

Surge Protective Devices (SPDs)

protection against transient overvoltages

Protection against lightning and overvoltages

Protection against the effects of lightning is essentially based on:

- Protecting buildings using a lightning protection system (LPS or lightning conductors) to catch lightning strikes and to drive the lightning current to earth.
- The use of surge protective devices (SPDs) to protect equipment.
- The design of the earthing system (passive protection of the installation).

Throughout the world, there are millions of lightning strikes each day in the summer (up to 1000 lightning strikes/second). Lightning is responsible for 25% to 40% of all damage to equipment. When added to industrial overvoltages (switching overvoltages due to the operation of internal equipment), they account for more than 60% of all electrical damages, which can be prevented by installing SPDs (according to the country and type of installation - source: insurance companies).

In some countries, and depending on the end use of the building, national regulations may always stipulate the installation of SPDs (for example, Germany, Austria, Norway, etc.). If there are no specific national regulations, SPDs are usually specified by national installation standards (based on HD/IEC 60364 international installation standards) and EN/IEC 62305 standards.

External lightning protection system (LPS) or lightning conductors: protection of buildings (EN/IEC 62305)

An external lightning protection system (LPS) protects buildings against direct lightning strikes. It is generally based on the use of lightning conductors (single rod, with sparkover device, meshed cage, etc.) and/or the metallic structure of the building.

If there is an LPS or if a lightning risk assessment has been carried out in accordance with EN/IEC 62305 standards, SPDs are generally required in the main distribution board (T1 or T1+T2 SPDs) and distribution boards (T2 SPDs).

Determination of the SPDs in the main distribution board in accordance with EN/IEC 62305 and TS/IEC 61643-12 (if there is insufficient information available):

| LPL ¹ : Lightning protection level | Total lightning current of the LPS | Min. value of Imp current of the SPD (T1 or T1+T2) | Usage practices |
|---|------------------------------------|--|---------------------|
| I | 200 kA | 25 kA/pole (IT: 35kA min.) | Power installations |
| II | 150 kA | 18.5 kA/pole | Rarely used |
| III/IV | 100 kA | 12.5 kA/pole | Small installations |

1: LPL (Lightning Protection Level)

Surge protective device (SPD) (internal protection)

The SPD

- Protects sensitive devices against overvoltages caused by lightning and industrial overvoltages, by limiting the overvoltages to values that are tolerated by the equipment
- Limits the possible harmful consequences in terms of the safety of people (medical equipment installed in the home, security systems, environmental systems, etc.)
- Maximises the continuity of operation of equipment and limits production losses

SPDs and standards

Standards EN/IEC 61643-11

| Type of SPD | | Test waves |
|-------------|---------------|---|
| EN 61643-11 | IEC 61643-11 | |
| Type 1 (T1) | Class I (T1) | limp: 10/350 µs (discharge current) In: 8/20 µs (nominal current, 15 shocks) |
| Type 2 (T2) | Class II (T2) | Imax: 8/20 µs (discharge current) In: 8/20 µs (nominal current, 15 shocks) |

T1+T2 SPDs: tested in accordance with both methods.

T1 or T1+T2 SPDs are increasingly used at the supply origin of installations, even when there is no lightning conductor, as they enable higher energies to be discharged and increase the service life of the SPD.

HD/IEC 60364 electrical installation standards

According to articles 443 and 534 of HD/IEC 60364 standards from year 2015 and the TS/IEC 61643-12 guides, the use of SPDs in new or renovated buildings is compulsory for buildings with:

- Risks for human life, e.g. safety services, medical care facilities, hospitals...
- Public services and cultural heritage, e.g. loss of public services, data centres, museums, religious buildings, ...
- Commercial or industrial activities, e.g. hotels, banks, industries, commercial markets, farms, ...
- With direct lightning protection and/or designed according to EN/IEC 62305-2 (with LPS: T1 or T1+T2 SPDs, limp ≥ 12.5 kA)

- Receiving large number of persons, e.g. large residential, offices, schools, ... (Europe)

In the case of small buildings, e.g. small commercial buildings, houses, small multi-family buildings, ..., a risk analysis shall be realized (article 443.5). If this is not done, SPDs are made mandatory by HD/IEC 60364 installation standards.

Countries still following earlier versions of HD/IEC installation standards:

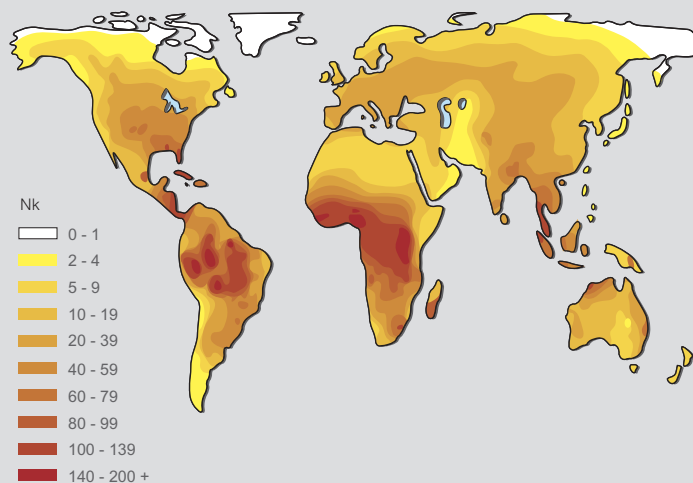
According to articles 443 and 534 of HD/IEC 60364 standards and the TS/IEC 61643-12 guides, the use of SPDs in new or renovated buildings is compulsory at the supply origin of the installation in the following cases:

- Buildings with lightning conductors or LPS (T1 or T1+T2 SPDs, limp ≥ 12.5 kA)
- Buildings with totally or partially overhead power supplies in AQ2 geographical areas (article 443.3.2.1 - AQ2: Nk > 25, see map below) and based on a risk assessment taking into account the type of power supply to the building (article 443.3.2.2)

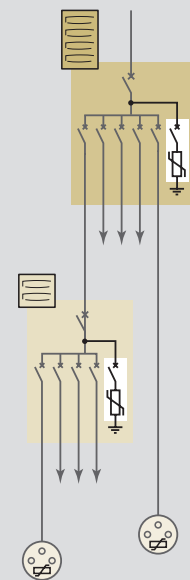
According to article 443.3.2.2, SPDs (Type 2) are also required in the following cases:

- Commercial/industrial buildings, public buildings and services, religious buildings, schools and large residential complexes, etc.
- Hospitals and buildings containing medical equipment and/or safety services for people and property (fire alarm, technical alarms, etc.)

Important: it is advisable to install an SPD when the safety of people may depend on the continuity of service of equipment (even if this is not required by national standards). Although not compulsory according to national installation standards, an SPD should always be installed to protect the communication equipment when there is an SPD on the low voltage power network.



Protection of distribution boards and sensitive equipment (cascaded protection)



Effective protection against overvoltages cannot generally be assured with a single SPD if its protection level (U_p) is greater than 1.2 kV (EN/IEC 62305 and TS/IEC 61643-12).

When there are overvoltages, an SPD protects equipment by limiting these overvoltages to values that can be tolerated by the equipment. Thus, depending on its discharge capacity (discharge current I_{max} , etc.) and its protection level (U_p), an SPD will limit these overvoltages to varying values depending on the energy levels involved. The overvoltage values that may be transmitted downstream of the SPD may double over distances of more than 10 m due to resonances associated with the type of electrical installation and the type of equipment. Overvoltages greater than 2.5 kV may then occur and damage equipment if the residual energy is high enough (2.5 kV being the insulation level of most electrical and electronic equipment, or typically 1.5 kV for electrical domestic appliances).

SPDs should be installed in the distribution boards supplying equipment that is sensitive or critical for the activity being carried out (and/or near to equipment with proximity SPDs).