



State of the art for the installation of lightning protection systems

1.1 Installation standards

With the new IEC 62305 (EN 62305) standard series, the state of the art in the field of lightning protection is incorporated in a uniform and updated international (European) standard. The actual lightning protection standards (IEC 62305-3 (EN 62305-3) and IEC 62305-4 (EN 62305-4)) are preceded by two general standard parts (IEC 62305-1 (EN 62305-1) and 62305-2 (EN 62305-2)) (Table 1.1.1). The supplements to the German standards include important national information (Table 1.1.2).

IEC 62305-1 (EN 62305-1): General principles

This part contains information about the risk of lightning strikes, lightning characteristics and the resulting parameters for simulating the effects of lightning strikes. In addition, an overview of the IEC 62305 (EN 62305) standard series is given. Procedures and protection principles, which form the basis for the following parts, are explained.

IEC 62305-2 (EN 62305-2): Risk management

Risk management in accordance with IEC 62305-2 (EN 62305-2) includes a risk analysis to determine whether lightning protection is required. A technically and economically optimum protection measure is then defined. Finally, the

remaining residual risk is determined. Starting with the unprotected state of the building, the remaining risk is reduced and reduced until it is below the tolerable risk. This method can be both used for a simple determination of the class of LPS in accordance with IEC 62305-3 (EN 62305-3) and to establish a complex protection system against lightning electromagnetic impulses (LEMP) in accordance with IEC 62305-4 (EN 62305-4).

Supplement 1 of the German DIN EN 62305-2 standard (Supplement 1 of the German VDE 0185-305-2 standard): Lightning threat in Germany

This supplement includes a map of the ground flash density N_g in Germany. N_g is required for a risk analysis according to IEC 62305-2 (EN 62305-2).

Supplement 2 of the German DIN EN 62305-2 standard (Supplement 2 of the German VDE 0185-305-2 standard): Calculation assistance for assessment of risk for structures

This supplement includes a calculation assistance for assessing the risk according to IEC 62305-2 (EN 62305-2) to protect structures and persons according to IEC 62305-3 (EN 62305-3) as well as electrical and electronic systems in structures according to IEC 62305-4 (EN 62305-4).

Classification	Title
IEC 62305-1 (EN 62305-1):2010-12	Protection against lightning Part 1: General principles
IEC 62305-2 (EN 62305-2):2010-12	Protection against lightning Part 2: Risk management
IEC 62305-3 (EN 62305-3):2010-12	Protection against lightning Part 3: Physical damage to structures and life hazard
IEC 62305-4 (EN 62305-4):2010-12	Protection against lightning Part 4: Electrical and electronic systems within structures

Table 1.1.1 Lightning protection standards valid since December 2010

Standard	Supplement	Title
DIN EN 62305-2	1	Lightning threat in Germany
	2	Calculation assistance for assessment of risk for structures
	3	Additional information for the application of DIN EN 62305-2 (VDE 0185-305-2)
DIN EN 62305-3	1	Additional information for the application of DIN EN 62305-3 (VDE 0185-305-3)
	2	Additional information for special structures
	3	Additional information for the testing and maintenance of lightning protection systems
	4	Use of metallic roofs in lightning protection systems
	5	Lightning and overvoltage protection for photovoltaic power supply systems
DIN EN 62305-4	1	Sharing of the lightning current

Table 1.1.2 Supplements to the German DIN EN 62305 standard

Supplement 3 of the German DIN EN 62305-2 standard (Supplement 3 of the German VDE 0185-305-2 standard): Additional information for the application of DIN EN 62305-2 (VDE 0185-305-2)

This supplement includes information and figures to make it easier to use and understand the standard and considers new findings.

IEC 62305-3 (EN 62305-3): Physical damage to structures and life hazard

This part deals with the protection of structures and persons from material damage and life-threatening situations caused by the effects of lightning currents or dangerous sparking, especially in the event of direct lightning strikes. A lightning protection system comprising external lightning protection (air-termination system, down-conductor system and earth-termination system) and internal lightning protection (lightning equipotential bonding and separation distance) serves as a protection measure. The lightning protection system is defined by its class of LPS, class of LPS I being more effective than class of LPS IV. The class of LPS required is determined with the help of a risk analysis carried out in accordance with IEC 62305-2 (EN 62305-2), unless otherwise laid down in regulations (e.g. building regulations).

Supplement 1 of the German DIN EN 62305-3 standard (Supplement 1 of the German VDE 0185-305-3 standard): Additional information for the application of DIN EN 62305-3 (VDE 0185-305-3)

Supplement 1 provides more detailed information on Annex E "Guidelines for the design, construction, maintenance and inspection of lightning protection systems" of the standard. It focuses on the dimensioning of the air-termination system, use of metal components, positioning of air-termination conductors and rods, use of protected volumes, etc. Moreover, information on the fire behaviour of construction materials and components is provided. To define the scope of the standard, the fields where special regulations apply are listed (e.g. railway systems, electrical transmission, distribution and generation systems outside a structure, pipelines, vehicles, ships, aircrafts and offshore systems).

Moreover, different terms and definitions were defined more exactly (e.g. down-conductor system, earth electrode, lightning equipotential bonding) and notes on the correct use of aluminium conductors mounted on, in or under the surface, mortar and concrete were added. The note that it is **basically** not allowed to use aluminium in the ground is paramount. The use of connecting lines for single earth electrodes is explained based on several sample figures.

Protection measures against touch and step voltage and the use of gutters, downpipes and steel columns, natural earth

electrodes, manually or industrially produced components and corrosion protection measures were also added or illustrated in figures.

Supplement 2 of the German DIN EN 62305-3 standard (Supplement 2 of the German VDE 0185-305-3 standard): Additional information for special structures

This supplement includes information on special structures such as hospitals, sports grounds, swimming baths, silos with potentially explosive areas, high-rack warehouses, sewage plants and biogas plants, thus taking into account the technological development over the last years.

Supplement 3 of the German DIN EN 62305-3 standard (Supplement 3 of the German VDE 0185-305-3 standard): Additional information for the testing and maintenance of lightning protection systems

This supplement gives information on the inspection of lightning protection systems and provides flow charts. Moreover, terms and their meaning (e.g. lightning protection specialist) are defined. This supplement includes figures on the different measuring methods for inspecting lightning protection systems (contact resistance, earth resistance) and information on the documentation.

Supplement 4 of the German DIN EN 62305-3 standard (Supplement 4 of the German VDE 0185-305-3 standard): Use of metallic roofs in lightning protection systems

Metallic roofs can be used as a natural component of a lightning protection system. The aim of this supplement is to provide additional information on the use of metallic roofs according to the IEC 62305 (EN 62305) standard.

Supplement 5 of the German DIN EN 62305-3 standard (Supplement 5 of the German VDE 0185-305-3 standard): Lightning and overvoltage protection for photovoltaic power supply systems

This supplement describes the protection of photovoltaic power supply systems in case of lightning interference and surges of atmospheric origin. The requirements and measures for ensuring the protection, operation and availability of photovoltaic power supply systems are described.

IEC 62305-4 (EN 62305-4): Electrical and electronic systems within structures

This part deals with the protection of structures with electrical and electronic systems against the effects of the lightning electromagnetic impulse. Based on the protection measures according to IEC 62305-3 (EN 62305-3), this standard also considers the effects of electrical and magnetic fields as well

as induced voltages and currents caused by direct and indirect lightning strikes.

The importance and necessity of this standard derive from the increasing use of different electrical and electronic systems, which are referred to as information systems. To protect these information systems, the structure is divided into lightning protection zones (LPZs). This allows to consider local differences in number, type and sensitivity of the electrical and electronic devices when choosing the protection measures. For each lightning protection zone, a risk analysis in accordance with IEC 62305-2 (EN 62305-2) is performed to select those protection measures which provide optimum protection at minimum cost.

The IEC 62305 (EN 62305) standards Parts 1 to 4 can be used to design, install, inspect and maintain lightning protection systems for structures, their installations, their contents and the persons within.

1.2 Work contracts

A work contractor is fundamentally liable for ensuring that his service is free of deficiencies. Compliance with the recognised engineering rules is the decisive starting point for work and service free of deficiencies. Relevant national standards are used here in order to fill the factual characteristic of the "recognised engineering rules" with life. If the relevant standards are complied with, it is presumed that the work and service is free of deficiencies. The practical significance of such a prima facie evidence lies in the fact that a customer who lodges a complaint of non-conform service by the work contractor (for example for the installation of a lightning protection system) has basically little chance of success if the work contractor can show that he complied with the relevant technical standards. As far as this effect is concerned, standards and preliminary standards carry equal weight. The effect of the presumption of technical standards is removed, however, if either the standards are withdrawn, or it is proven that the actual standards no longer represent the state of the art. Standards cannot statically lay down the state of the recognised engineering rules in tablets of stone as technical requirements and possibilities are continually changing. If standards are withdrawn and replaced with new standards or preliminary standards, it is primarily the new standards which correspond to the state of the art. National supplements reflect the recognised state of the art. Contractors and those placing an order for work regularly agree that the work must conform to the general state of the art without the need to make specific mention of this. If the work shows a negative deviation from this general state of the art, it is faulty. This can result in a claim being made against the contractor for material defect liability. The material defect

liability only exists, however, if the work was already faulty at the time of acceptance! Circumstances occurring subsequently – such as a further development of the state of the art – do not belatedly make the previously accepted, defect-free work faulty!

For the question of the deficiency of work and service, the state of the recognised engineering rules at the time of the acceptance is the sole deciding factor.

Since, in the future, only the new lightning protection standards will be relevant at the time of completion and acceptance of lightning protection systems, they have to be installed in accordance with these standards. It is not sufficient that the service conformed to the engineering rules at the time it was provided, if, between completion of a contract, service provision and acceptance of the construction work, the technical knowledge and hence the engineering rules have changed.

Thus, works which have been previously installed and already accepted under the old standards do not become defective because, as a result of the updating of the standards, a "higher technical standard" is demanded.

With the exception of lightning protection systems for nuclear facilities, lightning protection systems have only to conform to the state of the art at the time they are installed, i.e. they do not have to be updated to the latest state of the art. Existing systems are inspected in the course of maintenance tests according to the standards in force at the time they were installed.

1.3 Product standards

Materials and components for lightning protection systems must be designed and tested for the electrical, mechanical and chemical stress (e.g. corrosion) which has to be expected during use. This affects both the components of the external and internal lightning protection system.

IEC 62561-1 (EN 62561-1): Lightning protection system components (LPSC) – Requirements for connection components

This standard describes test procedures for metal connection components. Components falling within the scope of this standard are:

- ➔ Clamps
- ➔ Connectors
- ➔ Connection components
- ➔ Bridging components
- ➔ Expansion pieces
- ➔ Test joints

DEHN clamps and connectors meet the requirements of this test standard.

IEC 62561-2 (EN 62561-2): Lightning protection system components (LPSC) – Requirements for conductors and earth electrodes

This standard specifies the requirements on conductors, air-termination rods, earth lead-in rods and earth electrodes.

IEC 62561-3 (EN 62561-3): Lightning protection system components (LPSC) – Requirements for isolating spark gaps (ISG)

IEC 62561-4 (EN 62561-4): Lightning protection system components (LPSC) – Requirements for conductor fasteners

IEC 62561-5 (EN 62561-5): Lightning protection system components (LPSC) – Requirements for earth electrode inspection housings and earth electrode seals

IEC 62561-6 (EN 62561-6): Lightning protection system components (LPSC) – Requirements for lightning strike counters (LSC)

IEC 62561-7 (EN 62561-7): Lightning protection system components (LPSC) – Requirements for earthing enhancing compounds

IEC 61643-11 (EN 61643-11): Surge protective devices connected to low-voltage power systems – Requirements and test methods

This standard describes the requirements on, and inspections of, surge protective devices (SPDs) to ensure protection against the effects of indirect and direct lightning strikes or other transients.

IEC 61643-12 (CLC/TS 61643-12): Surge protective devices connected to low-voltage power distribution systems – Selection and application principles

This standard/technical specification must be used together with the IEC 61643-11 (EN 61643-11) standard and includes information on parameters which are required for the correct selection of surge protective devices. It also provides information on the selection and coordination of SPDs. In this context, the entire operating environment of the SPDs used such as equipment to be protected, system properties, insulation lev-

els, types of surges, installation methods, place of installation of SPDs, coordination of SPDs, types of faults of SPDs and the consequences in case of failure of the equipment to be protected must be taken into account. The standard/technical specification describes the principles for the selection, operation, place of installation and coordination of SPDs connected to 50/60 Hz a.c. systems and equipment with nominal voltages up to 1000 V (r.m.s. value). This standard/technical specification only covers SPDs in electrical installations of buildings. Surge protective devices installed in devices are not taken into account.

IEC 61643-21 (EN 61643-21): Surge protective devices connected to telecommunications and signalling networks

This standard describes the performance requirements and test procedures for surge protection devices used for the protection of telecommunications and signalling networks including

- ➔ Data networks
- ➔ Voice transmission networks
- ➔ Emergency alarm systems and
- ➔ Automation systems

IEC 61643-22 (CLC/TS 61643-22): Low-voltage surge protective devices – Surge protective devices connected to telecommunications and signalling networks – Selection and application principles

This standard/technical specification describes the principles for the selection and application of surge protective devices (SPDs) used to protect telecommunications and signalling networks.

IEC 61663-1 (EN 61663-1): Lightning protection – Telecommunication lines – Fibre optic installations

IEC 61663-2 (EN 61663-2): Lightning protection – Telecommunication lines – Lines using metallic conductors

Supplement 1 of the German DIN VDE 0845 standard (Supplement 1 of the German VDE 0845 standard): Overvoltage protection of information technology equipment (IT installations)

This supplement provides additional information on how to protect IT installations against surges. Normative requirements are included in IEC 61663-1 (EN 61663-1), IEC 61663-2 (EN 61663-2) and IEC 61643-21 (EN 61643-21).



