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Interested committees:

Title: Draft BS EN IEC 61643-01 Low-voltage surge protective devices. Part 01: General Requirements and test methods.

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Introduction

This draft standard is based on national and international discussions. Your comments on this draft are invited and will assist in the preparation of the consequent standard.

For international standards, comments will be reviewed by the relevant UK national committee before sending the consensus UK vote and comments to the international committee, which will then decide appropriate action. If the international standard is approved, it is usual for the text to be published as a British Standard.

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UK Vote

Please indicate whether you consider the UK should submit a negative (with supporting technical reasons) or positive vote on this draft. Please indicate if you are aware of any reason why this draft standard should not be published as a British Standard.

Submission of Comments

- **Annotated drafts are not acceptable and will be rejected.**
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Template for comments and secretariat observations

Date: xx/xx/20xx	Document: ISO/DIS xxxx
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1	2	(3)	4	5	(6)	7
MB	Clause No./ Subclause No./Annex (e.g. 3.1)	Paragraph/Figure/ Table/Note	Type of comment	Commend (justification for change) by the MB	Proposed change by the MB	Secretariat observations on each comment submitted
	3.1	Definition 1	ed	Definition is ambiguous and needs clarifying.	Amend to read '...so that the mains connector to which no connection...'	
	6.4	Paragraph 2	te	The use of the UV photometer as an alternative cannot be supported as serious problems have been encountered in its use in the UK.	Delete reference to UV photometer.	



37A/366/CD

COMMITTEE DRAFT (CD)

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37A/338/CD, 37A/345A/CC

IEC SC 37A : LOW-VOLTAGE SURGE PROTECTIVE DEVICES

SECRETARIAT:

United States of America

SECRETARY:

OF INTEREST TO THE FOLLOWING COMMITTEES:

SC 37B, TC 64, TC 81, TC 82, TC 109

PROPOSED HORIZONTAL STANDARD:

☐

Other TC/SCs are requested to indicate their interest, if any, in this CD to the secretary.

FUNCTIONS CONCERNED:

☐ EMC

☐ ENVIRONMENT

☐ QUALITY ASSURANCE

☒ SAFETY

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TITLE:

Low-voltage surge protective devices - Part 01: General Requirements and test methods

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

LOW-VOLTAGE SURGE PROTECTIVE DEVICES –**Part 01: General requirements and test methods**

FOREWORD

- 1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
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- International Standard IEC 61643-01 has been prepared by subcommittee SC37A Low-voltage surge protective devices, of IEC technical committee 37: Surge arresters.
- This standard together with the second edition of IEC 61643-11 cancels and replaces the first edition of IEC 61643-11, published in 2011-03-09. It contains the common requirements for all SPDs. The specific requirements for SPDs for AC applications are contained in the second edition of IEC 61643-11. This edition constitutes a technical revision.
- This edition includes the following significant technical changes with respect to the first edition of IEC 61643-11:
- a) Clarification on test application either to a complete SPD, to a "mode of protection", or to a complete "SPD assembly"
 - b) Additional measurement of voltage protection level on "combined modes of protection" between live conductors and PE (see new Annex H)

- c) Additional duty test for T1 SPD and T2 SPD with follow current to check for increased follow current at lower impulse current amplitude (see 9.3.5.5)
- d) Modified and amended short circuit current test requirements to better cover up-to-date internal SPD disconnecter technologies (see 9.3.6.3)
- e) Improved dielectric test requirements for the SPD's main circuits and added dielectric test requirements for "electrically separated circuits" (see 9.3.7 and 9.3.8)
- f) Additional clearance requirements for "electrically separated circuits" (see 9.4.4)
- g) Additional information and details for SPDs for DC installations

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

FDIS	Report on voting
XX/XX/FDIS	XX/XX/RVD

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

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

The committee has decided that the contents of this 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.

The National Committees are requested to note that for this publication the stability date is 20XX.

THIS TEXT IS INCLUDED FOR THE INFORMATION OF THE NATIONAL COMMITTEES AND WILL BE DELETED AT THE PUBLICATION STAGE.

INTRODUCTION

It has been assumed in the drafting of this International Standard that the execution of its provisions is entrusted to appropriately qualified and experienced persons.

This standard is a product family standard dealing with the safety and performance of SPDs and takes precedence over horizontal and generic standards covering the same subject.

This part 01 of the IEC 61643 series addresses the general safety and performance tests for surge protective devices (SPDs).

NOTE: Throughout this publication, when "Part 01" is mentioned, it refers to IEC 61643-01.

This standard recognizes the internationally accepted level of protection against hazards such as electrical, mechanical, thermal, fire and radiation of SPDs when operated as in normal use taking into account the manufacturer's instructions. It also covers abnormal situations that can be expected in practice.

This standard takes into account the requirements of IEC 60364 as far as possible so that there is compatibility with the wiring rules when the SPD is connected to the supply mains. However, national wiring rules may differ.

If the intended applications of an SPD are covered by different parts of the IEC 61643-X1 series of standards, all relevant parts are applied, as far as is reasonable.

This standard is only to be applied together with the latest edition of one or more of the subsequent parts of the IEC 61643-X1 series of standards.

SPDs containing additional features or functions not addressed in this standard and the relevant subsequent part(s) may require additional consideration and tests to ensure the main SPD function is not adversely affected and no hazards may arise from these additional features or functions. If appropriate standards exist to cover such functions they should be applied.

There are three SPD Types for SPDs intended to be installed in power systems:

T1 SPDs are subjected to impulses simulating conducted partial lightning currents.

T2 SPDs and T3 SPDs are subjected to impulses of shorter duration.

LOW-VOLTAGE SURGE PROTECTIVE DEVICES –

Part 01: General requirements and test methods

Scope

This part 01 of the IEC 61643 series is applicable to devices for surge protection against indirect and direct effects of lightning or other transient overvoltages.

These devices are intended to be connected to circuits or equipment rated up to 1 000 V AC (RMS) or 1 500 V DC. Performance, characteristics, general requirements, test methods and ratings of these devices (SPD) are specified in this standard. These devices contain at least one nonlinear component and are intended to limit surge voltages and divert surge currents.

Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60068-2-14:2009, *Environmental testing – Part 2-14: Tests – Test N: Change of temperature*

IEC 60112, *Method for the determination of the proof and the comparative tracking indices of solid insulating materials*

IEC 60269 series, *Low-voltage fuses*

IEC 60269-1:2014, *Low-voltage fuses - Part 1: General requirements*

IEC 60269-2:2016, *Low-voltage fuses - Part 2: Supplementary requirements for fuses for use by authorized persons (fuses mainly for industrial application) – Examples of standardized systems of fuses A to K*

IEC 60529, *Degrees of protection provided by enclosures (IP Code)*

IEC 60664-1:2007, *Insulation coordination for equipment within low-voltage systems – Part 1: Principles, requirements and tests*

IEC 60695-2-11:2014, *Fire hazard testing – Part 2-11: Glowing/hot-wire based test methods – Glow-wire flammability test method for end-products (GWEPT)*

IEC 60898 series, *Electrical accessories – Circuit-breakers for overcurrent protection for household and similar installations*

IEC 60898-1:2019, *Electrical accessories – Circuit-breakers for overcurrent protection for household and similar installations - Part 1: Circuit-breakers for AC operation*

IEC 60898-3:2019, *Electrical accessories – Circuit-breakers for overcurrent protection for household and similar installations - Part 3: Circuit-breakers for DC operation*

IEC 60947-2:2019, *Low-voltage switchgear and controlgear – Part 2: Circuit-breakers*

- 411 IEC 61000 (all parts), *Electromagnetic compatibility (EMC)*
- 412 IEC 61180, *High-voltage test techniques for low-voltage equipment - Definitions, test and*
413 *procedure requirements, test equipment*
- 414 *IEC 62475:2010, High-current test techniques – Definitions and requirements for test currents*
415 *and measuring systems*
- 416

Terms, definitions and abbreviated terms

3.1 General

For the purposes of this document, the following terms, definitions and abbreviations apply.

ISO and IEC maintain terminological database for use in standardization at the following addresses:

- IEC Electropedia: available at <http://www.electropedia.org/>
- ISO Online browsing platform: available at <http://www.iso.org/obp>

3.2 Terms and definitions

3.2.1

1,2/50 voltage impulse

voltage impulse with a nominal virtual front time of 1,2 μs and a nominal time to half-value of 50 μs

Note 1 to entry: IEC 60060-1 provides the voltage impulse definitions of front time, time to half-value and waveshape.

3.2.2

8/20 current impulse

current impulse with a nominal virtual front time of 8 μs and a nominal time to half-value of 20 μs

Note 1 to entry: IEC 62475 provides the current impulse definitions of front time, time to half-value and waveshape.

3.2.3

acceptance test

contractual test to prove to the customer that the item meets certain conditions of its specification

[SOURCE IEC 60050-151:2001, 151-16-23]

3.2.4

combination SPD

SPD that incorporates both, voltage switching components and voltage limiting components

3.2.5

combination wave

wave characterized by defined voltage amplitude (U_{OC}) and waveshape under open-circuit conditions and a defined current amplitude (I_{CW}) and waveshape under short-circuit conditions

Note 1 to entry: The voltage amplitude, current amplitude and waveform that is delivered to the SPD are determined by the combination wave generator (CWG) impedance Z_f and the impedance of the DUT.

3.2.6

combination wave generator short-circuit current

I_{CW}

prospective short-circuit current of the combination wave generator, at the point of connection of the device under test

Note 1 to entry: When the SPD is connected to the combination wave generator, the current that flows through the device is generally less than I_{CW}

3.2.7**continuous current** **I_C**

current flowing through the SPD's mode of protection while energized at U_C

3.2.8**current path**

An electrical path intended to conduct at least part of an impulse current applied to an SPD's mode of protection.

Note 1 to entry: An SPD's mode of protection may contain only one current path or several current paths, when voltage limiting and/or voltage switching components are connected in parallel.

Note 2 to entry: Examples are provided in Annex I

3.2.9**decoupling network**

electrical circuit intended to prevent surge energy from being propagated to the power network during energized testing of SPDs

Note 1 to entry: This electrical circuit is sometimes called a "back filter".

3.2.10**degradation (of performance)**

undesired permanent departure in the operational performance of equipment or a system from its intended performance

3.2.11**degree of protection of enclosure****IP**

classification preceded by the symbol IP indicating the extent of protection provided by an enclosure against access to hazardous parts, against ingress of solid foreign objects and possibly harmful ingress of water

3.2.12**earthing connection**

connection provided on equipment or on a device and intended for the electric connection with the earthing arrangement

[SOURCE IEC 195-02-31, MOD, terminal replaced by connection]

3.2.13**electrically separated circuit**

Electric circuit which is provided with terminations for connection to external circuits and insulated from the SPD main circuit(s) according to the requirements for simple or for protective separation.

Note 1 to entry: Electrical circuits not provided with at least simple or even protective separation from the SPD main circuit(s) are considered as part of the main circuit(s).

3.2.14**extra-low voltage****ELV**

voltage not exceeding the maximum value of the prospective touch voltage which is permitted to be maintained indefinitely under specified conditions of external influences

Note 1 to entry: according to IEC 61140, values for ELV stands for voltages below or equal to 50 V AC or 120 V DC.

[SOURCE: IEC 61140:2016, 3.26]

3.2.15**flush-mounted**, adj

qualifies a device mounted into a recess in a mechanical structure so that the shape of the mounting surface remains essentially unchanged

[SOURCE: IEC 151-16-40]

3.2.16**follow current** I_f

peak current supplied by the electrical power system and flowing through the SPD after a discharge current impulse

3.2.17**highest crest value of measured voltages** $U_{\max}$

highest value of voltage measured between the connections of the SPD during the application of impulses of specified waveshape and amplitude, including $I_{\max}$

3.2.18**impulse discharge current** I_{imp}

crest value of a discharge current through an SPD's mode of protection with specified charge transfer Q and specified specific energy W/R in the specified time

Note 1 to entry: This is used to characterize T1 SPDs or category D1 (IEC 61643-21) tested SPDs

3.2.19**isolation**

function intended to make dead for reasons of safety all or a discrete section of the electrical installation by separating the electrical installation or section from every source of electric energy

[SOURCE: IEC 826-17-01]

3.2.20**load-side surge withstand capability for a two-port SPD**

ability of a two-port SPD to withstand surges on the output connections originating in circuitry downstream of the SPD

3.2.21**maximum continuous operating voltage** U_C

maximum voltage, which may be continuously applied to the SPD's mode of protection

Note 1 to entry: U_C may exceed 1 000 V AC or 1 500 V DC

3.2.22**maximum discharge current** $I_{\max}$

crest value of a current through an SPD's mode of protection having an 8/20 current impulse and magnitude according to the manufacturer's specification

3.2.23**means for short-circuiting the SPD (SC-means)**

internal method for short-circuiting an SPD under specified conditions, with a current carrying capacity equal to the short-circuit current rating I_{SCCR} of the SPD

3.2.24**measured limiting voltage**

highest value of voltage measured between the connections of the SPD during the application of impulses of specified waveshape and amplitude, excluding $I_{\max}$

3.2.25**minimum short-circuit current rating** **I_{SCCRMIN}**

minimum prospective short-circuit current from the power system for which the SPD, in conjunction with the internal disconnector, is rated

3.2.26**mode of protection**

intended circuitry between two connections, that contains one or more protective components, declared by the manufacturer

Note 1 to entry: Additional connections may be included within this circuitry

Note 2 to entry: Such modes may be line to line, line to neutral, line to PE, neutral to PE, plus to minus, plus to PE and minus to PE

Note 3 to entry: Examples are provided in Annex I

3.2.27**multimode SPD**

SPD with more than one mode of protection, or a set of electrically interconnected SPDs offered as a unit

3.2.28**nominal discharge current** **I_n**

crest value of an 8/20 current impulse through an SPD's mode of protection

Note 1 to entry: This is used to characterize T2 SPDs

3.2.29**nominal varistor voltage** **$U_{1\text{mA}}$**

voltage across the MOV measured at 1 mA DC

3.2.30**nominal voltage of a system**

a suitable approximate value of voltage used to designate or identify a system

[SOURCE: IEC 601-01-21]

3.2.31**one-port SPD**

SPD having no intended series impedance

Note 1 to entry: A one-port SPD may have separate input and output connections

Note 2 to entry: Overcurrent protection devices e.g fuses or CBs are not considered as specific intended series impedance.

3.2.32**open-circuit mode****OCM**

end of life behaviour whereby an SPD assembly changes to a permanent high impedance or open-circuit state under specified conditions

593 Note 1 to entry: A low impedance intermediate state is possible for a limited time until the final end of life mode is
594 reached.

595 **3.2.33**
596 **open-circuit voltage**

597 U_{oc}

598 open-circuit voltage of the combination wave generator at the point of connection of the device
599 under test

600 Note 1 to entry: This is used to characterize T3 SPDs

601 **3.2.34**
602 **output contact**

603 contact included in a circuit separate from the main circuit of an SPD, and linked to a
604 disconnector or status indicator

605 **3.2.35**
606 **PELV system**

607 electric system in which the voltage cannot exceed the value of extra-low voltage:

- 608 – under normal conditions and
- 609 – under single fault conditions, except earth faults in other electric circuits

610 Note 1 to entry: PELV is the abbreviation for protective extra-low voltage.

611 Note 2 to entry: PELV has protective separation from all circuits other than PELV, SELV or earth.

612 [SOURCE: IEC 60050-826:2004, 826-12-32]

613 **3.2.36**
614 **PEN conductor**
615 **PEN**

616 conductor combining the functions of both a protective earthing conductor and a neutral
617 conductor

618 [SOURCE: IEC 195-02-12]

619 **3.2.37**
620 **prospective short-circuit current**
621 I_p

622 current which would flow at a given location in a circuit if it were short-circuited at that location
623 by a link of negligible impedance

624 **3.2.38**
625 **protective conductor**
626 **PE**

627 conductor provided for purposes of safety, for example protection against electric shock

628 [SOURCE: IEC 195-02-09]

629 **3.2.39**
630 **protective conductor current**
631 I_{PE}

632 current expected to flow through the PE connection of the SPD, when the SPD is installed in a
633 grounded power supply system

634 **3.2.40**
635 **(electrically) protective separation**

636 separation of one electric circuit from another by means of:

- 637 – double insulation; or
- 638 – basic insulation and electrically protective screening (shielding); or
- 639 – reinforced insulation

640 [SOURCE: IEC 61140:2016, 3.24]

641 **3.2.41**
642 **rated load current**
643 I_L

644 maximum current that can be continuously conducted between the input and the output
645 connections of the SPD

646 Note 1 to entry: This current does not influence the impedance of current-limiting components.

647 **3.2.42**
648 **residual current device**
649 **RCD**

650 switching device or associated devices intended to cause the opening of the power circuit when
651 the residual or unbalance current attains a given value under specified conditions

652 **3.2.43**
653 **residual voltage**
654 U_{res}

655 crest value of voltage measured between the connections of the SPD during the passage of
656 discharge current

657 **3.2.44**
658 **routine test**

659 test made on each SPD or on parts and materials as required to ensure that the product meets
660 the design specifications

661 [SOURCE IEC 60050-151:2001, 151-16-17]

662 **3.2.45**
663 **SELV system**

664 electric system in which the voltage cannot exceed the value of extra-low voltage:

- 665 – under normal conditions and
- 666 – under single fault conditions, including earth faults in other electric circuits

667 Note 1 to entry: SELV is the abbreviation for safety extra-low voltage.

668 Note 2 to entry: SELV has simple separation from PELV and other SELV systems, and earth and protective separation
669 from all other circuits.

670 [SOURCE: IEC 60050-826:2004, 826-12-31]

671 **3.2.46**
672 **short-circuit current rating**
673 I_{sCCR}

674 maximum prospective short-circuit current from the power system for which the SPD, in
675 conjunction with any external disconnector(s) specified, is rated

676 Note 1 to entry: The term SPD includes internal disconnectors as well as any internal SC-means which are part of
677 the SPD.

3.2.47**Short-Circuit Disconnection Component****SCDC**

component specifically included in an OCM SPD, or SPD assembly, associated to a particular mode of protection and acting as an SPD disconnecter in the event of an SPD short-circuit

Note 1 to entry This does not exempt components with combined functionality, e.g. voltage switching function and short-circuit protection function

Note 2 to entry the term "components" is to be understood as components or devices (e.g. a circuit breaker or fuses) which are, in case of SPD assemblies, embedded in a single unit or, pre-wired/pre-assembled in the factory and cannot be disassembled without the aid of a tool.

3.2.48**short-circuit mode****SCM**

end of life behaviour whereby an SPD assembly changes to an intended permanent low impedance or short-circuit state under specified conditions

Note 1 to entry: Such SPD has no external disconnecter

3.2.49**short-circuiting SPD**

SPD which changes its characteristic by an SC-means to an intentional internal short-circuit due to an impulse according to the transition surge current rating

3.2.50**simple separation**

separation between electric circuits or between an electric circuit and local earth by means of basic insulation

[SOURCE: IEC 60050-195:2021, 195-06-30]

3.2.51**sparkover voltage of a voltage switching SPD****trigger voltage of a voltage switching SPD**

maximum voltage value at which the sudden change from high to low impedance starts for a voltage switching SPD

3.2.52**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

[SOURCE: IEC 60364-5-53:2001+AMD1:2002+AMD2:2015]

3.2.53**SPD disconnector (disconnecter)**

device for disconnecting an SPD, or part of an SPD, from the power system in the event of SPD end of life

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 end of life. 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.

3.2.54**specific energy for T1 SPD test****W/R**

energy dissipated by a unit resistance of 1 Ω with the impulse discharge current I_{imp}

726 Note 1 to entry: This is equal to the time integral of the square of the current ($W/R = \int i^2 dt$).

727 **3.2.55**

728 **status indicator**

729 means to indicate the operational status of an SPD or SPD disconnecter or an SPD assembly,
730 or a part of an SPD

731 Note 1 to entry: Such indicators may be local with visual and/or audible alarms and/or may have remote signalling
732 and/or output contact capability.

733 **3.2.56**

734 **surge protective device**

735 **SPD**

736 device that contains at least one nonlinear component that is intended to limit surge voltages
737 and divert surge currents

738 Note 1 to entry: An SPD is a complete unit or device, having appropriate connecting means.

739 Note 2 to entry: Secondary functions may be incorporated, such as current-limiting function.

740 Note 3 to entry: Nonlinearity may be caused by frequency change.

741 Note 4 to entry: The IEC 61643-3xx series of standards covers surge protective components.

742 **3.2.57**

743 **temporary overvoltage test value**

744 U_T

745 test voltage applied to the SPD for a specific duration t_T , to simulate the stress under TOV
746 conditions

747 **3.2.58**

748 **test current**

749 I_{test}

750 test current derived from specific application condition

751 **3.2.59**

752 **test voltage**

753 U_{test}

754 test voltage derived from the system voltage

755 **3.2.60**

756 **thermal equilibrium**

757 state reached when the temperature of the parts of a component or equipment operating in a
758 given environment no longer varies faster than a specified limit

759 [SOURCE IEC 151-16-33]

760 **3.2.61**

761 **thermal stability**

762 a condition of the SPD when the current flowing into the SPD or the power dissipation does not
763 increase during a defined time of application of the maximum continuous operating voltage U_C

764 **3.2.62**

765 **total discharge current**

766 I_{Total}

767 current which flows through the earthing connection of a multimode SPD during the total
768 discharge current test

769 Note 1 to entry: The aim is to take into account cumulative effects that occur when multiple modes of protection of
770 a multimode SPD conduct at the same time.

771 Note 2 to entry: I_{Total} is particularly relevant for T1 SPDs and is used for the purpose of lightning protection
772 equipotential bonding according to IEC 62305 series.

773 Note 3 to entry: This is sometimes called "Total surge current".

774 Note 4 to entry: The earthing connection is sometimes called "common connection C".

775 Note 5 to entry: A multi-mode SPD are sometimes called multi-connection SPD.

776 **3.2.63**
777 **transition surge current rating**
778 I_{trans}

779 crest value of an 8/20 current impulse for T2 SPD or an impulse discharge current for T1 SPD,
780 that will force a short-circuiting SPD into an intended short-circuit

781 **3.2.64**
782 **two-port SPD**
783 SPD having a specific series impedance connected between separate input and output
784 connections

785 **3.2.65**
786 **Type of SPD**

787 **3.2.65.1**

788 **T1 SPD**
789 SPD that is tested with the impulse discharge current I_{imp} , with an 8/20 current impulse having
790 a crest value equal to the crest value of I_{imp} , and, if relevant, with a 1,2/50 voltage impulse

791 Note 1 to entry: This was called class I test in IEC 61643-11:2011

792 **3.2.65.2**

793 **T2 SPD**
794 SPD that is tested with the nominal discharge current I_n , and, if relevant, with a 1,2/50 voltage
795 impulse

796 Note 1 to entry: This was called class II test in IEC 61643-11:2011

797 **3.2.65.3**

798 **T3 SPD**
799 SPD that is tested with the combination wave with an open circuit voltage U_{OC}

800 Note 1 to entry: This was called class III test in IEC 61643-11:2011

801 **3.2.66**
802 **type test**
803 conformity test made on one or more items representative of the production

804 [SOURCE IEC 60050-151:2001, 151-16-16]

805 **3.2.67**
806 **voltage fluctuation**
807 series of voltage changes or a continuous variation of the rms or peak value of the voltage

808 **3.2.68**
809 **voltage limiting SPD**
810 SPD that has a high shunt impedance when no surge is present, but will reduce it continuously
811 with increased surge current and voltage

812 Note 1 to entry: Common examples of components used in voltage limiting SPDs are varistors (e.g. MOVs) and
813 avalanche breakdown diodes (ABDs). These are sometimes called "clamping" components.

814 **3.2.69**
815 **voltage protection level**
816 **U_p**

817 maximum voltage to be expected at the SPD connections due to an impulse stress with defined
818 voltage steepness and an impulse stress with a discharge current with given amplitude and
819 waveshape

820 **3.2.70**
821 **voltage rate-of-rise of a two-port SPD**

822 rate of change of voltage with time measured at the output connections of a two port SPD under
823 specified test conditions

824 **3.2.71**
825 **voltage switching SPD**

826 SPD that has a high impedance when no surge is present, but can have a sudden reduction in
827 impedance in response to a voltage surge

828 Note 1 to entry: Common examples of components used in voltage switching type SPDs are spark gaps, gas
829 discharge tubes (GDTs) and thyristor surge suppressors (TSS).

830 **3.3 Acronyms / Symbols**

831 The Table 1 below provides the list of acronyms and symbols used in this standard.

832 **Table 1 – List of Acronyms and Symbols**

Acronym/symbol	Description	Definition/clause
General acronyms and symbols		
ABD	avalanche breakdown device	8.3.6.2
CWG	combination wave generator	3.2.5
DUT	device under test	General
IP	degree of protection of enclosure	3.2.11
k	trip current factor for overload behaviour	Table 26
PE	terminal/connection for a protective conductor	3.2.38
PEN	terminal/connection for a PEN conductor	3.2.36
RCD	residual current device	3.2.42
SPD	surge protective device	3.2.53
T_1 , T_2 and/or T_3	product marking for T1 SPD, T2 SPD and/or T3 SPD	6.1
TOV	temporary overvoltage	General
W/R	specific energy for T1 SPD test	3.2.54
Z_f	fictive impedance (of combination wave generator)	9.1.5c)
Acronyms and symbols related to voltage		
U_{1mA}	nominal varistor voltage	3.2.29
U_C	maximum continuous operating voltage	3.2.21
U_{max}	highest crest value of measured voltages (used for clearance determination)	3.2.17
U_{OC}	open circuit voltage of the combination wave generator	0

Acronym/symbol	Description	Definition/clause
U_P	voltage protection level	3.2.69
U_{res}	residual voltage	0
U_T	temporary overvoltage test value	3.2.57
U_{test}	test voltage	3.2.59
Acronyms and symbols related to current		
I_{CW}	short-circuit current of the combination wave generator	3.2.6
I_C	continuous current	3.2.7
I_f	follow current	3.2.12
I_{imp}	impulse discharge current for T1 SPD test	3.2.18
I_L	rated load current	3.2.41
I_{max}	maximum discharge current	3.2.22
I_n	nominal discharge current for T2 SPD test	3.2.28
I_P	prospective short-circuit current of the power supply	3.2.37
I_{PE}	protective conductor current	3.2.38
I_{SCCR}	short-circuit current rating	3.2.46
I_{test}	test current	3.2.58
I_{Total}	total discharge current for multipole SPD	3.2.62
I_{trans}	transition surge current rating	3.2.63
Acronyms and symbols related to time		
t_T	TOV application time for testing	3.2.57

Classification

4.1 General

The manufacturer shall classify the SPDs in accordance with the following parameters.

4.2 Number of ports

4.2.1 One

4.2.2 Two

4.3 SPD design

4.3.1 Voltage switching

4.3.2 Voltage limiting

4.3.3 Combination

4.4 Type of SPD

Information required for T1 SPD, T2 SPD and T3 SPD is given in Table 2.

Table 2 – Type of SPD

Type of SPD	Required information	Test procedures (see subclauses)
T1 SPD	I_{imp}	9.1.2; 9.1.3; 9.1.4
T2 SPD	I_n	9.1.3; 9.1.4
T3 SPD	U_{OC}	9.1.5; 9.1.5.2

NOTE: T1 SPD, T2 SPD and T3 SPD is relating to former Class I, Class II and Class III tests.

4.5 Location

4.5.1 Indoor

SPDs intended for use in enclosures and/or inside buildings or shelters.

NOTE 1: SPDs installed in outdoor enclosures or shelters are considered for indoor use.

NOTE 2: This classification addresses SPDs for use in weather protected locations having neither temperature nor humidity control, and corresponds to the characteristics of external influences code AB4 in IEC 60364-5-51.

4.5.2 Outdoor

SPDs intended for use without enclosures and outside of buildings or shelters

NOTE: This classification addresses SPDs for use in non-weather protected locations.

4.5.2.1 Submersible SPDs

SPDs, which can face temporary or permanent submersion.

4.6 Accessibility

4.6.1 Accessible

An SPD which can be fully or partly touched by an unskilled person, without the use of a tool to open any covers or enclosures, once installed.

4.6.2 Inaccessible

An SPD which cannot be touched by an unskilled person either due to being mounted out of reach or due to being located within enclosures which can only be opened by using a tool, once installed.

4.7 Mounting method**4.7.1 Fixed****4.7.2 Portable****4.8 Location of disconnector (including overcurrent protection)****4.8.1 Internal****4.8.2 External****4.8.3 Both (internal and external)****4.9 Degree of protection provided by enclosures according to IEC 60529 (IP code)****4.10 Temperature and humidity range****4.10.1 Normal****4.10.2 Extended****4.11 SPD modes of protection****4.11.1 Single mode SPD****4.11.2 Multimode SPD****4.12 End of life mode of the SPD assembly****4.12.1 Open-circuit mode (OCM)****4.12.2 Short-circuit mode (SCM)****4.13 Short-Circuit Disconnection Component (SCDC)****4.13.1 Normally open disconnector (NOD)**

An SCDC, with an open status under normal conditions (in absence of any surge event), that disconnects the SPD mode of protection in the event of a short circuit.

Note: when in normal conditions, such an SCDC cannot drive any current in between its incoming and outgoing connections (equivalent to a very high impedance).

4.13.2 Normally closed disconnector (NCD)

An SCDC, with a closed status under normal conditions (in absence of any surge event), that disconnects the SPD mode of protection in the event of a short circuit.

Note: when in normal conditions, such an SCDC can drive a current in between its incoming and outgoing connections (equivalent to a very low impedance).

Void

Marking and other product information

6.1 General

Where space does not allow all the required markings to be placed, at least the markings according 6.2, a1) and a7) (if connections are not interchangeable) are sufficient on the SPD. The other required markings for which there is not enough space shall appear in the installation instructions.

An SPD may be classified to more than one Type according to 6.2, a2) (e.g. T1 SPD and T2 SPD). If in such case the manufacturer declares only one protection level, the highest protection level shall appear in the marking.

Compliance is checked by visual inspection.

6.2 List of items

The following is a list of marking and other product information items. To determine which of these items are applicable to a specific SPD, refer to the corresponding sections of the relevant subsequent part(s) of IEC 61643.

a1) Manufacturer's name or trademark and model number

a2) SPD Type classification:

- For T1 SPD: "T1" (T1 in a square)
- For T2 SPD: "T2" (T2 in a square)
- For T3 SPD: "T3" (T3 in a square)

NOTE: In Japan SPDs can be marked "class I" instead of "T1", "class II" instead of "T2" and "class III" instead of "T3".

a3) Indication of disconnecter operation (if any) or SC-means operation (if any), see 6.3

a4) Information that enables the manufacturer to trace the date of manufacture.

a5) Maximum continuous operating voltage U_C for each mode of protection (if U_C is different for each mode of protection declared by the manufacturer)

a6) Type of current as applicable:

- AC or "∼" and/or frequency (if other than 50 Hz and 60 Hz)
- DC
- other types (e.g. combined AC + DC, non-sinusoidal)

a7) SPD discharge parameters (if different, for each mode of protection declared by the manufacturer):

- For T1 SPD: " I_{imp} " together with the value in kA (e.g. I_{imp} 25 kA)
- For T2 SPD: " I_n " together with the value in kA (e.g. I_n 25 kA)
- For T3 SPD: " U_{OC} " together with the value in kV (e.g. U_{OC} 6 kV)

a8) Identification of connections or leads (if not otherwise identified on the devices) including any connections to protective earth or any other reference earth.

a9) Rated load current I_L for two port SPDs and for one port SPDs with separate input and output connections.

a10) Nominal AC and/or DC system voltages, as applicable, for which the SPD is designed

a11) Maximum allowed voltage fluctuation (% of the nominal AC and/or DC system voltage)

a12) Voltage protection level U_p for each mode of protection (if U_p is different)

- NOTE: A discharge current versus protection level diagram/graph can be additionally provided by the manufacturer, allowing extracting the SPD's protection level at the discharge current necessary for a specific application.
- a13) Voltage protection level U_p for series connection of SPD's modes of protection, e.g. line to PE (if declared by the manufacturer, see Annex H)
 - a14) Degree of protection provided by the enclosure (IP code) if > IP20
 - a15) Location (See 0)
 - a16) Number of ports
 - a17) Method of mounting
 - a18) Short-circuit current rating I_{SCCR}
 - a19) Ratings and characteristics for external disconnector(s), if required, and/or internal disconnector(s), if applicable.
 - a20) Orientation for normal installation, if significant
 - a21) Type of system for which the SPD is designed (e.g. TN-system, TT-system, IT-system) and intended installation location(s) (power distribution, fixed installation, portable) or overvoltage categories (OVC II, III, IV)
 - a22) Intended connection (e.g. line to neutral or mid-point, line to ground, neutral or mid-point to ground, line to line, etc.)
 - a23) Mechanical dimensions, lead lengths, etc.
 - a24) Temperature and humidity range (see 7.3 and 7.4)
 - a25) Continuous current I_C for each mode of protection (if I_C is different)
 - a26) Protective conductor current I_{PE} (AC and/or DC as applicable)
 - a27) Short-circuiting SPD and its transition surge current rating I_{trans} (see Annex E)
 - a28) The minimum distance from any earthed conductive surface at which the SPD can be installed
 - a29) I_{max} (if declared by the manufacturer)
 - a30) End of life mode of the SPD assembly
 - a31) Temporary overvoltage U_T and/or the type(s) of power system(s) the SPD is designed for and corresponding connection details. Test values and details are provided in the relevant subsequent part(s) of IEC 61643 as applicable.
 - a32) Total discharge current I_{Total} for multimode SPDs and the respective SPD Type, except for T3 SPDs (if declared by the manufacturer)
 - a33) Voltage drop for two port SPDs (if declared by the manufacturer)
 - a34) Load-side surge withstand capability for two-port SPDs (if declared by the manufacturer)
 - a35) Information about replaceable parts (indicators, fuses, etc. if applicable)
 - a36) Voltage rate of rise du/dt (if declared by the manufacturer)
 - a37) Current factor k , if different from Table 26
 - a38) Modes of protection declared by the manufacturer (for multimode SPDs)
 - a39) Any warning labels that are required shall be provide with each product delivered (e.g. for SCM SPDs)
 - a40) Information about the kind of separation (simple separation/basic insulation or protective separation/double or reinforced insulation) between the SPDs main circuit and any electrically separated circuits as well as between electrically separated circuits (if there is more than one)
- NOTE Examples of such electrically separated circuits are auxiliary contact circuits, separate power supply circuits e.g. for SPDs with additional electronic functions, telecommunication ports like e.g. LAN.
- a41) Presence of switching component(s) (see Annex B)

- a42) Follow current to be expected, if applicable see Annex B
- a43) If the status indication circuitry does not use certified components operated within their ratings, the manufacturer shall provide the appropriate testing standards for the specific component to allow it to be tested.
- a44) Rating and characteristic for the internal overcurrent protection, if required
- a45) Prospective minimum short-circuit current rating $I_{SCCRMIN}$ for tests at low short-circuit currents according to 9.3.6.3.4 c)
- a46) Information about the presence of SCDCs according to 4.13.1 or 4.13.2, if applicable

6.3 Information about status indicator

The manufacturer shall provide information about the function of the indicator and the actions to be taken after change of status indication.

Compliance is checked by visual inspection.

Service conditions

7.1 Voltage

The voltage applied continuously between the connections of the surge protective device (SPD) shall not exceed its maximum continuous operating voltage U_C .

7.2 Air pressure and altitude

Air pressure is 80 kPa to 106 kPa. These values represent an altitude of +2 000 m to -500 m, respectively.

7.3 Temperatures

- normal range: -5 °C to +40 °C
- extended range: -40 °C to +70 °C

NOTE: Temperature ranges exceeding the above may be declared by the manufacturer.

7.4 Humidity

- normal range: 5 % to 95 %
- extended range: 5 % to 100 %

Requirements

8.1 General requirements

Requirements from IEC 61643-01 apply to subsequent parts of IEC 61643 only when they are explicitly called up in that subsequent part.

For SPDs classified to more than one Type according to 6.2, a2), the tests in 9.3.4, 9.3.5, Annex E and 9.6.5.2 shall be performed for each declared Type.

SPDs shall not create any hazard when operated under the test conditions in accordance with this standard.

8.2 Marking

Markings on the device shall be indelible and legible and shall not be placed on screws or removable parts.

NOTE: A plug-in SPD module is not considered a removable part.

Compliance is checked by the test in accordance with 9.2.

8.3 Electrical requirements

8.3.1 Protection against electric shock

8.3.1.1 Protection against direct contact

For protection against direct contact (inaccessibility of live parts), SPDs shall be designed in such a way that live parts cannot be touched when the SPD is installed for the intended use.

SPDs, except SPDs classified inaccessible, shall be so designed that, when they are wired and mounted as for normal use, live parts are not accessible, even after removal of parts which can be removed without the use of a tool.

After installation according to the manufacturer's installation instructions the protection against touching of live parts for SPDs, which may be accessible for uninstructed persons, shall at least comply with the requirements for IP2XC according IEC 60529.

The connection between the earthing connections and all accessible conductive parts shall be of low resistance.

Compliance is checked by the tests in accordance with IEC 60529 and according 9.3.1.

8.3.1.2 Protection during maintenance and replacement

When SCM is declared for the SPD assembly, then the SPD shall

- either be constructed in a way that it cannot be removed or unplugged without the use of a tool or a key after reaching their end of life mode and
- be provided with a warning label that needs to be placed adjacent to the SPD and visible after installation, providing the information that the SPD circuit shall be switched off before removal or unplugging.

NOTE 1: In case it is necessary to remove or change the SPD it may be required to provide isolation.

NOTE 2: According to the installation rules provided in IEC 60364 series this is not sufficient in case uninstructed persons have access to the SPD.

Compliance is checked by visual inspection and by a manual check if necessary.

8.3.2 Continuous current I_C

The current flowing through the SPDs mode of protection shall be measured when energized at the maximum continuous operating voltage U_C , and connected according to the manufacturer's instructions.

Compliance is checked by the test in accordance with 9.3.2.

8.3.3 Protective conductor current I_{PE}

For SPDs having an earthing connection, the current I_{PE} shall be measured at U_{test} on the SPD assembly.

Compliance is checked by the test according 9.3.3.

8.3.4 Voltage protection level U_p

The measured limiting voltage of the SPDs, determined from

- the front-of-wave sparkover (if the SPD includes voltage switching components) and the residual voltage measurements at 8/20 current impulses having corresponding crest values up to I_{imp} for T1 SPD or up to I_n for T2 SPD,
- the combination wave measurements up to U_{OC} for T3 SPD,

shall not exceed the voltage protection level that is specified by the manufacturer.

Secretary's note:

The installation rules IEC 60364-5-53, clause 534.4.4.2 requires the SPD's protection level between live conductors and PE to be below the impulse withstand voltage required for equipment, but this protection level requirement sometimes involves more than one mode of protection (e.g. L1 to N and N to PE) connected in series.

National committees are therefore requested to provide their opinion, if for such SPD configurations, where the above protection level requirement involves more than one mode of protection connected in series, the additional declaration of such combined mode of protection as such (e.g. from L1 to PE) shall be mandatory or not.

Compliance is checked by the test in accordance with 9.3.4.

8.3.5 Operating duty

The SPD shall be capable of withstanding specified discharge currents during application of the maximum continuous operating voltage U_C without unacceptable changes in its characteristics.

In addition, voltage-switching SPDs or combination SPDs shall be able to interrupt any follow current up to the short-circuit current rating.

Compliance is checked by the test in accordance with 9.3.5.

8.3.6 Disconnectors, SC-means and status indicators

8.3.6.1 Disconnector and SC-means

8.3.6.1.1 Disconnectors

When OCM is declared, SPDs shall be provided with disconnectors (which can be either internal, external or both), except SPDs for connection N-PE or M-PE in TN and/or TT systems only. The operation of the disconnector(s) shall be indicated by a corresponding status indicator or by other means.

NOTE: An SPD for connection N-PE is an SPD connected between the Neutral conductor and PE, an SPD for connection M-PE is an SPD connected between the Midpoint conductor and PE in a DC-system.

External disconnectors, if declared, shall comply with a relevant IEC standard for overcurrent protection and/or residual current protection.

Information on the inclusion of disconnectors during the various type tests is provided in the relevant subsequent part(s) of IEC 61643.

1094 Compliance is checked by the test in accordance with 9.3.6.

1095 **8.3.6.1.2 SC-means**

1096 When SCM is declared, SPDs shall be provided with SC-means. Their operation shall be
1097 indicated by a corresponding status indicator.

1098 Compliance is checked by the test in accordance with 9.3.6.

1099 **8.3.6.2 Thermal protection**

1100 SPDs shall be protected against overheating due to degradation or overstress and shall reach
1101 its end of life without causing a hazardous condition.

1102 Compliance is checked by the test in accordance with 9.3.6.2.

1103 This test is not performed on SPDs modes of protection containing only voltage switching
1104 components and/or ABD devices.

1105 **8.3.6.3 Short-circuit current behaviour**

1106 An SPD shall reach its end of life without causing a hazardous condition and withstand the
1107 prospective short-circuit currents of the power system.

1108 Any external disconnecter (if required) shall comply with a relevant IEC standard for overcurrent
1109 protection, e.g. IEC 60269 series for fuses, IEC 60898 series or IEC 60947-2 for circuit
1110 breakers.

1111 Note SPD disconnectors not compliant with a relevant IEC standard for overcurrent protection can only be declared
1112 internal according to 4.8.1.

1113 For internal disconnectors, SPD manufacturers shall declare SCDCs according to 4.13 for the
1114 relevant mode(s) of protection. SCDCs shall be associated with at least one additional surge
1115 protection component (SPC) installed in series within the relevant mode of protection. If a mode
1116 of protection contains different current paths, this applies to each of them.

1117 Note Surge protective component (SPC) are defined in IEC 61643 series, e.g. IEC 61643-311 for metal oxide
1118 varistors (MOV).

1119 Where internal disconnectors do not comply with an IEC standard for overcurrent protection,
1120 the SPD manufacturer shall declare a value for the minimum short-circuit current rating
1121 $I_{SCCRMIN}$ according to a45), at which the SCDC operates within 5 s.

1122 Compliance is checked by the test in accordance with 9.3.6.3.

1123 These tests are not performed on:

- 1124 • SPDs classified outdoor and inaccessible,
- 1125 • SPDs for connection N-PE or M-PE in TN and/or TT systems only.
- 1126 • SPD assemblies classified SCM

1127 **8.3.6.4 Overstress behaviour**

1128 An SPD shall reach its end of life without causing hazardous conditions.

1129 Compliance is checked by the test in accordance with 9.3.6.4.

1130 This test is not performed on:

- 1131 • SPDs classified outdoor and inaccessible,
- 1132 • SPDs for connection N-PE or M-PE in TN and/or TT systems only.

1133 8.3.6.5 Status indicators

1134 A status indicator may be composed of two parts (one of which is not replaced on replacement
1135 of the SPD), linked by a coupling mechanism which can be mechanical, optical, audio,
1136 electromagnetic, etc. The part of the status indicator which is not replaced shall be capable of
1137 operating at least 50 times.

1138 Compliance is checked by the test in accordance with 9.3.6.5.

1139 8.3.7 Insulation resistance

1140 The insulation resistance of the SPD shall be sufficient with respect to leakage currents and
1141 protection against direct contact.

1142 Compliance is checked by the test in accordance with 9.3.7.

1143 8.3.8 Dielectric withstand

1144 The dielectric withstand of the SPD shall be sufficient with respect to insulation breakdown and
1145 protection against direct contact.

1146 Compliance is checked by the test in accordance with 9.3.8.

1147 8.3.9 Behaviour under temporary overvoltages

1148 An SPD shall behave in a safe manner when subjected to TOVs.

1149 Compliance is checked by the test in accordance with 9.3.9.

1150 For SPDs with a U_C greater than or equal to U_T there is no need to perform this test.

1151 NOTE: The tests given do not take into account the possibility of a surge occurring simultaneously with a TOV
1152 event.

1153 8.3.10 Maximum discharge current I_{max}

1154 If the manufacturer declares I_{max} for the SPD, the SPD shall withstand at least one impulse at
1155 I_{max} .

1156 I_{max} shall be equal to or greater than

- 1157 • the crest value of I_{imp} for T1 SPD
- 1158 • I_n for T2 SPD
- 1159 • the calculated value in kA of 0.5 times U_{OC} in kV for T3 SPD.

1160 Compliance is checked by the test in accordance with 9.3.10.

1161 8.4 Mechanical requirements

1162 8.4.1 Mounting

1163 SPDs shall be provided with appropriate means for mounting that will ensure mechanical
1164 stability.

1165 Mechanical coding/interlock shall be provided to prevent incorrect combinations of plug-in SPD
1166 modules and sockets.

1167 Compliance is checked by visual inspection.

1168 **8.4.2 Screws, current carrying parts and connections**

1169 Compliance is accordance with 9.4.2 and checked by inspection and trial mounting.

1170 **8.4.3 External connections**

1171 **8.4.3.1 General**

1172 Electrical connections shall be possible using one of the following means:

- 1173 • screw terminals and bolted connections;
- 1174 • screwless terminals;
- 1175 • insulation piercing connections;
- 1176 • flat quick connect terminations;
- 1177 • flying leads (pigtail connections);
- 1178 • other equally effective means;
- 1179 or
- 1180 • standardised plugs and/or sockets.

1181 The following requirements do not apply to standardised plugs and/or sockets:

1182 Connections shall be designed for the connection of cables having a minimum and a maximum
1183 cross-sectional area according to 9.4.3.

1184 Connections shall be fastened to the SPD in such a way that they will not loosen if the clamping
1185 screws or the lock nuts are tightened or loosened. A tool shall be required to loosen the
1186 clamping screws or the lock nuts.

- 1187 a) Connections for external conductors shall be such that the conductors may be connected
1188 so as to ensure that the necessary contact pressure is maintained permanently. The
1189 connections shall be readily accessible under the intended conditions of use.
- 1190 b) The means for clamping the conductors in the connections shall not serve to fix any other
1191 component, although they may hold the terminals in place or prevent them from turning.
- 1192 c) Connections shall have adequate mechanical strength.
- 1193 d) Connections shall be so designed that they clamp the conductor without undue damage to
1194 the conductor.
- 1195 e) Connections shall be so designed that they clamp the conductor reliably and between metal
1196 surfaces.
- 1197 f) Connections shall be so designed or positioned that neither a rigid solid conductor nor a
1198 wire of a stranded conductor can slip out while the clamping screws or nuts are tightened.

1199 **8.4.3.2 Screw terminals and bolted connections**

- 1200 a) Screws and nuts for clamping the conductors shall have a metric ISO thread or a thread
1201 comparable in pitch and mechanical strength.

1202 SI, BA and UN threads may be used as they are virtually equivalent in pitch and mechanical
1203 strength to metric ISO threads.

- 1204 b) Connections shall be so fixed or located that, when the clamping screws or nuts are
1205 tightened or loosened, the connections shall not loosen from their fixings to the SPDs.

1206 These requirements do not imply that the connections shall be so designed that their
1207 rotation or displacement is prevented, but any movement shall be sufficiently limited so as
1208 to prevent non-compliance with the requirements of this standard.

1209 The use of sealing compound or resin is considered to be sufficient for preventing a
1210 connection from working loose, provided that:

- 1211 • the sealing compound or resin is not subject to stress during normal use, and
- 1212 • the effectiveness of the sealing compound or resin is not impaired by temperatures
1213 attained by the connections under the least favourable conditions specified in this
1214 standard.

1215 c) Clamping screws or nuts of connections intended for the connection of protective
1216 conductors shall be adequately secured against accidental loosening.

1217 d) Screws shall not be made of metal that is soft or liable to creep, such as zinc or aluminium

1218 Compliance is checked by inspection and by the tests in accordance with 9.4.3.2.

1219 **8.4.3.3 Screwless terminals**

1220 Terminals shall be so designed and constructed that:

- 1221 a) each conductor is clamped individually. During the connection or disconnection, the
1222 conductors can be connected or disconnected either at the same time or separately,
- 1223 b) it is possible to clamp securely any number of conductors up to the maximum provided.

1224 Compliance is checked by inspection and by the tests in accordance with 9.4.3.2.2.2.

1225 **8.4.3.4 Insulation piercing connections**

1226 Compliance is checked by inspection and by the tests in accordance with 9.4.3.4.

1227 **8.4.3.5 Flat quick connect terminations**

1228 Compliance is checked by inspection and by the tests in accordance with 9.4.3.6 (under
1229 consideration).

1230 **8.4.3.6 Pigtail connections (flying leads)**

1231 Compliance is checked by inspection and by the tests in accordance with 9.4.3.7.

1232 **8.4.3.7 Standardized plugs and/or socket outlets**

1233 Plugs and socket outlets for SPDs for power applications shall comply with the relevant
1234 international or national requirements (e.g. IEC 60884-1, IEC 60320-series).

1235 Connectors for SPDs for telecommunication and signalling applications shall comply with
1236 relevant international standards (e.g. IEC 60603-series).

1237 **8.4.4 Air clearances and creepage distances**

1238 The SPD shall have sufficient air clearances and creepage distances.

1239 Compliance is checked by the test in accordance with 9.4.4.

1240 **8.4.5 Mechanical strength**

1241 All parts of the SPD relating to the protection against direct contact shall have sufficient
1242 mechanical strength.

1243 Compliance is checked by the test in accordance with 9.4.5.

1244 **8.5 Environmental and material requirements**

1245 **8.5.1 Protection provided by enclosure (IP code)**

1246 SPDs shall be provided with an enclosure for protection against ingress of solid objects and
1247 water in accordance with the IP code declared by the manufacturer.

1248 Compliance is checked by inspection and by the tests in accordance with 9.5.1.

1249 **8.5.2 Heat resistance**

1250 SPDs shall be sufficiently resistant to heat.

1251 Compliance is checked by the tests in accordance with 9.3.6.1 and 9.5.2.

1252 **8.5.3 Resistance to abnormal heat and fire**

1253 Insulating parts of the housing shall be either non-flammable or self-extinguishing.

1254 Compliance is checked by the test in accordance with 9.5.3.

1255 **8.5.4 Tracking resistance**

1256 Insulating materials shall provide sufficient resistance against tracking.

1257 Compliance is checked by the test in accordance with 9.5.4.

1258 Testing is not necessary if the creepage distances are greater or equal to double the values
1259 indicated in 9.4.4 or in case of inorganic insulating materials like ceramic, mica or similar.

1260 **8.5.5 Ageing behaviour under damp heat**

1261 SPDs for DC application shall withstand long term humidity without unacceptable increase of
1262 leakage current.

1263 Compliance is tested in accordance with 9.5.5.

1264 **8.5.6 Electromagnetic compatibility**

1265 **8.5.6.1 Electromagnetic immunity**

1266 SPDs either not incorporating electronic circuits or incorporating electronic circuits in which all
1267 components are passive (for example diodes, resistors, capacitors, inductors, varistors and
1268 other surge protective components) are not sensitive to electromagnetic disturbances expected
1269 under normal service conditions and therefore no immunity tests are required. For SPDs
1270 containing sensitive electronic circuits, refer to IEC 61000 series.

1271 **8.5.6.2 Electromagnetic emission**

1272 For SPDs not incorporating electronic circuits or incorporating electronic circuits that do not
1273 generate fundamental frequencies greater than 9 kHz in normal operation, electromagnetic
1274 disturbances can only be generated during protective operations. The duration of these
1275 disturbances is in the order of microseconds to milliseconds.

1276 The frequency, level and the consequences of these emissions are considered as part of the
1277 normal electromagnetic environment of low-voltage installations. Therefore, the requirements
1278 for electromagnetic emissions are deemed to be satisfied and no verification is necessary.