IEC 60364-4-44

Edition 2.0 2015-09

INTERNATIONAL STANDARD

NORME INTERNATIONALE

colour inside

AMENDMENT 1
AMENDEMENT 1

Low-voltage electrical installations – Part 4-44: Protection for safety – Protection against voltage disturbances and electromagnetic disturbances

Installations électriques à basse tension – Partie 4-44: Protection pour assurer la sécurité – Protection contre les perturbations de tension et les perturbations électromagnétiques

IEC 60364-4-44:2007-08/AMD1:2015-09(en-fr)

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FOREWORD

This amendment has been prepared by IEC technical committee 64: Electrical installations and protection against electric shock.

The text of this amendment is based on the following documents:

FDIS	Report on voting
64/2032/FDIS	64/2073/RVD

Full information on the voting for the approval of this amendment can be found in the report on voting indicated in the above table.

The committee has decided that the contents of this amendment and the base publication will remain unchanged until the stability date indicated on the IEC web site under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

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FOREWORD

Add the following new text:

The reader's attention is drawn to the fact that Annex C lists all of the “in-some-country” clauses on differing practices of a less permanent nature relating to the subject of this standard.

440.2 Normative references

Replace the date of IEC 60038 from "1983" *to* "2009".

Add the following new references:

IEC 60364-5-53:2001, *Electrical installations of buildings - Part 5-53: Selection and erection of electrical equipment - Isolation, switching and control*
IEC 60364-5-53:2001/AMD1:2002
IEC 60364-5-53:2001/AMD2:2015

IEC 61643-11:2011, *Low-voltage surge protective devices – Part 11: Surge protective devices connected to low-voltage power systems – Requirements and test methods*

IEC 61643-22, *Low-voltage surge protective devices – Part 22: Surge protective devices connected to telecommunications and signalling networks – Selection and application principles*

IEC 62305 (all parts), *Protection against lightning*

443 Protection against overvoltages of atmospheric origin or due to switching

Replace the existing Clause 443, including its title, by the following new title and text:

443 Protection against transient overvoltages of atmospheric origin or due to switching

443.1 General

Clause 443 specifies requirements for protection of electrical installations against transient overvoltages of atmospheric origin transmitted by the supply distribution system including direct strikes to the supply system and against switching overvoltages. Clause 443 does not specify requirements for protection against transient overvoltage due to direct or nearby lightning strokes on the structure.

NOTE 1 For risk management for protection against transient overvoltage due to direct or nearby lightning strokes on the structure, see IEC 62305-2.

In general, switching overvoltages have lower amplitude than transient overvoltages of atmospheric origin and therefore the requirements regarding protection against transient overvoltages of atmospheric origin normally cover protection against switching overvoltages.

If no transient overvoltage protection against disturbances of atmospheric origin is installed, protection against switching overvoltages may need to be provided.

NOTE 2 Overvoltages due to switching can be longer in duration and can contain more energy than the transient overvoltages of atmospheric origin. See 443.4.

The characteristics of transient overvoltages of atmospheric origin depend on factors such as:

– the nature of the supply distribution system (underground or overhead);
– the possible existence of at least one surge protective device (SPD) upstream of the origin of the installation;
– the voltage level of the supply system.

NOTE 3 As regards transient overvoltages of atmospheric origin, no distinction is made between earthed and unearthed systems.

Protection against transient overvoltages is provided by the installation of surge protective devices (SPDs).

Selection and installation of SPDs shall be in compliance with Clause 534 of IEC 60364-5-53:2001, IEC 60364-5-53:2001/AMD1:2002 and IEC 60364-5-53/AMD2:2015.

If there is a need for SPDs on the power supply lines, additional SPDs on other lines such as telecom lines are also recommended.

Requirements for protection against transient overvoltages transmitted by data transmission systems are not covered by Clause 443. See IEC 61643-22.

Clause 443 does not apply to installations where the consequences caused by overvoltages affect:

a) structures with risk of explosion;

b) structures where the damage may also involve the environment (e.g. chemical or radioactive emissions).

443.2 Void

443.3 Terms and definitions

443.3.1
urban environment
area with a high density of buildings or densely populated communities with tall buildings

Note 1 to entry: A town centre is an example of an urban environment.

443.3.2
suburban environment
area with a medium density of buildings

Note 1 to entry: Town outskirts are an example of a suburban environment.

443.3.3
rural environment
area with a low density of buildings

Note 1 to entry: The countryside is an example of a rural environment.

443.3.4
surge protective device
SPD

device that contains at least one non-linear component that is intended to limit surge voltages and divert surge currents

Note 1 to entry: An SPD is a complete assembly, having appropriate connecting means.

Note 2 to entry: This note applies to the French language only.

[SOURCE: IEC 61643-11:2011, 3.1.1]

443.3.5
calculated risk level
CRL
calculated value of risk used to evaluate the need for transient overvoltage protection

Note 1 to entry: This note applies to the French language only.

443.3.6

rated impulse voltage
U_W
impulse withstand voltage value assigned by the manufacturer to the equipment or to a part of it, characterizing the specified withstand capability of its insulation against transient overvoltages.

[SOURCE: IEC 60664-1:2007, 3.9.2, Modified — symbol added]

443.4 Overvoltage control

Protection against transient overvoltage shall be provided where the consequence caused by overvoltage affects:

a) human life, e.g. safety services, medical care facilities;

b) public services and cultural heritage, e.g. loss of public services, IT centres, museums;

c) commercial or industrial activity, e.g. hotels, banks, industries, commercial markets, farms.

For all other cases, a risk assessment according to 443.5 shall be performed in order to determine if protection against transient overvoltage is required. If the risk assessment is not performed, the electrical installation shall be provided with protection against transient overvoltage.

However the transient overvoltage protection is not required for single dwelling units where the total economic value of the electrical installation to be protected is less than 5 times the economic value of the SPD located at the origin of the installation.

NOTE 1 National Committees can modify the exception criteria related to single dwelling units or to not apply it.

Protection against switching overvoltages should be considered in the case of equipment likely to produce switching overvoltages or disturbances exceeding the values according to the overvoltage category of the installation e.g. where a LV generator supply the installation or where inductive or capacitive loads (e.g. motors, transformers, capacitor banks, etc.), storage units or high current loads are installed.

NOTE 2 Annex B provides guidance for overvoltage control where utility provided SPDs are installed on overhead lines.

For a low-voltage installation supplied from a high-voltage distribution network through a separate transformer (i.e. an industrial application), additional means for protection against overvoltages due to lightning should be installed on the high-voltage side of the transformer.

443.5 Risk assessment method

NOTE 1 For protection of a structure and its electrical systems against lightning and surges of atmospheric origin, IEC 62305 applies

Calculated risk level (CRL) is used to determine if protection against transient overvoltages of atmospheric origin is required. The CRL is found by the following formula

$$CRL = f_{env} / (L_P \times N_g)$$

where

– f_{env} is an environmental factor and the value of f_{env} shall be calculated according to Table 443.1.

Table 443.1 – Calculation of f_{env}

Environment	f_{env}
Rural and suburban environment	85 × F
Urban environment	850 × F

The value of coefficient F shall be taken equal to 1 for all installations. However, National Committees may adjust the value of coefficient F from 1 to 3 for dwellings.

– N_g is the lightning ground flash density (flash per km^2 per year) relevant to the location of the power line and connected structure;

NOTE 2 According to IEC 62305-2:2010, Clause A.1, 25 thunderstorm days per year are equivalent to a value of 2,5 flashes per km^2 per year. This is derived from the formula N_g = 0,1 × Td, where Td is the number of thunderstorm days per year (keraunic level).

– the risk assessment length L_P is calculated as below:

$$L_P = 2\ L_{PAL} + L_{PCL} + 0{,}4\ L_{PAH} + 0{,}2\ L_{PCH}$$

where

L_{PAL} is the length (km) of low-voltage overhead line;

L_{PCL} is the length (km)of low-voltage underground cable;

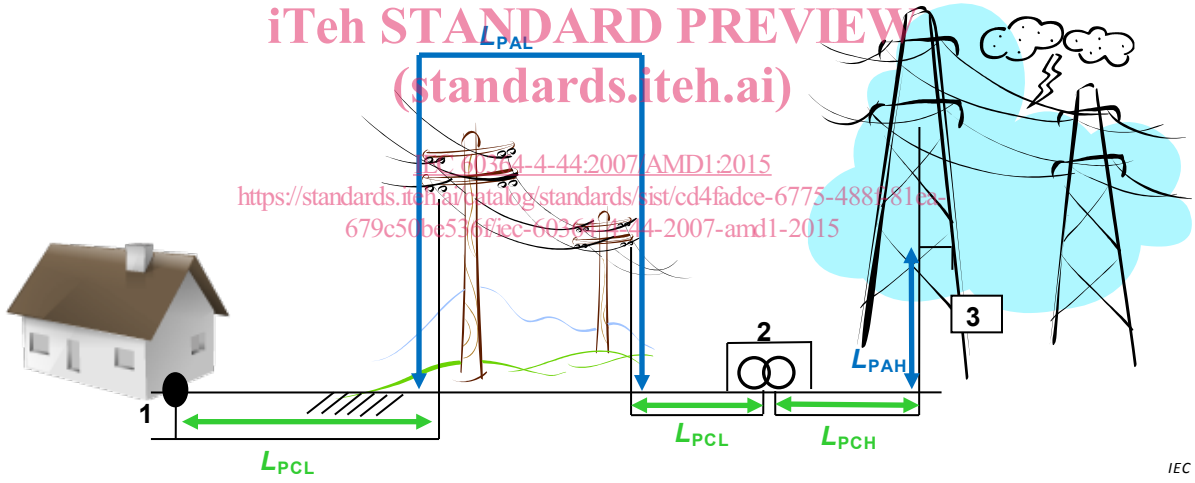
L_{PAH} is the length (km)of high-voltage overhead line;

L_{PCH} is the length (km)of high-voltage underground cable.

The total length ($L_{PAL} + L_{PCL} + L_{PAH} + L_{PCH}$) is limited to 1 km or by the distance from the first overvoltage protective device installed in the power network to the entrance of the installation whichever is the smaller.

If the distribution networks lengths are totally or partially unknown then L_{PAL} shall be taken equal to the remaining distance to reach a total length of 1 km.

For example, if only the distance of underground cable is known (e.g. 100 m), then the L_{PAL} shall be taken equal to 90 m. An illustration of an installation showing the lengths to consider is given in Figure 443.1.



Key

1 origin of the installation

2 LV/HV transformer

3 surge arrestor (overvoltage protective device)

Figure 443.1 – Illustration of an installation showing the lengths to consider

If CRL ≥ 1 000, no protection against transient overvoltages of atmospheric origin is needed;

If CRL < 1 000, protection against transient overvoltages of atmospheric origin is required.

NOTE 3 Examples of calculations of CRL are given in Annex A.

443.6 Classification of rated impulse voltages (overvoltage categories)

443.6.1 Purpose of classification of rated impulse voltages (overvoltage categories)

Clause 443.6 gives information on the overvoltage category of the equipment.

NOTE 1 Overvoltage categories are defined within electrical installations for the purpose of insulation coordination and a related classification of equipment with rated impulse voltages is provided (see IEC 60364-5-53:2001/AMD2:2015, Table 534.1).

The rated impulse voltage is used to classify equipment energized directly from the low-voltage electrical installation into overvoltage category.

Rated impulse voltages for equipment selected according to the nominal voltage are provided to distinguish different levels of availability of equipment with regard to continuity of service and an acceptable risk of failure.

Inherent overvoltage control based only on the impulse voltage withstand of the equipment in accordance with IEC 60664-1 might not be sufficient, because:

– transient overvoltages transmitted by the supply distribution system are not significantly attenuated downstream in most installations. Insulation coordination can be achieved in the whole installation, by transient overvoltage protection of the equipment corresponding to the classified rated impulse voltage, reducing the risk of failure to an acceptable level;

– in installations supplied by a completely buried low-voltage system not including overhead lines, surge currents and partial lightning currents are distributed via the underground cables;

– equipment is often connected to two different services, e.g. power line and data line. Field experience shows that much surge related damage is experienced on this kind of equipment.

It is necessary to consider the rated impulse voltage U_W (see IEC 60664-1) of the most sensitive equipment to be protected in the system or, in cases where a temporary loss of function of equipment is critical, the equipment level immunity (see IEC 61000-4-5).

443.6.2 Rated impulse voltages of equipment and overvoltage categories

The following points shall be noted:

a) Equipment with a rated impulse voltage corresponding to overvoltage category IV is suitable for use at, or in the proximity of, the origin of the installation, for example upstream of the main distribution board. Equipment of category IV has a very high impulse withstand capability providing the required high degree of reliability, and shall have a rated impulse voltage not less than the value specified in Table 443.2.

NOTE 1 Examples of such equipment include electricity meters, primary overcurrent protective devices and ripple control units.

b) Equipment with a rated impulse voltage corresponding to overvoltage category III is suitable for use in the fixed installation downstream of and including the main distribution board, providing a high degree of availability, and shall have a rated impulse voltage not less than the value specified in Table 443.2.

NOTE 2 Examples of such equipment include distribution boards, circuit-breakers, wiring systems (see IEC 60050-826:2004, 826-15-01), including cables, busbars, junction boxes, switches, socket-outlets) in the fixed installation, and equipment for industrial use and some other equipment, e.g. stationary motors with permanent connection to the fixed installation.

c) Equipment with a rated impulse voltage corresponding to overvoltage category II is suitable for connection to the fixed installation, providing a degree of availability normally required for current-using equipment, and shall have a rated impulse voltage not less than the value specified in Table 443.2.

NOTE 3 Examples of such equipment include household appliances and similar loads.

d) Equipment with a rated impulse voltage corresponding to overvoltage category I is only suitable for use in the fixed installation where SPDs are installed outside the equipment to limit transient overvoltages to the specified level, and shall have a rated impulse voltage not less than the value specified in Table 443.2. Therefore, equipment with a rated impulse voltage corresponding to overvoltage category I should preferably not be installed at or near the origin of installation.

NOTE 4 Examples of such equipment include those containing electronic circuits like computers, home electronics, etc.

Table 443.2 – Required rated impulse voltage of equipment U_W

Nominal voltage of the installation [a] V	**Voltage line to neutral derived from nominal voltages a.c. or d.c. up to and including** V	**Required rated impulse voltage of equipment** [c] kV			
		Overvoltage category IV (equipment with very high rated impulse voltage)	**Overvoltage category III (equipment with high rated impulse voltage)**	**Overvoltage category II (equipment with normal rated impulse voltage)**	**Overvoltage category I (equipment with reduced rated impulse voltage)**
		For example, energy meter, telecontrol systems	For example, distribution boards, switches socket-outlets	For example, distribution domestic appliances, tools	For example, sensitive electronic equipment
120/208	150	4	2,5	1,5	0,8
230/400 [b, d] 277/480 [b]	300	6	4	2,5	1,5
400/690	600	8	6	4	2,5
1 000	1 000	12	8	6	4
1 500 d.c.	1 500 d.c.			8	6

[a] According to IEC 60038:2009.

[b] In Canada and USA, for voltages to earth higher than 300 V, the rated impulse voltage corresponding to the next highest voltage in this column applies.

[c] This rated impulse voltage is applied between live conductors and PE.

[d] For IT systems operations at 220-240 V, the 230/400 row shall be used, due to the voltage to earth at the earth fault on one line.

Annex A – Explanatory notes concerning 442.1 and 442.2

Replace the existing Annex A, including its title, by the following new Annex A and new title:

Annex A
(informative)

Examples of calculated risk level CRL for the use of SPDs

A.1 Example 1 – Building in rural environment

Ground flash density N_g = 1

Environmental factor f_{env} = 85

Risk assessment length $L_P = 2\ L_{PAL} + L_{PCL} + 0{,}4\ L_{PAH} + 0{,}2\ L_{PCH}$

$= (2 \times 0{,}4) + (0{,}4 \times 0{,}6)$

$= 1{,}04$

where

L_{PAL} is the length (km) of low-voltage overhead line= 0,4;

L_{PAH} is the length (km) of high-voltage overhead line= 0,6;

L_{PCL} is the length (km) of low-voltage underground cable = 0;

L_{PCH} is the length (km) of high-voltage underground cable = 0.

$CRL = f_{env} / (L_P \times N_g) = 85 / (1{,}04 \times 1) = 81{,}7$

In this case, SPD protection shall be installed as the CRL is less than 1 000.

A.2 Example 2 – Building in rural environment powered in HV

Ground flash density N_g = 0,4

Environmental factor f_{env} = 85

Risk assessment length $L_P = 2\ L_{PAL} + L_{PCL} + 0{,}4\ L_{PAH} + 0{,}2\ L_{PCH}$

$= 0{,}2 \times 1$

$= 0{,}2$

where

L_{PAL} is the length (km) of low-voltage overhead line = 0;

L_{PAH} is the length (km) of high-voltage overhead line = 0;

L_{PCL} is the length (km) of low-voltage underground cable = 0;

L_{PCH} is the length (km) of high-voltage underground cable= 1.

$CRL = f_{env} / (L_P \times N_g) = 85 / (0{,}2 \times 0{,}4) = 1\ 062{,}5$

In this case, SPD protection is not mandatory as the CRL is greater than or equal to 1 000.

A.3 Example 3 – Building in urban environment powered by overhead lines

Ground flash density N_g = 1

Environmental factor f_{env} = 850

Risk assessment length $L_P = 2\ L_{PAL} + L_{PCL} + 0{,}4\ L_{PAH} + 0{,}2\ L_{PCH}$

$= 2 \times 0{,}4 + 0{,}4 \times 0{,}6$

$= 1{,}04$

where

L_{PAL} is the length (km) of low-voltage overhead line = 0,4;

L_{PAH} is the length (km) of high-voltage overhead line = 0,6;

L_{PCL} is the length (km) of low-voltage underground cable = 0;

L_{PCH} is the length (km) of high-voltage underground cable = 0.

CRL = f_{env} / ($L_P \times N_g$) = 850 / (1 × 1,04) = 817

In this case, SPD protection shall be installed as the CRL is less than 1 000.

A.4 Example 4 – Building in urban environment powered by underground cables

Ground flash density N_g = 0,5

Environmental factor f_{env} = 850

Risk assessment length $L_P = 2\ L_{PAL} + L_{PCL} + 0{,}4\ L_{PAH} + 0{,}2\ L_{PCH}$

= 1

where

L_{PAL} is the length (km) of low-voltage overhead line = 0;

L_{PAH} is the length (km) of high-voltage overhead line = 0;

L_{PCL} is the length (km) of low-voltage underground cable= 1;

L_{PCH} is the length (km) of high-voltage underground cable = 0.

CRL = f_{env} / ($L_P \times N_g$) = 850 / (1 × 0,5) = 1 700.

In this case, an SPD is not mandatory as the CRL is greater than or equal to 1 000.

Annex B – Guidance for overvoltage control by SPDs applied to overhead lines

Replace the existing Annex B, including its title by the following new Annex B and new title: