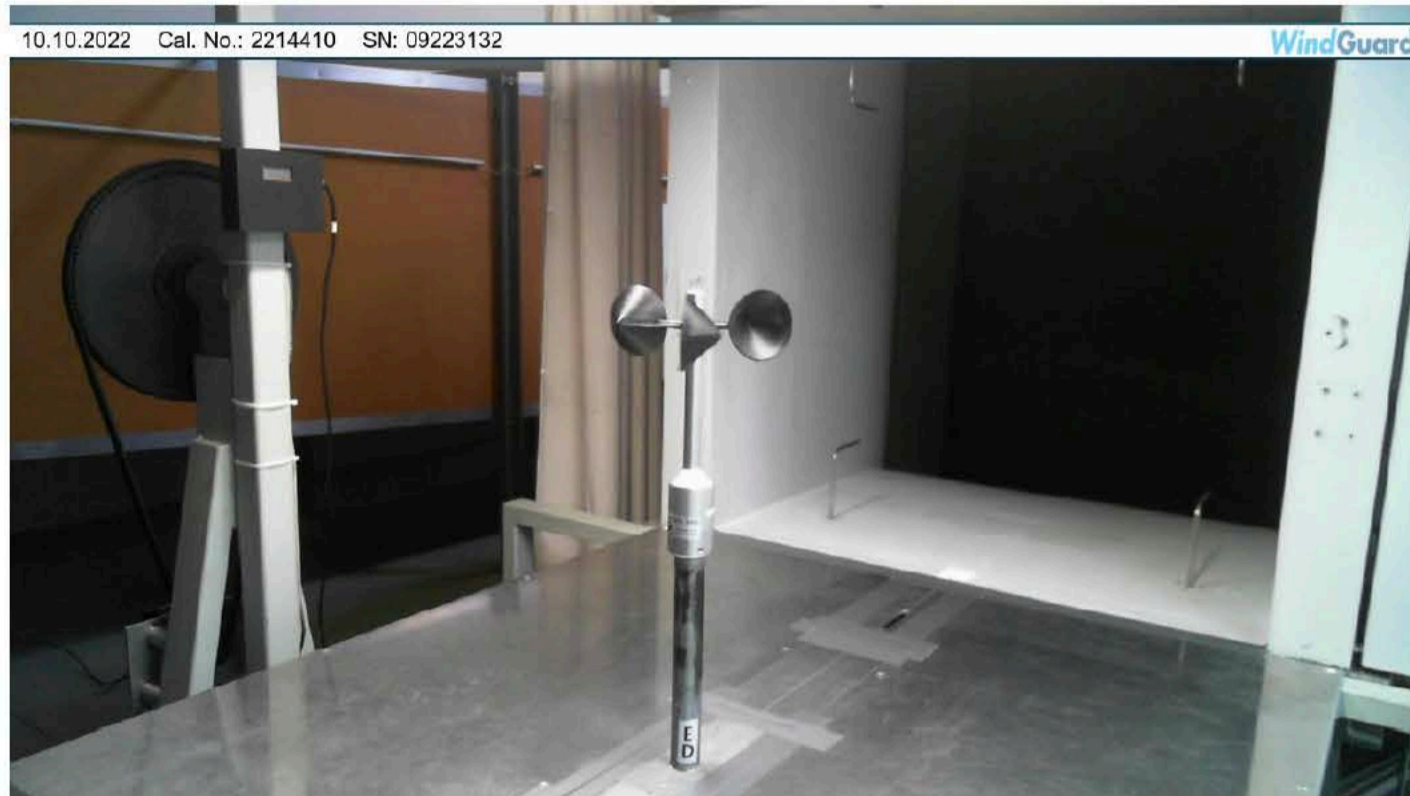
<b>Statistical analysis</b>	Slope $m$	$0.04570 \text{ (m/s)/(Hz)} \pm 0.00006 \text{ (m/s)/(Hz)}$
	Offset $b$	$0.2476 \text{ m/s} \pm 0.013 \text{ m/s}$
	Standard error (Y) / RSD	$0.0169 \text{ m/s}$
	Correlation coefficient $R$	$0.999991$

**Remarks** The calibrated sensor complies with the demanded linearity of MEASNET





**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.

- End of document / Ende des Dokuments -





Test Report issued under the responsibility of:

**DEUTSCHE  
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**TEST REPORT  
IEC 61400-12-1 Annex F  
Anemometer Calibration Certificate**

IECRE Report Number..... :	IECRE.WE.TR.AC.22-32924-R0
RETL Calibration Certificate. .... :	2214410
Date of issue .....	10.10.2022
RE Testing Laboratory..... : (Name & Address)	Deutsche WindGuard Wind Tunnel Services GmbH D-26316 Varel
Applicant..... : (Name & Address)	TecnoGaia S.r.l. I-25063 Gardone Val Trompia (Brescia)
Test item description .....	Cup Anemometer
Manufacturer..... :	Thies Clima
Model/Type reference .....	4.3352.00.000
Ratings / Serial number .....	09223132

Tested by (name, function, signature) .....	Printed name/function	Signature
	Chè Krüger Operator	
Approved by (name, function, signature) .....	Printed name/function	Signature
	Heiko Westermann, B. Sc. Head of calibration laboratory	

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Stazione anemometrica 0743 Monte Cerchio

Prova di registrazione dopo l'installazione

Date/time	Anemometer40m;wind_speed;Avg	Anemometer40m;wind_speed;Max	Anemometer40m;wind_speed;Min	Anemometer40m;wind_speed;StdDev	Anemometer30m;wind_speed;Avg	Anemometer30m;wind_speed;Max	Anemometer30m;wind_speed;Min	Anemometer30m;wind_speed;StdDev	WindVane40m;wind_direct;Avg	WindVane40m;wind_direct;StdDev	WindVane30m;wind_direct;Avg	WindVane30m;wind_direct;StdDev	Temp3m;temperature;Avg	V;Avg
11/29/2022 09:00	0.96	3.98	0.22	0.77	1.31	8.98	0.25	1.22	167.43	54.05	159.94	50.36	2.37	11.90
11/29/2022 09:10	0.86	2.79	0.22	0.54	0.83	2.62	0.25	0.51	168.30	36.06	152.29	57.17	2.33	11.91
11/29/2022 09:20	0.90	3.06	0.22	0.57	0.81	2.40	0.25	0.49	158.29	29.25	159.93	52.48	2.38	11.91
11/29/2022 09:30	0.79	3.06	0.22	0.56	0.73	3.72	0.25	0.51	161.89	60.90	184.19	58.67	2.35	11.91
11/29/2022 09:40	1.42	3.48	0.27	0.71	1.23	2.72	0.25	0.61	225.95	59.28	183.00	46.63	2.31	11.91
11/29/2022 09:50	1.45	3.11	0.22	0.61	1.44	4.63	0.25	0.77	226.30	44.43	224.30	17.94	2.40	11.91
11/29/2022 10:00	1.50	3.38	0.27	0.56	1.48	3.08	0.25	0.57	225.01	37.52	223.09	29.45	2.53	11.91
11/29/2022 10:10	1.27	3.25	0.22	0.64	1.23	2.85	0.25	0.63	207.05	63.13	212.08	37.15	2.86	11.95
11/29/2022 10:20	1.32	2.79	0.27	0.52	1.33	2.90	0.29	0.49	215.10	46.37	216.16	19.25	3.07	11.95
11/29/2022 10:30	2.10	4.39	0.27	0.79	1.99	3.95	0.25	0.72	242.09	30.75	252.77	27.69	2.83	11.94
11/29/2022 10:40	2.88	4.76	0.68	0.75	2.78	4.54	1.07	0.66	258.92	19.73	267.95	19.00	2.54	11.94
11/29/2022 10:50	2.58	4.35	0.72	0.57	2.54	4.09	0.98	0.52	288.26	26.42	290.98	24.97	2.57	11.95
11/29/2022 11:00	2.71	5.17	1.18	0.70	2.70	5.55	1.12	0.73	287.31	18.27	285.80	14.04	2.59	11.91
11/29/2022 11:10	3.85	6.41	2.01	0.90	3.86	6.87	2.08	0.87	291.20	17.12	293.44	15.22	2.48	11.91
11/29/2022 11:20	4.81	6.55	2.47	0.80	4.63	6.92	2.62	0.80	294.45	14.10	299.29	15.62	2.40	11.91
11/29/2022 11:30	4.81	8.34	2.60	1.11	4.59	8.29	1.98	1.08	294.44	14.01	298.32	15.10	2.40	11.91
11/29/2022 11:40	4.56	6.23	2.15	0.87	4.43	6.37	2.49	0.80	296.89	13.27	302.31	14.04	2.36	11.91
11/29/2022 11:50	4.80	8.89	1.69	1.20	4.62	8.43	2.17	1.12	294.04	15.87	298.44	14.62	2.30	11.91
11/29/2022 12:00	4.47	7.37	2.42	1.04	4.42	7.33	1.48	1.11	295.26	15.89	301.32	18.16	2.29	11.91
11/29/2022 12:10	5.15	7.79	2.79	0.98	4.93	7.74	2.85	0.99	296.02	13.74	302.38	14.74	2.23	11.91
11/29/2022 12:20	4.25	7.19	2.05	1.03	4.13	7.38	2.40	0.87	299.81	18.67	305.53	17.92	2.14	11.91
11/29/2022 12:30	4.75	7.33	2.74	0.88	4.56	7.65	2.17	0.91	297.97	14.43	301.10	14.71	2.06	11.91
11/29/2022 12:40	4.25	7.70	1.46	1.01	4.00	5.82	1.85	0.79	298.52	15.35	302.56	13.72	2.04	11.91
11/29/2022 12:50	4.03	7.37	1.37	1.20	3.97	7.51	1.02	1.20	298.43	19.00	304.79	18.96	2.03	11.91
11/29/2022 13:00	3.72	6.73	1.60	1.07	3.59	7.29	1.80	0.93	296.33	20.86	300.17	20.40	2.06	11.91
11/29/2022 13:10	4.94	7.33	1.73	1.13	4.53	6.87	2.17	1.01	300.36	18.33	304.45	17.39	2.11	11.91
11/29/2022 13:20	4.65	7.10	2.15	1.06	4.36	7.38	1.89	1.04	300.83	17.02	305.34	18.06	2.13	11.91
11/29/2022 13:30	4.46	7.56	2.05	1.10	4.26	7.01	1.66	1.09	302.96	19.55	307.51	18.76	2.21	11.91
11/29/2022 13:40	3.36	6.41	1.18	0.98	3.31	6.28	1.53	0.91	291.42	19.48	294.64	17.69	2.28	11.91
11/29/2022 13:50	3.33	6.92	1.55	0.90	3.24	5.91	1.62	0.82	294.24	21.23	301.35	21.89	2.27	11.88
11/29/2022 14:00	3.57	6.41	1.46	0.95	3.51	8.25	1.39	1.05	314.16	19.64	318.15	18.79	2.27	11.91
11/29/2022 14:10	3.47	6.60	1.27	0.96	3.31	6.19	1.34	0.92	302.72	24.99	312.00	25.95	2.21	11.91
11/29/2022 14:20	3.32	7.42	1.09	1.09	3.25	6.74	1.53	0.96	303.85	23.73	308.65	22.46	2.22	11.90
11/29/2022 14:30	2.46	4.76	0.72	0.75	2.43	4.50	0.70	0.69	308.54	23.74	311.05	19.47	2.19	11.91
11/29/2022 14:40	2.75	6.46	0.91	0.87	2.88	5.55	1.34	0.78	313.32	19.64	319.81	17.02	2.20	11.91
11/29/2022 14:50	3.73	6.92	1.18	1.43	3.71	6.87	1.30	1.44	311.19	18.96	316.46	20.83	2.18	11.91
11/29/2022 15:00	4.70	7.05	1.60	1.21	4.65	8.11	1.89	1.14	310.20	16.29	313.81	16.70	2.11	11.91
11/29/2022 15:10	4.02	6.60	2.05	0.96	3.79	5.96	1.66	0.92	308.68	18.14	314.47	17.58	2.07	11.90
11/29/2022 15:20	4.02	7.88	1.92	1.03	3.91	7.51	1.48	1.08	313.86	18.61	319.87	20.40	2.07	11.89
11/29/2022 15:30	4.71	7.24	1.92	1.08	4.53	7.56	1.98	1.09	322.18	15.23	326.55	17.45	2.04	11.88
11/29/2022 15:40	4.69	9.94	2.01	1.28	4.35	8.47	2.12	1.19	314.08	20.95	319.25	22.36	2.04	11.88
11/29/2022 15:50	5.84	8.98	2.83	1.23	5.54	8.93	2.94	1.31	300.96	16.79	302.55	16.93	2.00	11.87
11/29/2022 16:00	5.74	9.16	2.05	1.43	5.55	9.25	1.76	1.56	301.09	20.37	306.41	19.97	1.97	11.86
11/29/2022 16:10	4.83	9.12	2.51	1.05	4.69	8.38	2.40	1.05	307.45	16.05	313.97	16.70	1.97	11.86
11/29/2022 16:20	4.87	7.60	2.05	1.17	4.79	7.19	1.66	1.06	310.92	13.66	317.51	14.93	1.96	11.86
11/29/2022 16:30	5.56	9.07	2.79	1.42	5.29	9.62	2.62	1.43	296.50	18.90	302.28	19.77	1.96	11.86
11/29/2022 16:40	5.41	8.89	2.33	1.55	5.05	8.84	1.85	1.61	301.27	18.61	306.41	17.41	1.94	11.86
11/29/2022 16:50	5.53	8.80	2.42	1.23	5.57	8.47	2.72	1.26	302.73	17.29	308.31	17.47	1.93	11.86
11/29/2022 17:00	4.15	7.74	1.27	1.06	4.04	6.87	0.57	1.04	296.14	19.61	302.48	18.62	1.93	11.86
11/29/2022 17:10	5.46	7.83	2.74	0.98	5.12	7.97	2.99	0.96	308.24	13.08	312.98	12.81	1.92	11.86



RIPRESE FOTOGRAFICHE DELLA STAZIONE ANEMOMETRICA  
**MONTE CERCHIO (CAIRO MONTENOTTE - SV)**



La stazione vista da Nord



RIPRESE FOTOGRAFICHE DELLA STAZIONE ANEMOMETRICA  
**MONTE CERCHIO (CAIRO MONTENOTTE - SV)**



La stazione vista da Est



RIPRESE FOTOGRAFICHE DELLA STAZIONE ANEMOMETRICA  
**MONTE CERCHIO (CAIRO MONTENOTTE - SV)**



La stazione vista da Sud



RIPRESE FOTOGRAFICHE DELLA STAZIONE ANEMOMETRICA  
**MONTE CERCHIO (CAIRO MONTENOTTE - SV)**



La stazione vista da Ovest



RIPRESE FOTOGRAFICHE DALLA STAZIONE ANEMOMETRICA  
**MONTE CERCHIO**  
**(CAIRO MONTENOTTE - SV)**



Dal punto di misura verso Nord



Dal punto di misura verso Est



RIPRESE FOTOGRAFICHE DALLA STAZIONE ANEMOMETRICA  
**MONTE CERCHIO**  
**(CAIRO MONTENOTTE - SV)**



Dal punto di misura verso Sud



Dal punto di misura verso Ovest