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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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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/338/CD

COMMITTEE DRAFT (CD)

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DATE OF CIRCULATION:

2019-07-12

CLOSING DATE FOR COMMENTS:

2019-10-04

SUPERSEDES DOCUMENTS:

37A/336/RR

IEC SC 37A : LOW-VOLTAGE SURGE PROTECTIVE DEVICES

SECRETARIAT:

United States of America

SECRETARY:

Mr Muhammad Ali

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

NOTE FROM TC/SC OFFICERS:

This document contains references in the definition section, which are crossed out. These crossed out references will be kept up to the CDV stage to enable tracking within the WG during the development process, but will be deleted afterwards and should not be considered as part of the draft.

There are some secretary's notes within this document requesting NCs to specifically reply on certain subjects and to provide input. The notes are in Italics and framed

CONTENTS

1		
2		
3	FOREWORD.....	7
4	INTRODUCTION.....	9
5	1 Scope.....	10
6	2 Normative references	10
7	3 Definitions	11
8	3.1 General.....	11
9	3.2 Terms and definitions.....	11
10	3.3 Acronyms / Symbols	19
11	4 Classification.....	20
12	4.1 General.....	20
13	4.2 Number of ports	21
14	4.2.1 One	21
15	4.2.2 Two	21
16	4.3 SPD design.....	21
17	4.3.1 Voltage switching	21
18	4.3.2 Voltage limiting.....	21
19	4.3.3 Combination	21
20	4.4 Type of SPD	21
21	4.5 Location.....	21
22	4.5.1 Indoor.....	21
23	4.5.2 Outdoor	21
24	4.6 Accessibility.....	21
25	4.6.1 Accessible	21
26	4.6.2 Inaccessible	21
27	4.7 Mounting method	22
28	4.7.1 Fixed	22
29	4.7.2 Portable.....	22
30	4.8 Location of disconnecter (including overcurrent protection).....	22
31	4.8.1 Internal.....	22
32	4.8.2 External	22
33	4.8.3 Both (internal and external)	22
34	4.9 Degree of protection provided by enclosures according to IEC 60529 (IP	
35	code)	22
36	4.10 Temperature and humidity range.....	22
37	4.10.1 Normal	22
38	4.10.2 Extended	22
39	4.11 Multimode SPD	22
40	4.12 End of life mode of the SPD assembly	22
41	4.12.1 Open-circuit mode (OCM).....	22
42	4.12.2 Short-circuit mode (SCM)	22
43	5 Void.....	22
44	6 Marking and other product information.....	22
45	6.1 General.....	22
46	6.2 List of items	22
47	6.3 Information about status indicator	24

48	7	Service conditions	24
49	7.1	Voltage	24
50	7.2	Air pressure and altitude	24
51	7.3	Temperatures	24
52	7.4	Humidity	24
53	8	Requirements	24
54	8.1	General requirements	24
55	8.2	Marking.....	25
56	8.3	Electrical requirements	25
57	8.3.1	Protection against electric shock	25
58	8.3.2	Continuous current I_C	25
59	8.3.3	Protective conductor current I_{PE}	26
60	8.3.4	Voltage protection level U_p	26
61	8.3.5	Operating duty.....	26
62	8.3.6	Disconnectors, SC-means and status indicators	26
63	8.3.7	Insulation resistance.....	27
64	8.3.8	Dielectric withstand	28
65	8.3.9	Behaviour under temporary overvoltages	28
66	8.3.10	Maximum discharge current I_{max} , if declared by the manufacturer	28
67	8.4	Mechanical requirements	28
68	8.4.1	Mounting	28
69	8.4.2	Screws, current carrying parts and connections	28
70	8.4.3	External connections	28
71	8.4.4	Air clearances and creepage distances.....	30
72	8.4.5	Mechanical strength	30
73	8.5	Environmental and material requirements	30
74	8.5.1	Protection provided by enclosure (IP code).....	30
75	8.5.2	Heat resistance	30
76	8.5.3	Resistance to abnormal heat and fire.....	30
77	8.5.4	Tracking resistance	31
78	8.5.5	Ageing behaviour under damp heat	31
79	8.5.6	Electromagnetic compatibility	31
80	8.6	Additional requirements for specific SPD designs	31
81	8.6.1	Two port SPDs and one port SPDs with separate input/output connections	31
82			
83	8.6.2	Environmental stress for outdoor SPDs	32
84	8.6.3	SPDs with separated circuits	32
85	8.6.4	Total Discharge Current I_{Total} (for multimode SPDs).....	32
86	8.6.5	Two port SPDs only	32
87	9	Tests	33
88	9.1	General.....	33
89	9.1.1	General testing procedures.....	33
90	9.1.2	Impulse discharge current.....	37
91	9.1.3	8/20 Current impulse	38
92	9.1.4	1,2/50 Voltage impulse	38
93	9.1.5	Combination wave	39
94	9.2	Indelibility of markings	41
95	9.3	Electrical tests	41

96	9.3.1	Protection against direct contact.....	41
97	9.3.2	Continuous current I_C	42
98	9.3.3	Protective conductor current I_{PE}	42
99	9.3.4	Measured limiting voltage.....	42
100	9.3.5	Operating duty test.....	45
101	9.3.6	Disconnectors, SC-means and safety performance of overstressed	
102		SPDs.....	49
103	9.3.7	Insulation resistance.....	55
104	9.3.8	Dielectric withstand.....	56
105	9.3.9	Behaviour under temporary overvoltages (TOVs).....	57
106	9.3.10	Maximum discharge current I_{max} , if declared by the manufacturer.....	57
107	9.4	Mechanical tests.....	57
108	9.4.1	General.....	57
109	9.4.2	Reliability of screws, current-carrying parts and connections.....	57
110	9.4.3	Tests for external connections.....	58
111	9.4.4	Verification of air clearances and creepage distances.....	62
112	9.4.5	Mechanical strength.....	65
113	9.5	Environmental and material tests.....	68
114	9.5.1	Resistance to ingress of solid objects and to harmful ingress of water.....	68
115	9.5.2	Heat resistance.....	68
116	9.5.3	Resistance to abnormal heat and fire.....	70
117	9.5.4	Tracking resistance.....	71
118	9.5.5	Life test under damp heat.....	71
119	9.6	Additional tests for specific SPD designs.....	71
120	9.6.1	Tests for two-port SPDs and one-port SPDs with separate input/output	
121		connections.....	71
122	9.6.2	Environmental tests for outdoor SPDs.....	76
123	9.6.3	SPDs with separated circuits.....	76
124	9.6.4	Total discharge current test for multimode SPDs.....	76
125	9.6.5	Tests for two port SPDs only.....	77
126	Annex A (normative)	Routine and acceptance tests.....	79
127	A.1	Routine tests.....	79
128	A.2	Acceptance tests.....	79
129	Annex B (normative)	Tests to determine the presence of a switching component and	
130		the magnitude of the follow current.....	80
131	B.1	Test to determine the presence of a switching (crowbar) component.....	80
132	B.2	Test to determine the magnitude of the follow current.....	80
133	Annex C (normative)	Temperature rise limits.....	82
134	Annex D (normative)	Environmental tests for outdoor SPDs.....	83
135	D.1	Accelerated aging test with UV radiation.....	83
136	D.1.1	Test procedure.....	83
137	D.1.2	Pass criteria.....	83
138	D.2	Water immersion test.....	83
139	D.3	Dielectric test.....	83
140	D.3.1	Test procedure.....	83
141	D.3.2	Pass criteria.....	84
142	D.4	Temperature cycle test.....	84
143	D.4.1	Test procedure.....	84

144	D.4.2	Pass criteria	84
145	D.5	Verification of resistance to corrosion	84
146	D.5.1	Test procedure	84
147	D.5.2	Pass criteria	85
148	Annex E (normative)	Transition surge current rating test, if declared by the	
149		manufacturer	86
150	E.1	Short-circuiting SPDs.....	86
151	E.2	Transition surge current rating test	86
152	E.2.1	General	86
153	E.2.2	Test to reach the short-circuit mode of a short-circuiting SPD	86
154	E.2.3	Surge withstand test (in short-circuited condition).....	87
155	Annex F (informative)	Tests set-up to measure the residual voltage with 8/20 current	
156		impulses.....	88
157	F.1	Introduction.....	88
158	F.2	General.....	88
159	F.3	Guidance for the test arrangement.....	91
160	F.3.1	Method 1: Voltage probe placed at a certain distance	91
161	F.3.2	Method 2: Minimized loop of measurement lines	94
162	Annex G (informative)	Application of the metallic foil to test for insulation resistance	
163		and dielectric strength	95
164	G.1	Surfaces which are touchable after installation as for normal use are as	
165		follows:	95
166	G.2	Surfaces on which the SPD can be mounted or it can be in contact with	
167		metal surfaces:	95
168	G.3	Conclusion:.....	96
169	G.4	Test-set-up to measure the Insulation Resistance clause 9.3.7 and Dielectric	
170		Withstand clause 9.3.8 according IEC 61643-01	97
171	Bibliography.....		98
172			
173	Figure 1 – I/U characteristics for linear power source.....		33
174	Figure 2 – Metallic screen test setup.....		35
175	Figure 3 – Example of a decoupling network for single-phase power.....		40
176	Figure 4 – Example of a decoupling network for three-phase power.....		40
177	Figure 5 – Alternate test for the measured limiting voltage		41
178	Figure 6 – Flow chart of testing to check the voltage protection level Up.....		43
179	Figure 7 – Flow chart of the operating duty test		46
180	Figure 8 – Example of test set-up for operating duty test		46
181	Figure 9 – Operating duty test timing diagram for T1 SPDs and T2 SPDs		47
182	Figure 10 – Additional duty test timing diagram for T1 SPD.....		48
183	Figure 11 – Operating duty test timing diagram for T3 SPDs		49
184	Figure 12 – Example for test circuit for Thermal disconnection test.....		52
185	Figure 13 – Test apparatus for impact test		65
186	Figure 14 – Striking element of the pendulum hammer.....		66
187	Figure 15 – Ball thrust tester.....		69
188	Figure 16 – Loading rod for ball thrust tester.....		69
189	Figure 17 – Examples of appropriate test circuits for the rated load current test.....		72
190	Figure 18 – Examples for appropriate test circuits of the load side short-circuit test.....		76

191	Figure 19 – Example of test set-up for load side surge operating duty test.....	78
192	Figure E.1 – Differences in test procedure for short circuiting SPDs	86
193	Figure F.1 – 8/20 current impulse and induced voltage	88
194	Figure F.2 – Test arrangement A	89
195	Figure F.3 – Test arrangement B	90
196	Figure F.4 – Test arrangement C	90
197	Figure F.5 – measured voltages of test arrangements A, B and C during 8/20 current	
198	application	91
199	Figure F.6 – Routing of the measurement lines of an SPD having a single mode of	
200	protection	92
201	Figure F.7 – Wrong routings of the measurement lines	92
202	Figure F.8 – Routing of the measurement lines of a multipole SPD, example 1	93
203	Figure F.9 – Routing of the measurement lines of a multipole SPD, example 2	93
204	Figure F.10 – Example for the application of method 2 at an SPD having a single mode	
205	of protection	94
206		
207	Table 1 – List of Acronyms and Symbols.....	19
208	Table 2 – Type of SPD.....	21
209	Table 3 – Pass criteria for type tests	36
210	Table 4 – Example parameters for impulse discharge current	37
211	Table 5 – Tests to be performed to determine the measured limiting voltage	43
212	Table 6 – Prospective short circuit current to be applied depending on the maximum	
213	overcurrent protection specified, for fuses of the gG type.....	54
214	Table 7 – Dielectric withstand	56
215	Table 8 – Screw thread diameters and applied torques	58
216	Table 9 – Cross-sections of copper conductors for screw-type or screwless terminals	59
217	Table 10 – Conductor dimensions	59
218	Table 11 – Pulling forces (screw terminals and bolted connections)	60
219	Table 12 – Pulling forces (screwless terminals)	61
220	Table 13 – Air clearances for SPDs	62
221	Table 14 – Creepage distances for SPDs.....	63
222	Table 15 – Relationship between material groups and classifications.....	64
223	Table 16 – Fall distances for impact requirements	67
224	Table 17 – Test conductors for rated load current test	72
225	Table 18 – Current factor k for overload behaviour	73
226	Table 19 – Tolerances for proportional surge currents	77
227	Table C.1 – Temperature-rise limits	82
228		
229		

INTERNATIONAL ELECTROTECHNICAL COMMISSION

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

FOREWORD

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International Standard IEC 61643-01 has been prepared by subcommittee Low-voltage surge protective devices, of IEC technical committee 37: Surge arresters.

This **standard** cancels and replaces the **first edition of IEC 61643-11**, published in **2011-03-09**, and contains the common requirements for all SPDs. The specific requirements for SPDs for AC applications from the first edition of IEC 61643-11, published in 2011-03-09, 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) To be completed at CDV stage;

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

FDIS

Report on voting

XX/XX/FDIS	XX/XX/RVD
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284 Full information on the voting for the approval of this standard can be found in the report on
285 voting indicated in the above table.

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

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

- 290 • reconfirmed,
- 291 • withdrawn,
- 292 • replaced by a revised edition, or
- 293 • amended.

294 The National Committees are requested to note that for this publication the stability date is
295 **20XX**.

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

298

INTRODUCTION

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

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

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

308 If the intended applications of an SPD are covered by different parts of IEC 61643, all
309 relevant parts are applied, as far as is reasonable.

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

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

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

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

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

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

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

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

325

LOW-VOLTAGE SURGE PROTECTIVE DEVICES –**Part 01: General Requirements****1 Scope**

This part of IEC 61643 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 r.m.s. or 1 500 V DC. Performance characteristics, standard methods for testing and ratings are established. These devices contain at least one nonlinear component and are intended to limit surge voltages and divert surge currents.

The IEC 61643 series does not apply to SPDs for railway applications.

2 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 60112, *Method for the determination of the proof and the comparative tracking indices of solid insulating materials*

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 61000 (all parts), *Electromagnetic compatibility (EMC)*

IEC 61180, *High-voltage test techniques for low-voltage equipment - Definitions, test and procedure requirements, test equipment*

3 Definitions

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 μ s and a nominal time to half-value of 50 μ s

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

~~[SOURCE IEC 61643-11:2011, MOD]~~

3.2.2

8/20 current impulse

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

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

~~[SOURCE IEC 61643-11:2011, MOD]~~

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

~~[SOURCE IEC 61643-31-37A/282/CDV, MOD]~~

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.

~~[SOURCE IEC 61643-11:2011]~~

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}

~~[SOURCE IEC 61643-11:2011]~~

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

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

~~[SOURCE IEC 61643-31-37A/282/CDV, MOD]~~

3.2.8**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".

~~[SOURCE IEC 61643-11:2011]~~

3.2.9**degradation (of performance)**

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

~~[SOURCE IEC 61643-11:2011]~~

3.2.10**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

~~[SOURCE IEC 61643-11:2011]~~

3.2.11**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]

3.2.12**follow current** **I_f**

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

~~[SOURCE IEC 61643-11:2011]~~

3.2.13**highest crest value** **U_{max}**

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

~~[SOURCE IEC 61643-31-37A/282/CDV, MOD]~~

3.2.14

impulse discharge current

I_{imp}

crest value of a discharge current through the SPD with specified charge transfer Q and specified energy W/R in the specified time

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

~~[SOURCE IEC 61643-11:2011, MOD]~~

3.2.15

impulse test classification

3.2.15.1

T1 SPD

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

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

~~[SOURCE IEC 61643-31-37A/282/CDV]~~

3.2.15.2

T2 SPD

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

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

~~[SOURCE IEC 61643-31-37A/282/CDV]~~

3.2.15.3

T3 SPD

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

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

~~[SOURCE IEC 61643-31-37A/282/CDV]~~

3.2.16

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

~~[SOURCE IEC 61643-11:2011, MOD]~~

3.2.17

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

~~[SOURCE IEC 61643-11:2011, MOD]~~

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

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

~~[SOURCE IEC 61643-11:2011]~~

3.2.19**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

~~[SOURCE: IEC 61643-31, 3.1.44, MOD]~~

3.2.20**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 $I_{\max}$

~~[SOURCE IEC 61643-11:2011, MOD]~~

3.2.21**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

~~[SOURCE IEC 61643-11:2011, MOD]~~

3.2.22**multimode SPD**

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

~~[SOURCE IEC 61643-11:2011, MOD]~~

3.2.23**nominal discharge current** **I_n**

crest value of an 8/20 current impulse through the SPD

Note 1 to entry: This is used for example to characterize T2 SPD tested SPDs

~~[SOURCE IEC 61643-31-37A/282/CDV, MOD]~~

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

voltage across the MOV measured at 1mA DC

~~[SOURCE IEC 61643-31-37A/282/CDV]~~

3.2.25**one-port SPD**

SPD having no intended series impedance

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

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

525 ~~[SOURCE IEC 61643-31-37A/282/CDV]~~

526 **3.2.26**

527 **open-circuit mode**

528 **OCM**

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

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

533 ~~[SOURCE: IEC 61643-31, 3.1.40, modified]~~

534 **3.2.27**

535 **open-circuit voltage**

536 U_{oc}

537 open-circuit voltage of the combination wave generator at the point of connection of the
538 device under test

539 Note 1 to entry: This is used to characterize T3 SPD tested SPDs

540 ~~[SOURCE IEC 61643-11:2011, MOD]~~

541 **3.2.28**

542 **output contact**

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

545 ~~[SOURCE IEC 61643-11:2011]~~

546 **3.2.29**

547 **prospective short-circuit current**

548 I_p

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

551 ~~[SOURCE IEC 61643-31-37A/282/CDV]~~

552 **3.2.30**

553 **protective conductor current**

554 I_{PE}

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

557 **3.2.31**

558 **rated load current**

559 I_L

560 maximum current that can be continuously conducted between the input and the output
561 connections of the SPD

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

563 ~~[SOURCE IEC 61643-11:2011, MOD]~~

3.2.32**residual current device****RCD**

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

~~[SOURCE IEC 61643-11:2011]~~

3.2.33**residual voltage** **U_{res}**

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

~~[SOURCE IEC 61643-11:2011, MOD]~~

3.2.34**routine test**

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

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

3.2.35**short-circuit current rating** **I_{SCCR}**

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

~~[SOURCE IEC 61643-11:2011]~~

3.2.36**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 disconnector

~~[SOURCE: IEC 61643-31, 3.1.41, MOD]~~

3.2.37**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

~~[SOURCE IEC 61643-11:2011, MOD]~~

3.2.38**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

~~[SOURCE IEC 61643-11:2011]~~

3.2.39**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

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

610 **3.2.40**

611 **SPD disconnecter (disconnecter)**

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

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

619 [~~SOURCE IEC 61643-11:2011, MOD~~]

620 **3.2.41**

621 **specific energy for T1 SPD test**

622 **W/R**

623 energy dissipated by a unit resistance of $1\ \Omega$ with the impulse discharge current I_{imp}

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

625 [~~SOURCE IEC 61643-11:2011~~]

626 **3.2.42**

627 **status indicator**

628 means to indicate the operational status of an SPD or SPD disconnecter or an SPD assembly,
629 or a part of an SPD

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

632 [~~SOURCE IEC 61643-11:2011~~]

633 **3.2.43**

634 **surge protective device**

635 **SPD**

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

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

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

640 [~~SOURCE IEC 61643-11:2011, MOD~~]

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

642 Note 4 to entry: The IEC 6164-3-3xx series of standards covers surge protective components.

643 **3.2.44**

644 **temporary overvoltage test value**

645 **U_T**

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

648 [~~SOURCE IEC 61643-11:2011~~]

649 **3.2.45**

650 **test current**

651 **I_{test}**

652 test current derived from specific application condition.

653 ~~[SOURCE IEC 61643-31, 37A_282_CDV2016-05, MOD]~~

654 **3.2.46**

655 **test voltage**

656 U_{test}

657 test voltage derived from the system voltage

658 ~~[SOURCE IEC 61643-31, 37A_282_CDV2016-05, MOD]~~

659 **3.2.47**

660 **thermal equilibrium**

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

663 [SOURCE IEC 151-16-33]

664 **3.2.48**

665 **thermal stability**

666 is a condition of the SPD where the current flowing into the SPD or the power dissipation does
667 not increase during a defined time of application of the maximum continuous operating
668 voltage U_C

669 ~~[SOURCE IEC 61643-11:2011]~~

670 **3.2.49**

671 **total discharge current**

672 I_{Total}

673 current which flows through the earthing connection of a multimode SPD during the total
674 discharge current test

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

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

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

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

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

682 ~~[SOURCE IEC 61643-31 37A/282/CDV, MOD]~~

683 **3.2.50**

684 **transition surge current rating**

685 I_{trans}

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

688 ~~[SOURCE IEC 61643-11:2011, MOD]~~

689 **3.2.51**

690 **two-port SPD**

691 SPD having a specific series impedance connected between separate input and output
692 connections

693 ~~[SOURCE IEC 61643-11:2011]~~

3.2.52**type test**

conformity test made on one or more items representative of the production

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

3.2.53**voltage limiting SPD**

SPD that has a high shunt impedance when no surge is present, but will reduce it continuously with increased surge current and voltage

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

~~[SOURCE IEC 61643-31-37A/282/CDV, MOD]~~

3.2.54**voltage protection level**

U_p

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

~~[SOURCE IEC 61643-31-37A/282/CDV]~~

3.2.55**voltage rate-of-rise of a two-port SPD**

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

~~[SOURCE IEC 61643-11:2011, MOD]~~

3.2.56**voltage switching SPD**

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

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

~~[SOURCE IEC 61643-31-37A/282/CDV, MOD]~~

3.3 Acronyms / Symbols

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

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	3.2.10
k	trip current factor for overload behaviour	Table 18
RCD	residual current device	3.2.32
SPD	surge protective device	3.2.40

Acronym/symbol	Description	Definition/clause
$T1$, $T2$, and/or $T3$	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	3.2.41
Z_f	fictive impedance (of combination wave generator)	9.1.5c)
Acronyms and symbols related to voltage		
U_{1mA}	nominal varistor voltage	3.2.24
U_C	maximum continuous operating voltage	3.2.17
U_{max}	voltage for clearance determination	3.2.13
U_{OC}	open circuit voltage of the combination wave generator	3.2.27
U_P	voltage protection level	3.2.54
U_{res}	residual voltage	3.2.33
U_T	temporary overvoltage test value	3.2.44
U_{test}	test voltage	3.2.46
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	3.2.11
I_{imp}	impulse discharge current for T1 SPD test	3.2.14
I_L	rated load current	3.2.31
I_{max}	maximum discharge current	3.2.18
I_n	nominal discharge current for T2 SPD test	3.2.23
I_P	prospective short-circuit current of the power supply	3.2.29
I_{PE}	protective conductor current	3.2.30
I_{SCCR}	short-circuit current rating	3.2.35
I_{test}	test current	3.2.45
I_{Total}	total discharge current for multipole SPD	3.2.49
I_{trans}	transition surge current rating	3.2.50
Acronyms and symbols related to time		
t_T	TOV application time for testing	3.2.44

4 Classification

4.1 General

The manufacture 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 (former test class I)	I_{imp}	9.1.2; 9.1.3; 9.1.4
T2 SPD (former test class II)	I_n	9.1.3; 9.1.4
T3 SPD (former test class III)	U_{OC}	9.1.5; 9.1.5.2

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.

4.6 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 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)****5 Void****6 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, a4) (e.g. T1 and T2). 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).

a1) Manufacturer's name or trademark and model number

a2) Maximum continuous operating voltage U_C for each mode of protection (if U_C is different)

a3) Type of current:

- AC or “~” and/or frequency (if not applicable for 50 Hz and 60 Hz)
- DC

- other types (e.g. combined AC + DC, non-sinusoidal)
- a4) SPD Type classification and discharge parameters shall be printed next to each and, if different, for each mode of protection declared by the manufacturer:
- For T1 SPD:

“ $\boxed{T1}$ ” (T1 in a square) and “ I_{imp} ” together with the value in kA
 (e.g. $\boxed{T1}$ I_{imp} 25 kA)
 - For T2 SPD:

“ $\boxed{T2}$ ” (T2 in a square) and “ I_n ” together with the value in kA
 (e.g. $\boxed{T2}$ I_n 25 kA)
 - For T3 SPD:

“ $\boxed{T3}$ ” (T3 in a square) and “ U_{OC} ” together with the value in kV
 (e.g. $\boxed{T3}$ U_{OC} 6 kV).
- a5) Voltage protection level U_p for each mode of protection (if U_p is different)
- a6) Degree of protection provided by the enclosure (IP code) if > IP20
- a7) Identification of connections or leads (if not otherwise identified on the devices) including any connections to protective earth or any other reference earth.
- a8) Rated load current I_L for two port SPDs and for one port SPDs with separate input and output connections.
- a9) Location (See 4.5)
- a10) Number of ports
- a11) Method of mounting
- a12) Short-circuit current rating I_{SCCR} (exemptions see 8.3.6.3)
- a13) Ratings and characteristics for external disconnector(s), if required.
- a14) Indication of disconnector operation (if any) or SC-means operation (if any), see 6.3
- a15) Orientation for normal installation, if significant
- a16) type of systems for which the SPD is designed (e.g. TN-system, TT-system, IT-system)
- a17) intended connection (e.g. line to neutral or mid-point, line to ground, neutral or mid-point to ground, line to line, etc.)
- a18) nominal AC and/or DC system voltages and maximum allowed voltage regulation/voltage variation for which the SPD is designed
- a19) mechanical dimensions, lead lengths, etc.
- a20) Temperature and humidity range (see 7.3 and 7.4)
- a21) Continuous current I_C for each mode of protection (if I_C is different)
- a22) Protective conductor current I_{PE}
- a23) Short-circuiting SPD and its transition surge current rating I_{trans}
- a24) The minimum distance from any earthed conductive surface at which the SPD can be installed
- a25) I_{max}
- a26) End of life mode of the SPD assembly
- a27) 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.

- a28) Total discharge current I_{Total} for multimode SPDs and the respective SPD Type, except for T3 SPDs
- a29) Voltage drop for two port SPDs
- a30) Load-side surge withstand capability for two-port SPDs
- a31) Information about replaceable parts (indicators, fuses, etc. if applicable)
- a32) Voltage rate of rise du/dt
- a33) Current factor k , if different from Table 18
- a34) Modes of protection (for multimode SPDs)
- a35) Presence of switching component(s) (see Annex B)
- a36) Follow current to be expected, if applicable see Annex B)
- a37) 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.
- a38) Insulation and dielectric withstand of separate circuits
- a39) Rating and characteristic for the internal overcurrent protection, if required
- a40) Prospective short-circuit current for the test at low short-circuit current, if required according 9.3.6.3.4
- a41) Information that enables the manufacturer to trace the date of manufacture.

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.

7 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 $+40\text{ °C}$
- extended range: -40 °C to $+70\text{ °C}$

7.4 Humidity

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

8 Requirements

8.1 General requirements

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

For SPDs classified to more than one Type according to 6.2, a4), the tests in 8.3.4, 8.3.5, E.1 and 8.6.5.2 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 they cannot be removed or unplugged without the use of a tool or a key after reaching their end of life mode or
- shall be provided with a warning label that needs to be placed adjacent to the SPD and visible after installation, providing the following information

Disconnect supply before removal or unplugging the SPD

NOTE: 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 applicable) and the residual voltage measurements at amplitudes corresponding 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.

Compliance is checked by the test in accordance with 9.3.4.

An SPD may be classified to more than one SPD Type according 6.2, a4) (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.

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. Their operation shall be indicated by a corresponding status indicator.

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.

Information on the inclusion of disconnectors during the various type tests is provided in the relevant subsequent part(s). Compliance is checked by the test in accordance with 9.3.6.

8.3.6.1.2 SC-means

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

Compliance is checked by the test in accordance with 9.3.6.

8.3.6.2 Thermal protection

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

Compliance is checked by the test in accordance with 9.3.6.2.

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

8.3.6.3 Short-circuit current behaviour

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

Compliance is checked by the test in accordance with 9.3.6.3.

These tests are not performed on:

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

8.3.6.4 Overstress behaviour

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

Compliance is checked by the test in accordance with 9.3.6.4.

This test is not performed on:

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

8.3.6.5 Status indicators

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

The action of the coupling mechanism which operates the non-replaced part of the status indicator may be simulated by means other than operation of the section within the replaced part of the SPD, e.g. a separate electromagnet or a spring.

Where there is an appropriate standard for the type of indication used, this shall be met by the non-replaced part of the status indicator, with the exception that the indicator need only be tested for 50 operations.

8.3.7 Insulation resistance

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

Compliance is checked by the test in accordance with 9.3.7.

8.3.8 Dielectric withstand

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

Compliance is checked by the test in accordance with 9.3.8.

8.3.9 Behaviour under temporary overvoltages

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

Compliance is checked by the test in accordance with 9.3.9.

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

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

8.3.10 Maximum discharge current I_{max} , if declared by the manufacturer

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

I_{max} shall be equal to or greater than

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

Compliance is checked by the test in accordance with 9.3.10.

8.4 Mechanical requirements**8.4.1 Mounting**

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

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

Compliance is checked by visual inspection.

8.4.2 Screws, current carrying parts and connections

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

8.4.3 External connections**8.4.3.1 General**

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

- screw terminals and bolted connections;
- screwless terminals;
- insulation piercing connections;

- 1015 • flat quick connect terminations;
- 1016 • flying leads (pigtail connections);
- 1017 • other equally effective means;
- 1018 or
- 1019 • standardised plugs and/or sockets.

1020 The following requirements do not apply to standardised plugs and/or sockets:

1021 Connections shall be designed for the connection of cables having a minimum and a
1022 maximum cross-sectional area according to 9.4.3.

1023 Connections shall be fastened to the SPD in such a way that they will not work loose if the
1024 clamping screws or the lock nuts are tightened or loosened. A tool shall be required to loosen
1025 the clamping screws or the lock nuts.

- 1026 a) Connections for external conductors shall be such that the conductors may be connected
1027 so as to ensure that the necessary contact pressure is maintained permanently. The
1028 connections shall be readily accessible under the intended conditions of use.
- 1029 b) The means for clamping the conductors in the connections shall not serve to fix any other
1030 component, although they may hold the terminals in place or prevent them from turning.
- 1031 c) Connections shall have adequate mechanical strength.
- 1032 d) Connections shall be so designed that they clamp the conductor without undue damage
1033 to the conductor.
- 1034 e) Connections shall be so designed that they clamp the conductor reliably and between
1035 metal surfaces.
- 1036 f) Connections shall be so designed or positioned that neither a rigid solid conductor nor a
1037 wire of a stranded conductor can slip out while the clamping screws or nuts are tightened.

1038 **8.4.3.2 Screw terminals and bolted connections**

- 1039 a) Screws and nuts for clamping the conductors shall have a metric ISO thread or a thread
1040 comparable in pitch and mechanical strength.

1041 NOTE: SI, BA and UN threads may be used as they are virtually equivalent in pitch and mechanical strength
1042 to metric ISO threads.

- 1043 b) Connections shall be so fixed or located that, when the clamping screws or nuts are
1044 tightened or loosened, the connections shall not work loose from their fixings to the
1045 SPDs.

1046 These requirements do not imply that the connections shall be so designed that their
1047 rotation or displacement is prevented, but any movement shall be sufficiently limited so
1048 as to prevent non-compliance with the requirements of this standard.

1049 The use of sealing compound or resin is considered to be sufficient for preventing a
1050 connection from working loose, provided that:

- 1051 • the sealing compound or resin is not subject to stress during normal use, and
- 1052 • the effectiveness of the sealing compound or resin is not impaired by
1053 temperatures attained by the connections under the least favourable conditions
1054 specified in this standard.
- 1055 c) Clamping screws or nuts of connections intended for the connection of protective
1056 conductors shall be adequately secured against accidental loosening.
- 1057 d) Screws shall not be made of metal that is soft or liable to creep, such as zinc or
1058 aluminium

1059 Compliance is checked by inspection and by the tests in accordance with 9.4.3.2.