Design of Lightning Protection Systems

DEHNsupport Toolbox Software

www.dehn-international.com

No more complicated calculations with DEHNsupport Toolbox

Software for design and calculation of lightning protection systems

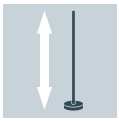
When designing lightning protection systems, various parameters must be taken into account. The DEHNsupport Toolbox software makes this complex topic simpler than ever before since it performs all calculations. It consists of the following five parts:

DEHN Risk Tool **Page 4**

The DEHN Risk Tool makes risk management easier and ensures standard-compliant assessment in just a few steps. It includes a risk analysis according to the new IEC 62305-2* standard with national adaptations.

DEHN Distance Tool **Page 10**

The separation distance defines the minimum distance of the lightning protection system from electrically conductive materials. The DEHN Distance Tool makes it possible to calculate the separation distance and to visualise the building as a 3D model.



DEHN Air-Termination Tool **Page 12**

Dimensioning of air-termination rods is an important criterion for creating protected volumes. The DEHN Air-Termination Tool makes it possible to calculate the air-termination rod length depending on the class of LPS.

DEHN Earthing Tool **Page 13**

The DEHN Earthing Tool calculates the earth electrode length as per IEC 62305-3** – for foundation earth electrodes, ring earth electrodes, earth rods and the soil resistivity.

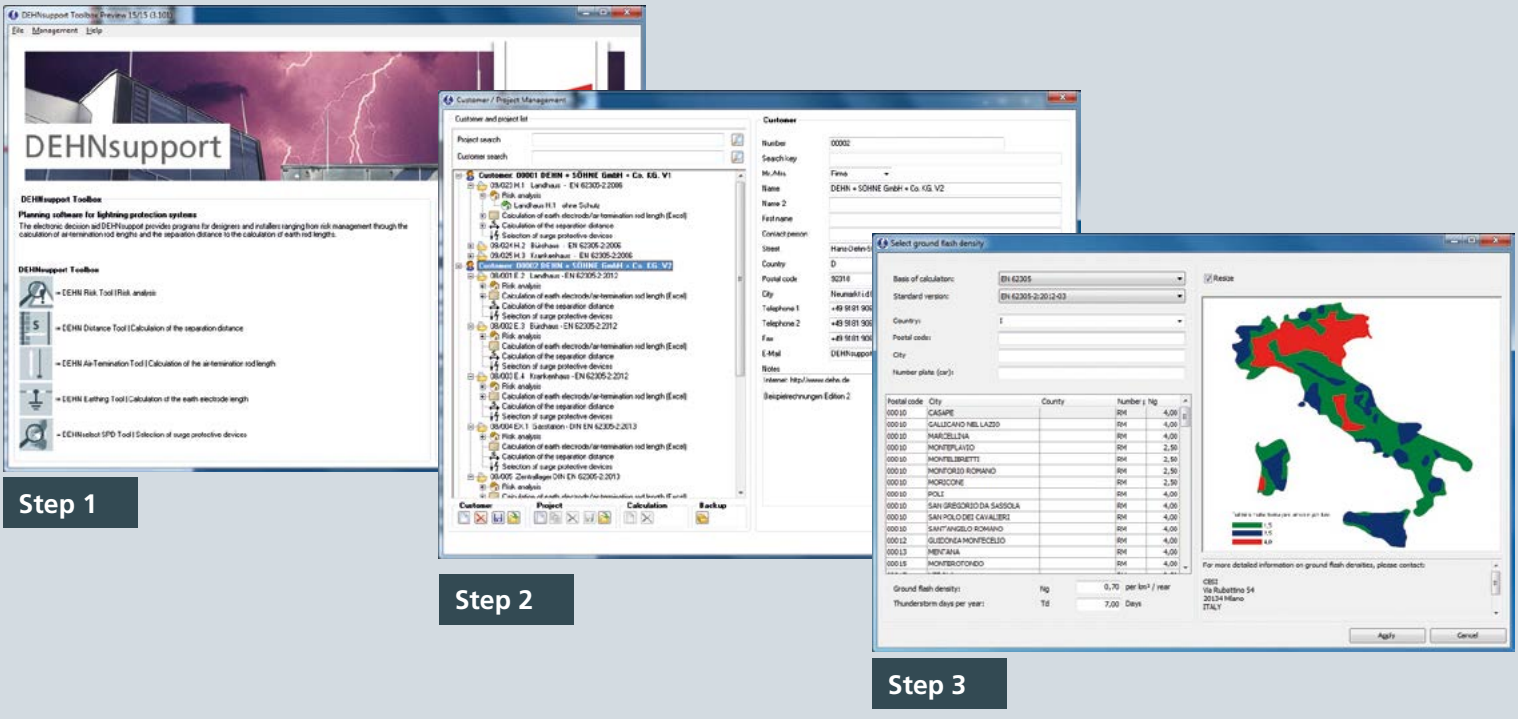
DEHNselect SPD Tool **Page 15**

With the new DEHNselect SPD Tool you can plan internal lightning protection and surge protection measures, making it considerably easier to implement a professional surge protection concept.

Benefits of the DEHNsupport Toolbox software:

- user-friendly interface
- structured customer and project management
- detailed documentation of results
- based on the international IEC 62305 standard
- easy design thanks to the DEHNselect SPD Tool
- meets specific requirements of 13 national standards
- user support via e-mail and phone
- excellent value for money

* IEC 62305-2: Protection against lightning – Part 2: Risk management
** IEC 62305-3: Protection against lightning – Part 3: Physical damage to structures and life hazard



DEHN Risk Tool: Customer and project management

Easy management of all customer data

The DEHNsupport Toolbox software includes a customer and project data management where all calculations are structured and permanently stored. These calculations can be retrieved and changed at a later date. Moreover, further customer or project data can be entered which are also integrated in the result report.

Ground flash density data

The ground flash density, which is selected in the customer and project data management, is important for performing a risk analysis according to IEC 62305-2.

Country-specific versions

The DEHNsupport Toolbox software includes ground flash density data and the associated maps for:

- Austria
- Belgium
- Czech Republic
- Croatia
- France
- Germany
- Great Britain
- Hungary
- Italy
- Macedonia
- Poland
- Russia
- Slovakia

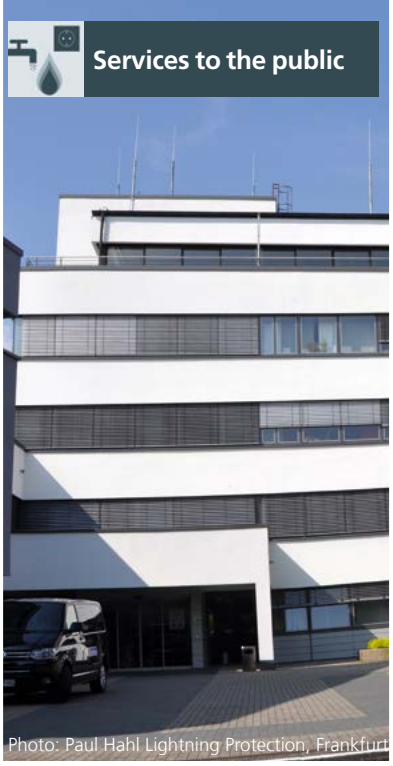


Photo: Paul Hahl Lightning Protection, Frankfurt

Photo: fotolia.com

Risk analysis according to IEC 62305-2

Risk management and assessment of the building

A risk analysis is performed to assess the potential risks for a structure. Based on this analysis, measures can be taken to reduce the risks. The aim is to select economically sound protection measures which are perfectly adapted to the building's properties and utilisation.

A risk analysis not only helps to determine the class of LPS, but also to create a complete protection concept including the necessary LEMP protection measures.

The aim of a risk analysis is to reduce the existing risk to a tolerable risk RT. Therefore, the tolerable risk RT is defined when selecting the risks. These tolerable risks are specified in the standard, however, competent bodies may define them differently.

Risks to be considered

At the beginning of a risk analysis, the purpose of the structure is required to determine the risks to be considered for the object in need of protection.

Four different risks are distinguished:

- Risk R_1: Loss of human life
- Risk R_2: Loss of services to the public
- Risk R_3: Loss of cultural heritage
- Risk R_4: Loss of economic value

One or more risks may be relevant for the structure. The planner has to decide which risks are to be considered.

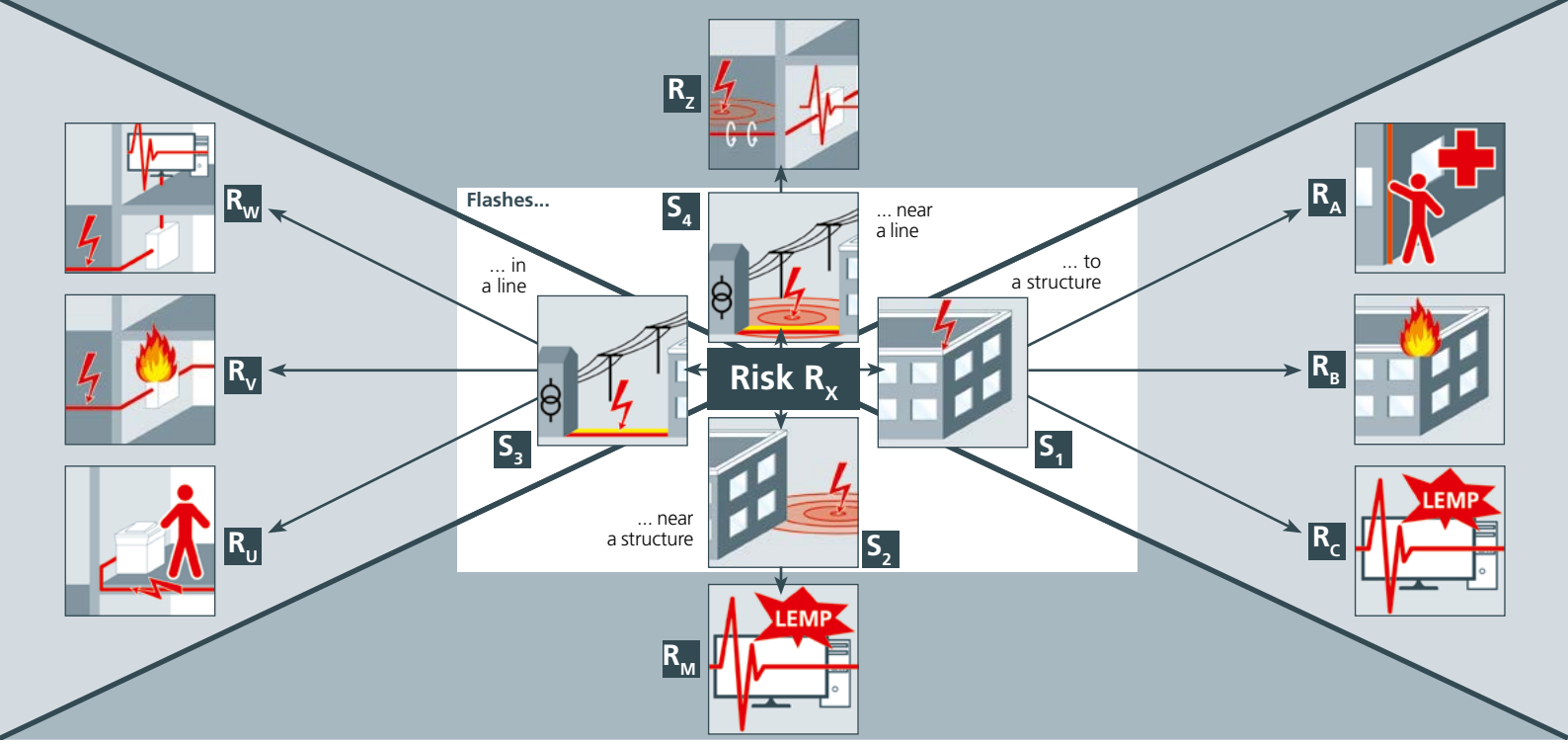
Risk R_1: Loss of human life

Risk R_2: Loss of services to the public

Risk R_3: Loss of cultural heritage

Risik R_4: Loss of economic value

LPS = Lightning Protection System
LEMP = Lightning Electromagnetic Pulse



DEHN Risk Tool: Assessment and reduction of risk

Risk composition
When performing a risk analysis, not only the risks R_1 to R_4, but also the composition of the total risk is considered since each risk consists of individual risk components.

Subdivision of the risk components according to the sources of damage
The sources of damage form the basis for the subdivision of the risk components. The IEC 62305-2 standard describes different types of lightning effects as sources of damage. When performing a risk analysis, the following sources of damage must be considered:

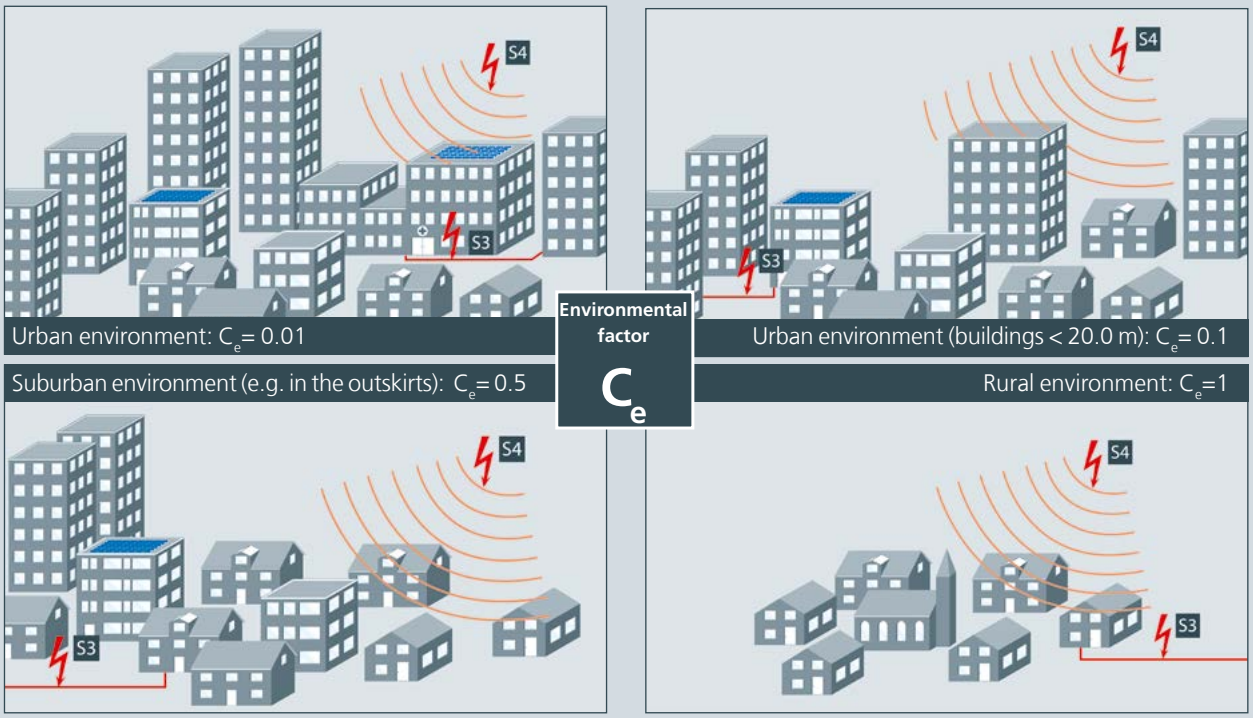
Source of damage S_1:
Flashes to a structure
R_A = Step and touch voltage inside and outside a structure
R_B = Fire
R_C = Overvoltage / LEMP

Source of damage S_2:
Flashes near a structure
R_M = Overvoltage / LEMP

Source of damage S_3:
Flashes to a line
R_U = Touch voltage inside a structure
R_V = Fire
R_W = Overvoltage

Source of damage S_4:
Flashes near a line
R_Z = Overvoltage

LEMP = Lightning Electromagnetic Pulse



Each risk component consists of different factors:

$R_X = N_X \times P_X \times L_X$

These factors are defined as follows:

N_X = Frequency of dangerous events
P_X = Probability of damage defined by the properties of the structure
L_X = Loss

Frequency of dangerous events N_X

A variety of parameters is required to calculate the frequency of dangerous events N_X, for example:

- Ground flash density N_G
- Collection areas A
- Location factor C_D
- Environmental factor C_E

Probability of damage P_X

The probability P_X describes the building and installation properties of a structure. These properties can reduce or increase the risk. The risk of fire, which defines the specific fire load of a structure, plays a particularly important role in a risk analysis.

Loss L_X

In addition to the frequency of dangerous events and the probability of damage, possible losses must be calculated. Losses are differentiated according to the risks considered in the risk analysis and thus according to the risk components. The following losses can be determined:

L_1 Loss of human life:

- Touch and step voltage
- Fire
- Overvoltage / LEMP

L_2 Loss of services to the public:

- Fire
- Overvoltage / LEMP

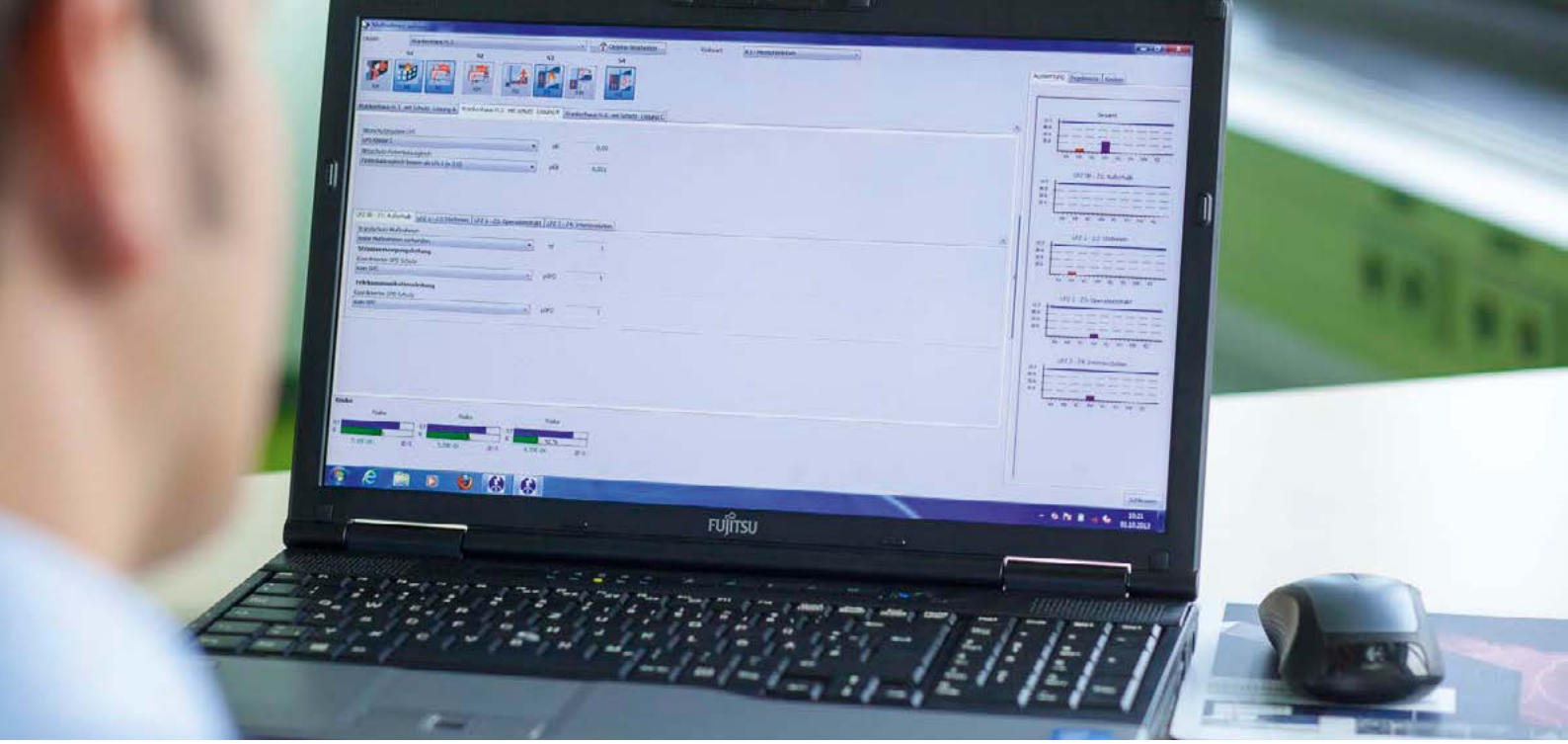
L_3 Loss of cultural heritage:

- Fire

L_4 Loss of economic value:

- Touch and step voltage
- Fire
- Overvoltage / LEMP

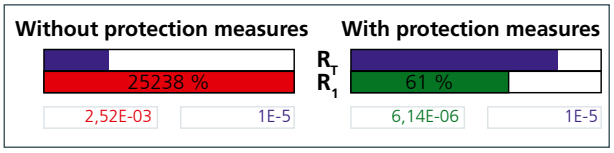
LEMP = Lightning Electromagnetic Pulse



DEHN Risk Tool: Focus on cost-effectiveness

Correct assessment of the result

The risk to be considered is displayed in the form of a graphic. Blue stands for the tolerable risk, red or green for the risk calculated for the structure to be protected.



Determination of the potential risks

The risk components describe the potential risks for a structure. Therefore, they must be thoroughly considered when performing a risk analysis. The aim of a risk analysis is to reduce the main risks by taking reasonable measures.

Determination of the main risks

Each risk component can be reduced or increased by different parameters.

Selection of measures in the DEHN Risk Tool

Measures can be defined with the help of a selection matrix. These measures are displayed according to the risk components selected.

Cost-effectiveness of protection measures

Owners of buildings often ask what kind of damage can result from lightning strikes and, consequently, how high the cost of protection measures should be in relation to the value of the building. Economic aspects are therefore a decisive factor. Together with the risk analysis according to IEC 62305-2, the consideration of economic feasibility which is integrated in the DEHN Risk Tool helps to reach a decision.

Country-specific normative adaptations

The lightning protection standard is an IEC standard and has therefore been incorporated in the standards of the CENELEC* member states whilst taking national circumstances into account.

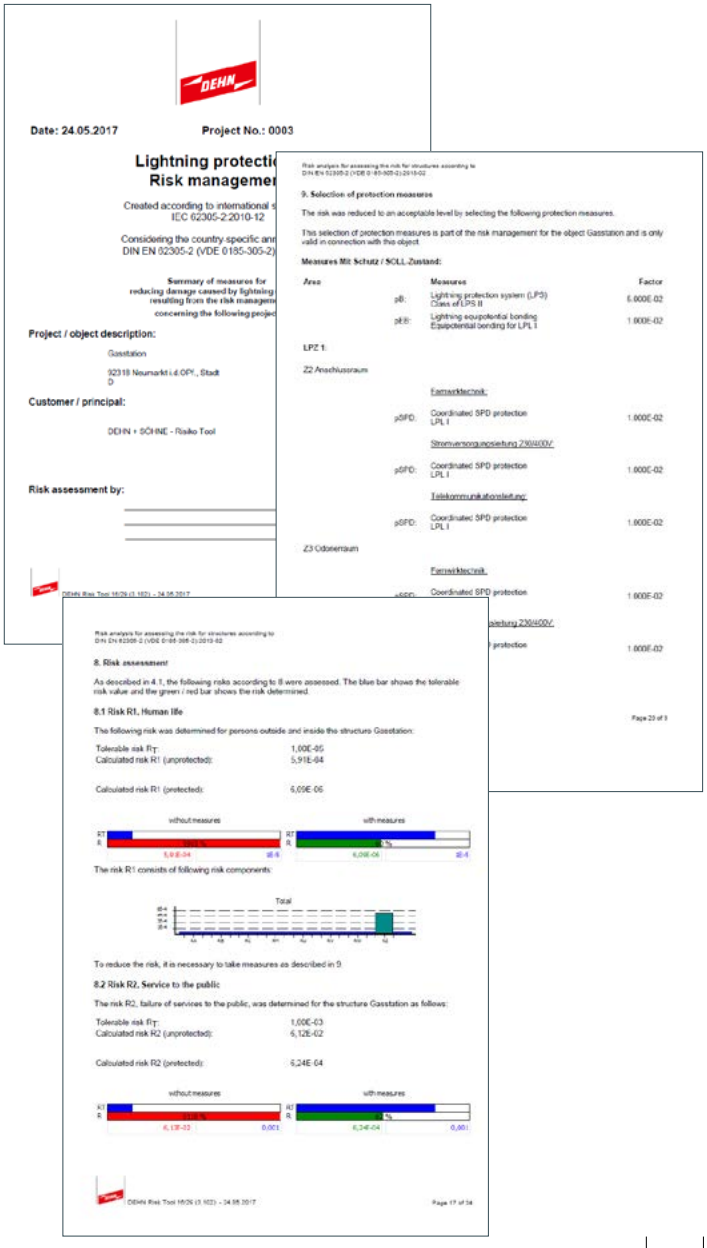
Documentation and printout

Country-specific standard designations and the associated national calculation values can be selected and displayed in the DEHN Risk Tool software. The results of the risk analysis can be printed as a summary or detailed report in the relevant language.

Country-specific versions

The DEHNsupport Toolbox software is available for the following countries:

- Austria
- Belgium
- Czech Republic
- Croatia
- France
- Germany
- Great Britain
- Hungary
- Italy
- Macedonia
- Poland
- Russia
- Slovakia



* CENELEC: European Committee for Electrotechnical Standardisation, www.cenelec.eu

DEHN Distance Tool: Separation distance

Conventional calculation according to IEC 62305-3

Specific protection measures must be taken to prevent lightning damage. Knowledge evolved from lightning research has also led to improvements in the calculation of the separation distance.

The current IEC 62305-3 standard requires that roof-mounted structures be located within the protected zone using air-termination rods or elevated air-termination systems (elevated ring conductor or spanned cables). The calculated separation distance s must also be taken into account.

The following general equation is used to calculate s:

$$\mathbf{s} = k_i \cdot \frac{k_c}{k_m} \cdot l\ (m)$$

where

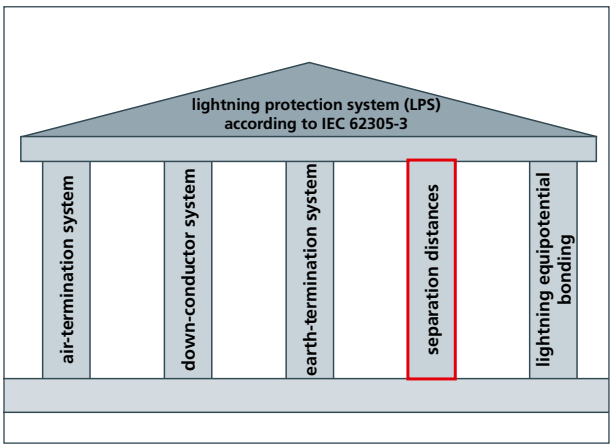
- k_i depends on the class of LPS selected
- k_m depends on the electrical insulation material
- k_c depends on the (partial) lightning current flowing through the air-termination systems and down conductors
- l is the length along the air-termination system or down conductor from the point where the separation distance is to be determined to the nearest equipotential bonding point or the earth-termination system.

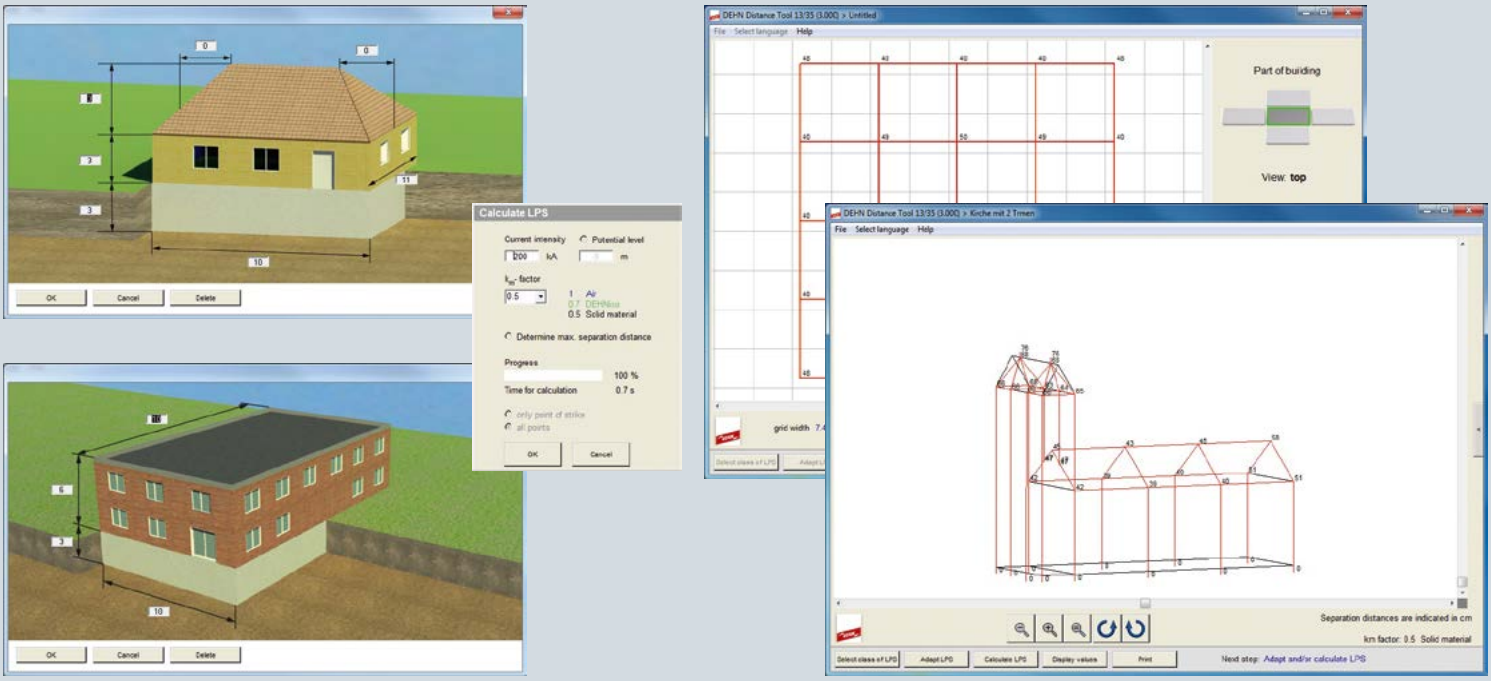
The length l can be disregarded in structures with continuous metal roofs acting as natural down conductor.

Distance version: Calculation according to nodal analysis

The Basic Version can be upgraded to the Distance Version which includes calculation of the separation distance by way of nodal analysis.

Nodal analysis is a method for network analysis used in electrical engineering. A constant earthing resistance is assumed for the calculation (type B earth electrode). Nodal analysis provides much more exact results than conventional calculations according to the IEC 62305-3 standard.





Visualisation as a 3D building model

Automatic calculation of the separation distances and visualisation as a 3D building model
To facilitate the user's work and to save time, building types can be selected from a picture gallery. After selecting and activating a building type, the dimensions of the building can be defined. The separation distances are calculated and shown as a 3D building model after selecting the class of LPS.

Editing a lightning protection system (LPS)
Mesh sizes often cannot be kept and air-termination systems have to be adapted to local conditions. The following changes can be made in the DEHN Distance Tool module:

- inserting ring conductors
- adding down conductors
- inserting internal down conductors
- inserting air-termination rods
- inserting or deleting air-termination conductors and down conductors
- shifting air-termination conductors and down conductors
- shifting or raising the zero potential level
- inserting measuring points
- inserting points of strike
- inserting texts and notes

Free layout of complex buildings
The DEHN Distance Tool module can also cope with complex individual building structures as it allows the integration of various annexes and roof-mounted structures.

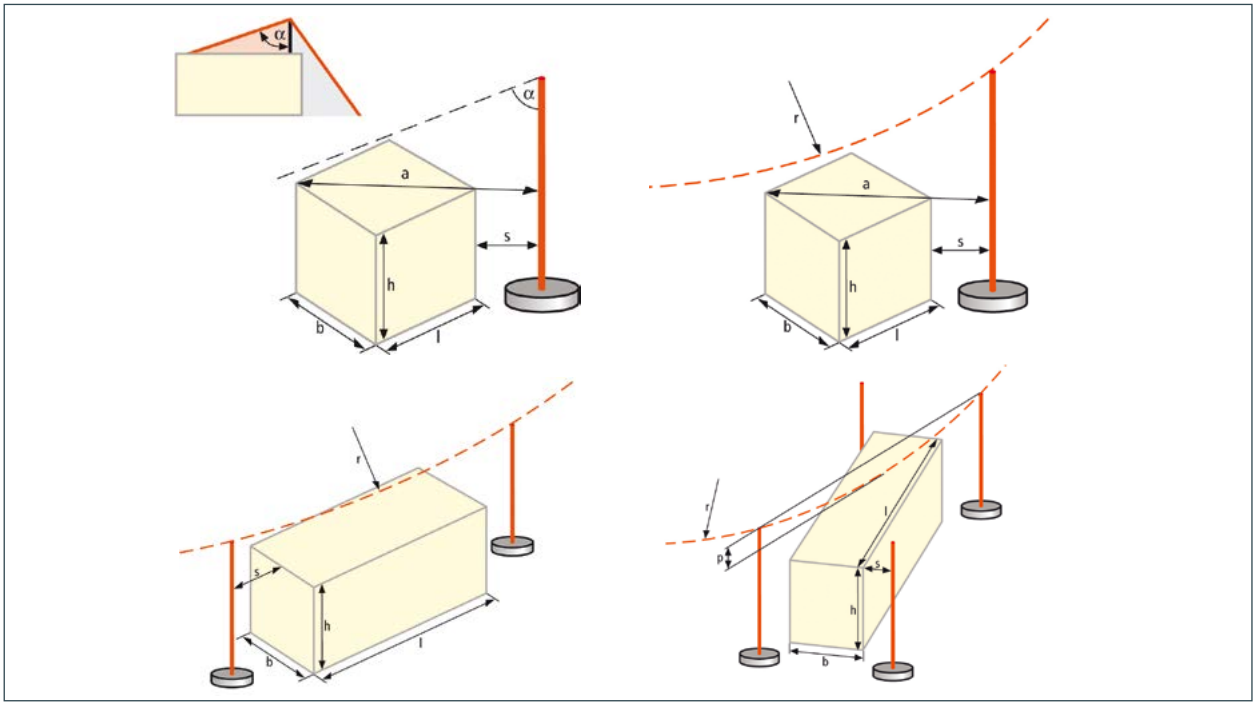
LPS = Lightning Protection System

DEHN Air-Termination Tool: Length of air-termination rods

Determining the length of air-termination rods
Air-termination rods make it possible to integrate large areas in the protected volume of 0_B. The length of air-termination rods can easily be determined using the DEHN Air-Termination Tool. It may be necessary to produce diagrams appropriate to the protection class of LPS. To make life easier for professional users, the software includes calculations for various constellations.

Calculation options:
1. Protective angle method
2. Rolling sphere method for one, two or four air-termination rods
3. Rolling sphere method for four air-termination rods on pitched roof surfaces

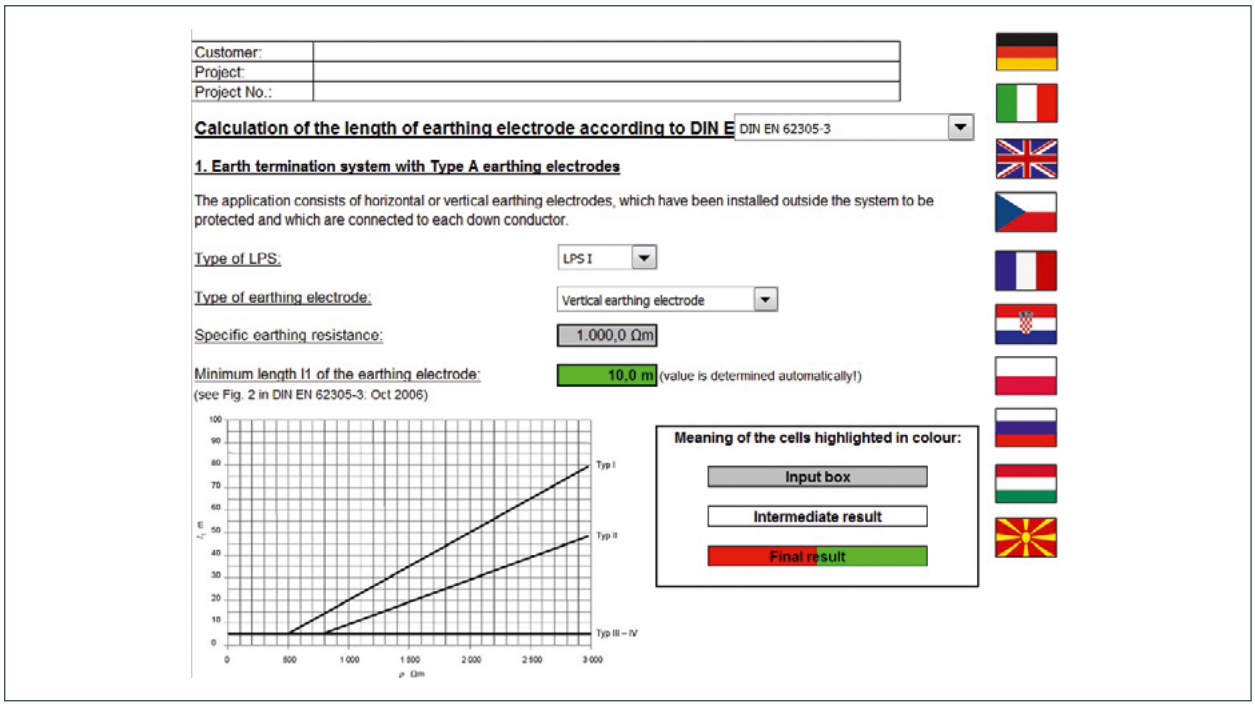
To ensure a technically correct external lightning protection system, the protected volume must be properly dimensioned according to the height of the air-termination rod.



DEHN Earthing Tool: Length of earth electrodes

Calculating the length of earth electrodes

With the DEHN Earthing Tool one can calculate the length of earth electrodes in compliance with IEC 62305-3. In this context, the different types of earth electrodes are important: Foundation earth electrode, ring earth electrode or earth rod. The soil resistivity is also an important factor for determining the required length of the earth electrodes.



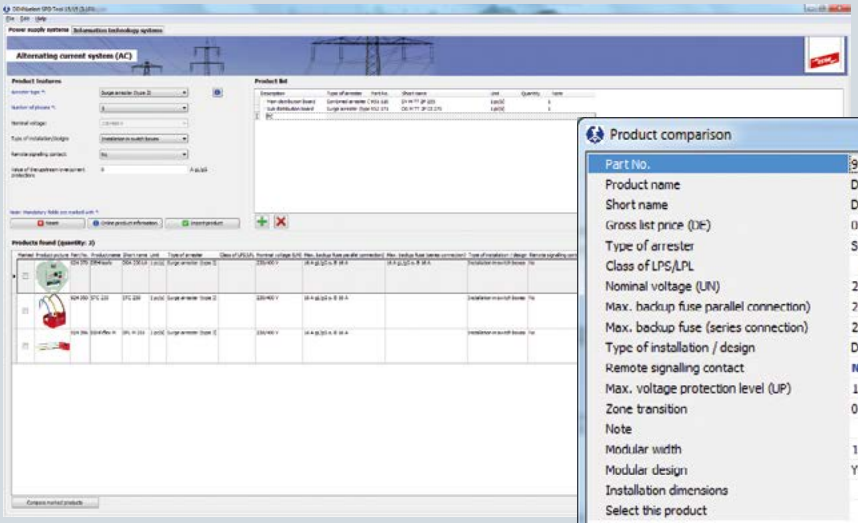
Surges cause damage to the tune of several million euros annually

When lightning strikes, a huge amount of energy is discharged in just a split second. This energy can cause surge damage to electronically controlled devices in a radius of up to two kilometres from the point of strike. Switching overvoltages are also a potential source of damage. These can occur when switching devices or luminaires on and off or as a result of switching operations in the power grid.

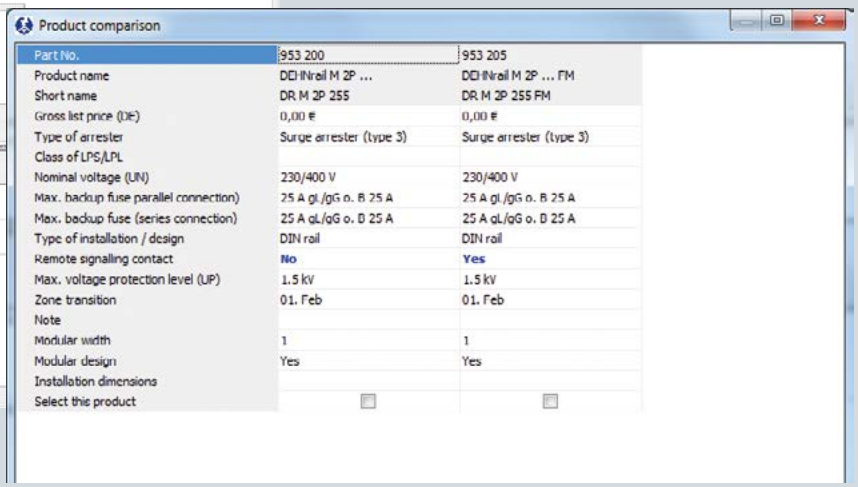
Surges can damage electric devices, for example TVs and telephones, DSL routers, PV systems, etc. Aside from failure of the heating, shutter or light controllers, data may also be lost.

As far as industrial plants or office and administration buildings are concerned failure can bring everything to a standstill and important data may be lost. Expensive equipment, in particular, requires special protection.

A surge protection concept is therefore a prerequisite for safe operation and damage prevention.



Filter function ensures easy product selection



Product comparison

DEHNselect SPD Tool: Planning of internal lightning protection and surge protection measures

The DEHNselect SPD Tool software makes it possible to create a complete surge protection concept for a building in just a few steps.

Surge protective devices can be selected for the following systems:

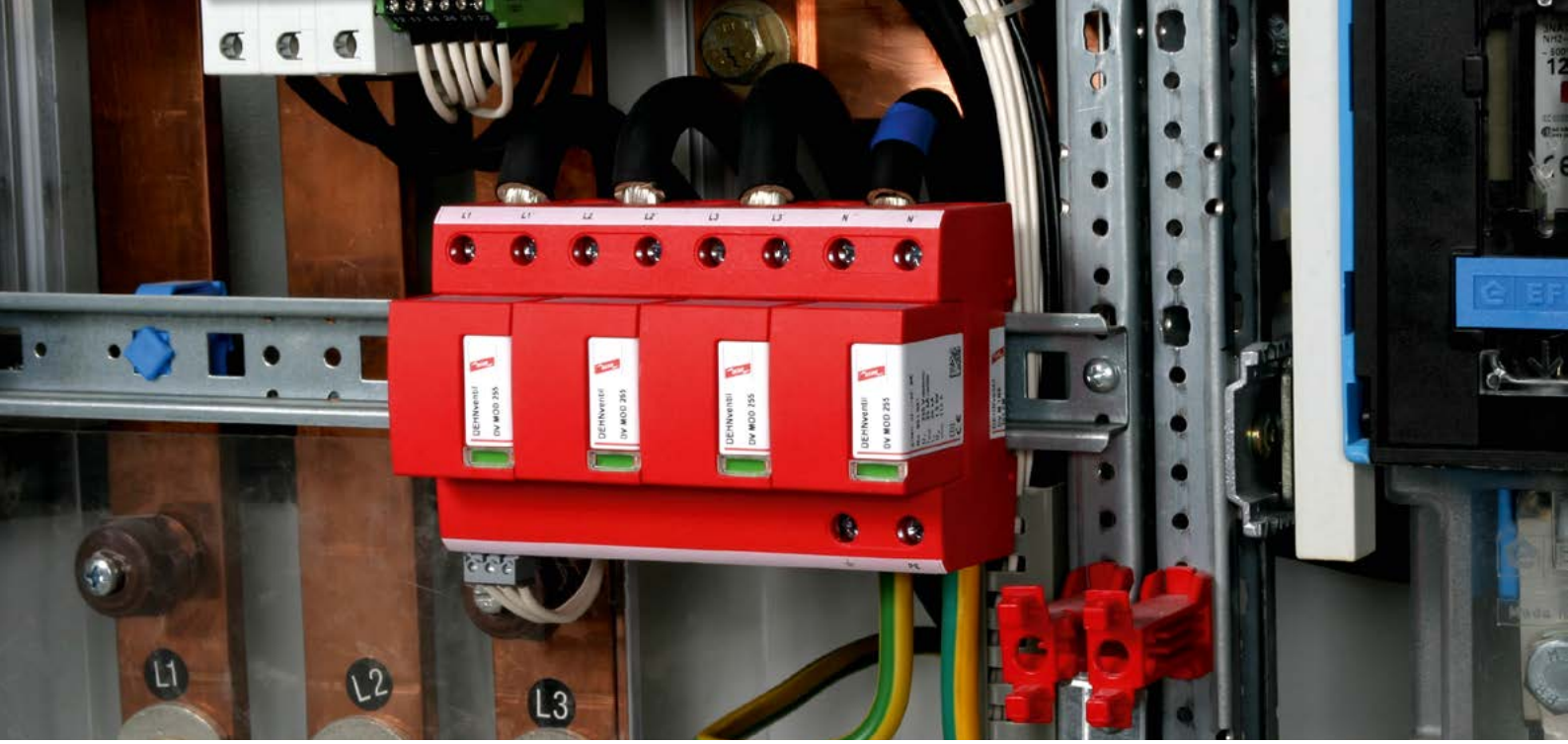
- a.c. systems
- d.c. systems
- data and information technology systems
- photovoltaic systems

Intuitive operation is one of the special features of the DEHNselect SPD Tool which guides the user through the individual areas.

Only a few details need to be entered before the appropriate surge arresters can be filtered out from the wide range available. The questions are quick and easy to answer thanks to the information provided on the topic of surge protection.

The integrated product comparison makes it easier to select the required surge arresters.

The full version of the DEHNselect SPD Tool is included in the demo version of the DEHNsupport Toolbox software which means that all DEHN customers can use the DEHNselect SPD Tool **free of charge**.



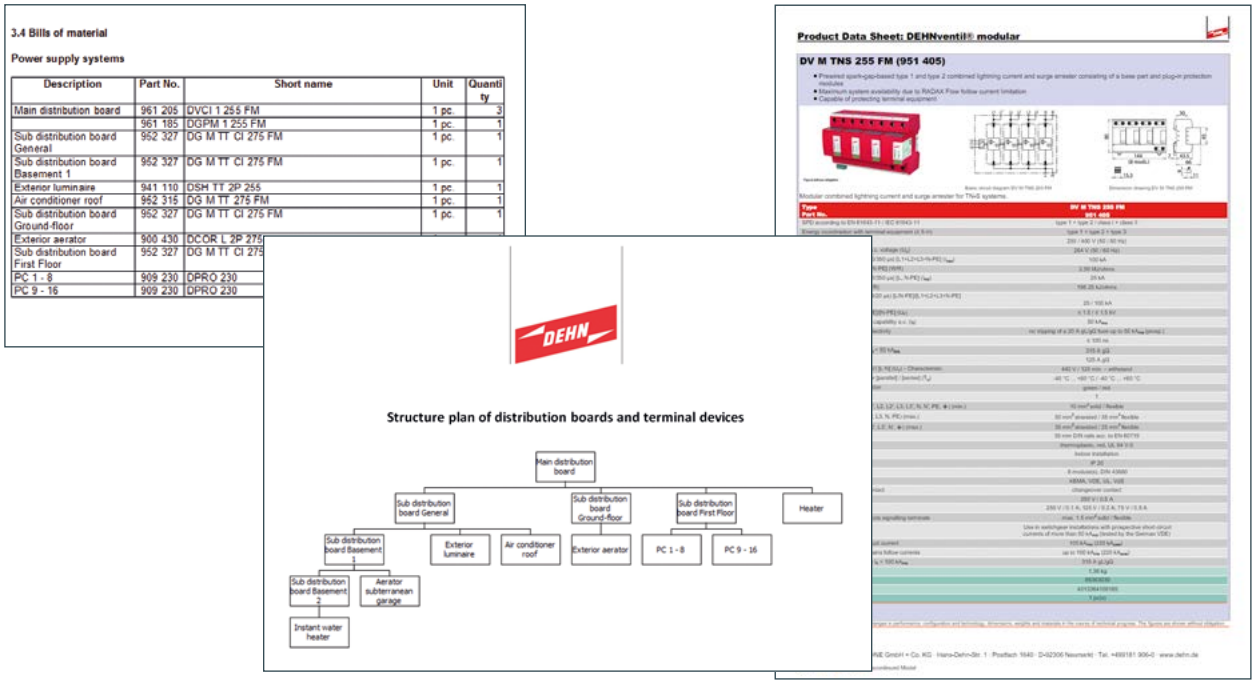
DEHNselect SPD Tool: Planning of internal lightning protection and surge protection

Documentation and printout

The DEHNselect SPD Tool creates a structure plan with a bill of materials. It allows fast online access to information about the selected products, for example data sheets and installation instructions*. These documents offer practical support for correctly implementing a surge protection concept.

Country-specific adaptations

Due to the international requirements, this software module is available in various languages and can thus be internationally distributed.



3.4 Bills of material

Power supply systems

Description	Part No.	Short name	Unit	Quanti ty
Main distribution board	961 205	DVCI 1 255 FM	1 pc.	3
	961 185	DGPM 1 255 FM	1 pc.	1
Sub distribution board General	952 327	DG M TT CI 275 FM	1 pc.	1
Sub distribution board Basement 1	952 327	DG M TT CI 275 FM	1 pc.	1
Exterior luminaire	941 110	DSH TT 2P 255	1 pc.	1
Air conditioner roof	952 315	DG M TT 275 FM	1 pc.	1
Sub distribution board Ground-floor	952 327	DG M TT CI 275 FM	1 pc.	1
Exterior aerator	900 430	DCOR L 2P 275		
Sub distribution board First Floor	952 327	DG M TT CI 275		
PC 1 - 8	909 230	DPRO 230		
PC 9 - 16	909 230	DPRO 230		

Structure plan of distribution boards and terminal devices

Product Data Sheet: DEHNventil® modular

DV M TNS 255 FM (951 405)

* Internet connection must be available.

Ordering information

Different versions of the DEHNsupport Toolbox software are available:

DEHNsupport Basic Version software
Including risk analysis, calculation of earth electrode lengths, calculation of air-termination rod lengths, selection of surge protective devices.

DEHNsupport Distance Edition software
Including risk analysis, calculation of earth electrode lengths, calculation of air-termination rod lengths, calculation of the separation distance according to nodal analysis and selection of surge protective devices.

Upgrade from Basic Version to Distance Edition
An upgrade for calculating the separation distance according to nodal analysis is available for the Basic Version.

Multi-user system
The price of multi-user systems for more than two workplaces depends on the number of users.

Updates
Our software is constantly being modified and adapted. We will inform you about our free updates as soon as they are available.

Ordering information
The DEHNsupport Toolbox software can be ordered directly from DEHN. It includes two single-user licences. Installation on a server is also possible. Please follow the instructions in the software under the menu item "Help".

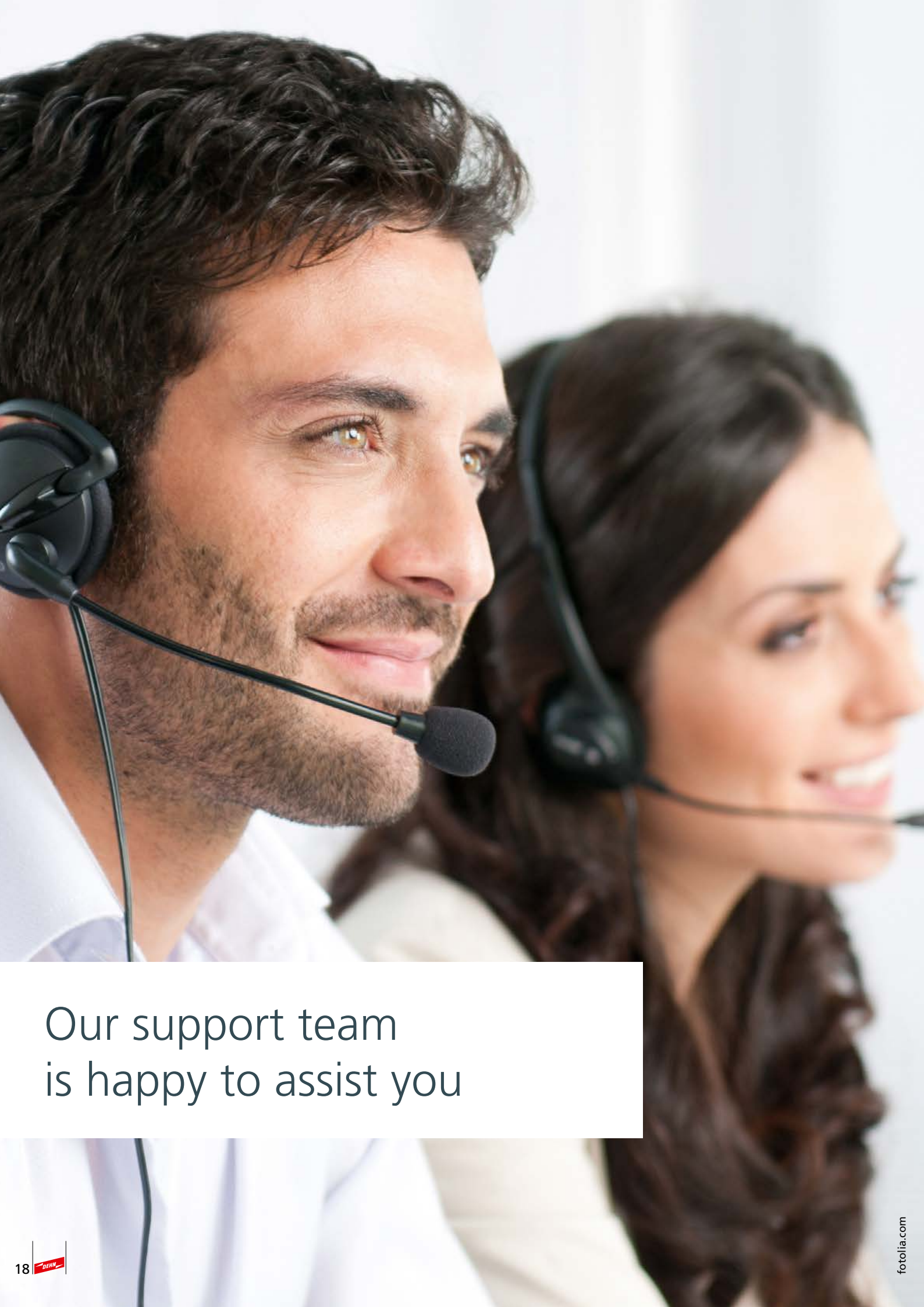
System requirements*

Operating systems:
- Microsoft® Windows® Vista (all versions), 7, 8, 8 Pro, 8.1, 10 Home, 10 Pro, 10 Enterprise

Minimum hardware requirements:
- Intel®/AMD® processor or compatible processor
- Hard disc storage: 1 GB
- 2000 MHz, 2GB RAM (Windows® Vista)
- 2000 MHz, 2GB RAM (Windows® 7/8/8.1/10)
- Screen resolution: 1024x768 pixels
- VGA graphics card: 64 MB
- 100 MBit/s network connection for multi-user systems

Software requirements:
- Microsoft® Excel®

* Microsoft, Windows and Excel are registered trademarks of the Microsoft Corporation, USA. Intel is a registered trademark of the Intel Corporation, USA.



Our support team is happy to assist you

fotolia.com

More know-how and support

Brief instructions
The individual steps of a risk analysis are described in our brief instructions.

We are here to support you!
We are happy to assist you in case of application queries. Please call
+49 9181 906-1601.

Our support team also provides assistance in case of technical problems. Please call +49 9181 906-1594.

Or simply send an e-mail with your questions to dehnsupport@dehn.de

DEHNsupport Toolbox

www.dehn-international.com/partners

Surge Protection
Lightning Protection
Safety Equipment
DEHN protects.®

DEHN + SÖHNE
GmbH + Co.KG.

Hans-Dehn-Str. 1
P. O. Box 1640
92306 Neumarkt
Germany

Phone +49 9181 906-0
Fax +49 9181 906-1100
info@dehn.de
www.dehn.de

DEHNsupport Toolbox

Follow us on Facebook, LinkedIn, YouTube, Google+, Xing.

DS709/E/1017