IEC 60364-5-53

Edition 3.0 2015-09

INTERNATIONAL STANDARD

NORME INTERNATIONALE

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AMENDMENT 2
AMENDEMENT 2

Electrical installations of buildings –
Part 5-53: Selection and erection of electrical equipment – Isolation, switching and control

Installations électriques des bâtiments –
Partie 5-53: Choix et mise en oeuvre des matériels électriques – Sectionnement, coupure et commande

IEC 60364-5-53:2001-08/AMD2:2015-09(en-fr)

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Installations électriques des bâtiments – Partie 5-53: Choix et mise en oeuvre des matériels électriques – Sectionnement, coupure et commande

INTERNATIONAL ELECTROTECHNICAL COMMISSION

COMMISSION ELECTROTECHNIQUE INTERNATIONALE

ICS 29.130; 91.140.50

ISBN 978-2-8322-2883-8

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
64/2031/FDIS	64/2072/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 website 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- withdrawn,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.

IMPORTANT – The 'colour inside' logo on the cover page of this publication indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.

FOREWORD

Replace the existing text, including the text provided in Amendment 1:2002 that reads:

"This publication has been drafted, as close as possible, in accordance with the ISO/IEC Directives, Part 3"

by the following new sentence:

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

Delete, from both IEC 60364-5-53:2001 and from Amendment 1:2002, the sentence that reads "Annexes A, B, C and D are for information only."

530.2 Normative references

Add the following new references:

IEC 60038, *IEC standard voltages*

IEC 60364-5-54, *Low-voltage electrical installations – Part 5-54: Selection and erection of electrical equipment – Earthing arrangements and protective conductors*

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 62305 (all parts), *Protection against lightning*

IEC 62305-1, *Protection against lightning – Part 1: General principles*

IEC 62305-2, *Protection against lightning – Part 2: Risk management*

IEC 62305-4, *Protection against lightning – Part 4: Electrical and electronic systems within structures*

Replace the current reference to "IEC 61643-12" *by the following:*

IEC 61643-12:2008, *Low-voltage surge protective devices – Part 12: Surge protective devices connected to low-voltage power distribution systems – Selection and application principles*

Replace the existing date "2001" *for IEC 60364-4-41 by* "2005"

Replace the existing date "2001" *for IEC 60364-4-43 by* "2008"

Replace the existing date "2001" *for IEC 60364-4-44 by* "2007"

Replace the existing date "1996" *for IEC 61008-1 by* "2010"

534 Devices for protection against electromagnetic and voltage disturbances

Replace the existing title and text of Clause 534, including the text provided in Amendment 1:2002, by the following new title and text:

534 Devices for protection against transient overvoltages

534.1 General

This clause contains provisions for the application of voltage limitation in order to obtain insulation coordination in the cases described in IEC 60364-4-44, IEC 60664-1, IEC 62305-1, IEC 62305-4 and IEC 61643-12.

This clause focuses mainly on the requirements for the selection and erection of SPDs for protection against transient overvoltages where required by Clause 443 of IEC 60364-4-44:2007, the IEC 62305 series, or as otherwise specified.

This clause does not take into account:

– surge protective components which may be incorporated in the appliances connected to the installation;

– portable SPDs.

NOTE Further information can be found in IEC 61643-12.

This clause applies to a.c. power circuits. As far as it is applicable, the requirements of this clause may be followed for d.c. power circuits.

534.2 Void

534.3 Terms and definitions

534.3.1
SPD assembly
one SPD or a set of SPDs, in both cases including all SPD disconnectors required by the SPD manufacturer, providing the required overvoltage protection for a type of system earthing

534.3.2
SPD disconnector
disconnector
device for disconnecting an SPD, or part of an SPD, from the power system

Note 1 to entry: This disconnecting device is not required to have isolating capability for safety purposes. It is to prevent a persistent fault on the system and is used to give an indication of an SPD's failure. Disconnectors can be internal (built in) or external (required by the manufacturer). There may be more than one disconnector function, for example an over-current protection function and a thermal protection function. These functions may be in separate units.

[SOURCE: IEC 61643-11:2011, 3.1.28]

534.3.3
mode of protection of an SPD
intended current path, between terminals that contains protective components, e.g. line-to-line, line-to-earth, line-to-neutral, neutral-to-earth

[SOURCE: IEC 61643-11:2011, 3.1.8]

534.3.4
follow current interrupt rating
I_{fi}
prospective short-circuit current that an SPD is able to interrupt without operation of a disconnector

[SOURCE: IEC 61643-11:2011, 3.1.39]

534.3.5
short-circuit current rating
I_{SCCR}
maximum prospective short-circuit current from the power system for which the SPD, in conjunction with the disconnector specified, is rated

[SOURCE: IEC 61643-11:2011, 3.1.27]

534.3.6
voltage protection level
U_P
maximum voltage to be expected at the SPD terminals due to an impulse stress with defined voltage steepness and an impulse stress with a discharge current with given amplitude and waveshape

Note 1 to entry: The voltage protection level is given by the manufacturer and may not be exceeded by:

– the measured limiting voltage determined for front-of-wave sparkover (if applicable) and the measured limiting voltage determined from the residual voltage measurements at amplitudes corresponding to I_n and/or I_{imp} respectively for test classes II and/or I;

– the measured limiting voltage at the open circuit voltage of the combination wave generator (U_{OC}), determined for the combination wave for test class III.

[SOURCE: IEC 61643-11:2011, 3.1.14]

534.3.7
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 MOD]

534.3.8
maximum continuous operating voltage
U_C
maximum r.m.s. voltage, which may be continuously applied to the SPD's mode of protection

Note 1 to entry: The U_C value covered by this standard may exceed 1 000 V.

[SOURCE: IEC 61643-11:2011, 3.1.11]

534.3.9
nominal discharge current for class II test
I_n
crest value of the current through the SPD having a current waveshape of 8/20

[SOURCE: IEC 61643-11:2011, 3.1.9]

534.3.10
impulse discharge current for class I test
I_{imp}
crest value of a discharge current through the SPD with specified charge transfer *Q* and specified energy *W/R* in the specified time

[SOURCE: IEC 61643-11:2011, 3.1.10]

534.3.11
two-port SPD
SPD having specific series impedance connected between separate input and output connections

[SOURCE: IEC 61643-11:2011, 3.1.3]

534.4 Selection and erection of SPDs

534.4.1 SPD location and SPD test class

SPDs shall at least be installed as close as possible to the origin of the installation. For protection against effects of lightning and against switching overvoltages, class II tested SPDs shall be used.

Where the structure is equipped with an external lightning protection system or protection against effects of direct lightning is otherwise specified, class I tested SPDs shall be used.

Where the structure is not equipped with an external lightning protection system and where the occurrence of direct lightning strike to the overhead lines between the last pole and the entrance of the installation is to be taken into consideration, class I tested SPDs at or near the origin of the electrical installation may be also selected according to Annex B.

NOTE 1 The origin of the installation could be the location where the supply enters the building or the main distribution board.

NOTE 2 Following the product standard, the marking of the product is as follows:

- for test class I: either “test class I” and/or “T1“ (T1 in a square);
- for test class II: either “test class II” and/or “T2“ (T2 in a square);
- for test class III: either “test class III, and/or “T3“(T3 in a square).

Additional class II tested or class III tested SPDs may be needed to sufficiently protect the installation according to 534.4.4.2 and shall be located downstream in the fixed electrical installation, for example in the sub-distribution boards or at the socket outlets. These SPDs shall not be used without SPDs being installed at the origin of the installation and shall be coordinated with SPDs located upstream (see 534.4.4.5).

If a class I tested SPD is not able to provide protection according to 534.4.4.2, it shall be accompanied by a coordinated class II tested or class III tested SPD to ensure the required voltage protection level.

Additional class II tested SPDs or class III tested SPDs may be needed close to sensitive equipment to sufficiently protect the equipment according to Table 534.1 and shall be coordinated with SPDs located upstream.

NOTE 3 Such additional SPDs may be part of the fixed electrical installation or may be portable SPDs.

Additional SPDs may be necessary to provide transient overvoltage protection regarding threats coming from other sources such as:

– switching overvoltages produced by current using equipment located within the installation;

– overvoltages on other incoming services such as telephone lines, internet connections;

– overvoltages on other services feeding other structures such as secondary buildings, external installations/lighting, power lines feeding external sensors;

in which case one should consider installing SPDs located as close as possible to the origin of such threats. More information may be found in IEC 61643-12.

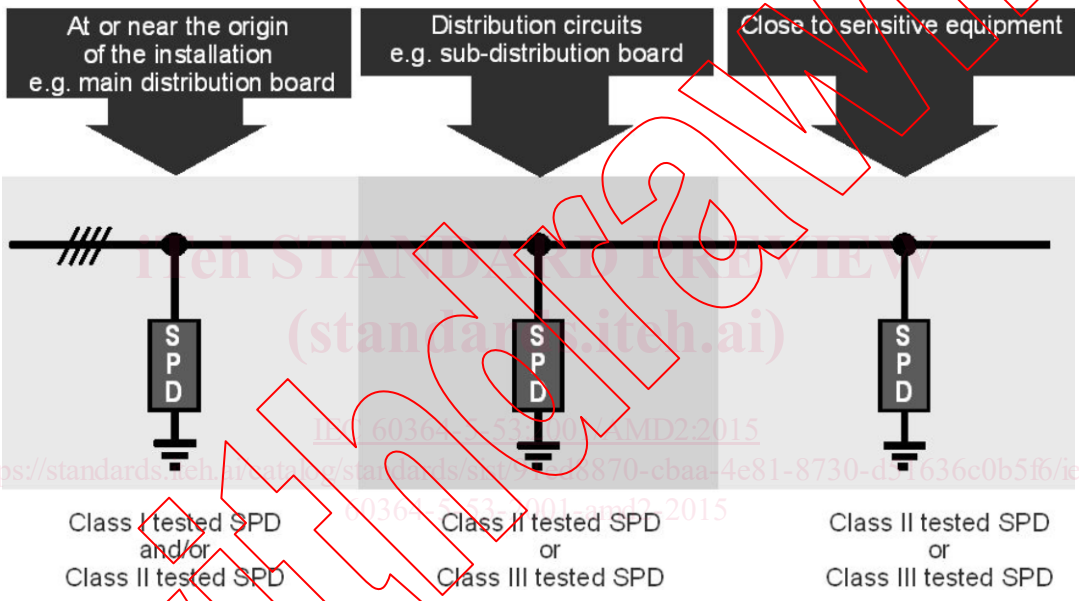


Figure 534.1 – Example of installation of class I, class II and class III tested SPDs

The presence of SPDs installed downstream of a distribution board (e.g. in a socket-outlet) shall be permanently indicated (e.g. by a label) in this distribution board.

534.4.2 Transient overvoltage protection requirements

Protection against transient overvoltages may be provided:

– between live conductors and PE (common mode protection);

– between live conductors (differential mode protection)

NOTE 1 Connection type CT1 provides primarily common mode protection. If differential mode protection is also necessary, this will in most cases require additional SPDs between live conductors.

NOTE 2 Connection type CT2 provides a combination of common mode protection and differential mode protection.

Protection between live conductors and PE (including neutral to PE if there is a neutral conductor) is compulsory.

Protection between line conductors and neutral (if there is a neutral conductor) is recommended to ensure equipment protection.

Protection between line conductors (in the case of multiple phases) is optional.

Some equipment may require both common mode protection (for impulse withstand) and differential mode protection (for impulse immunity).

NOTE 3 For example, electronic class I equipment or class II equipment with FE-connection requires common mode as well as differential mode protection to ensure overall protection against transient overvoltages due to switching or from atmospheric origin.

534.4.3 Connection types

Connection type CT1 (e.g. 3+0 or 4+0-configuration): SPD assembly providing a mode of protection between each live conductor (line and neutral conductors, if available) and PE or between each line conductor and PEN.

Two examples of connection type CT1 for application in a three-phase system are represented in Figure 534.2 and in Figure 534.3.

Connection type CT2 (e.g. 3+1-configuration): SPD assembly providing a mode of protection between each line conductor and the neutral conductor, and between the neutral conductor and PE.

An example of connection type CT2 for application in a three-phase system is represented in Figure 534.4

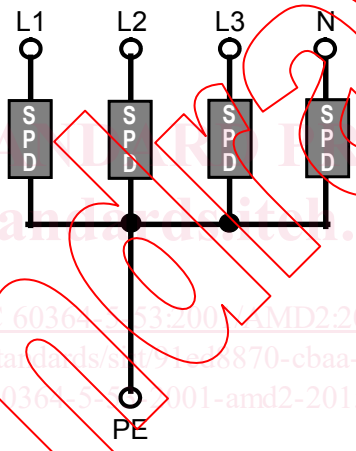


Figure 534.2 – Connection type CT1 (4+0-configuration) for a three-phase system with neutral

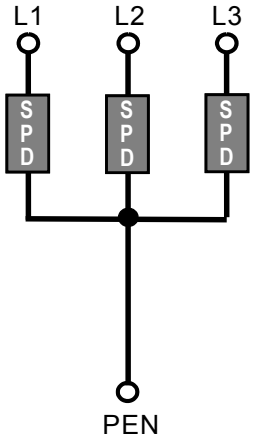


Figure 534.3 – Connection type CT1 (3+0-configuration) for a three-phase system

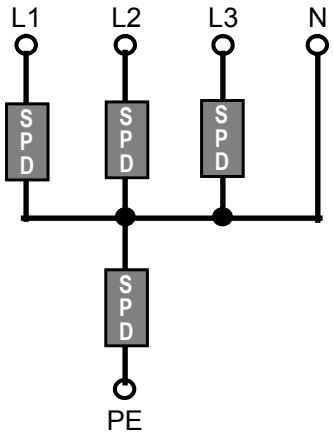


Figure 534.4 – Connection type CT2 (e.g. 3+1-configuration) for a three-phase system with neutral

When assembling SPDs, attention should be drawn to the selection of parameters for SPDs connected between N and PE, depending on the connection type.

In TN-S or TN-C-S systems, the SPD between neutral and PE may be omitted if the distance between the separation point of PE to N and the location of the installed SPDs is less than 0,5 m or if the separation point and the SPDs are located in the same distribution board.

If a line conductor is earthed, it is considered to be technically equivalent to a neutral conductor for the application of this subclause. However correct choice of the SPD parameters requires special considerations in such case.

534.4.4 Selection of SPDs

534.4.4.1 General

The selection of SPDs shall be based on the following parameters:

– voltage protection level (U_p) and rated impulse voltage (U_W) of equipment to be protected (see 534.4.4.2);

– continuous operating voltage (U_c), i.e. supply system (TT, TN, IT) (see 534.4.4.3);

– nominal discharge current (I_n) and impulse discharge current (I_{imp}) (see 534.4.4.4);

– SPD coordination (see 534.4.4.5);

– expected short-circuit current (see 534.4.4.6);

– follow current interrupting rating (see 534.4.4.7).

SPDs shall comply with the requirements of IEC 61643-11.

NOTE Additional information regarding selection and application is given in IEC 61643-12.

534.4.4.2 Selection of voltage protection level (U_p) as a function of equipment rated impulse voltage (U_W)

The voltage protection level U_p of SPDs shall be selected in accordance with required rated impulse voltage according to overvoltage category II of Table 534.1. In order to provide adequate protection of equipment, the voltage protection level between live conductors and PE shall in no case exceed the required rated impulse voltage of the equipment according to Table 534.1.

NOTE 1 Where only overvoltage category III or IV equipment is to be protected, reference is made to the required rated impulse voltage of Table 443.2.

Where protection between line conductors and PE is provided by a series connection of SPD protection modes (e.g. single mode SPDs, line–to-neutral + neutral-to-PE, according CT2), this series connection shall fulfill the above voltage protection level requirement.

Where such combined voltage protection level between line conductor and PE is not provided in the data sheet of the manufacturer, it shall be calculated by addition of the voltage protection levels given for the individual SPDs modes of protection, which are connected in series.

It is recommended that the voltage protection level provided by SPDs does not exceed 80 % of the required rated impulse voltage for equipment according to Table 534.1 and corresponding to overvoltage category II, but shall in no case exceed the required rated impulse voltage of the equipment.

This safety margin is not necessary where one of the following cases applies:

– where the equipment is connected directly to the SPD terminals;
– where a protection scheme according Figure 534.9 is already applied;
– where the voltage drop across the overcurrent protection in the SPD branch circuit is already taken into account for the voltage protection level U_p;
– where protection according to overvoltage category II is provided but only overvoltage category III or IV equipment is installed at this location.

NOTE 2 IEC 61643-12 gives additional information about the rated impulse voltage of equipment and the given U_p for the SPD.

Table 534.1 – Required rated impulse voltage of equipment

Nominal voltage of the supply system[a] Three-phase systems	Nominal voltage of the supply system[a] Single -phase systems	Voltage line to neutral from nominal a.c. or d.c. voltages up to and including	Required rated impulse voltage[c] (U_W) of equipment for	
			Overvoltage category II (equipment with normal rated impulse voltage)	Overvoltage category I (equipment with reduced rated impulse voltage)
V	V	V	kV	kV
		50	0,5	0,33
		100	0,8	0,5
	120/240	150	1,5	0,8
230/400 277/480		300	2,5	1,5
400/690		600	4	2,5
1 000		1 000	6	4
		1 500 d.c.	8 [b]	6 [b]

[a] According to IEC 60038;
[b] Recommended values based on Annex D of IEC 60664-2-1:2011;
[c] The rated impulse voltage applies between live conductor and PE.

Additional SPDs between live conductors may be needed to avoid equipment malfunctions. An appropriate voltage protection level needs to be evaluated based on equipment immunity and availability requirements (see IEC 61643-12).

Where the required voltage protection level cannot be met with a single SPD assembly, additional coordinated SPDs shall be applied to ensure the required voltage protection level.

534.4.4.3 Selection of SPDs with regard to continuous operating voltage (U_c)

In a.c., the maximum continuous operating voltage U_c of SPDs shall be equal to or higher than required in Table 534.2.

Table 534.2 – U_c of the SPD dependent on supply system configuration

SPD connected between (as applicable)	System configuration of distribution network		
	TN system	TT system	IT system
Line conductor and neutral conductor	$\frac{1{,}1\ U}{\sqrt{3}}$ or $(0{,}64 \times U)$	$\frac{1{,}1\ U}{\sqrt{3}}$ or $(0{,}64 \times U)$	$\frac{1{,}1\ U}{\sqrt{3}}$ or $(0{,}64 \times U)$
Line conductor and PE conductor	$\frac{1{,}1\ U}{\sqrt{3}}$ or $(0{,}64 \times U)$	$\frac{1{,}1\ U}{\sqrt{3}}$ or $(0{,}64 \times U)$	$1{,}1 \times U$
Line conductor and PEN conductor	$\frac{1{,}1\ U}{\sqrt{3}}$ or $(0{,}64 \times U)$	N/A	N/A
Neutral conductor and PE conductor	$\frac{U}{\sqrt{3}}$ [a]	$\frac{U}{\sqrt{3}}$ [a]	$\frac{1{,}1\ U}{\sqrt{3}}$ or $(0{,}64 \times U)$
Line conductors	$1{,}1\ U$	$1{,}1\ U$	$1{,}1\ U$

NOTE 1 N/A: not applicable.

NOTE 2 U is the line-to-line voltage of the low-voltage system.

[a] These values are related to worst-case fault conditions, therefore the tolerance of 10 % is not taken into account.

534.4.4.4 Selection of SPDs with regard to nominal discharge current (I_n) and impulse discharge current (I_{imp})

At or near the origin of the installation, SPDs shall comply with one of the following cases, as applicable:

– where the building is protected against direct lightning strike, SPDs at the origin of the installation shall be selected according to 534.4.4.4.2 and Table 534.4;

– in other cases, SPDs shall be selected according to 534.4.4.4.1.

Further SPDs installed downstream of the SPDs at or near the origin of the installation shall also comply with the coordination requirements in 534.4.4.5.

Overvoltages due to switching can be longer in duration and can contain more energy than the transient overvoltages of atmospheric origin. This has to be considered for the selection of SPDs with regard to nominal discharge current and impulse discharge current

534.4.4.4.1 Class II tested SPDs

Where class II tested SPD are required at or near the origin of installation, their nominal discharge current shall be not less than that given in Table 534.3.

Table 534.3 – Nominal discharge current (I_n) in kA depending on supply system and connection type

Connection	Supply system			
	Single-phase		Three-phase	
	CT1	CT2	CT1	CT2
L – N		5		5
L – PE	5		5	
N – PE	5	10	5	20

534.4.4.4.2 Class I tested SPDs

Where class I tested SPDs are required at or near the origin of the installation, one of the following cases applies:

a) Where no risk analysis according to IEC 62305-2 has been carried out, the impulse discharge current (I_{imp}) shall be not less than as given in Table 534.4:

Table 534.4 – Selection of impulse discharge current (I_{imp}) where the building is protected against direct lightning strike

Connection	I_{imp} in kA			
	Supply system			
	Single phase		Three phase	
	CT1	CT2	CT1	CT2
L – N		12,5		12,5
L – PE	12,5		12,5	
N – PE	12,5	25	12,5	50
NOTE This table refers to lightning protection levels (LPL) III and IV.				

b) Where the risk analysis according to IEC 62305-2 has been carried out, the impulse discharge current (I_{imp}) shall be determined according to the IEC 62305 series.

534.4.4.5 Coordination of two or several SPDs

Coordination of SPDs in the installation needs to be ensured. The manufacturer's instructions on how to achieve coordination between SPDs shall be followed with reference IEC 61643-12.

534.4.4.6 Selection of SPDs with regard to the short-circuit current rating I_{SCCR}

In general, the short-circuit current rating I_{SCCR} of the SPD, as stated by the manufacturer, shall be not lower than the maximum prospective short-circuit current at the connection points of the SPD assembly. See Figure 534.5

This requirement does not apply to SPDs connected between neutral conductor and PE in TN or TT systems, for which this is already covered by the product standard IEC 61643-11.

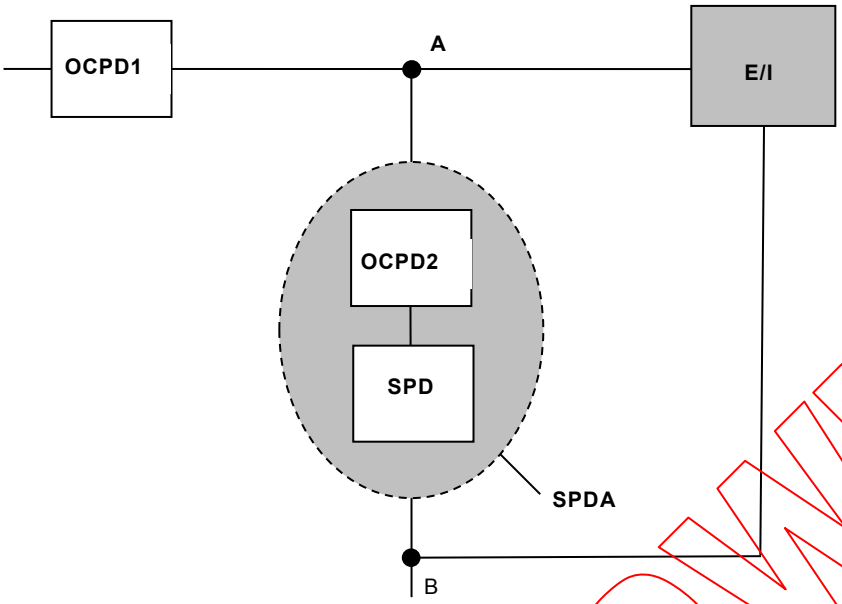
For SPDs connected between the neutral conductor and PE in IT systems, the short-circuit current rating I_{SCCR} of the SPD shall not be lower than the maximum prospective short-circuit current at the connection points of this SPD in case of a double earth fault under worst case conditions.

534.4.4.7 Selection of SPDs with regard to the follow current interrupting rating

In general, the follow current interrupting rating I_{fi} of the SPD, if declared by the manufacturer, shall not be lower than the maximum prospective short-circuit current at the connection points of the SPD assembly. See Figure 534.5.

This requirement does not apply to SPDs connected between neutral conductor and PE conductor in TN or TT systems, for which this is already covered by the product standard IEC 61643-11.

For SPDs connected between the neutral conductor and PE in IT systems, the follow current interrupting rating I_{fi} of the SPD if declared by the manufacturer shall not be lower than the maximum prospective short-circuit current at the connection points of this SPD in case of a double earth fault under worst case conditions.



Key

OCPD1	overcurrent protective device in the installation
OCPD2	overcurrent protective device (SPD disconnector) required by the SPD manufacturer
SPD	surge protective device
SPDA	SPD assembly
A & B	connection points of SPD assembly
E/I	equipment or installation to be protected

Figure 534.5 – Connection points of an SPD assembly

534.4.5 Protection of the SPD against overcurrent

534.4.5.1 General

SPD installations shall be protected against overcurrent with respect to short-circuit currents. This protection may be internal and/or external to the SPD according to the manufacturer's instructions.

The ratings and characteristics of external overcurrent protective device(s) (OCPD) for protecting the SPD assembly shall be selected:

– according to Clause 434; and

– as high as possible, to ensure a high surge current capability for the complete assembly

but not exceeding the ratings and characteristics as required in the SPD manufacturer's installation instructions for the maximum overcurrent protection.

534.4.5.2 Arrangement of SPDs with relation to overcurrent protection

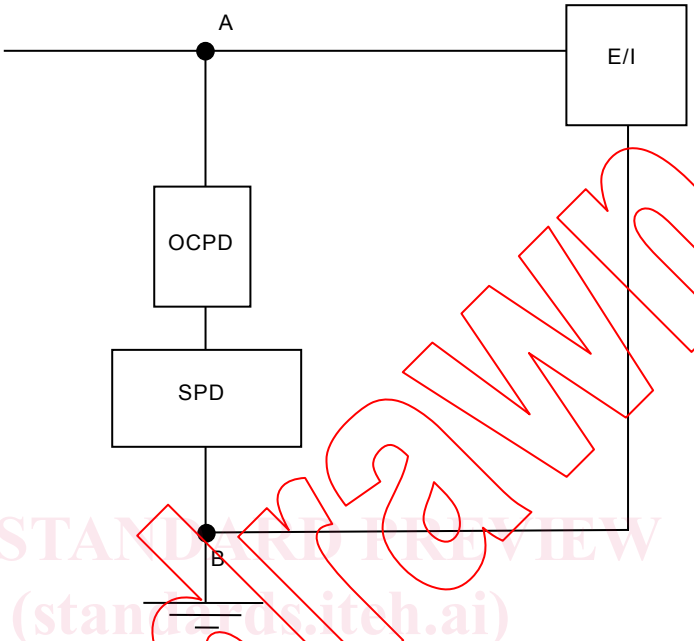
The location of overcurrent protective devices used to protect the SPDs may have an influence on the continuity of supply of the installation and the effective voltage protection level within the installation.

NOTE 1 National committees may decide which of the following arrangement is to be preferred, depending on the type of installation.

a) If the overcurrent protective device for the SPD is located in the SPD branch circuit, the continuity of the supply is unaffected in case of SPD failure, but neither the installation nor the equipment is protected against possible further overvoltages (see Figure 534.6) after

tripping of such protective devices. In such an arrangement, the effective voltage protection level within the installation is increased due to the voltage drop at the external overcurrent protective device connected in series with the SPD.

NOTE 2 If the protection against overcurrent is internal to the SPD the voltage drop of the overcurrent protective device is already included in the SPD's voltage protection level U_p.



Key

OCPD	overcurrent protective device (SPD disconnector) required by the SPD manufacturer
SPD	surge protective device
A and B	connection points of SPD assembly
E/I	equipment or installation to be protected

Figure 534.6 – Example of overcurrent protection in the SPD branch by using a dedicated external overcurrent protective device

b) If the overcurrent protective device for the SPD is installed upstream of the SPD branch circuit, continuity of the supply is not likely to be provided in the event of SPD failure (see Figure 534.7). Nevertheless, in such an arrangement, the effective voltage protection level within the installation is kept to a minimum.

However, protection according to Figure 534.6 shall also be applied whenever the rating of the upstream overcurrent protective device (OCPD) is higher than the maximum overcurrent protection recommended by the SPD manufacturer.