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Surge Protection
Lightning Protection
Safety Equipment
DEHN protects.

DEHN + SÖHNE
GmbH + Co.KG.

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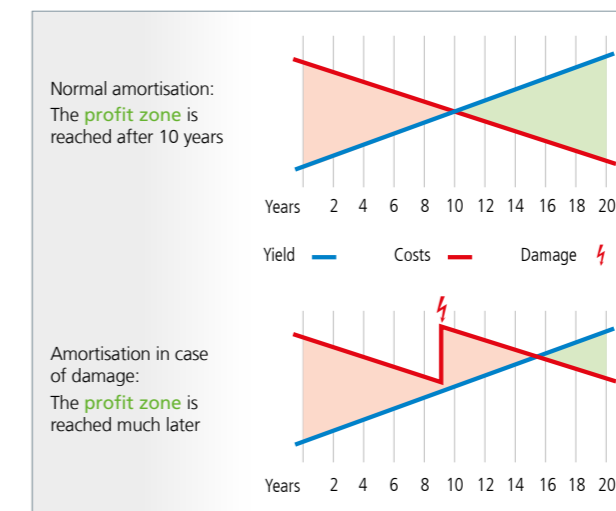
DEHN protects Photovoltaic Systems



This is why **investors** often decide in favour of protection solutions by DEHN

Surges often cause considerable damage to photovoltaic systems. The resulting reinvestment costs are high. This delays the return on investment and postpones the break-even-point.

A lightning and surge protection concept by DEHN effectively protects your investment in the PV system.



This is what is important to **planning engineers**

From an economic point of view, the topic of lightning and surge protection should be integrated in the planning of a PV system right from the start – retrofitting is significantly more expensive.

Simple, quick and accurate planning: with the help of DEHN's know-how and tools.



The top priority for EPCs

High product quality and reliable technical support facilitate the rapid and efficient realisation of projects. This means that systems can connect with the grid quicker and remain permanently available. Here, the worldwide partner network of the DEHNgroup is in situ to support EPCs ¹⁾.

This is what matters to solar park operators

The objective is a maximum performance ratio for the system. A sound lightning and surge protection concept helps to optimise system availability.

High-quality, durable products by DEHN secure failure-free operation. This also reduces service costs.

¹⁾ EPC stands for Engineering - Procurement - Construction



Lightning and surge protection for rooftop systems

Rooftop systems are extremely exposed and therefore particularly prone to damage caused by direct and indirect lightning effects. Since the PV system is directly connected to the electrical installation of the building, lightning effects can have severe consequences for the building itself, the people inside and electrical devices.

According to the current state of scientific knowledge, PV modules do not increase the risk of a lightning strike which means that the need for lightning protection measures cannot be derived directly from them. The risk of damage due to lightning should there be assessed in compliance with IEC 62305-2 ¹⁾. National regulations, e.g., the state building code, should also be considered.

A professional lightning protection system consists of

- External lightning protection with air-termination systems, down conductors and an earthing system
- internal lightning protection for lightning equipotential bonding and surge protection

The German national supplement 5 of DIN EN 62305-3 describes protective measures for external and internal lightning protection when using PV power supply systems. Implementation of the protective measures described there has also proven its worth on an international level ²⁾.

In addition, IEC 61643-32 and IEC 60364-7-712 provide information on selecting and implementing surge protective devices in PV power supply systems ³⁾.

Both IEC 61643-32 and supplement 5 of DIN EN 62305-3 describe **three different applications for PV installations on buildings:**

- Buildings with PV systems, without external lightning protection
- Buildings with PV systems, with external lightning protection and sufficient separation distance
- Buildings with PV systems, with external lightning protection, without sufficient separation distance

¹⁾ IEC 62305-2: Protection against lightning – Part 2 Risk management

²⁾ DIN EN 62305-3 (VDE 0185-305-3) Supplement 5: Protection against lightning - Part 3: Physical damage to structures and life hazard – Supplement 5: Lightning and overvoltage protection for photovoltaic power supply systems

³⁾ IEC 60364-7-712: Low voltage electrical installations – Part 7-712: Requirements for special installations or locations - Solar photovoltaic (PV) power supply systems
IEC 61643-32: Low-voltage surge protective devices – Part 32: Surge protective devices connected to the d.c. side of photovoltaic installations – Selection and application principles

Buildings with PV installations

Without external lightning protection



Surge protective devices should be installed even if there is no external lightning protection system.

The standards IEC 60364-7-712 and IEC 61643-32 describe type 2 arresters as protective devices. DEHN recommends type 1 arresters because these protective devices can be installed upstream of the meter and offer additional protection against partial lightning currents. This provides optimum protection for devices such as smart meters.

It is necessary to protect both the electrical components on the AC and DC side and any data interfaces. The protective devices should be installed as closely as possible to the device to be protected, e.g., inverter. If the line between the surge protective device and, e.g., the inverter is longer than 10 metres, an additional type 2 surge protective device is required.

The same applies to battery storage systems; If the storage system is in the immediate proximity (less than 10 m) of the surge protective device, no further protective devices are required.

| A Main distribution board | | Part No. |
|---|--|--|
|  | DEHNshield Basic (depending on the system configuration) The combined arrester is mounted directly at the entrance point into the building. It protects the electrical installations in the immediate vicinity. | 941 306 (TNC) 941 406 (TNS) 941 316 (TT) |
|  | alternatively: DEHNgard modular (depending on the system configuration) This surge arrester protects against overvoltages from inductive couplings by distant lightning strikes and from switching overvoltages. It must be installed downstream of the electricity meter which means that it does not protect the Smart Meter and Smart Meter Gateway. | 952 400 (TNS) 952 381 (TT) |
| B Internet / telephone / broadband | | Part No. |
|  | DEHNbox TC180 The combined arrester offers protection in the event of lightning strikes and overvoltages. It secures telephone and DSL connections. Its compact design makes it quick to install in new buildings and easy to retrofit in existing buildings. | 922 210 |
| C PV installation | | Part No. |
|  | DEHNgard M YPV This type 2 arrester is specially designed for application in PV systems and protects the DC side of the inverter against surges from inductive couplings. If there is more than 10 metres of cable between the PV system and the inverter, a further arrester is necessary in the roof area. | 952 565 (1170 V) 952 567 (1500 V) |
|  | alternatively: DEHNCube YPV SCI 1000 Type 2 arrester DEHNCube YPV SCI provides comprehensive protection for a PV system in an enclosure. It is mounted directly upstream of the inverter and is available in two versions, 1 MPPT and 2 MPPT. If there is more than 10 metres of cable between the PV system and the inverter, a further arrester is necessary in the roof area. | 900 910 (1 MPPT) 900 920 (2 MPPT) |
| D AC side inverter | | Part No. |
|  | DEHNgard M TNS or DEHNgard M TT The surge arrester protects against overvoltages from inductive couplings by distant lightning strikes and from switching overvoltages. If there is more than 10 metres of cable between the service entrance box and the inverter, a further type 2 surge arrester is required at the inverter. | 952 405 (TNS) 952 315 (TT) |
| E Equipotential bonding | | Part No. |
|  | UNI earthing clamps/saddle clamps The clamps are suitable for integrating the mounting systems of PV installations in the functional equipotential bonding / the functional earthing or the lightning equipotential bonding. | 540 250 365 250 |

Further info on the topic of lightning and surge protection for modern residential buildings can be found on our website.

www.de.hn/pvrb

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Buildings with PV installations

With external lightning protection and sufficient separation distance










The PV modules must be located in the protected volume of the isolated air-termination system – whilst also maintaining the separation distance “s”.

It is always advisable to favour a lightning protection system which, taking the required separation distance into account, has no direct connection with the PV power supply system. The HVI Conductor by DEHN comes into its own here. High-voltage-resistant insulated down conductors make it possible to maintain an equivalent separation distance of, e.g., $s \leq 0.75$ m (in air) and still make optimum use of the roof surface.

Type 2 arresters are used on the DC side to protect the module and the inverter. The AC side is protected by a combined arrester near the grid connection. On both the AC and DC sides, the protective devices are installed as closely as possible to the device to be protected.

If the cable is longer than 10 metres, e.g., between the grid connection point and the inverter, additional type 2 surge protective devices are required. Battery storage systems which are less than 10 m away from the point where the surge protective device is installed are also protected.

| A | Main distribution board | Part No. |
|---|--|--|
|  | DEHVentil (depending on the system configuration) The combined arrester is mounted directly at the entrance point to the building. It protects the electrical installation in the direct environment and, thanks to the patented RADAX Flow Technology, offers high follow current limitation and thus maximum system availability. | 951 315 (TT) 951 405 (TNS) 951 305 (TNC) |
| B | Data interface | Part No. |
|  | BLITZDUCTOR XTU The combined arrester protects balanced data interfaces (e.g. RS 485). Via the integrated actiVsense Technology the arrester automatically detects the operating voltage of the useful signal and optimally adapts the voltage protection level to it. | 920 349 (Module) 920 300 (Base Part) |
| C | PV installation | Part No. |
|  | DEHGuard M YPV This type 2 arrester is specially designed for application in PV systems and protects the DC side of the inverter against surges from inductive couplings. If there is more than 10 metres of cable between the PV system and the inverter, a further arrester is necessary in the roof area. | 952 565 (1170 V) 952 567 (1500 V) |
|  | alternatively: DEHncube YPV SCI 1000 Type 2 arrester DEHncube YPV SCI provides comprehensive protection for a PV system in an enclosure. It is mounted directly upstream of the inverter and is available in two versions, 1 MPPT and 2 MPPT. If there is more than 10 metres of cable between the PV system and the inverter, a further arrester is necessary in the roof area. | 900 910 (1 MPPT) 900 920 (2 MPPT) |
| D | AC side inverter | Part No. |
|  | DEHGuard M TNS or DEHGuard M TT The surge arrester protects against overvoltages from inductive couplings by distant lightning strikes and from switching overvoltages. If there is more than 10 metres of cable between the service entrance box and the inverter, a further type 2 surge arrester is required at the inverter. | 952 405 (TNS) 952 315 (TT) |
| E | Equipotential bonding | Part No. |
|  | UNI earthing clamps/saddle clamps The clamps are suitable for integrating the mounting systems of PV installations in the functional equipotential bonding / the functional earthing or the lightning equipotential bonding. | 540 250 365 250 |
| F | External lightning protection | Part No. |
|  | HVI Conductor With the high-voltage-resistant insulated down conductors it is possible to make optimum use of the roof surface whilst still maintaining the separation distance from conductive parts. | |

Further info on the topic of lightning and surge protection for modern industrial buildings can be found on our website.

www.de.hn/pvip

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Buildings with PV installations

With external lighting protection, without sufficient separation distance





If the separation distance “s” cannot be maintained, lightning equipotential bonding is required.

If the separation distance calculated acc. to IEC 62305-2 cannot be maintained, e.g., on metal roofs, lightning equipotential bonding must be established ¹⁾. The metal components must be connected to the lightning protection systems and the connections should be capable of carrying lightning current.

At the same time, the lines leading into the building must be integrated in the lightning equipotential bonding. This is done using type 1 combined arresters on the AC, DC and data side.

If the lines between the arrester and the device to be protected are longer than 10 metres, e.g., on the DC side between the inverter and PV modules, additional protective devices should be installed. Supplement 5 of DIN EN 62305-3 describes such additional type 1 arresters ²⁾.

¹⁾ IEC 62305-3: Protection against lightning - Part 3: Physical damage to structures and life hazard
²⁾ DIN EN 62305-3 (VDE 0185-305-3) Supplement 5: Protection against lightning - Part 3: Physical damage to structures and life hazard – Supplement 5: Lightning and overvoltage protection for photovoltaic power supply systems

| A | Main distribution board | Part No. |
|---|--|--|
|  | DEHNventil (depending on the system configuration) The combined arrester is mounted directly at the entrance point to the building. It protects the electrical installation in the direct environment and, thanks to the patented RADAX Flow Technology, offers high follow current limitation and thus maximum system availability. | 951 315 (TT) 951 405 (TNS) 951 305 (TNC) |
| B | Data interface | Part No. |
|  | BLITZDUCTOR XTU The combined arrester protects balanced data interfaces (e.g. RS 485). Via the integrated actiVsense Technology the arrester automatically detects the operating voltage of the useful signal and optimally adapts the voltage protection level to it. | 920 349 (Module) 920 300 (Base Part) |
| C | PV installation | Part No. |
|  | DEHNcombo YPV This combined arrester was specially developed for use in PV installations and protects the DC side of the inverter against partial lightning currents and surges. If the cable length between the PV system and the inverter is longer than 10 metres, an additional arrester is required in the roof area. | 900 075 (1200 V) 900 076 (1500 V) |
| D | AC side inverter | Part No. |
|  | DEHNshield TNS Basic FM or DEHNshield TT Basic FM If the cable length between the grid connection and the inverter is longer than 10 metres, an additional combined arrester is required at the inverter. This application-optimised combined lightning current and surge arrester fulfils the requirements LPS class III at the point of installation and thus protects the inverter against any partial lightning currents and surges. | 941 406 (TNS) 941 316 (TT) |
| E | Equipotential bonding | Part No. |
|  | UNI earthing clamps/saddle clamps The clamps are suitable for integrating the mounting systems of PV installations in the functional equipotential bonding / the functional earthing or the lightning equipotential bonding. | 540 250 365 250 |
| F | External lightning protection | Part No. |
|  | Air-termination and down conductor system Air termination rods and down conductors are required to protect the building and the PV installation and any additional components against the effects of direct lightning strikes. | |

Further info on the topic of lightning and surge protection for modern industrial buildings can be found on our website.

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Lightning and surge protection for solar parks

In many countries, large-scale PV power plants are becoming an important part of the power supply infrastructure. As a result, they must also meet requirements for stable network operation. The supply reliability and volume of investment make it necessary to assess the risk of damage due to lightning. Damage may be the result of direct lightning strikes or of inductive or capacitive coupled voltage. An integrated lightning protection system, consisting of external and internal lightning protection, is needed to prevent damage.

The German supplement 5 of DIN EN 62305-3 and IEC 61643-32 describe protective measures for free field PV systems ¹⁾. The basis for an effective lightning and surge protection system is a meshed earthing system. This produces a large equipotential surface which significantly reduces the voltage interference of electrical connecting cables in case of lightning interference. Mesh sizes between 20 x 20 metres and 40 x 40 metres have proven effective.

When selecting surge protective devices, you must differentiate between systems with central inverters and systems with string inverters.

The German supplement 5 of DIN EN 62305-3 and IEC 61643-32 both point out the minimum discharge capacity of the arresters to be implemented in solar parks, making selection easier.

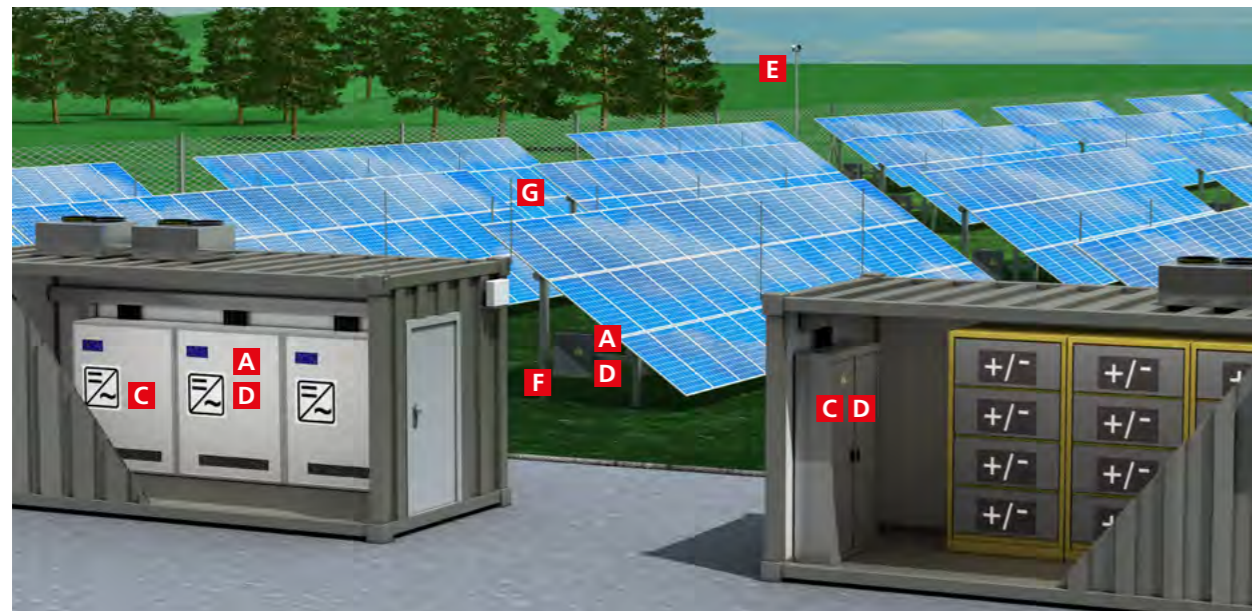
You will find the following protection concepts on the next few pages:

- Solar parks, configuration with central inverter
- Solar parks, configuration with string inverter

¹⁾ DIN EN 62305-3 (VDE 0185-305-3) Supplement 5: Protection against lightning - Part 3: Physical damage to structures and life hazard – Supplement 5: Lightning and overvoltage protection for photovoltaic power supply systems
IEC 61643-32: Low-voltage surge protective devices – Part 32: Surge protective devices connected to the d.c. side of photovoltaic installations – Selection and application principles

Solar parks

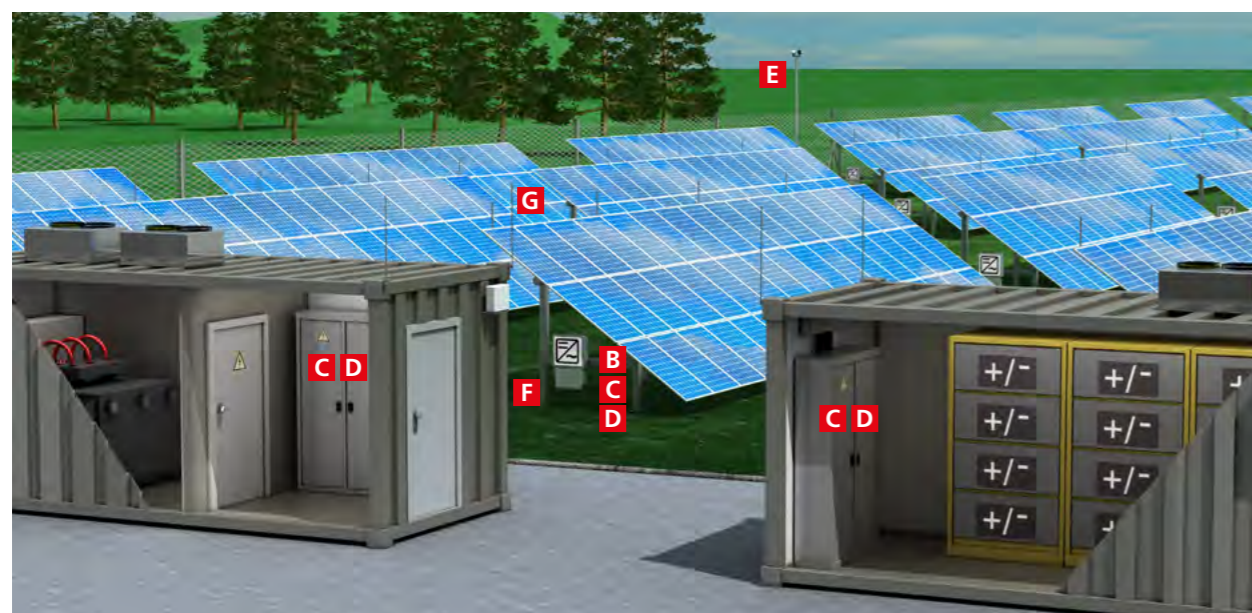
Configuration with central inverter



System concepts with central inverter technology lead to extensive direct current cabling in the field. If lightning directly strikes the air-termination rod on the mounting frame, the extensive DC cabling acts as an equipotential bonding conductor between the "local" earth potential of the module field and the "distant" equipotential surface of the feed transformer/central inverter.

Due to the partial lightning currents anticipated on the DC cables, type 1 arresters are used to protect the electrical systems within the PV power plant. Any battery storage systems must also be protected against lightning and surges. This is done by protecting the electrical cables entering the building or container with combined arresters.

Configuration with string inverters



If the PV power plants are designed with decentralised string inverters, a large portion of the cabling is shifted from the DC to the AC side. In case of a direct lightning strike, the AC cabling acts as an equipotential bonding conductor between the "local" earth potential of the module field and the "distant" equipotential surface of the feed transformer. For this reason, type 1 arresters are used on the AC side.

On the DC side, type 2 SPDs suffice to essentially limit induced interference impulses. Any battery storage systems must also be protected against lightning and surges. This is done by protecting the electrical cables entering the building or container with combined arresters.

| A | DC side central inverter | Part No. |
|---|--|--|
|  | DEHNCombo YPV This combined arrester was specially developed for use in PV installations and protects the DC side of the inverter against partial lightning currents and surges. | 900 075 (1200 V) 900 076 (1500 V) |
| B | DC side string inverter | Part No. |
|  | DEHNGuard M YPV This type 2 arrester is specially designed for application in PV systems and protects the DC side of the inverter and the PV modules against surges from inductive couplings. | 952 565 (1170 V) 952 567 (1500 V) |
|  | alternatively: DEHNCube YPV SCI 1000 Type 2 arrester DEHNCube YPV SCI provides comprehensive protection for a PV system in an enclosure. It is mounted directly upstream of the inverter and is available two versions, 1 MPPT and 2 MPPT. | 900 910 (1 MPPT) 900 920 (2 MPPT) |
| C | AC side | Part No. |
|  | DEHNshield (depending on the system configuration) The application-optimised combined lightning current and surge arrester can be installed to protect the AC side of central and string inverters or AC-coupled battery storage systems. | 941 305 (TNC) 951 405 (TNS) 941 315 (TT) |
| D | Data interface | Part No. |
|  | BLITZDUCTOR XTU The combined arrester protects balanced data interfaces (e.g. RS 485). Via the integrated actiVsense Technology the arrester automatically detects the operating voltage of the useful signal and optimally adapts the voltage protection level to it. | 920 349 (Module) 920 300 (Base Part) |
| E | Monitoring camera | Part No. |
|  | DEHNpatch CLE IP 66 The complete unit consisting of surge protection and outdoor enclosure (IP 66) protects, e.g. IP camera systems. | 929 221 |
| F | Equipotential bonding / earthing | Part No. |
|  | UNI earthing clamps/saddle clamps The clamps are suitable for integrating the mounting systems of PV installations in the functional equipotential bonding / the functional earthing or the lightning equipotential bonding. | 540 250 365 250 |
|  | Earthing-systems Highly durable round wires or strips should be used to set up a meshed earth-termination system. | |
| G | External lightning protection | Part No. |
|  | Angled air-termination rod The 10 mm air-termination rod is fixed to the metal support structure of PV modules to protect them from direct lightning strikes. Total length 1 m. Air-termination rod (including two saddle clamps) | 101 010 101 110 |

Further info on the topic of lightning and surge protection for solar parks can be found on our website.

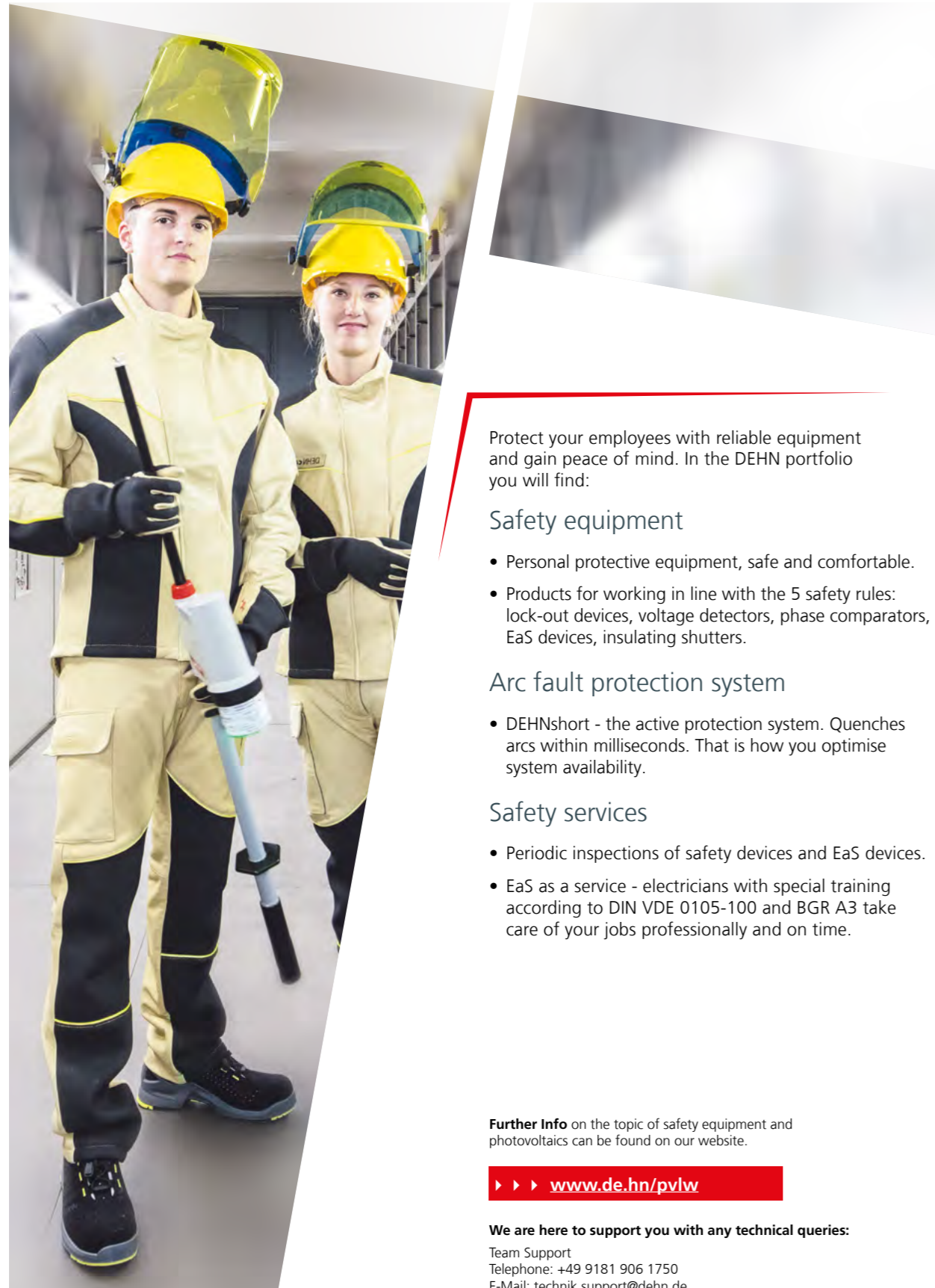
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DEHN Safety Equipment

Safe service and maintenance



Protect your employees with reliable equipment and gain peace of mind. In the DEHN portfolio you will find:

Safety equipment

- Personal protective equipment, safe and comfortable.
- Products for working in line with the 5 safety rules: lock-out devices, voltage detectors, phase comparators, EaS devices, insulating shutters.

Arc fault protection system

- DEHNshort - the active protection system. Quenches arcs within milliseconds. That is how you optimise system availability.

Safety services

- Periodic inspections of safety devices and EaS devices.
- EaS as a service - electricians with special training according to DIN VDE 0105-100 and BGR A3 take care of your jobs professionally and on time.

Further Info on the topic of safety equipment and photovoltaics can be found on our website.

▶ ▶ ▶ www.de.hn/pvlw

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DEHN Services

Know-how for your projects



Quick answers to technical questions

You have some technical questions on the topic of PV? Information on the selection and application of products, state-of-the-art technology and the standards is available from our technical support. On the phone: +49 9181 906 1750 or per E-Mail: technik.support@dehn.de

Plan with intelligent tools

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

Personal consultation

You have special questions on the topic? Get in touch with our experts in technical support or have someone come by and advise you.

Easily acquire knowledge

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

Safely test components

Have the lightning current carrying capacity of your PV components tested with the most modern methods. The DEHN Test Centre can generate lightning currents of up to 400 kA (10/350 μ s) making it one of the most powerful test laboratories in the world.

All conveniently from a complete solution provider

You want products and solutions from one source? All perfectly coordinated? In the DEHN portfolio you will find a multitude of protection solutions and services as well as high-quality products for surge protection, lightning protection, earthing, equipotential bonding and safety equipment.