

Low voltage surge protective devices —

**Part 21: Surge protective devices
connected to telecommunications and
signalling networks — Performance
requirements and testing methods**

ICS 29.120.50, 33.040.30

National foreword

This British Standard is the UK implementation of EN 61643-21:2001+A2:2013. It is derived from IEC 61643-21:2000, incorporating corrigendum March 2001 and amendment 2:2012. It supersedes BS EN 61643-21:2001+A1:2009, which is withdrawn.

The start and finish of text introduced or altered by amendment is indicated in the text by tags. Tags indicating changes to IEC text carry the number of the IEC amendment. For example, text altered by IEC amendment 1 is indicated by A1 A1.

Where a common modification to an IEC amendment has been introduced, the tags carry the number of the amendment. For example, the common modifications introduced by CENELEC to IEC amendment 1 are indicated by C1 C1.

The UK participation in its preparation was entrusted by Technical Committee PEL/37, Surge Arresters – High Voltage, to Subcommittee PEL/37/1, Surge arresters – Low voltage.

A list of organizations represented on this subcommittee can be obtained on request to its secretary.

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Low voltage surge protective devices
Part 21: Surge protective devices connected to
telecommunications and signalling networks -
Performance requirements and testing methods
(IEC 61643-21:2000 + corrigendum 2001)

Parafoudres basse-tension
Partie 21: Parafoudres connectés
aux réseaux de signaux et de
télécommunications -
Prescriptions de fonctionnement et
méthodes d'essais
(CEI 61643-21:2000 + corrigendum 2001)

Überspannungsschutzgeräte für
Niederspannung
Teil 21: Überspannungsschutzgeräte für
den Einsatz in Telekommunikations- und
signalverarbeitenden Netzwerken -
Leistungsanforderungen und
Prüfverfahren
(IEC 61643-21:2000 + Corrigendum 2001)

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CENELEC

European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

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BS EN 61643-21:2001+A2:2013
EN 61643-21:2001+A2:2013

Foreword

The text of document 37A/101/FDIS, future edition 1 of IEC 61643-21, prepared by SC 37A, Low-voltage surge protective devices, of IEC TC 37, Surge arresters, was submitted to the IEC-CENELEC parallel vote and was approved by CENELEC as EN 61643-21 on 2000-11-01.

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Endorsement notice

The text of the International Standard IEC 61643-21:2000 + corrigendum March 2001 was approved by CENELEC as a European Standard without any modification.

Foreword to amendment 1

The text of amendment 1:2008 to the International Standard IEC 61643-21:2000, prepared by SC 37A, Low-voltage surge protective devices, of IEC TC 37, Surge arresters, together with common modifications prepared by the Technical Committee CENELEC TC 37A, Low voltage surge protective devices, was submitted to the Unique Acceptance Procedure and was approved by CENELEC as amendment A1 to EN 61643-21:2001 on 2009-03-01.

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Annex ZA, which was added by CENELEC, has been updated to reflect the changes in the normative references.

Foreword to amendment 2

The text of document 37A/236/FDIS, future amendment 2 to edition 1 of IEC 61643-21, prepared by IEC/SC 37A "Low-voltage surge protective devices" of IEC/TC 37 "Surge arresters" was submitted to the IEC-CENELEC parallel vote and approved by CENELEC as EN 61643-21:2001/A2:2013.

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Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CENELEC [and/or CEN] shall not be held responsible for identifying any or all such patent rights.

This standard covers the Principle Elements of the Safety Objectives for Electrical Equipment Designed for Use within Certain Voltage Limits (LVD - 2006/95/EC).

Endorsement notice

The text of the International Standard IEC 61643-21:2000/A2:2012 was approved by CENELEC as a European Standard without any modification.

In the Bibliography of EN 61643-21:2001, the following note has to be **added** for the standard indicated:

IEC 60664-1 NOTE Harmonised as EN 60664-1.

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INTRODUCTION

The purpose of this International Standard is to identify the requirements for Surge Protective Devices (SPDs) used in protecting telecommunication and signalling systems, for example, low-voltage data, voice, and alarm circuits. All of these systems may be exposed to the effects of lightning and power line faults, either through direct contact or induction. These effects may subject the system to overvoltages or overcurrents or both, whose levels are sufficiently high to harm the system. SPDs are intended to provide protection against overvoltages and overcurrents caused by lightning and power line faults. This standard describes tests and requirements which establish methods for testing SPDs and determining their performance.

The SPDs addressed in this International Standard may contain overvoltage protection components only, or a combination of overvoltage and overcurrent protection components. Protection devices containing overcurrent protection components only are not within the coverage of this standard. However, devices with only overcurrent protection components are covered in annex A.

An SPD may comprise several overvoltage and overcurrent protection components. All SPDs are tested on a "black box" basis, i.e., the number of terminals of the SPD determines the testing procedure, not the number of components in the SPD. The SPD configurations are described in 1.2. In the case of multiple line SPDs, each line may be tested independently of the others, but there may also be a need to test all lines simultaneously.

This standard covers a wide range of testing conditions and requirements; the use of some of these is at the discretion of the user. How the requirements of this standard relate to the different types of SPD is described in 1.3. Whilst this is a performance standard and certain capabilities are demanded of the SPDs, failure rates and their interpretation are left to the user. Selection and application principles will be covered in IEC 61643-22 ¹⁾.

If the SPD is known to be a single component device, it has to meet the requirements of the relevant standard as well as those in this standard.

¹⁾ Under consideration.

LOW VOLTAGE SURGE PROTECTIVE DEVICES –

Part 21: Surge protective devices connected to telecommunications and signalling networks – Performance requirements and testing methods

1 General

1.1 Scope

This International Standard is applicable to devices for surge protection of telecommunications and signalling networks against indirect and direct effects of lightning or other transient overvoltages.

The purpose of these SPDs is to protect modern electronic equipment connected to telecommunications and signalling networks with nominal system voltages up to 1 000 V (r.m.s.) a.c. and 1 500 V d.c.

1.2 SPD configurations

The SPD configurations described in this standard are shown in figure 1. Each SPD configuration is composed of one or more voltage-limiting components and may include current-limiting components.

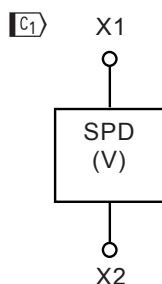


Figure 1a – Two-terminal SPD

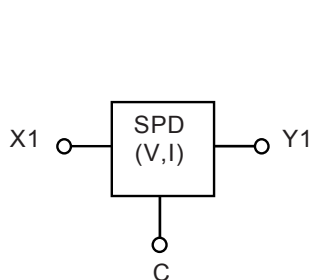


Figure 1b – Three-terminal SPD

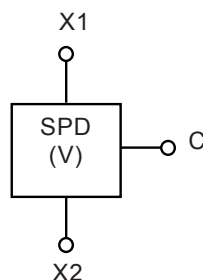


Figure 1c – Three-terminal SPD

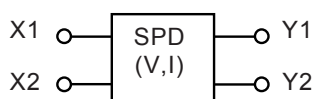


Figure 1d – Four-terminal SPD

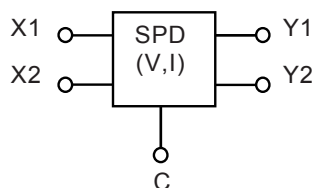
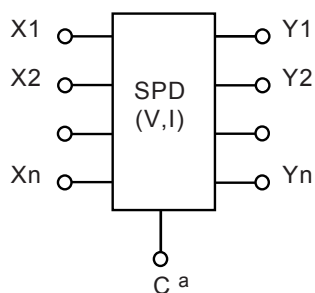


Figure 1e – Five-terminal SPD



^a The common terminal C may not be provided.

Figure 1f – Multi-terminal SPD **Key**

V	voltage-limiting component
V, I	voltage-limiting components or a combination of voltage-limiting and current-limiting components
X1, X2...Xn	line terminals
Y1, Y2...Yn	protected line terminals
C	common terminal

Figure 1 – SPD configurations

Table 1 – General SPD requirements

Test series ^d	Requirement – Test	Sub-clause	Type of SPD					
			SPD with only voltage-limiting function	SPD with both voltage-limiting and current-limiting functions	SPD with voltage-limiting function and linear component between its terminals	SPD having both voltage-limiting and current-limiting functions with enhanced transmission capabilities	SPD having only voltage-limiting function but intended for use in extended range environment	SPD having both voltage-limiting and current-limiting functions but intended for use in extended range environment
1	General test	6.1						
	Identification and documentation	6.1.1	A	A	A	A	A	A
	Marking	6.1.2	A	A	A	A	A	A
	Transmission tests	6.2.3						
	Capacitance	6.2.3.1	A	O	O	O	A	O
	Insertion loss	6.2.3.2	O	A	A	A	O	A
	Return loss	6.2.3.3	O	O	O	A	O	O
	Longitudinal balance	6.2.3.4	O	O	O	A	O	O
	Bit Error Ratio (BER)	6.2.3.5	O	O	O	O	O	O
	Near-end crosstalk (NEXT)	6.2.3.6	O	O	O	A	O	O
	Mechanical tests	6.3						
	Terminals and connectors	6.3.1	A	A	A	A	A	A
	General testing procedure	6.3.1.1	A	A	A	A	A	A
	Terminals with screws	6.3.1.2	A	A	A	A	A	A
	Screwless terminals	6.3.1.3	A	A	A	A	A	A
	Insulating pierced connections	6.3.1.4	A	A	A	A	A	A
	Pull-out-test on SPD terminals designed for single-core conductors	6.3.1.4.1	A	A	A	A	A	A
	Pull-out-test on SPD terminals designed for multi-core cables and cords	6.3.1.4.2	A	A	A	A	A	A
	Mechanical strength (mounting)	6.3.2	A	A	A	A	A	A

A2

Table 1 (continued)

Test series ^d	Requirement – Test	Sub-clause	Type of SPD					
			SPD with only voltage-limiting function	SPD with both voltage-limiting and current-limiting functions	SPD with voltage-limiting function and linear component between its terminals	SPD having both voltage-limiting and current-limiting functions with enhanced transmission capabilities	SPD having only voltage-limiting function but intended for use in extended range environment	SPD having both voltage-limiting and current-limiting functions but intends for use in extended range environment
	Resistance to ingress of solid objects and to harmful ingress of water	6.3.3	A	A	A	A	A	A
	Protection against direct contact	6.3.4	A	A	A	A	A	A
	Fire resistance	6.3.5	A	A	A	A	A	A
	Environmental tests	6.4						
	High temperature and humidity endurance	6.4.1	O	O	O	O	A	A
	Environmental cycling with impulse surges	6.4.2	O	O	O	O	A	A
	Environmental cycling with AC surges	6.4.3	O	O	O	O	A	A
2	Voltage limiting tests	6.2.1						
	Maximum continuous operating voltage (Uc)	6.2.1.1	A	A	A	A	A	A
	Insulation resistance	6.2.1.2	A	A	A	A	A	A
	Impulse durability for voltage limiting function ^a	6.2.1.6	A	A	A	A	A	A
	Impulse-limiting voltage ^b	6.2.1.3	A	A	A	A	A	A
	Impulse reset switching types	6.2.1.4	A	A	A	A	A	A
	AC durability for voltage limiting function ^a	6.2.1.5	O	O	O	O	O	O
	Blind spot test multi stage SPD	6.2.1.8	A	A	A	A	A	A
	Overstressed fault mode	6.2.1.7	O	O	O	O	O	O
3	Current limiting tests	6.2.2						
	Rated current	6.2.2.1	A ^e	A	A	A	A ^e	A
	Series resistance	6.2.2.2	N.A.	A	A	A	N.A.	A
	Current response time	6.2.2.3	N.A.	A	N.A.	A ^c	N.A.	A ^c
	Current reset time	6.2.2.4	N.A.	A	N.A.	A ^c	N.A.	A ^c
	Maximum interrupting voltage	6.2.2.5	N.A.	A	N.A.	A ^c	N.A.	A ^c
	Operating duty test	6.2.2.6	N.A.	A	N.A.	A ^c	N.A.	A ^c
	AC durability for current limiting function ^a	6.2.2.7	N.A.	A	N.A.	A ^c	N.A.	A ^c
	Impulse durability for current limiting function ^a	6.2.2.8	N.A.	A	N.A.	A ^c	N.A.	A ^c
4	Acceptance tests	6.5	O	O	O	O	O	O

A1 Table 1 (continued) A1

A2	A	Applicable.
	N.A.	Not applicable.
	O	Optional.
	a	For each category of test impulse a new set of samples can be used.
	b	It is admissible to measure the impulse-limiting voltage 6.2.1.3 while testing impulse durability 6.2.1.6.
	c	Test not applicable if there is a linear component between its terminals.
	d	Each test series is carried out on three samples.
	e	Applicable only for 4/5 terminal SPD (see fig. 1d and 1e)

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this part of IEC 61643. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this part of IEC 61643 are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of ISO and IEC maintain registers of currently valid International Standards.

IEC 60050(702):1992, *International Electrotechnical Vocabulary – Chapter 702: Oscillations, signals and related devices*

IEC 60050(726):1982, *International Electrotechnical Vocabulary – Chapter 726: Transmission lines and waveguides*

IEC 60060-1:1989, *High-voltage test techniques – Part 1: General definitions and test requirements*

IEC 60068-2-30:1980, *Environmental testing – Part 2: Tests – Test Db and guidance: Damp heat, cyclic (12 + 12-hour cycle)*

A1 IEC 60529 A1, *Degrees of protection provided by enclosures (IP code)*

IEC 60695-2-1/1:1994, *Fire hazard testing – Part 2: Test methods – Section 1/sheet 1: Glow-wire end-product test and guidance*

IEC 60950:1999, *Safety of information technology equipment*

A2 IEC 60999-1, *Connecting devices – Electrical copper conductors – Safety requirements for screw-type and screwless-type clamping units – Part 1: General requirements and particular requirements for clamping units for conductors from 0,2 mm² up to 35 mm² (included)* A2

A1 IEC 61000-4-5 A1, *Electromagnetic compatibility (EMC) – Part 4: Testing and measurement techniques – Section 5 – Surge immunity test*

A1 IEC 61083-1 A1, *Digital recorders for measurements in high voltage impulse tests – Part 1: Requirements for digital recorders*

IEC 61180-1:1992, *High-voltage test techniques for low-voltage equipment – Part 1: Definitions, test and procedure requirements*

Ⓐ₁ IEC 61643-1 Ⓐ₁, *Surge protective devices connected to low-voltage power distribution systems – Part 1: Performance requirements and testing methods*

Ⓐ₂ IEC 61643-11:2011, *Surge protective devices connected to low-voltage power distribution systems – Part 1: Performance requirements and testing methods* Ⓐ₂

Ⓒ₁ 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* Ⓒ₁

Ⓐ₁ IEC 61643-22:2004, *Low-voltage surge protective devices – Part 22: Surge protection devices connected to telecommunications and signalling networks – Selection and application principles* Ⓐ₁

Ⓒ₁ IEC 62305-4:2006, *Protection against lightning – Part 4: Electrical and electronic systems within structures* Ⓒ₁

Ⓐ₁ Text deleted Ⓐ₁

Ⓐ₂ ITU-T Recommendation K.82, *Characteristics and ratings of solid-state, self-restoring overcurrent protectors for the protection of telecommunications installations*

ITU-T Recommendation K.44: 2011, *Resistibility tests for telecommunication equipment exposed to overvoltages and overcurrents – Basic Recommendation* Ⓐ₂

Ⓐ₁ ITU-T Recommendation K.55:2002, *Overvoltage and overcurrent requirements for insulation displacement connectors (IDC) terminations* Ⓐ₁

Ⓐ₂ Text deleted Ⓐ₂

Ⓐ₁ ITU-T Recommendation O.9:1999, *Measuring arrangements to assess the degree of unbalance about earth* Ⓐ₁

3 Definitions

For the purpose of this part of IEC 61643, the following definitions apply.

3.1

model number

code, either applied to the SPD or included in its documentation, that is used to identify the SPD

3.2

preferred values

values for the parameters listed in the tables for the various tests, preferred in the sense that their use promotes uniformity and provides a means of comparison among various protective devices. They also provide a common engineering language beneficial to the user and manufacturer of surge protectors used in telecommunications and signalling networks. However, specific applications may require values other than the preferred values of the tables

3.3**overstressed fault mode**

mode 1 condition wherein the voltage-limiting part of the SPD has been disconnected. The voltage-limiting function is no longer present, but the line is still operable

mode 2 condition wherein the voltage-limiting part of the SPD has been short-circuited by a very low impedance within the SPD. The line is inoperable, but the equipment is still protected by a short circuit

mode 3 situation wherein the SPD has undergone an internal open circuit on the network side of the voltage-limiting part of the SPD. The line is inoperable but the equipment is still protected by an open line

3.4**protection**

application of methods and means to prevent the propagation of stressful electrical energy beyond a designed interface

3.5**current response time**

time required for a current-limiting component to operate at a specified current and a specified temperature

3.6**maximum continuous operating voltage U_c**

maximum voltage (d.c. or r.m.s.) which may be continuously applied to SPD terminals without causing any degradation in the transmission characteristics of the SPD

3.7**maximum interrupting voltage**

maximum voltage (d.c. or r.m.s.) that can be applied to the current-limiting components of an SPD without degradation of the SPD. This voltage may be equal to the U_c of the SPD or may be a higher value depending on the arrangement of the current-limiting component(s) within the SPD

**3.8****surge protective device****SPD**

device that restricts the voltage of a designated port or ports, caused by a surge, when it exceeds a predetermined level

NOTE 1 Secondary functions may be incorporated, such as a current-limiting to restrict a terminal current.

NOTE 2 Typically the protective circuit has at least one non-linear voltage-limiting surge protective component.

NOTE 3 An SPD is a complete assembly, having terminals to connect to the circuit conductors.

3.9**voltage limiting**

action of the SPD that causes all voltages exceeding a predetermined value to be reduced

3.10**current limiting**

action of an SPD, containing at least one non-linear current-limiting component, that causes currents exceeding a predetermined value to be restricted 

A2 3.11**total discharge current I_{Total}**

current which flows through the earthing terminal (common terminal C) of a multi-terminal SPD during the total discharge current test.

NOTE This may also be called "Total surge current". **A2**

3.12**resettable current limiting**

action of an SPD that limits current and can be manually reset after operating

3.13**self-resetting current limiting**

action of an SPD that limits current and will self-reset after the disturbing current is removed

A1 3.14**voltage clamping type SPD**

SPD that has high shunt impedance and will have a continuous reduction in impedance with increasing current in response to a voltage surge exceeding the threshold level of the SPD

NOTE Examples of components used in voltage clamping type SPDs: varistors (e.g. MOV) and avalanche breakdown diodes (ABD).

3.15**voltage switching type SPD**

SPD that has a high shunt impedance and will have a sudden and large reduction in impedance in response to a voltage surge exceeding the threshold level of the SPD

NOTE Examples of components used in voltage switching type SPDs: air gaps, gas discharge tubes (GDT) and thyristor surge suppressors (TSS). **A1**

3.16**voltage protection level U_p**

parameter that characterizes the performance of the SPD in limiting the voltage across its terminals. This value of voltage is greater than the highest measured value of impulse-limiting voltage and is specified by the manufacturer

3.17**multi-stage SPD**

SPD which has more than one voltage-limiting component. These voltage-limiting components may or may not be electrically separated by a series component. The voltage-limiting components may be either switching or clamping types

3.18**blind spot**

situation where voltages above the maximum continuous operating voltage U_c may cause incomplete operation of the SPD. Incomplete operation of the SPD means not all of the stages in a multi-stage SPD have operated during the impulse test. This may result in overstressing of components in the SPD

3.19**a.c. durability**

characteristic of an SPD which allows it to conduct alternating current of a specific magnitude and duration for a specified number of times

3.20**impulse durability**

characteristic of an SPD which allows it to conduct impulse current of a specified waveform and peak value for a specified number of times

3.21**current reset time**

time required for a self-resettable current limiter to revert to its normal or quiescent state

3.22**rated current**

maximum current a current-limiting SPD can conduct continuously with no change in the

A1 impedance of the current-limiting components

NOTE This is also applicable to linear series components. **A1**

3.23**insulation resistance**

resistance between designated terminals of an SPD when U_c is applied to those terminals

3.24**return loss**

modulus of the reciprocal of the reflection factor, generally expressed in decibels (dB)

NOTE When impedances can be defined, the return loss in dB is given by the formula:

$$20 \log_{10} \text{MOD} [(Z_1 + Z_2)/(Z_1 - Z_2)]$$

where Z_1 is the characteristic impedance of the transmission line ahead of the discontinuity, or the impedance of the source, and Z_2 is the impedance after the discontinuity or load impedance seen from the junction between the source and the load [IEV 702-07-25, modified]

3.25**bit error ratio (BER)**

ratio of the number of bit errors to the total number of bits transmitted in a given time interval

3.26**insertion loss**

loss resulting from the insertion of an SPD into a transmission system. It is the ratio of the power delivered to that part of the system following the SPD, before insertion of the SPD, to the power delivered to that same part after insertion of the SPD. The insertion loss is generally expressed in decibels [IEV 726-06-07, modified]

3.27**near-end crosstalk (NEXT)**

crosstalk that is propagated in a disturbed channel in the direction opposite to the direction of propagation of the current in the disturbing channel. The terminal of the disturbed channel at which the near-end crosstalk is present is ordinarily near to, or coincides with, the energized terminal of the disturbing channel

3.28**longitudinal balance (analogue voice frequency circuits)**

electrical symmetry of the two wires comprising a pair with respect to ground

3.29**longitudinal balance (data transmission)**

measure of the similarity of impedance to ground (or common) for the two or more conductors of a balanced circuit. This term is used to express the degree of susceptibility to common mode interference

3.30**longitudinal balance (communication and control cables)**

ratio of the disturbing common mode (longitudinal) r.m.s. voltage (V_s) to ground and the resulting differential mode (metallic) r.m.s. voltage (V_m) of the SPD under test, expressed in decibels (dB)

NOTE The longitudinal balance in dB is given by the formula:

$$20 \log_{10} V_s/V_m$$

where V_s and V_m are measured at the same frequency.

3.31**longitudinal balance (telecommunications)**

ratio of the disturbing common mode (longitudinal) voltage V_s and the resulting differential mode (metallic) voltage V_m of the SPD under test, expressed in decibels (dB)

A1 3.32**surge (telecommunications)**

temporary excessive voltage or current, or both, coupled on a telecommunication line, from an external electrical source

NOTE 1 Typical electrical sources are lightning and AC/DC power systems.

NOTE 2 Electrical source coupling can be one or more of the following; electric, magnetic, electromagnetic, conductive. **A1**

A2 3.33**nominal discharge current I_n**

crest value of the current through the SPD having a current waveshape of 8/20

3.34**rated surge current I_{SM}**

maximum value of SPD impulse current with a defined waveshape

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

crest value of a discharge current (10/350) through the SPD **A2**

4 Service and test conditions**4.1 Service conditions****4.1.1 Normal service conditions****A1 4.1.1.1 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.

4.1.1.2 Ambient temperature

- normal range: –5 °C to +40 °C

NOTE 1 This range normally addresses SPDs for indoor use. This corresponds to code AB4 in IEC 60364-5-51. **A1**

- A1** • extended range: $-40\text{ }^{\circ}\text{C}$ to $+70\text{ }^{\circ}\text{C}$

NOTE 2 This range normally addresses SPDs for outdoor use in non weather-protected locations, class 3K7 in IEC 60721-3-3.

- storage range: $-40\text{ }^{\circ}\text{C}$ to $+70\text{ }^{\circ}\text{C}$

NOTE 3 All values beyond will be specified by the manufacturer.

4.1.1.3 Relative humidity

- normal range: 5 % to 95 %

NOTE 1 This range normally addresses SPDs for indoor use. This corresponds to code AB4 in IEC 60364-5-51.

- extended range: 5 % to 100 %

NOTE 2 This range normally addresses SPDs for outdoor use in non weather-protected locations (e.g. SPD is contained in a weather proofed enclosure). **A1**

4.1.2 Abnormal service conditions

Exposure of the SPD to abnormal service conditions may require special consideration in the design or application of the SPD, and shall be called to the attention of the manufacturer.

4.2 Test temperature and humidity

- A2** The SPDs shall be tested at a temperature of $25\text{ }^{\circ}\text{C} \pm 10\text{ }^{\circ}\text{C}$ with relative humidity from 25 % to 75 %.

If required by the manufacturer or customer, the SPDs shall be tested at the extreme temperatures of the service temperature range selected for the intended application. The selected temperature range may be narrower than the full range of 4.1 depending on the application. **A2**

For particular SPD technologies, it may be known beforehand that only one of the extreme temperatures of the selected temperature range represents the worst-case test condition. In this case, the testing shall be performed only at the extreme temperature representing the worst-case test condition. This extreme temperature may be different for each test described in clause 6 for the same SPD technology.

When testing is required to be performed at extreme temperatures, SPDs shall be gradually heated or cooled to the specified extreme temperature, taking sufficient time to avoid thermal shock. Unless otherwise specified, a minimum of 1 h should be used. SPDs shall be held at the specified temperature for a time sufficient to reach thermal equilibrium before testing. Unless otherwise specified, a minimum of 15 min should be used.

4.3 SPD testing

- A1** The SPDs covered by this standard shall be tested using the connections or terminations that are used when the SPDs are installed in the field. Also, the measurements shall be made at the connections or terminations of the SPDs. For those that are intended to be used with a base or connector, that base or connector shall be part of the tests.

For telecommunication applications ITU-T gives requirements in the K-series for protection holders (K.65) and termination modules (K.55). **A1**

- A2** When a base is used for testing, the measurements shall be made as close as possible to the terminals of the SPD base (termination module) intended for external connections. Waveform recorders used for measurements shall have a minimum performance in accordance with IEC 61083-1 with respect to the specific measurement.

NOTE For waveform recorders settings, see Annex D.

SPDs of Figures 1c, 1e and 1f may have a common current path (including protective components or just internal connections) that conducts the total impulse current I_{Total} . The manufacturer shall state the maximum value of impulse current for this current path. This value of impulse current may be less than n times the maximum current capability of each line terminal, where n equals the number of line terminals. **A2**

A2 Text deleted **A2**

- A1** Matters of sample size and permissible failure rates are to be agreed between the customer and manufacturer. **A1**

4.4 Waveform tolerances

The definition of the waveform parameters A/B where A is the front time in microseconds and B is the time to half-value in microseconds shall be in accordance with IEC 60060-1 (see also IEC 61000-4-5). Table 2 shows the tolerances for the waveforms used in this standard.

Table 2 – Waveform tolerances

Waveform item	1,2/50 or 10/700 Open-circuit voltage	8/20 or 5/300 Short-circuit current	Other waveforms
Peak	±10 %	±10 %	±10 %
Front time	±30 %	±20 %	±30 %
Time to half-value	±20 %	±20 %	±20 %

5 Requirements

5.1 General requirements

The following requirements apply to all SPDs covered by this standard.

5.1.1 Identification and documentation

The information indicated in items a) through n) shall either be marked on the body of the SPD, as described in 5.1.2, or included in the documentation or on the packaging. Any abbreviations used shall be explained in the data sheet. For each test performed on the SPD from clause 6, the test conditions shall be stated in the documentation.

- a) Manufacturer's name or trade mark
- b) Year and week of manufacture, or serial number
- c) Model number
- d) Service conditions
- A_2 e) Maximum continuous operating voltage U_c (AC and/or DC) A_2
- f) Rated current
- g) Voltage protection level U_p
- h) Impulse reset (if applicable)
- i) AC durability
- A_2 j) Impulse rating (according to Table 3 - category and corresponding parameters e.g. C2: 2k V/ 1kA) A_2
- k) Overstressed fault mode
- A_2 l) Transmission characteristics (appropriate to the intended SPD use)
- m) Additional information, where applicable:
 - replaceable components,
 - the use of radioisotopes,
 - 'i_n' and 'AC overstress current' when impulse overstress test (6.2.1.7) is required
 - surge currents as I_{SM} , I_n , I_{imp} , I_{Total} A_2
- n) Series resistance (if applicable)
- A_2 o) (SPD-) Category and rating (if the category is printed on the SPD it is recommended to frame the category in a square. Example: $\boxed{\text{C2}}$) A_2

5.1.2 Marking

- A_2 The SPDs shall be clearly marked with 5.1.1 items: a) the manufacturer's name or trademark, b) manufacturing traceability, c) model number, and e) the maximum continuous operating voltage. The marking material shall be wipe resistant and resistant to solvents normally used in the SPD application. The location can be under a cover of the enclosure, but shall be easily accessible by the end user (e.g. no tools). Any notes for special handling shall be included in the documentation or on the packaging. Compliance is checked in accordance with 6.1.2. A_2

5.2 Electrical requirements

The SPD shall meet the following requirements when tested in accordance with the subclauses of clause 6.

5.2.1 Voltage-limiting requirements

When the SPD contains only voltage-limiting components, the SPD shall conform to all requirements of 5.2.1. An SPD that contains both voltage-limiting and current-limiting components shall conform to all requirements of 5.2.1 and to all applicable requirements of 5.2.2.

An SPD that contains any linear component between its line terminals and protected line terminals shall conform to the applicable requirements of 5.2.2.