DEHN protects Wind Turbines

www.dehn-international.com

Ensure smooth operation, protect investments: With lightning and surge protection by DEHN

Secure **profit** on your **investment**

The feed-in remuneration for renewables is sinking worldwide and putting the wind branch under increasing pressure. To ensure that investments in new wind turbines pay off in future, too, the top priority is to optimise the availability of the turbines. This prevents loss of revenue due to downtime and high service and repair costs.

Their height makes wind turbines particularly susceptible to destructive lightning events. If insufficient protective measures are taken, the risk of damage and downtime due to lightning is correspondingly high. An integrated lightning protection system is therefore a must. It consists of external and internal lightning protection, earthing and equipotential bonding.

Take the safe option and entrust the globally recognised specialist DEHN with your lightning and surge protection. Our high-quality and durable products protect turbines on all continents, from the foundations to the rotor blades. Take advantage of our services and make quicker and verifiable progress. We can assist you by, for example,conducting risk analyses, creating bespoke protection concepts and product solutions, or conducting system tests in our accredited test centre.


LPZ 0A
LPZ 0B
LPZ 2
LPZ 1
pitch
LPZ 0A
LPZ 1
generator
LPZ 2
main bearing
LPZ 2
WTC
LPZ 0A
LPZ 1
LPZ 0A
LPZ 0A
LPZ 1
WTC
UPS
LPZ 2
LVMDB
LPZ 2
inverter
LPZ 0B
LPZ 2
LPZ 1
LPZ 0B
transformer
20 kV/690 V

Developing **lightning protection zone concepts** with expertise

To secure the availability of wind turbines, the lightning protection zone concept aims to prevent lightning damage to mechanical and electric components. This is achieved by discharging lightning current and controlling surges.

The lightning protection zone concept for wind turbines described in IEC 61400-24 deals with the topic of lightning protection for wind turbines including detailed information on the selection of lightning and surge protection measures [1].

As the basis for creating a protection concept, a wind turbine is subdivided into **lightning protection zones**. One distinguishes here between external zones (LPZ 0A und 0B) and internal zones (LPZ 1, LPZ 2…n) [2]. The external zones of a wind turbine – except the rotor blade – are determined by way of the **rolling sphere method**. The subdivision of the internal zones very much depends on the construction of the individual wind turbine and should be conducted accordingly.

Having laid down the relevant lighting protection zones, one can then define the necessary **protective measures**. It is advisable to create a lightning protection concept at the initial planning stage of a wind turbine to avoid later cost-intensive repairs and retrofitting.

Long experience in the field of lightning and surge protection and the numerous system tests conducted for the wind industry have given DEHN the know-how to develop effective lightning protection systems for wind turbines. We will assist you in developing a lightning protection concept for your turbine consisting of external lightning protection, internal lightning protection, equipotential bonding and earthing.

[1] IEC 61400-24 Lightning Protection of Wind Turbines
[2] LPZ: Lightning Protection Zone

Always reliably informed with DEHNdetect

Lightning current measuring system prevents subsequent damage

Photo: GEKRU GmbH

Damage resulting from a lightning strike does not necessarily lead to the immediate failure of the turbine. This means that lightning events often remain undetected, especially in the case of upward flashes where the initial long stroke current flowing is only a few 100A and can be the main cause of damage, e.g., to the rotor blades. Continued operation of the turbine can lead to serious subsequent damage. Lightning current measuring systems are often employed to detect lightning events and prevent subsequent damage. However, **dangerous upward flashes** are not always fully detected due to the low current flow of the measuring system. As well as impulse currents, DEHNdetect also reliably registers these dangerous long stroke currents, thus preventing expensive maintenance work and long downtimes.

DEHNdetect identifies the following parameters:

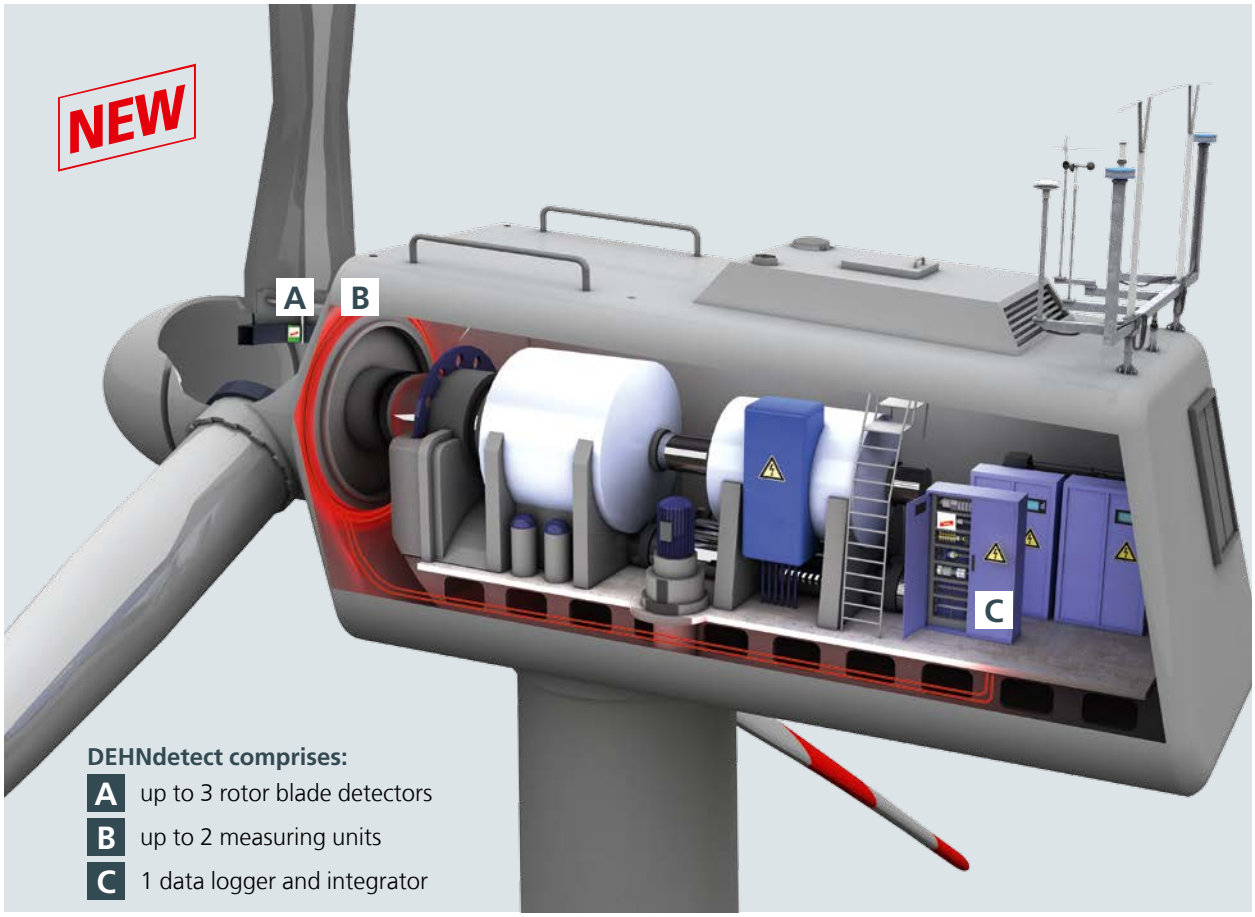
- Impulse current [kA]
- Long stroke current [A]
- Load [C]
- Specific energy [MJ/Ω]
- Rise time [kA/µs]

Your benefits:

- Prevention of subsequent damage
- Reduction of maintenance / repair costs
- Reduction of downtime

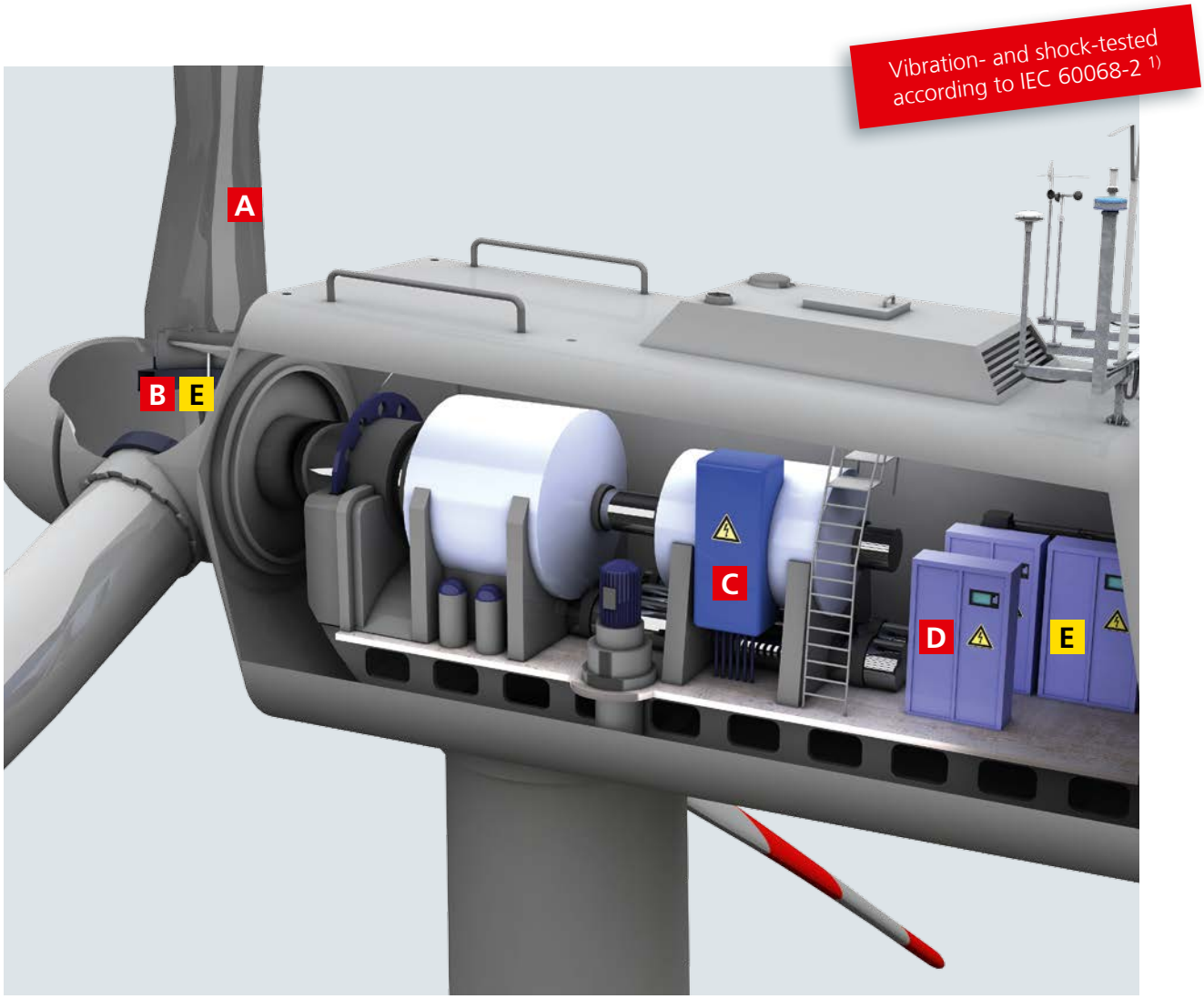
The system can be integrated in the IT infrastructure of the wind turbine via existing interfaces. The data can then simply be read out and managed using the available SCADA systems. If direct integration is not possible, the data can be transmitted to a cloud and evaluated via a web application. This makes it possible to monitor several turbines or even entire wind parks.

Invest in availability to secure the power supply of your turbine, today and tomorrow.



Possible configurations		Further information
	**DEHNdetect DDL** Data logger with different interfaces for integration in IT systems.	Short link: de.hn/rden
	**DEHNdetect ICC** Measuring coil long stroke current, measuring range 100 A to 2500 A **DEHNdetect IIMP** Measuring coil impulse current, measuring range 500 A to 250 kA	
	**DEHNdetect BDU** Detector for the wireless detection of lightning current in the rotor.	

Lightning and surge protection in the nacelle



Power supply systems

By implementing coordinated surge protection measures for power supply systems, the risk of system downtime due to lightning currents and surges can be avoided. This increases the availability of the wind turbine in the long term.

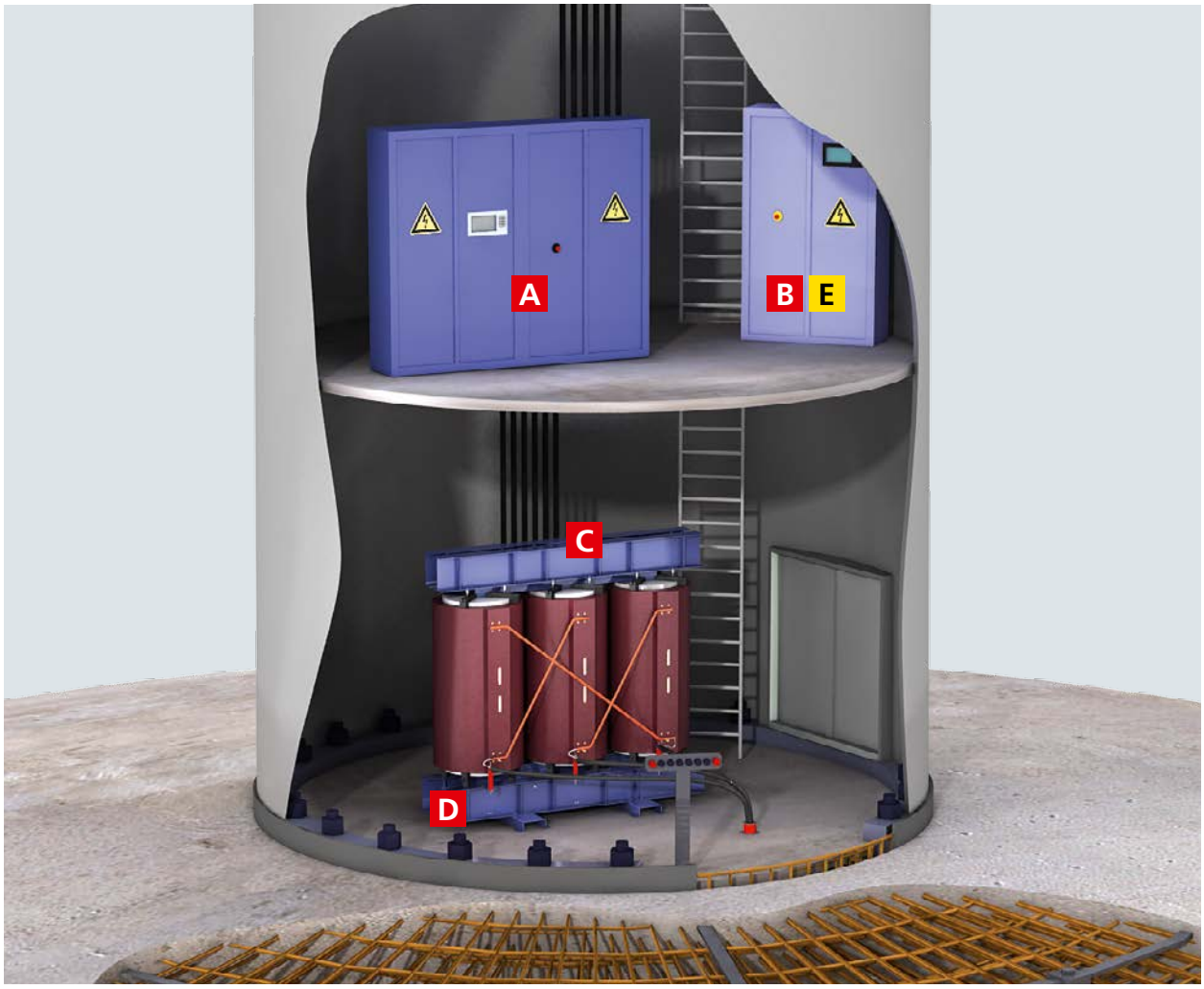
Information technology systems

A consistent protection concept prevents damage to information and data systems. Condition monitoring is indispensable for the safe operation and availability of wind turbines. This is ensured by the LifeCheck® arrester monitoring system with RFID technology which also allows remote monitoring of arresters, for example, via a wireless network.

1) All lightning and surge protective devices by DEHN for application in wind turbines are vibration- and shock-tested in compliance with IEC 60068-2.

Application			Type	Part No.
Power supply systems				
A		Rotor blade heating	**DEHNsolid** Coordinated type 1 SPD, with 200 kA discharge capacity and low voltage protection level ($U_p \leq 2{,}5$ kV).	**900 230**
B		Pitch system, aircraft warning light	**DEHNguard® M TN CI** Type 2 SPD, especially space- and cost-saving due to integrated backup fuse.	**952 178**
C		Generator	**DEHNguard® SE H 1000 VA FM + earthing clip** Type 2 SPD, further development of the "Neptune circuit" – Advantages: small dimensions save space and costs, improved protection level.	3x **952 940** **900 418**
D		Voltage supply	**DEHNguard® M TNC** Type 2 SPD	**952 305**
Information technology systems				
E		Protects signal, bus or control lines, Ethernet	**BLITZDUCTOR® XT** Space-saving type 1 SPD with LifeCheck®. **Base part BXT BAS** for BLITZDUCTOR® XT/SP	**920 324** (signal core) **920 371** (bus signals) **920 300**
			**BLITZDUCTOR® SP** Space-saving type 2 SPD **Base part BXT BAS** for BLITZDUCTOR® XT/SP	**926 324** (signal core) **926 371** (bus signals) **920 300**
			**DEHNconnect SD2** Type 2 SPD, with disconnection function, only 6 mm wide, safe conductor connection thanks to spring-loaded system.	**917 921** (signal core) **917 970** (bus signals)
			**DEHNpatch Class E** Universal type 2 SPD for Ethernet and structured cabling up to 250 MHz.	**929 121**
		Weather station	**BLITZDUCTOR® VT** Type 1 SPD for applications with nominal currents up to 7 A.	**918 408**
		Monitoring surge arresters	**DEHNrecord Alert Modbus** Modbus TCP/RTU communication module to integrate SPDs in a monitoring system. **DEHNrecord Alert MCM** Monitoring of up to 10 BXT – relays the status, the bus address and the part number to the DEHNrecord Alert communication unit.	**910 694** **910 698**
			**DEHNrecord SCM XT** Monitoring of up to 10 BXT SPDs for pre-damage – Fault indication both visual and via remote signalling contact.	**910 696**
			**DEHNrecord LC M1+** Portable device for quickly testing BXT arresters for pre-damage.	**910 655**

Lightning and surge protection in the tower base



A comprehensive lightning protection concept comprises the protection of the nacelle and surge protection in the tower base. In the tower base, both the medium- and low-voltage power side and the data side require protection.

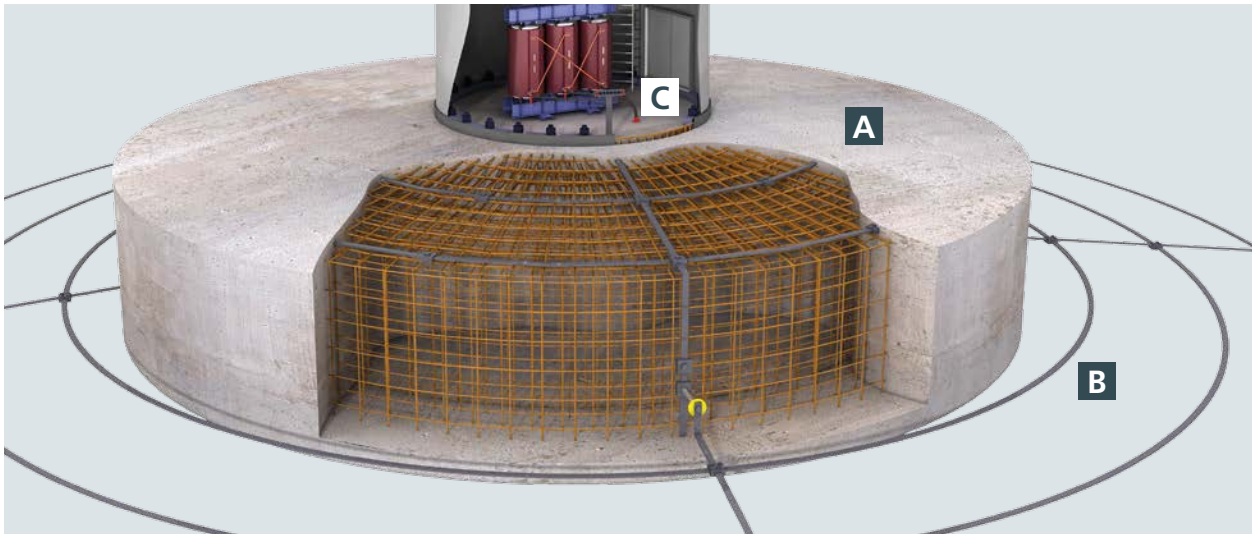
Depending on the concept of the wind turbine manufacturer, technologies with different **end of life behaviour** can be applied to the protective devices for inverters. If permanent availability is paramount, arresters with a defined disconnection of the protective element from the current circuit in case of overload are preferable. These devices from the DEHNguard® family are also available with an optional integrated backup fuse and remote signalling contact. The protective modules can simply be replaced when necessary.
However, if the main aim of the concept is to make sure that the system is safe after the protective device has overloaded, DEHN V SCP arresters can be used. Overloading the arrester causes a defined short-circuit in the protective device. This triggers the upstream protective element and disconnects the system being protected.

Whatever your concept, we are here to offer you advice!

Application			Type	Part No.
Power supply systems				
A		Inverter and main supply	**DEHNguard® M WE** **DEHNguard® SE CI WE** with integrated backup fuse Type 2 SPD, higher rated varistor voltage, especially for applications with higher voltage peaks.	**952 307** **952 923**
			**DEHN V SCP** Short-circuiting type 1 SPD, safe tripping of the backup fuse when SPD overloads.	**900 998** **900 999**
B		Voltage supply	**DEHNguard® M TNC** Type 2 SPD	**952 305**
C		Transformer low-voltage side	**DEHNbloc® Maxi** Coordinated type 1 SPD	**961 145** (440 V AC) **961 175** (760 V AC)
			**DEHNbloc® Maxi CI** Coordinated type 1 SPD, especially space- and cost-saving due to integrated backup fuse.	**961 146** (440 V AC) **961 176** (760 V AC)
D		Transformer medium-voltage side	**DEHNmid** Surge arrester for medium voltage systems.	**990 010**
Information technology systems				
E		Protects signal, bus or control lines, Ethernet	**BLITZDUCTOR® XT** Space-saving type 1 SPD with LifeCheck®. **Base part BXT BAS** for BLITZDUCTOR® XT/SP	**920 324** (signal core) **920 371** (bus signals) **920 300**
		Monitoring surge arresters	**DEHNrecord Alert Modbus** Modbus TCP/RTU communication module to integrate SPDs in a monitoring system. **DEHNrecord Alert MCM** Monitoring of up to 10 BXT – relays the status, the bus address and the part number to the DEHNrecord Alert communication unit.	**910 694** **910 698**
			**DEHNrecord SCM XT** Monitoring of up to 10 BXT SPDs for pre-damage – Fault indication both visual and via remote signalling contact.	**910 696**
			**DEHNrecord LC M1+** Portable device for quickly testing BXT arresters for pre-damage.	**910 655**

Safely discharging lightning current

Earthing and equipotential bonding at the foundation base



Application / Type			Part No.
Foundation earthing			
A		**Connecting clamps** Clamps for connecting round and flat conductors in concrete foundations and reinforcements with round and flat conductors with tested short circuit current carrying capacity (50 Hz).	**308 031**
		**Round wire 10 mm St/tZn** Round wire tested to IEC 62561-2 for use in lightning protection and earth-termination systems [1].	**800 010**
		**Strip 30 x 3.5 St/tZn** Strip tested to IEC 62561-2 for use in lightning protection and earth-termination systems [1].	**810 335**
		**Fixed earthing terminal type M V4A** Corrosion-resistant connection of the ring earthing with the foundation earthing at the base of the tower.	**478 011**
Ring earth electrode			
B		**Connection clamp with threaded bolt StSt (V4A)** For connection of round and flat V4A conductors to fixed earthing terminals.	**478 149**
		**Cross unit StSt V4A** Corrosion-resistant connection of the individual ring conductors in V4A.	**319 209**
		**Stainless steel strip V4A** Corrosion-resistant ring conductor in V4A.	**860 335**
Equipotential bonding			
C		**Equipotential bonding in the tower base/equipotential busbar StSt** Suitable for equipotential bonding and protective/functional equipotential bonding.	**472 209**

[1] IEC 62561-2 Lightning protection system components (LPSC) – Part 2: Requirements for conductors and earth electrodes

Application / Type		Part No.
External lightning protection		
	**HVI®power Conductor (in supporting tube with air-termination rod)** Class of LPS 1 – 200 kA (10/350 µs) – High-voltage-resistant, insulated down conductor for maintaining the separation distance.	**819 430**
	**HVI®power long Conductor (cut to length)** Individual lengths, on request we can assemble your conductors with the appropriate connection elements.	**819 163**
	**UNI disconnection clamp 200 kA** 200 kA lightning current carrying capability according to IEC 62561-1 [2], stainless steel V2A.	**459 200**
	**KS connector 200 kA** 200 kA lightning current carrying capability according to IEC 62561-1 [2], stainless steel V2A.	**301 209**
	**MV clamp 200 kA** 200 kA lightning current carrying capability according to IEC 62561-1 [2], stainless steel V2A. Lightning current carrying connection of the air-termination system and down conductor.	**392 209**
	**Tubular air-termination rod** Safe interception of the flash charge in permanently corrosion-resistant, stainless steel design.	**103 419**
	**Air-termination rod StSt** Safe interception of the flash charge in permanently corrosion-resistant, stainless steel design.	**101 009**

Earthing and equipotential bonding

Safe operation of electrical equipment and systems and a well-functioning lightning protection system require an earth-termination system designed according to IEC 61400-24 [1]. Connection elements which are capable of carrying short-circuit current ensure the safe contact of the earth-termination system with metal parts of the foundations and the main earthing busbar. A high level of product quality safeguards long-term mechanical strength and corrosion resistance.

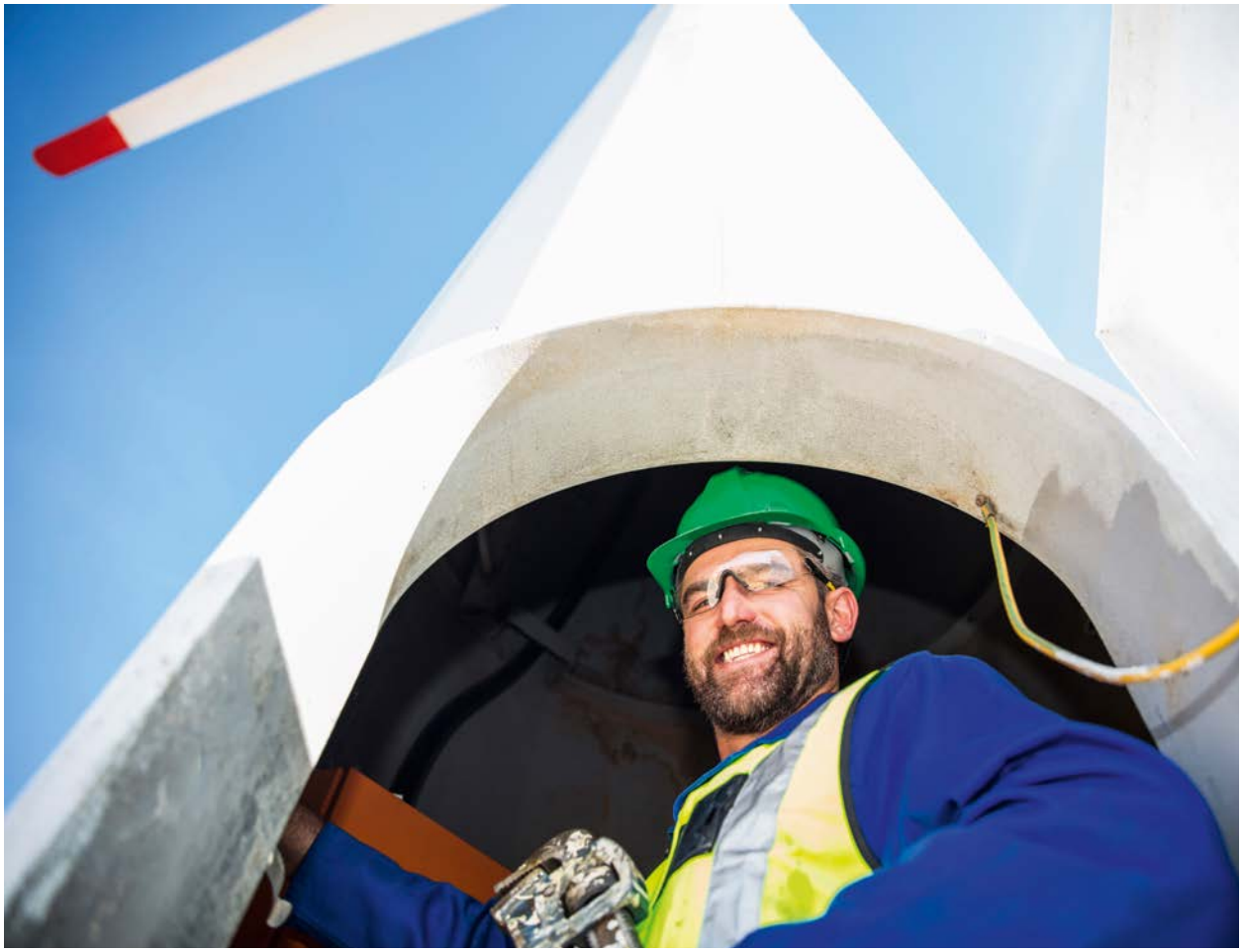
External lightning protection

Safe interception and discharge of direct lightning strikes is paramount for the availability of a wind turbine. DEHN ensures that this is the case by testing components like the HVI®power Conductor with a lightning current of 200 kA (10/350 µs) as stipulated in IEC 62561. The stainless steel design of the air-termination rods and connection elements fulfils stringent corrosion resistance requirements.

[1] IEC 61400-24 Wind turbines – Part 24: Lightning protection
[2] IEC 62561-1 Lightning protection system components (LPSC) – Part 1: Requirements for connection components

Safe service and maintenance work

DEHN safety equipment



Safe right down the line!

Work on electrical systems is becoming more and more demanding. Make sure you use safe and reliable equipment.

DEHN offers tested products and reliable services which protect your employees from injury caused by arc faults and secure the availability of your systems. This gives you, as the employer, legal certainty.

Safe at work with

- Personal protective equipment
- Voltage detectors
- EaS devices
- Fixed ball points
- Arc fault protection systems

Type / Application		Further information
Personal protective equipment		
	**Safe when it matters most** Reliable protection against arc faults in electrical installations: DEHNcare® personal protective equipment keeps you safe from the thermal effects of an arc fault. DEHNcare® equipment is also comfortable to wear thanks to the unique material combination of leather and neoprene. The protective equipment is tested to international standards and consists of a hood, safety helmet for electricians, face shield, protective gloves, jacket and trousers or coat.	Short link: de.hn/wpee
Voltage detectors		
	**Safe right down the line** Make sure that no voltage is present with a capacitive voltage detector from 1 to 420 kV. Choose from a wide range of voltage detectors – you are bound to find your voltage and frequency!	Short link: de.hn/wvde
EaS devices and fixed ball points		
	**Safe earthing and short-circuiting (EaS)** Configuring your individual EaS device for your system is simple and flexible at www.dehn.de/en/euk	
	**Fixed ball points** You can achieve maximum short-circuit strength by connecting the ball head cap and the connection clamps of the earthing and short-circuiting device.	Short link: de.hn/wfbpe
Arc fault protection system		
	**Safe – fast – flexible** DEHNshort quenches arc faults in your low-voltage switchgear installations in milliseconds. Your employees are safe when carrying out maintenance and repairs. Profit from optimised system availability: your system runs and runs, downtime due to an arc fault is significantly reduced.	Short link: de.hn/wsee

DEHN Services

More than just a product

Quick answers to technical questions

You have questions about the technology or applications?
Get in touch with our technical support:
Telephone: +49 9181 906 1750
E-mail: technik.support@dehn.de

Intelligent planning

Simple and safe planning with the help of the DEHNsupport Toolbox software. With DEHNconcept, the planning service for integrated protection solutions in the wind energy sector, you can save even more time.

Personal consultation

You have special questions on the topic?
One of our field staff will be happy to pay you a visit.

Easily acquire knowledge

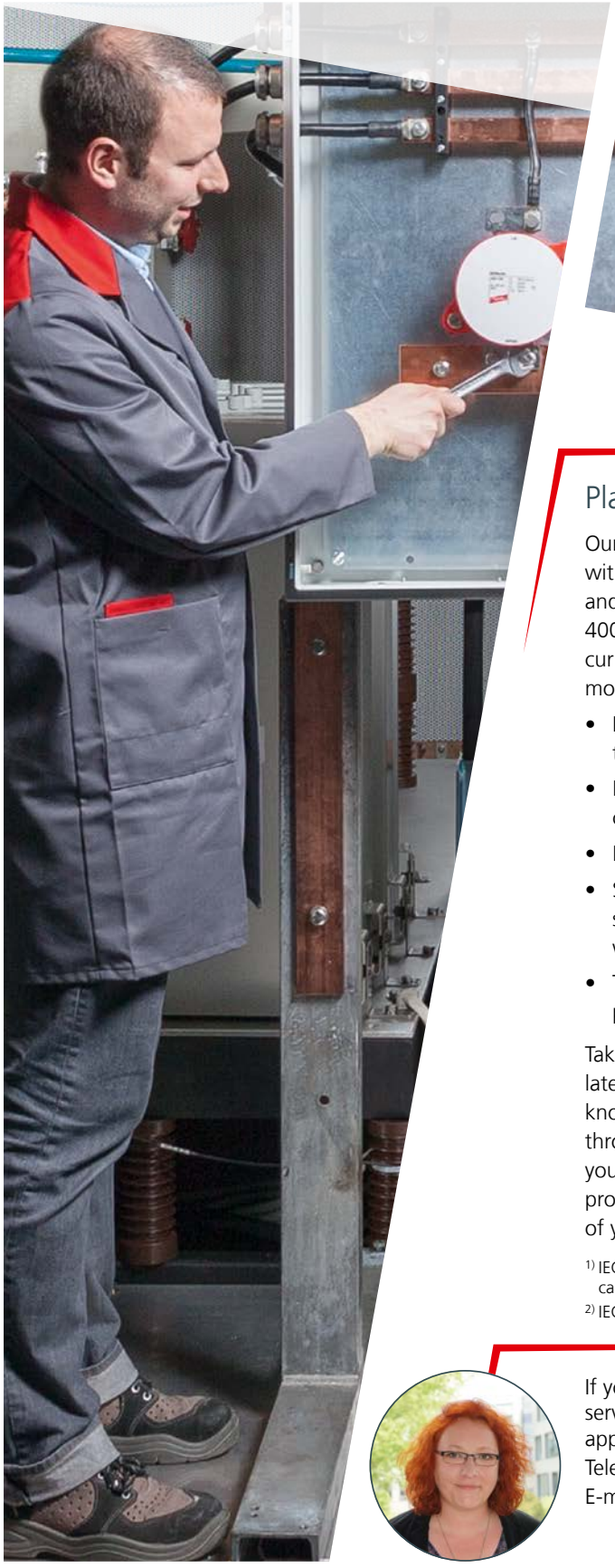
Get hold of practical information on all topics relating to lightning and surge protection and safety equipment at our DEHNacademy seminars and other training events.

All from a single source

At DEHN, you will find specific protection solutions, wide-ranging services and high-quality products for lightning protection/earthing, equipotential bonding, surge protection and safety equipment.

DEHN Test Centre

Testing components for wind turbines



DAkkS Deutsche Akkreditierungsstelle

Accredited according to IEC 17025 [1)]

Play it safe!

Our test centre – with a floor space of 800 m² – is equipped with the latest devices and technologies for engineering and testing services according to IEC 61400-24 [2)]. With 400 kA (10/350 µs), the testing facility in the lightning current laboratory, part of our test centre, is one of the most powerful of its kind in the world.

- Lightning current tests on bearings and gearboxes of the mechanical drive train
- High current tests on the receptors and down conductors of rotor blades
- High current and high voltage tests on rotor blades
- System-level immunity tests of important control systems such as the blade pitch control or aircraft warning light
- Tests on customer-specific prewired connection units to protect the electrical installation

Take advantage of our know-how when it comes to the latest standards and fundamental technical principles; know-how we are pleased to make available to you through our engineering and testing services. This makes your protection concepts practicable. In the long-term, you profit from the operational reliability and high availability of your wind turbines.

[1)] IEC 17025 General requirements for the competence of testing and calibration laboratories

[2)] IEC 61400-24: Wind turbines – Part 24: Lightning Protection

If you have questions about engineering and testing services for wind energy, please contact our product and application specialist: **Claudia Rother**

Telephone: **+49 9181 906 1707**

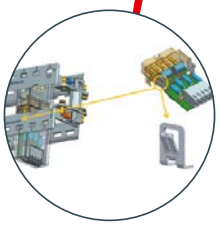
E-mail: **claudia.rother@dehn.de**

Bespoke solutions

We develop and produce bespoke solutions for our customers based on our sophisticated technologies and more than 20 years' experience in the effective protection of wind turbines. In a cooperative partnership with you we offer the highest level of reliability and quality, fulfilling your requirements in all respects.

Your benefits in a nutshell:

- Joint creation of solutions
- Design in line with the standards
- Testing and verification of the solution



Integration of a surge protective device in a client device.

Advantages:

- Space-saving
- Greatest flexibility
- Optimally adjusted protection

Two in one – integration of customised electronics in a surge protective device.

Advantages:

- Space-saving
- Optimally adjusted protection

Solution with high-voltage-resistant insulated HVI®power Conductor for conducting lightning currents safely past sensitive components.

Advantages:

- Reduces the load on electrical and mechanical systems
- Increases availability and lowers service costs

Offshore connection distributors for medium-voltage cables.

Advantages:

- High corrosion resistance
- Flexible connection possibilities
- Further information and purchase from Desitek A/S, www.desitek.dk/da/kontakt

If you have any questions about bespoke solutions for the wind sector, please contact:

Global Account Manager: **Christian Vögerl**
Telephone: **+49 9181 906 1633**
E-mail: **christian.voegerl@dehn.de**

www.dehn-international.com/partners

Surge Protection
Lightning Protection
Safety Equipment
DEHN protects.®

DEHN + SÖHNE
GmbH + Co.KG.

Hans-Dehn-Str. 1
Postfach 1640
92306 Neumarkt
Germany

Phone +49 9181 906 0
Fax +49 9181 906 1100
sales@dehn.de
www.dehn-international.com

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