



SPDTCF0407-LVD

**LVD Technical Construction File**  
**For**  
**Wenzhou Jinxu Electric Co.,Ltd.**  
**Surge Protective Device(SPD)**  
**Model: JXSPD**

**Prepared For :**     **Wenzhou Jinxu Electric Co.,Ltd.**  
                          **NO.98 Zhangzhai Road,Zhangqu Village,Liushi Town,Yueqing**  
                          **City,Zhejiang Province,China**

**Prepared By :**     **China Ceprei (Sichuan) Laboratory**  
                          **No.45 Wenming Dong Road Longquanyi District, Chengdu,**  
                          **Sichuan**

**Report Number:**   **SPDTCF0407-LVD**

**Date of Test:**       **Apr.12, 2023**

**Date of Report:**   **Apr.12, 2023**





SPDTCF0407-LVD

## TEST REPORT DECLARATION

Applicant : Wenzhou Jinxu Electric Co.,Ltd.  
Address : NO.98 Zhangzhai Road,Zhangqu Village,Liushi Town,Yueqing City,Zhejiang Province,China  
Manufacturer : Wenzhou Jinxu Electric Co.,Ltd.  
Address : NO.98 Zhangzhai Road,Zhangqu Village,Liushi Town,Yueqing City,Zhejiang Province,China  
EUT Description : Surge Protective Device(SPD)  
Model No. : JXSPD

Test Procedure Used:

EN 61643-11:2012+A11:2018


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The test results of this report relate only to the tested sample identified in this report.


Date of Test : Apr.12, 2023

Prepared by :

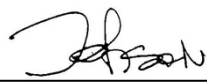


  
(Jack)

Checked by :

  
(Gina)

Approved by :

  
(Johnson)

EN 61643-11:2012+A11:2018		
Clause	Requirement	Result-Remar and Verdict
<b>1</b>	<b>General</b>	
1.1	Scope	
	This part of EN 61643 is applicable to devices for surge protection against indirect and direct effects of lightning or other transient overvoltages. These devices are packaged to be connected to 50/60 Hz a.c. power circuits, and equipment rated up to 1 000 V r.m.s.	Pass. This product is within this scope.
1.2	Normative references	
<b>2</b>	<b>Service conditions</b>	-
2.1	Normal	Pass.
2.1.1	Frequency: frequency of the supply mains is between 48 Hz and 62 Hz a.c.	Pass.
2.1.2	Voltage: the voltage applied continuously between the terminals of the Surge Protective Device (SPD) must not exceed its maximum continuous operating voltage.	Pass.
2.1.3	Altitude: altitude shall not exceed 2 000 m.	Pass.
2.1.4	Operating and storage temperatures	Pass.
	– normal range: –5 °C to +40 °C	Pass. 0 °C to +70 °C
	– extended range: –40 °C to +70 °C	Pass. 0 °C to +70 °C
2.1.5	Humidity – relative humidity: under indoor temperature conditions shall be between 30 % and 90 %.	Pass. It meet the requirement.
2.2	Abnormal	-
	Exposure of the SPD to abnormal service conditions may require special consideration in the design or application of the SPD, and should be called to the attention of the manufacturer.	Pass. It meet the requirement.
	For outdoor SPDs exposed to solar or other radiation, additional requirements may be necessary.	Pass.
<b>3</b>	<b>Definitions</b>	-
<b>4</b>	<b>Classification</b>	-
	The manufacture shall classify the SPDs in accordance with the following parameters.	Pass.
4.1	Number of ports	-
4.1.1	One	NA.
4.1.2	Two	Pass.
4.2	SPD design topology	-
4.2.1	Voltage switching type	Pass.

4.2.2	Voltage limiting type	Pass.
4.2.3	Combination type	Pass.
4.3	SPD types 1, 2 and 3 - test classes I, II and III	-
	Specific information required for testing SPD types 1, 2 and 3 is given in Table 1.	Pass.

	<p align="center"><b>Table 1 – Tests for SPD types 1, 2 and 3</b></p> <table border="1"> <thead> <tr> <th>SPD type</th><th>Test class</th><th>SPD type specific information</th></tr> </thead> <tbody> <tr> <td>Type 1</td><td>Test class I</td><td><math>I_{imp}, I_n</math></td></tr> <tr> <td>Type 2</td><td>Test class II</td><td><math>I_{max}, I_n</math></td></tr> <tr> <td>Type 3</td><td>Test class III</td><td><math>U_{oc}</math></td></tr> </tbody> </table>	SPD type	Test class	SPD type specific information	Type 1	Test class I	$I_{imp}, I_n$	Type 2	Test class II	$I_{max}, I_n$	Type 3	Test class III	$U_{oc}$	-
SPD type	Test class	SPD type specific information												
Type 1	Test class I	$I_{imp}, I_n$												
Type 2	Test class II	$I_{max}, I_n$												
Type 3	Test class III	$U_{oc}$												
4.4	Location	-												
4.4.1	Indoor	Pass.												
4.4.2	Outdoor	Pass.												
4.5	Accessibility	-												
4.5.1	Accessible	Pass.												
4.5.2	Inaccessible (out-of-reach)	NA.												
4.6	Mounting method	-												
4.6.1	Fixed	Pass.												
4.6.2	Portable	NA.												
4.7	SPD disconnecter	-												
4.7.1	Location	-												
4.7.1.1	Internal	Pass.												
4.7.1.2	External	NA.												
4.7.1.3	Both (one part internal and one part external)	NA.												
4.7.2	Protection functions													
4.7.2.1	Thermal	NA.												
4.7.2.2	Leakage current	Pass.												
4.7.2.3	Overcurrent	Pass.												
4.8	Overcurrent protection	-												
4.8.1	Specified	Pass.												
4.8.2	Not specified	NA.												
4.9	Degree of protection provided by enclosures according to IP codes of IEC 60529	Pass.												
4.10	Temperature range	-												
4.10.1	Normal	Pass.												
4.10.2	Extended	Pass.												
4.11	Multipole SPD ( if declared by manufacturer)	-												
<b>5</b>	<b>Preferred values</b>	-												
5.1	Preferred values of peak impulse current for class I tests $I_{peak}$	Pass.												
	$I_{peak}$ : 25; 20; 12,5; 10 and 5 kA	Pass.												

5.2	Preferred values of nominal discharge current for class II tests $I_n$	Pass.
	0,05 0,1 0,25 0,5 1,0 1,5 2,0 2,5 3,0 5,0 10 15 and 20 kA	Pass.
5.3	Preferred values of open-circuit voltage for class III tests $U_{oc}$	Pass.
	0,1 0,2 0,5 1 2 3 4 5 6 10 and 20 kV	Pass.
5.4	Preferred values of voltage protection level $U_p$	Pass.
	0,08 0,09 0,10 0,12 0,15 0,22 0,33 0,4 0,5 0,6 0,7 0,8 0,9 1,0	Pass.

	1,2 1,5 1,8 2,0 2,5 3,0 4,0 5,0 6,0 8,0 and 10 kV	
5.5	Preferred values of r.m.s. or d.c. maximum continuous operating voltage $U_c$	Pass.
	52 63 75 95 110 130 150 175 220 230 240 250 260 275 280 320 420 440 460 510 530 600 630 690 800 900 1000 and 1500 V	Pass.
<b>6</b>	<b>Requirements</b>	-
6.1	General requirements	-
6.1.1	Identification	-
	The following minimum information shall be provided by the manufacturer. Tested in accordance with clause 7.	Pass.

	a) Manufacturer's name or trade mark and model number b) Location category c) Number of ports d) Method of mounting e) Maximum continuous operating voltage $U_c$ (one value for each mode of protection except if all values are equal) f) SPD type and discharge parameters for each mode of protection declared by the manufacturer g) Nominal discharge current $I_n$ for Type 1 and Type 2 SPDs (one value for each mode of protection) h) Voltage protection level $U_p$ (one value for each mode of protection) i) Rated load current $I_L$ (if required) j) Degree of protection provided by the enclosure (IP code) (if $IP > 20$ ) k) Short-circuit withstand l) Maximum recommended ratings of overcurrent protection (if applicable) m) Indication of disconnector operation (if any) n) Position of normal use if significant o) Identification of terminals (if necessary) q) Type of current: a.c. frequency or d.c., or both r) Specific energy $W/R$ for Type 1 SPDs only (from 7.1.1) s) Temperature range t) Follow current interrupting rating (except in the case of voltage limiting SPDs) u) The external SPD disconnector requirements, if any, shall be defined by the manufacturer v) Residual current (optional) w) Temporary overvoltage characteristic x) Total discharge current $I_{Total}$ for multipole SPDs (if declared by the manufacturer)	Pass. related See the document.
6.1.2	Marking	-
	Markings a), e), f), g), h), j), l), o) and q) in 6.1.1 are	Pass.

	mandatory on the body, or permanently to the body, of the SPD. attached, or some designs of one port SPDs, there may not be a need to provide a rated load current.	It meet the requirement.
	Marking shall be indelible and legible and shall not be placed on screws and removable washers. Compliance is in accordance with the test of 7.2.	Pass. It meet the requirement.

<b>6.2</b>	<b>Electrical requirements</b>	-
6.2.1	Electrical connections	-
	Terminals shall be designed for the connection of cables having a minimum and a maximum cross-sectional area according to the manufacturer declaration.	Pass. It meet the requirement.
	Each of the tests must be passed by using the most severe configuration (i.e. the maximum or minimum cross-sectional area depending on the test (see clause 7). The SPD shall be equipped with terminals where electrical connection is possible by means of screws, nuts, plugs, sockets or equal effective means. This is checked in 7.3.	Pass. It meet the requirement.
6.2.2	Voltage protection level $U_p$	-
	The measured limiting voltage of SPDs shall not exceed the voltage protection level that is specified by the manufacturer. Compliance is in accordance with the test of 7.5.	Pass. It meet the requirement.
6.2.3	Class I impulse current test(s)	-
	An SPD shall be tested to class I test when the manufacturer declares that it meets those requirements. Compliance is in accordance with the test of 7.6.5.	Pass. It meet the requirement.
6.2.4	Class II nominal discharge current test(s)	-
	An SPD shall be tested to class II test when the manufacturer declares that it meets those requirements. Compliance is in accordance with 7.6.5.	Pass. It meet the requirement.
6.2.5	Class III combination wave test(s)	-
	An SPD shall be tested to class III test when the manufacturer declares that it meets those requirements. Compliance is in accordance with the test of 7.6.7.	Pass. It meet the requirement.
<b>6.2.6</b>	<b>Operating duty test</b>	-
	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. Compliance is in accordance with the test of 7.6.	Pass. It meet the requirement.
6.2.7	SPD disconnecter	-
	The SPD may have SPD disconnectors (which can be either internal, external or both). Their operation shall be indicated.	Pass. It meet the requirement.
	SPD disconnectors shall be tested with the SPD during the sequence of type tests of 7.7 and 7.8.3, except for RCDs which	Pass. It meet the requirement.
	are not tested during the operating duty test according to 7.7.1.	
6.2.8	Air clearances and creepage distances	-
	The SPD shall have sufficient air clearances and creepage distances. Testing is in accordance with 7.9.5.	Pass. It meet the requirement.

6.2.9	Tracking resistance	-
	Insulating materials necessary to retain live parts in their position shall be composed of nontracking material, or they shall be sufficiently dimensioned. Testing in accordance with 7.9.6.	Pass. It meet the requirement.
6.2.10	Dielectric withstand	-
	The dielectric withstand of the housing of the SPD shall be sufficient with respect to insulation breakdown and protection against direct contact. Testing in accordance with 7.9.8.	Pass. It meet the requirement.
6.2.11	Short-circuit withstand capability	-
	An overstressed (short-circuited) SPD shall withstand the power short-circuit currents that may occur in service. Testing is in accordance with 7.7.3.	Pass. It meet the requirement.
6.2.12	Status indicator operation	-
	General Requirements	-
	Throughout the entire type testing procedure, the status shown by the indicator(s) shall give a clear sign of the status of the part to which it is linked. For an SPD with a stated intermediate status indication, the intermediate status is not considered as a failure of the indicator. Where there is more than one method of status indication, for example local and remote indication, each type of indication shall be checked. The manufacturer shall provide information about the function of the indicator and the actions to be taken after change of status indication.	Pass. It meet the requirement.
	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.	Pass. It meet the requirement.
	In this situation, the part of the status indicator with the replaced part of the SPD shall be tested as above. The part of the status indicator which is not replaced shall be capable of operating at least 50 times.	Pass. It meet the requirement.
	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.	Pass. It meet the requirement.
6.2.13	Isolation between separate circuits	-
	Where a SPD includes a circuit which is electrically isolated from the main circuit, the manufacturer shall provide information about the isolation and dielectric withstand	Pass. It meet the requirement.
	voltages between the circuits as well as the relevant standards with which the manufacturer is claiming conformity.	



	Where there are more than two circuits, declarations shall be made with regard to each combination of circuits.	Pass. It meet the requirement.
	The isolation and dielectric withstand of the separate circuits shall be tested according to the manufacturer' s declaration.	Pass.
6.3	Mechanical requirements	-
	SPDs shall be provided with appropriate means for mounting that will ensure mechanical stability. Testing in accordance with 7.9.2.	Pass. It meet the requirement.
6.3.1	General	Pass.
	The SPD shall be equipped with terminals where electrical connection is possible by means of:	Pass. It meet the requirement.
	<ul style="list-style-type: none"> <li>– terminal with screw;</li> <li>– nuts;</li> <li>– plugs;</li> <li>– socket;</li> <li>– screwless terminal;</li> <li>– insulation piercing connections; – or equal effective means.</li> </ul>	Pass.
6.3.2	Mechanical connections	-
a)	Terminals shall be fastened to the SPD in such a way that they will not work loose if the clamping screws or the lock nuts are tightened or loosened. A tool shall be required to loosen the clamping screws or the lock nuts.	Pass. It meet the requirement.
b)	Plugs and socket outlets shall correspond to the relevant national requirements, and those clauses of IEC 60884-1 that may apply.	Pass. It meet the requirement.
c)	Screws, current-carrying parts and connections	Pass.
	1) Connections, whether electrical or mechanical, shall withstand the mechanical stresses occurring in normal use.	Pass. It meet the requirement.
	Screws operated when mounting the SPD during installation shall not be of the threadcutting type.	Pass. It meet the requirement.
	2) Electrical connections shall be so designed that contact pressure is not transmitted through insulating material other than ceramic, pure mica or other material with characteristics no less suitable, unless there is sufficient resilience in the metallic parts to compensate for any possible shrinkage or yielding of the insulating material.	Pass. It meet the requirement.
	The suitability of the material is considered in respect of the stability of the dimensions.	Pass. It meet the requirement.
	3) Current-carrying parts and connections including parts intended for protective conductors, if any, shall be of either	Pass.
	– copper, or	Pass.
	– an alloy containing at least 58 % copper for parts worked	Pass.

	cold, or at least 50 % copper for other parts, or	
	– other metal or suitably coated metal, no less resistant to corrosion than copper and having mechanical properties no less suitable.	Pass.
	New requirements and appropriate tests for determining the resistance to corrosion are under consideration. These requirements should permit other materials to be used if suitably coated.	Pass. It meet the requirement.
	The requirements of this subclause do not apply to contacts, magnetic circuits, heater elements, bimetals, current-limiting materials, shunts, parts of electronic devices nor to screws, nuts, washers, clamping plates and similar parts of terminals.	Pass. It meet the requirement.
d)	Terminals with screw for external conductors	-
	1) Terminals for external conductors shall be such that the conductors may be connected so as to ensure that the necessary contact pressure is maintained permanently.	Pass. It meet the requirement.
	Such arrangements may be either of the plug-in or of the bolt-on type.	Pass.
	The terminals shall be readily accessible under the intended conditions of use.	Pass.
	2) The means for clamping the conductors in the terminals shall not serve to fix any other component, although they may hold the terminals in place or prevent them from turning.	Pass. It meet the requirement.
	3) Terminals shall have adequate mechanical strength. Screws and nuts for clamping the conductors shall have a metric ISO thread or a thread comparable in pitch and mechanical strength.	Pass. It meet the requirement.
	Provisionally, SI, BA and UN threads may be used as they are virtually equivalent in pitch and mechanical strength to metric ISO threads.	Pass. It meet the requirement.
	4) Terminals shall be so designed that they clamp the conductor without undue damage to the conductor.	Pass. It meet the requirement.
	5) Terminals shall be so designed that they clamp the conductor reliably and between metal surfaces.	Pass. It meet the requirement.
	6) Terminals shall be so designed or positioned that neither a rigid solid conductor nor a wire of a stranded conductor can slip out while the clamping screws or nuts are tightened.	Pass. It meet the requirement.
	This requirement does not apply to lug terminals.	Pass.
	7) Terminals shall be so fixed or located that, when the clamping screws or nuts are tightened or loosened, the terminals shall not work loose from their fixings to the SPDs.	Pass. It meet the requirement.

	These requirements do not imply that the terminals shall be so designed that their rotation or displacement is prevented, but any movement shall be sufficiently limited so as to prevent non-compliance with the requirements of this standard.	Pass. It meet the requirement.
	The use of sealing compound or resin is considered to be sufficient for preventing a terminal from working loose, provided that	Pass.
	– the sealing compound or resin is not subject to stress during normal use, and	Pass.
	– the effectiveness of the sealing compound or resin is not impaired by temperatures attained by the terminal under the most unfavorable conditions specified in this standard.	Pass.
	8) Clamping screws or nuts of terminals intended for the connection of protective conductors shall be adequately secured against accidental loosening.	Pass. It meet the requirement.
e)	Screwless terminals for external conductors	Pass.
	1) Terminals shall be so designed and constructed that	Pass.
	– each conductor is clamped individually. During the connection or disconnection the conductors can be connected or disconnected either at the same time or separately;	Pass. It meet the requirement.
	– it is possible to clamp securely any number of conductors up to the maximum provided.	Pass. It meet the requirement.
	2) Terminals shall be so designed and constructed that they clamp the conductor without undue damage to the conductor	Pass. It meet the requirement.
f)	Insulation pierced connections for external conductors	-
	1) The insulation pierced connections shall make a reliable mechanical connection.	Pass. It meet the requirement.
	2) Screws for making contact-pressure shall not serve to fix any other component, although they may hold the SPD in place or prevent it from turning.	Pass. It meet the requirement.
	3) Screws shall not be of metal which is soft or liable to creep.	Pass. It meet the requirement.
6.3.3	Corrosive resistant metals	-
	Clamps, except clamping screws, lock nuts, binding clip thrust washers, wire, and similar, shall consist of corrosion resistant metal such as copper, brass, etc. (see IEC 60999).	Pass. It meet the requirement.
6.4	Environmental requirements	-
	SPDs shall be designed in such a way that they operate satisfactorily under the environmental conditions given by the normal service conditions. Compliance is tested in accordance with 7.9.9. Outdoor SPDs shall be contained in a weather shield	Pass. It meet the requirement.

	of glass, glazed ceramic or other acceptable material that is resistant to UV radiation, corrosion, erosion, and tracking.	
	They shall have sufficient surface creepage distance between any two parts of different potential.	Pass. It meet the requirement.
6.5	Safety requirements	-
	SPDs shall be safe when operated under normal service conditions in accordance with the recommendation.	Pass. It meet the requirement.
6.5.1	Protection against direct contact	-

	These requirements are valid for accessible SPDs where the maximum continuous operating voltage $U_c$ is above 50 V r.m.s. a.c.	Pass. It meet the requirement.
	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. Compliance is verified by standardized test methods of IEC 60529 and to 7.4.	Pass. It meet the requirement.
	SPDs, except SPDs classified as 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.	Pass. It meet the requirement.
	The connection between the earthing terminals and all accessible parts connected thereto shall be of low resistance. Compliance is checked by the test according to 7.4.2.	Pass. It meet the requirement.
6.5.1.1	Mechanical strength	-
	All parts of the SPD relating to the protection against direct contact shall have sufficient mechanical strength. Compliance is tested in accordance with 7.9.2.	Pass. It meet the requirement.
6.5.1.2	Heat resistance	-
	All parts relating to the protection against direct contact shall be sufficiently heat resistant. Compliance is tested in accordance with 7.9.3.	Pass. It meet the requirement.
6.5.1.3	Insulation resistance	-
	The insulation resistance of the SPD shall be sufficient. Compliance is tested in accordance with 7.9.7.	Pass. It meet the requirement.
6.5.2	Fire resistance	Pass.
	Insulating parts of the housing shall be either nonflammable or self-extinguishing. Compliance is tested in accordance with 7.9.4.	Pass. It meet the requirement.
6.5.3	Standby power consumption $P_C$	-

	For all SPDs, the PC shall be measured at the SPD's maximum continuous operating voltage (UC) when connected according to the manufacturer's instructions without a load.	Pass. It meet the requirement.
6.5.4	Residual current	-
	For all SPDs with a terminal for the protective conductor, the residual current shall be measured at the SPD's maximum continuous operating voltage (UC) when connected according to the manufacturer's instructions, without a load.	Pass. It meet the requirement.
6.5.5	Behaviour under temporary overvoltages	-
	An SPD shall either withstand a TOV without changes in functionality, or fail in a manner described in 7.7.4 and 7.7.6.	Pass.
6.5.5.1	TOVs caused by faults in the high (medium) voltage system	Pass.
	SPDs connected to PE and for use on power distribution systems shall be tested at UT in accordance with 7.7.4 and	Pass.

	Table B.1.	
6.5.5.2	TOVs caused by faults or disturbances in the low voltage system	Pass.
	If $U_c$ is greater or equal to $U_T$ there is no need to perform this test.	Pass.
	All other SPDs shall be tested using either the TOV voltages $U_T$ given in Table B.1 or the TOV voltages stated by the manufacturer according to 6.1.1 w), whichever values are higher. This test shall be performed in accordance with 7.7.6.	Pass. It meet the requirement.
6.5.6	Total discharge current $I_{Total}$	-
	This test is only conducted if the manufacturer claims a total discharge current in accordance with 7.9.10.	Pass.
6.6	Additional test requirements for two-port SPDs and one-port SPDs with separate input/output terminals	Pass.
6.6.1	Percent of voltage regulation	-
	The percent of voltage regulation shall be declared by the manufacturer and tested in accordance with 7.8.1.	See the related document.
6.6.2	Rated load current $I_L$	-
	The rated load current shall be declared by the manufacturer and tested in accordance with 7.8.2.	See the related document.
6.6.3	Load-side surge withstand capability	-
	When the value for load-side surge withstand capability is declared by the manufacturer it shall be tested in accordance with 7.8.4.	See the related document.
6.6.4	Overload behaviour	-

	The SPD shall not be damaged or altered by overloads, which may occur in normal use. Compliance with this requirement is checked according to 7.8.5.	Pass. It meet the requirement.
<b>7</b>	<b>Type tests</b>	-
	Type tests are carried out as indicated in Table 2 on three samples per test series. Within any test series, the tests shall be carried out in the order given in Table 2. The order in which test series are carried out may be varied.	Pass.
	If all samples pass a test series, the design of the SPD is acceptable for that test series. If two or more test samples fail a test series, the SPD does not comply with this standard.	Pass.
	In the event that a single sample does not pass a test, this test, and those preceding in the same test series that may have influenced the result of this test, shall be repeated with three new samples, but this time no failure of any sample is allowed.	Pass. It meet the requirement.
	A set of three samples may be used for more than one test series, if agreed by the manufacturer.	Pass.
	If the SPD is an integral part of a product covered by another international standard, the requirements of the other international standard shall apply to those parts of the product	Pass.

	which do not belong to the SPD section of the product.	
<b>7.1</b>	<b>General testing procedures</b>	-
	If not otherwise specified, the reference standard for testing procedure is IEC 61180-1.	Pass. It meet the requirement.
	Unless otherwise specified, a.c. values given in this standard are r.m.s values.	Pass.
	The SPD shall be mounted and electrically connected in accordance with the manufacturer s installation procedures. Neither external cooling nor heating shall be employed.	Pass. It meet the requirement.
	When not otherwise specified, the test shall be performed in free air and the ambient temperature shall be 20 °C ± 15 °C.	Pass.
	When testing SPDs for which the manufacturer supplies integral cables, the full length of those cables shall form part of the SPD under test.	Pass. See the related document.

	During the test, no maintenance or dismantling of the SPD is allowed. All SPD disconnectors shall be selected and connected as required by the manufacturer, where applicable. For SPDs having more than one mode of protection (see 3.7), for which the manufacturer declares a voltage protection level, the tests shall be performed on each mode, with the values chosen according to the manufacturer declaration, using new samples each time. For three phase devices in which the protective component circuitry per given mode is identical, the testing of each of the three phases will fulfill the three sample requirement.	Pass. It meet the requirement.
	It should be noted that good testing techniques are required for impulse testing and measurements. This is needed to ensure that correct test values are recorded.	Pass.
	If the manufacturer sets different requirements for the external SPD disconnector(s) depending upon the prospective short-circuit current of the supply system, all relevant test sequences shall be performed for every combination of required SPD disconnector(s) and corresponding prospective short-circuit currents.	Pass. It meet the requirement.
7.1.1	Class I impulse current test	-
	The test impulse current $I_{imp}$ is defined by its parameters peak value $I_{peak}$ , charge $Q$ and specific energy $W/R$ . The unipolar test impulse current shall obtain $I_{peak}$ within 50 s and the charge $Q$ and the specific energy $W/R$ within 10 ms.	Pass. It meet the requirement.
	Table 3 gives values of $Q$ (A.s) and $W/R$ (kJ/) for example values of $I_{peak}$ (kA).	-

	<b>Table 3 – Typical test values for class I test parameters</b> <table border="1"> <thead> <tr> <th><math>I_{peak}</math> within 50 <math>\mu</math>s kA</th><th><math>Q</math> within 10 ms As</th><th><math>W/R</math> within 10 ms kJ/<math>\Omega</math></th></tr> </thead> <tbody> <tr> <td>25</td><td>12,5</td><td>156</td></tr> <tr> <td>20</td><td>10</td><td>100</td></tr> <tr> <td>12,5</td><td>6,25</td><td>39</td></tr> <tr> <td>10</td><td>5</td><td>25</td></tr> <tr> <td>5</td><td>2,5</td><td>6,25</td></tr> </tbody> </table>	$I_{peak}$ within 50 $\mu$ s kA	$Q$ within 10 ms As	$W/R$ within 10 ms kJ/ $\Omega$	25	12,5	156	20	10	100	12,5	6,25	39	10	5	25	5	2,5	6,25	-
$I_{peak}$ within 50 $\mu$ s kA	$Q$ within 10 ms As	$W/R$ within 10 ms kJ/ $\Omega$																		
25	12,5	156																		
20	10	100																		
12,5	6,25	39																		
10	5	25																		
5	2,5	6,25																		
	The following tolerances shall apply:	-																		
	<ul style="list-style-type: none"> <li>– <math>I_{peak} \pm 10</math> %;</li> <li>– <math>Q \pm 20</math> %;</li> <li>– <math>W/R \pm 35</math> %.</li> </ul>	Pass.																		
7.1.2	Class I and class II nominal discharge current test	-																		



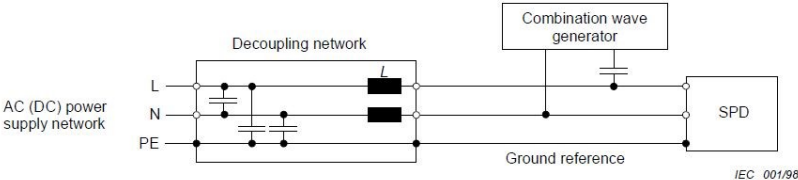
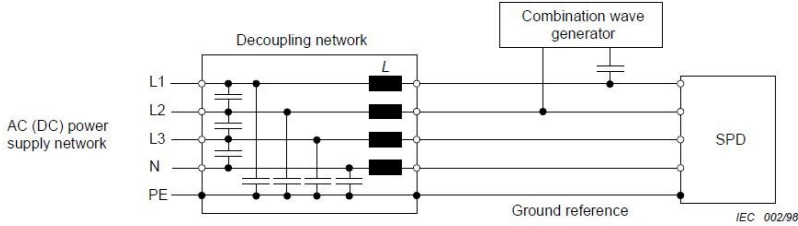
	The standard waveshape is 8/20. The tolerances on the current waveshape are the following:	Pass.
	<ul style="list-style-type: none"> <li>– peak value <math>\pm 10\%</math></li> <li>– front time <math>\pm 10\%</math></li> <li>– time to half value <math>\pm 10\%</math></li> </ul>	Pass. It meet the requirement.
	A small overshoot or oscillation is tolerated provided that the amplitude of any oscillation is not more than 5 % of the peak value. Any polarity reversal after the current has fallen to zero shall not be more than 20 % of the peak value.	Pass. It meet the requirement.
	In the case of two port devices, the magnitude of the reversal shall be less than 5 %, so that it does not affect the measured limiting voltage.	Pass. It meet the requirement.
7.1.3	Class I and II voltage impulse test	-
	The standard voltage waveshape is 1,2/50. The tolerances on the voltage waveshape are the following:	Pass.
	<ul style="list-style-type: none"> <li>– peak value <math>\pm 3\%</math></li> <li>– front time <math>\pm 30\%</math></li> <li>– time to half value <math>\pm 20\%</math></li> </ul>	Pass. It meet the requirement.
	Oscillations or overshoot may occur at the crest of the impulse. If the frequency of such oscillations is more than 500 kHz or the duration of the overshoot is less than 1 $\mu$ s, a mean curve shall be drawn and, for the purpose of the measurement, the maximum amplitude of this curve defines the peak value of the test voltage.	Pass. It meet the requirement.
	Oscillations exceeding 3 % of the peak value are not allowed at the rising portion of the voltage impulse.	Pass.
	The measuring devices shall have an overall bandwidth of at least 25 MHz and the overshoot shall be less than 3 %.	Pass. It meet the requirement.

	The short-circuit current of the test generator shall preferably be less than 20 % of the nominal discharge current $I_n$ , but sufficient to ensure that the SPD's voltage switching component(s) conduct during the test.	Pass. It meet the requirement.
7.1.4	Class III combination wave test	-
	The standard impulse of a combination waveform generator is characterized by the output voltage under open-circuit conditions and the output current under short-circuit conditions. The open-circuit voltage shall have a front time of 1,2 $\mu$ s and a time to half value of 50 $\mu$ s. The short-circuit current shall have a front time of 8 $\mu$ s and a time to half value of 20 $\mu$ s.	Pass. It meet the requirement.
	The following values are measured on the generator without a back filter.	Pass. .



	The tolerances on open circuit voltage $U_{oc}$ shall be the following:	Pass.
	<ul style="list-style-type: none"> <li>– peak value <math>\pm 3 \%</math></li> <li>– front time <math>\pm 30 \%</math></li> <li>– time to half value <math>\pm 20 \%</math></li> </ul>	Pass. It meet the requirement.
	Voltage overshoot or oscillations in the neighborhood of the crest are acceptable provided that the single peak amplitude is less than 5 % of the peak value. In commonly used impulse generator circuits, oscillations on that part of the wave front during which the voltage does not exceed 90 % of the peak value have generally negligible influence on the test results and thus may be disregarded. The voltage waveform shall be essentially unidirectional.	Pass. It meet the requirement.
	The tolerances on the short-circuit current shall be the following:	Pass.
	<ul style="list-style-type: none"> <li>– peak value <math>\pm 10 \%</math></li> <li>– front time <math>\pm 10 \%</math></li> <li>– time to half value <math>\pm 10 \%</math></li> </ul>	Pass. It meet the requirement.
	A current overshoot or oscillations are tolerated provided that their single peak amplitude at the crest of the waveform is less than 5 % of the peak value. Any polarity reversal after the current has fallen to zero shall be less than 20 % of the peak value.	Pass. It meet the requirement.
	In the case of two port devices the magnitude of the current reversal shall be less than 5 %, so that it does not affect the measured limiting voltage.	Pass. It meet the requirement.
	The fictive impedance of the generator shall be nominally 2 $\Omega$ . By definition, the fictive impedance is the ratio of the peak value of the open-circuit voltage $U_{oc}$ divided by the peak value of the short-circuit current $I_{sc}$ .	Pass. It meet the requirement.

	The maximum values for peak open-circuit voltage $U_{oc}$ and peak short-circuit current $I_{sc}$ are 20 kV and 10 kA respectively. Above these values (20 kV /10 kA), type II tests shall be performed.	Pass. It meet the requirement.
	Insert a decoupling network (back filter) according to figures 1 or 2. This circuit configuration will be used only for determining the measured limiting voltage of the SPD.	Pass.

	<p><b>Table 4 – Tolerances on class III test waveform parameters</b></p> <table> <tr> <th></th><th>Open-circuit voltage <math>U_{oc}</math></th><th>Short-circuit current <math>I_{sc}</math></th></tr> <tr> <td>Peak values</td><td><math>\pm 3 \%</math></td><td><math>U_{oc} / 2 \Omega \pm 10 \%</math></td></tr> <tr> <td>Front time</td><td><math>1,2 \pm 30 \%</math></td><td><math>8 \pm 10 \%</math></td></tr> <tr> <td>Time to half value</td><td><math>50 \pm 20 \%</math></td><td><math>20 \pm 10 \%</math></td></tr> </table> <p>NOTE This table includes the effects of decoupling network (back-filter).</p>		Open-circuit voltage $U_{oc}$	Short-circuit current $I_{sc}$	Peak values	$\pm 3 \%$	$U_{oc} / 2 \Omega \pm 10 \%$	Front time	$1,2 \pm 30 \%$	$8 \pm 10 \%$	Time to half value	$50 \pm 20 \%$	$20 \pm 10 \%$	-
	Open-circuit voltage $U_{oc}$	Short-circuit current $I_{sc}$												
Peak values	$\pm 3 \%$	$U_{oc} / 2 \Omega \pm 10 \%$												
Front time	$1,2 \pm 30 \%$	$8 \pm 10 \%$												
Time to half value	$50 \pm 20 \%$	$20 \pm 10 \%$												
	<p>The tolerances on waveform parameters, as shown in table 4, shall be met at the port where the SPD will be connected, with the circuits shown in figures 1 and 2. During the verification of the waveshape, the impedance of the mains is simulated by connecting together the L, N and PE conductors.</p>	Pass.												
	 <p><b>Figure 1 – Example of a decoupling network for single-phase power</b></p>	-												
	 <p><b>Figure 2 – Example of a decoupling network for three-phase power</b></p>	-												
7.1.5	Testing of SPDs classified outdoor only and for mounting out of reach	Pass.												
	For SPDs classified outdoor only and for mounting out of reach, the tests of 7.7 and 7.8 are performed without the cubic wooden box.	Pass.												
7.2	Identification and marking	-												
7.2.1	Verification of the identification and markings	Pass.												
	Verification of the identification and markings shall be checked against the respective requirements of 6.1.1 and 6.1.2 by	Pass. It meet the requirement.												
	inspection.													
7.2.2	Test of indelibility of markings	-												
	This test shall be applied on markings of all types except those made by impressing, molding and engraving.	Pass. It meet the requirement.												

	The test is made by rubbing the marking by hand for 15 s with a piece of cotton soaked with water and again for 15 s with a piece of cotton soaked with aliphatic solvent hexane (with a content of aromatics of maximum 0,1 % volume, a kauributanol value of 29, initial boiling-point approximately 65 °C and specific gravity of 0,68 g/cm <sup>3</sup> ).	Pass. It meet the requirement.
	After this test, the marking shall be easily legible.	Pass.
7.3	Terminals and connections	-
	Verification of the incorporated terminals and their conformity is met by the requirements of 7.3.1.	Pass.
7.3.1	General testing procedure	Pass.
	The SPD is mounted according to the manufacturer's recommendation, and is protected against undue external heating or cooling.	Pass. See the related document.
	Unless otherwise specified, the SPD terminals (3 samples of each construction used) shall be wired with conductors according to	Pass. It meet the requirement.
	– table 6 for two-port devices and one-port devices with separate input/output terminals,	Pass.
	– the manufacturer's instruction for other one-port devices,	Pass.
	and fixed on a dull, black-painted wood board of about 20 mm thickness. The method of fixing shall comply with any requirements relating to the means of mounting recommended by the manufacturer.	Pass. It meet the requirement.
	Nevertheless, SPDs tested according to class I and one-port SPDs with a nominal discharge current 5 kA tested according to class II shall be capable of clamping conductors up to a cross-section of at least 4 mm <sup>2</sup> .	Pass.
	During the test, no maintenance or dismantling of the sample is allowed.	Pass. It meet the requirement.
7.3.2	Terminals with screws	-
7.3.2.1	Test of reliability of screws, current-carrying parts and connections	-
	Compliance is checked by inspection and for screws which are operated when connecting up the SPD by the following test.	Pass.
	The screws are tightened and loosened	Pass.
	– ten times for screws in engagement with a thread of insulating material,	Pass.
	– five times in all other cases.	Pass.
	Screws or nuts in engagement with a thread of insulating	Pass.

	material are completely removed and reinserted each time unless the construction of the screw prevents this.																																																				
	The test is made by means of a suitable test screwdriver or spanner applying a torque as shown in table 5.	Pass.																																																			
	The screws shall not be tightened in jerks.	Pass.																																																			
	The conductor is moved each time the screw is loosened.	NA.																																																			
	<table><tr><th colspan="4">Table 5 – Screw thread diameters and applied torques</th></tr><tr><th rowspan="2">Nominal diameter of thread mm</th><th colspan="3">Torque Nm</th></tr><tr><th>I</th><th>II</th><th>III</th></tr><tr><td>Up to and including 2,8</td><td>0,2</td><td>0,4</td><td>0,4</td></tr><tr><td>Over 2,8 up to and including 3,0</td><td>0,25</td><td>0,5</td><td>0,5</td></tr><tr><td>Over 3,0 up to and including 3,2</td><td>0,3</td><td>0,6</td><td>0,6</td></tr><tr><td>Over 3,2 up to and including 3,6</td><td>0,4</td><td>0,8</td><td>0,8</td></tr><tr><td>Over 3,6 up to and including 4,1</td><td>0,7</td><td>1,2</td><td>1,2</td></tr><tr><td>Over 4,1 up to and including 4,7</td><td>0,8</td><td>1,8</td><td>1,8</td></tr><tr><td>Over 4,7 up to and including 5,3</td><td>0,8</td><td>2,0</td><td>2,0</td></tr><tr><td>Over 5,3 up to and including 6,0</td><td>1,2</td><td>2,5</td><td>3,0</td></tr><tr><td>Over 6,0 up to and including 8,0</td><td>2,5</td><td>3,5</td><td>6,0</td></tr><tr><td>Over 8,0 up to and including 10,0</td><td>–</td><td>4,0</td><td>10,0</td></tr></table>	Table 5 – Screw thread diameters and applied torques				Nominal diameter of thread mm	Torque Nm			I	II	III	Up to and including 2,8	0,2	0,4	0,4	Over 2,8 up to and including 3,0	0,25	0,5	0,5	Over 3,0 up to and including 3,2	0,3	0,6	0,6	Over 3,2 up to and including 3,6	0,4	0,8	0,8	Over 3,6 up to and including 4,1	0,7	1,2	1,2	Over 4,1 up to and including 4,7	0,8	1,8	1,8	Over 4,7 up to and including 5,3	0,8	2,0	2,0	Over 5,3 up to and including 6,0	1,2	2,5	3,0	Over 6,0 up to and including 8,0	2,5	3,5	6,0	Over 8,0 up to and including 10,0	–	4,0	10,0	-
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	Column I applies to screws without heads, if the screw, when tightened, does not protrude from the hole; it also applies to other screws which cannot be tightened by means of a screwdriver with a blade wider than the diameter of the screw.	Pass.																																																			
	Column II applies to other screws which are tightened by means of a screwdriver.	Pass.																																																			
	Column III applies to screws and nuts which are tightened by means other than a screwdriver.	Pass.																																																			
	Where a screw has a hexagonal head with a slot for tightening with a screwdriver and the values in columns II and III are different, the test is made twice, applying the torque specified in column III to the hexagonal head and, on another sample, applying the torque specified in column II by means of a screwdriver. If the values in columns II and III are the same, only the test with the screwdriver is made.	Pass.																																																			
	During the test, the screwed connections shall not work loose and there shall be no damage,such as breakage of screws or damage to the head slots, threads, washers or stirrups, that will impair the further use of the SPD.	Pass. It meet the requirement.																																																			
	Moreover, enclosures and covers shall not be damaged verification by visual inspection.	Pass. No damage.																																																			
7.3.2.2	Test of reliability of terminals for external conductors	-																																																			
	Compliance is checked by inspection and tested in accordance with 7.3.2.2.1, 7.3.2.2.2 and 7.3.2.2.3.	Pass.																																																			
	These tests are made by means of a suitable screwdriver or spanner applying a torque as shown in table 5.	Pass.																																																			

7.3.2.2.1	The terminals are fitted with copper conductors of the smallest or largest crosssectional areas specified in 7.3.1, solid or stranded, whichever is most unfavourable.	Pass.																																			
	The conductor is inserted into the terminal for the minimum distance prescribed or, where no distance is prescribed, until it just projects from the far side, and in the position most likely to assist the wire to escape.	Pass.																																			
	The clamping screws are then tightened with a torque equal to two-thirds of that shown in the appropriate column of table 5.	Pass.																																			
	Each conductor is then subjected to a pull of the value, in newtons, shown in table 7. The pull is applied without jerks, for 1 min, in the direction of the axes of the conductor space.	Pass.																																			
	During this test, the conductor shall not move noticeably in the terminal.	Pass. It meet the requirement.																																			
	<table><tr><th colspan="3">Table 6 – Connectable cross-sections of copper conductors for screw-type terminals or screwless terminals</th></tr><tr><th rowspan="2">Maximum continuous load current for two-port SPDs or one-port SPDs with separate input/output terminals<sup>1)</sup></th><th colspan="2">Range of nominal cross-sections to be clamped (single conductor)</th></tr><tr><th>ISO – mm<sup>2</sup></th><th>AWG – Terminal</th></tr><tr><td>Up to and including 13</td><td>1 to 2,5</td><td>18 to 14</td></tr><tr><td>Above 13 up to and including 16</td><td>1 to 4</td><td>18 to 12</td></tr><tr><td>Above 16 up to and including 25</td><td>1,5 to 6</td><td>16 to 10</td></tr><tr><td>Above 25 up to and including 32</td><td>2,5 to 10</td><td>14 to 8</td></tr><tr><td>Above 32 up to and including 50</td><td>4 to 16</td><td>12 to 6</td></tr><tr><td>Above 50 up to and including 80</td><td>10 to 25</td><td>8 to 3</td></tr><tr><td>Above 80 up to and including 100</td><td>16 to 35</td><td>6 to 2</td></tr><tr><td>Above 100 up to and including 125</td><td>25 to 50</td><td>4 to 1</td></tr><tr><td colspan="3"><sup>1)</sup> It is required that, for current ratings up to and including 50 A, terminals be designed to clamp solid conductors as well as rigid stranded conductors; the use of flexible conductors is permitted. Nevertheless, it is permitted that terminals for conductors having cross-sections for 1 mm<sup>2</sup> up to 6 mm<sup>2</sup> be designed to clamp solid conductors only.</td></tr></table>	Table 6 – Connectable cross-sections of copper conductors for screw-type terminals or screwless terminals			Maximum continuous load current for two-port SPDs or one-port SPDs with separate input/output terminals <sup>1)</sup>	Range of nominal cross-sections to be clamped (single conductor)		ISO – mm <sup>2</sup>	AWG – Terminal	Up to and including 13	1 to 2,5	18 to 14	Above 13 up to and including 16	1 to 4	18 to 12	Above 16 up to and including 25	1,5 to 6	16 to 10	Above 25 up to and including 32	2,5 to 10	14 to 8	Above 32 up to and including 50	4 to 16	12 to 6	Above 50 up to and including 80	10 to 25	8 to 3	Above 80 up to and including 100	16 to 35	6 to 2	Above 100 up to and including 125	25 to 50	4 to 1	<sup>1)</sup> It is required that, for current ratings up to and including 50 A, terminals be designed to clamp solid conductors as well as rigid stranded conductors; the use of flexible conductors is permitted. Nevertheless, it is permitted that terminals for conductors having cross-sections for 1 mm <sup>2</sup> up to 6 mm <sup>2</sup> be designed to clamp solid conductors only.			-
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	<table><tr><th colspan="6">Table 7 – Pulling forces (screw terminals)</th></tr><tr><th>Cross-section of conductor accepted by the terminal mm<sup>2</sup></th><th>Up to 4</th><th>Up to 6</th><th>Up to 10</th><th>Up to 16</th><th>Up to 50</th></tr><tr><td>Pull N</td><td>50</td><td>60</td><td>80</td><td>90</td><td>100</td></tr></table>	Table 7 – Pulling forces (screw terminals)						Cross-section of conductor accepted by the terminal mm <sup>2</sup>	Up to 4	Up to 6	Up to 10	Up to 16	Up to 50	Pull N	50	60	80	90	100	-																	
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7.3.2.2.2	The terminals are fitted with copper conductors of the smallest or largest crosssectional areas specified in 7.3.1 solid or stranded, whichever is the most unfavourable and the terminal screws are tightened with a torque equal to two-thirds of that shown in the appropriate column of table 5. The terminal screws are then loosened and the part of the conductor which may have been affected by the terminal is inspected.	Pass. It meet the requirement.																																			
	The conductors shall show neither undue damage nor severed wires.	Pass. It meet the requirement.																																			
	Conductors are considered to be unduly damaged if they show deep or sharp indentations.	Pass.																																			
	During the test, terminals shall not work loose and there shall	Pass.																																			

	be no damage such as breakage of screws or damage to the head slots, threads, washers or stirrups, that will impair the further use of the terminal.	It meet the requirement.																																				
7.3.2.2.3	The terminals are fitted with a rigid stranded copper conductor conforming to table 8.	Pass.																																				
	Before insertion in the terminal, the wires of the conductors are suitably reshaped.	Pass.																																				
	The conductor is inserted into the terminal until the conductor reaches the bottom of the terminal or just projects from the far side of the terminal and in the position most likely to assist a wire to escape. The clamping screw or nut is then tightened with a torque equal to two-thirds of that shown in the appropriate column of table 5.	Pass.																																				
	After the test, no wire of the conductor shall have escaped from the SPD terminal.	Pass. It meet the requirement.																																				
	<table><tr><th colspan="3">Table 8 – Conductor dimensions</th></tr><tr><th rowspan="2">Range of nominal cross-sections to be clamped  mm<sup>2</sup></th><th colspan="2">Stranded conductor</th></tr><tr><th>Number of wires</th><th>Diameter of wires mm</th></tr><tr><td>1 to 2,5*</td><td>7</td><td>0,67</td></tr><tr><td>1 to 4*</td><td>7</td><td>0,85</td></tr><tr><td>1,5 to 6*</td><td>7</td><td>1,04</td></tr><tr><td>2,5 to 10</td><td>7</td><td>1,35</td></tr><tr><td>4 to 16</td><td>7</td><td>1,70</td></tr><tr><td>10 to 25</td><td>7</td><td>2,14</td></tr><tr><td>16 to 35</td><td>19</td><td>1,53</td></tr><tr><td>25 to 50</td><td>Under consideration</td><td>Under consideration</td></tr><tr><td colspan="3">* If the terminal is intended to clamp solid conductors only (see note of table 6), the test is not made.</td></tr></table>	Table 8 – Conductor dimensions			Range of nominal cross-sections to be clamped  mm <sup>2</sup>	Stranded conductor		Number of wires	Diameter of wires mm	1 to 2,5*	7	0,67	1 to 4*	7	0,85	1,5 to 6*	7	1,04	2,5 to 10	7	1,35	4 to 16	7	1,70	10 to 25	7	2,14	16 to 35	19	1,53	25 to 50	Under consideration	Under consideration	* If the terminal is intended to clamp solid conductors only (see note of table 6), the test is not made.			-	
Table 8 – Conductor dimensions																																						
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7.3.3	Screwless terminals	-																																				
	Pull out test	-																																				
	Each conductor is then subjected to a pull of the value shown in the following table 9. The pull is applied without jerks for 1 min in the direction of the axis of the conductor.	Pass.																																				
	During the test there shall be no movement of the conductor in the terminal or any indication of damage.	Pass. It meet the requirement.																																				
	<table><tr><th colspan="12">Table 9 – Pulling force (screwless terminals)</th></tr><tr><th>Cross-sectional area mm<sup>2</sup></th><th>0,5</th><th>0,75</th><th>1,0</th><th>1,5</th><th>2,5</th><th>4</th><th>6</th><th>10</th><th>16</th><th>25</th><th>35</th></tr><tr><th>Pull force N</th><td>30</td><td>30</td><td>35</td><td>40</td><td>50</td><td>60</td><td>80</td><td>90</td><td>100</td><td>135</td><td>190</td></tr></table>	Table 9 – Pulling force (screwless terminals)												Cross-sectional area mm <sup>2</sup>	0,5	0,75	1,0	1,5	2,5	4	6	10	16	25	35	Pull force N	30	30	35	40	50	60	80	90	100	135	190	-
Table 9 – Pulling force (screwless terminals)																																						
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Pull force N	30	30	35	40	50	60	80	90	100	135	190																											
7.3.4	Insulation pierced connections	-																																				
7.3.4.1	Pull out test on SPD terminals designed for single core conductors	Pass.																																				
	Compliance is checked by the following tests.	Pass.																																				
	The terminals are fitted with new copper conductors of the	Pass.																																				



	smallest or largest cross-sectional area specified in 7.3.1. solid or stranded, whichever is most unfavourable.	
	Screws, if any, are tightened according to table 5.	-
	The conductors are connected and disconnected five times, new conductors being used each time. After each connection the conductors are subjected to a pull, without jerks, for 1 min in the axis of the tapping conductor according to the value given in table 9.	Pass.
	During the test, there shall be no movement of the conductor in the terminal or any sign of damage.	Pass. It meet the requirement.
7.3.4.2	Pull out test on SPD terminals designed for multi-core cables or cords	Pass.
	The pull-out test on the SPD terminals designed for multi-core cables or cords is carried out according to 7.3.4.1 except that the pull force is applied to the entire multicore cable or cord instead of to the individual core.	Pass.
7.3.5	Nuts, plug, socket	-
	Compliance is checked by inspection and trial mounting.	Pass.
7.4	Testing for protection against direct contact	-
7.4.1	Insulated parts	-
	The standard test finger (in accordance with IEC 60529) is applied in every possible position.	Pass.
	For plug-in SPDs (which can be changed without a tool), the test finger is applied in every possible position, when the plug is partially engaged or completely engaged with a socket outlet.	Pass.
	An electrical indicator with a voltage of not less than 40 V and not more than 50 V is used to show contact with the relevant part.	Pass.
7.4.2	Metal parts	-
	Metal parts which are accessible when the SPD is wired and mounted as for normal use have to be connected to earth through a low resistance connection, except of small screws and the like, isolated from live parts, for fixing bases and covers or cover plates of socket-outlets.	Pass.
	A current (derived from an a.c. source having a no-load voltage not exceeding 12 V) equal to 1,5 times the rated load current or 25 A, whichever is the greater, is passed between the earthing terminal and each of the accessible metal parts in turn.	Pass.
	The voltage drop between the earthing terminal and the accessible metal part is measured and the resistance is calculated from the current and this voltage drop. The resistance shall not exceed 0,05 .	Pass. It meet the requirement.
7.5	Determination of the measured limiting voltage	-

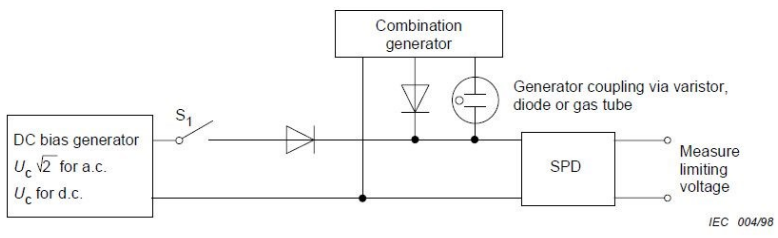
	The tests to be performed on the different SPD types to	Pass.																								
	determine their measured limiting voltages are according to the following table 10 and the flow chart in figure 3.																									
	<table><tr><th colspan="4">Table 10 – Tests to be performed to determine the measured limiting voltage</th></tr><tr><th></th><th>Class I</th><th>Class II</th><th>Class III</th></tr><tr><td>Test 7.5.2</td><td>X</td><td>X</td><td></td></tr><tr><td>Test 7.5.3</td><td>X*</td><td>X*</td><td></td></tr><tr><td>Test 7.5.4</td><td></td><td></td><td>X</td></tr><tr><td colspan="4">* To be performed only on voltage switching SPD types according to 7.5.1.</td></tr></table>	Table 10 – Tests to be performed to determine the measured limiting voltage					Class I	Class II	Class III	Test 7.5.2	X	X		Test 7.5.3	X*	X*		Test 7.5.4			X	* To be performed only on voltage switching SPD types according to 7.5.1.				-
Table 10 – Tests to be performed to determine the measured limiting voltage																										
	Class I	Class II	Class III																							
Test 7.5.2	X	X																								
Test 7.5.3	X*	X*																								
Test 7.5.4			X																							
* To be performed only on voltage switching SPD types according to 7.5.1.																										
	The following specific test conditions apply.	Pass.																								
a)	All one-port SPDs shall be tested unenergized. All two-port SPDs are to be tested energized by means of a voltage source having a nominal current of at least 5 A at Uc, unless the manufacturer can show that there is no difference in the value of the measured limiting voltage when the device is energized or unenergized.	Pass. It meet the requirement.																								
b)	For a one-port SPD having terminals, the test is performed without external disconnectors and the measured limiting voltage is measured at the terminals. For a one-port SPD having connecting leads, the measured limiting voltage is measured with an external lead length of 150 mm. For a two-port SPD, and a one-port SPD having separate load terminals, the measured limiting voltage is measured at the load port or load terminals of the SPD. The test shall include all ancillary parts in series with the SPD and parallel with the load such as disconnector, lights, indicators, fuse and other parts declared by the manufacturers of the SPD.	Pass. It meet the requirement.																								
c)	The measured limiting voltage is the highest voltage value of the tests performed according to table 10 and figure 3, relevant to the SPD test class.	Pass. It meet the requirement.																								
7.5.1	Test procedure to determine the presence of a switching (crowbar) component in an SPD	Pass.																								
	This test has to be performed only if the internal design of the SPD is not known. A new sample shall be used for this test only.	Pass. It meet the requirement.																								
	The standard 8/20 current impulse is used for class I and class II tests of SPDs with a magnitude of I <sub>max</sub> or I <sub>peak</sub> as declared by the manufacturer. For class III test of an SPD, a combination wave generator shall be used with an open-circuit voltage equal to the U <sub>oc</sub> declared by the manufacturer.	Pass. It meet the requirement.																								
	One impulse shall be applied to the SPD (in the case of a two-port SPD, the impulse shall be applied to its input and output terminals).	Pass. It meet the requirement.																								



	Oscillographic record of the voltage across the SPD shall be	Pass.
	taken (in the case of a two-port SPD, the voltage measurement shall be taken across the input terminal of the SPD).	It meet the requirement.
	If the waveshape of the recorded voltage shows a sudden collapse, the SPD is considered as containing a switching (crowbar) component.	Pass.
7.5.2	Test procedure to measure the residual voltage with 8/20 current impulses	Pass.
	a) The 8/20 current impulses shall be used with a sequence of peak values of approximately 0,1; 0,2; 0,5; 1,0 times $I_n$ . If the SPD contains only voltage limiting components then this test need only be carried out at $I_n$ .	Pass.
	b) One sequence of positive polarity and one sequence of negative polarity are applied to the SPD.	Pass.
	c) Finally, at least one impulse of $I_{max}$ or $I_{peak}$ providing $I_{max}$ or $I_{peak}$ is above $I_n$ is applied to the SPD at the polarity that showed higher residual voltages in previous tests.	Pass.
	d) The interval between individual impulses shall be long enough for the sample to cool down to ambient temperature.	Pass.
	e) A current and a voltage oscillogram shall be recorded for each impulse. The (absolute) peak values shall be plotted into a discharge current versus residual voltage diagram. A curve which best fits the data points shall be drawn. There shall be sufficient points on the curve to ensure that there are no significant deviations on the curve up to $I_{max}$ or $I_{peak}$ .	Pass.
	f) The residual voltage used for determining the measured limiting voltage is given by definition as the highest voltage on this curve corresponding in the range of currents for:	Pass.
	– class I: up to $I_{peak}$ or $I_n$ whichever is greater;	Pass.
	– class II: up to $I_n$ .	Pass.
7.5.3	Test procedure to measure the front-of-wave sparkover voltage	Pass.
	The 1,2/50 voltage impulse is used. The generator voltage is set to an open circuit output voltage of 6 kV.	Pass.
	a) 10 impulses are applied to the SPD, five of positive and five of negative polarity.	Pass.
	b) The interval between individual impulses shall be long enough to allow the sample to cool down to ambient temperature.	Pass. It meet the requirement.
	c) If sparkover is not observed during any of the 10 impulses on the front of the wave, then a) and b) above are repeated with a generator open circuit output voltage of 10 kV.	Pass.
	d) The voltage at the SPD shall be recorded with an oscilloscope.	Pass. It meet the requirement.

	e) The measured limiting voltage is the maximum value of the sparkover voltages recorded during the whole test sequence. ,	Pass.
7.5.4	Test procedure to measure the limiting voltage with the combination wave	-
	To perform this test a combination wave is used.	Pass.
	a) The combination wave will be applied to an energized SPD, with the mains voltage at $U_c$ .	Pass.
	b) For SPDs rated only on a.c. power systems, positive impulses are applied at the $90^\circ - 10^\circ$ point and negative impulse at $270^\circ - 10^\circ$ point on the sinusoidal voltage waveform.	Pass. It meet the requirement.
	c) For SPDs rated for use on d.c. systems, both positive and negative impulse surges are applied. The SPD will be energized at the d.c. $U_c$ .	Pass.
	d) The interval between the individual impulses shall be long enough for the sample to cool down to ambient temperature.	Pass. It meet the requirement.
	e) The voltage of the combination wave generator is set to provide an open-circuit voltage of 0,1; 0,2; 0,5; 1,0 times the $U_{oc}$ as declared by the manufacturer for the SPD. If the SPD contains only voltage limiting components then this test need only be carried out at $U_{OC}$ .	Pass. It meet the requirement.
	f) With these generator settings four surges will be applied to the SPD at each amplitude: two of positive and two of negative polarity.	Pass.
	g) An oscillographic record shall be made of the current delivered by the generator into the SPD and the voltage at the output port of the SPD for each impulse.	Pass. It meet the requirement.
	h) The measured limiting voltage is the maximum magnitude of the peak voltage recorded during the whole test sequence.	Pass.
7.5.5	Alternate test to the combination wave test (7.5.4), without a decoupling network	Pass.
	Two-port SPDs with reactive components create interaction with the reactive components of a back filter. This can produce artificially low values of measured limiting voltage. Tests in such cases shall use the alternative test method in figure 4.	Pass.
	For two-port SPDs with reactive components the following test procedure shall be adopted in addition to that of 7.5.4.	Pass.
	a) The test generator shall be configured as in figure 4.	Pass.
	b) For a.c. rated SPDs a d.c. voltage of $U_c \cdot 2$ , for d.c. rated SPDs a d.c. voltage of $U_c$ , shall be applied to the SPD via a diode. The impulse shall be applied via a diode, gas discharge tube, or varistor according to figure 4.	Pass. It meet the requirement.

c) The application of the impulse should occur at least 100 ms after closure of S1. The d.c. voltage should be disconnected within 10 ms after impulse application.	Pass. It meet the requirement.
d) Reverse polarity tests can be conducted by reversing the SPD connection to the generator.	Pass.
e) The interval between individual impulses shall be long	Pass.

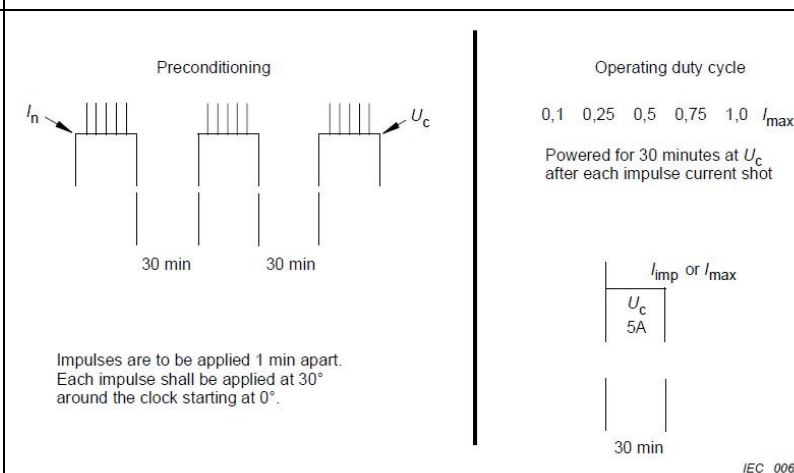
enough for the sample to cool down to ambient temperature.	It meet the requirement.
f) The voltage of the combination wave generator is set to provide an open-circuit voltage of 0,1; 0,2, 0,5; 1,0 times the $U_{oc}$ as declared by the manufacturer.	Pass. It meet the requirement.
g) With these generator settings, four surges will be applied to the SPD at each amplitude: two of positive polarity and two of reverse polarity.	Pass. It meet the requirement.
h) An oscillographic record shall be made of the current delivered by the generator into the SPD and the voltage at the output port for each impulse.	Pass. It meet the requirement.
i) The measured limiting voltage is the maximum magnitude of the voltage recorded at the output of the SPD for the whole test sequence.	Pass.
 <p>Figure 4 – Alternate test for the measured limiting voltage</p>	-

7.6	Operating duty test	-
	These tests are applicable only for SPDs used on a.c. (SPDs used on d.c. are under consideration).	Pass.
	See flow chart of operating duty test (figure 5).	Pass.
7.6.1	General	Pass.
	This is a test in which service conditions are simulated by the application of a stipulated number of specified impulses to the SPD while it is energized at the maximum continuous operating voltage $U_c$ via an a.c. source according to 7.6.3.	Pass.
	The test shall be made on three new samples which have not been subjected previously to any tests.	Pass.
	First the measured limiting voltage shall be determined using the tests described in 7.5.	Pass.
	To avoid overstress of the samples, the test of 7.5.2 is performed only at $I_n$ and the tests of 7.5.4 and 7.5.5 only at $U_{oc}$ . Text deleted	Pass.

7.6.2	Preliminary test to determine the magnitude of the follow current	Pass.
	This preliminary test is intended to determine if the peak value of the follow current is above or below 500 A.	Pass. It meet the requirement.
	If the internal design and the peak value of the follow current of the SPD are known, this preliminary test is not required.	Pass. It meet the requirement.
	a) The test shall be made with a separate test sample.	Pass.
	b) The prospective short circuit current shall be $I_p \geq 1,5 \text{ kA}$	Pass.

	with a power factor $\cos \varphi = 0,95_{-0,05}^{+0}$ .	
	c) It is connected to a power frequency voltage source with sinusoidal a.c. voltage. The power frequency voltage measured at the terminals, shall be the maximum equal to the continuous maximum operating voltage $U_c$ % . The frequency of the a.c. voltage source shall correspond to the rated frequency of the SPD.	Pass.
	d) The follow current shall be initiated with an impulse current 8/20 or a combination wave.	Pass.
	e) The peak value shall correspond to $I_{\max}$ or $I_{\text{peak}}$ or $U_{OC}$ .	Pass.
	f) The current impulse shall be initiated 60 electrical degrees before the peak of the power frequency voltage. Its polarity shall coincide with the polarity of the half wave of the power frequency voltage in which it is initiated.	Pass.
	g) If at this synchronization point there is no follow current, then the impulse current 8/20 has to be initiated later in steps of 10 electrical degrees each in order to determine if a follow current is generated.	Pass.
7.6.3	Power frequency source characteristics for preconditioning	Pass.
7.6.3.1	SPDs with follow current below 500 A	-
	The test sample shall be connected to a power frequency voltage source. The impedance of the power source shall be such that during the flow of follow current the peak value of the power frequency voltage, measured at the SPD terminals, does not fall below the peak value of its $U_c$ by more than 10 %.	Pass. It meet the requirement.
7.6.3.2	SPDs with follow current above 500 A	Pass.
	The test sample shall be connected to a power frequency voltage $U_c$ with a prospective short-circuit current equal to the follow current interrupt rating $I_{fi}$ declared by the manufacturer in accordance with Table 11, or 500 A, whichever is greater.	Pass. It meet the requirement.
	For SPDs connected between neutral and protective earth only, the prospective short-circuit current shall be at least 100 A.	Pass. It meet the requirement.
7.6.4	Class I and II preconditioning tests	-

	For this test, 15 current impulses 8/20 of positive polarity in three groups of five impulses each with peak values equal to $I_{peak}$ or $I_n$ , whichever is greater, for test class I and equal to $I_n$ for test class II are applied through the test sample connected to a power source according to 7.6.3. Each impulse shall be synchronized to the power frequency. Starting from $0^\circ$ the synchronization angle shall be increased in steps of $(30 \pm 5)^\circ$ intervals. The tests are described in Figure 6.	Pass. It meet the requirement.
	When testing SPDs to class I, current impulses with values equal to $I_{peak}$ or $I_n$ , whichever is greater, are applied.	Pass.
	When testing SPDs to class II, current impulses with values	Pass.

	equal to $I_n$ , are applied.	
	 <p>Figure 6 – Preconditioning and operating duty cycle test schedule</p>	-
	The interval between the impulses is 50 s – 60 s, the interval between the groups 25 min – 30 min.	Pass.
	It is not required that the test sample be energized between groups.	Pass.
	The current shall be recorded at each impulse and the current records shall show no sign of puncture or flashover of the samples.	Pass. It meet the requirement.
7.6.5	Class I and II operating duty test	-
	The SPD is energized at $U_c$ by means of a voltage source having a nominal current capability of at least 5 A. This test is carried out with current impulses in steps up to $I_{peak}$ (according to 3.9) or $I_{max}$ (according to 3.10) through the SPD.	Pass. It meet the requirement.
	The power frequency voltage remains applied for 30 min after each impulse to prove the thermal stability: the SPD is considered to be thermally stable if the peak of the resistive component of $I_c$ , or the power dissipation steadily decreases during the last 15 min of $U_c$ voltage application.	Pass.

	Current impulses of positive polarity shall be initiated in the corresponding positive peak value of the power frequency voltage source to the energized test sample as follows.	Pass. It meet the requirement.
	a) One current impulse at 0,1 ( $I_{peak}$ or $I_{max}$ ); check thermal stability; cool down to ambient temperature.	Pass.
	b) One current impulse at 0,25 ( $I_{peak}$ or $I_{max}$ ); check thermal stability; cool down to ambient temperature.	Pass.
	c) One current impulse at 0,5 ( $I_{peak}$ or $I_{max}$ ); check thermal stability; cool down to ambient temperature.	Pass.
	d) One current impulse at 0,75 ( $I_{peak}$ or $I_{max}$ ); check thermal stability; cool down to ambient temperature.	Pass.
	e) One current impulse at 1,0 ( $I_{peak}$ or $I_{max}$ ); check thermal	Pass.

	stability; cool down to ambient temperature.	
7.6.6	Pass criteria	-
	The SPD has passed the test if thermal stability is achieved after each impulse of the preconditioning and operating duty cycle. Additionally, any follow current has to be selfextinguished.Both the voltage and current records and visual inspection shall show no indication of puncture or flashover of the samples. Mechanical damage shall not occur during these tests.	Pass.
	One more impulse at $I_n$ or UOC shall be applied to the SPD whilst the SPD is energized at $U_c$ by means of a voltage source having a nominal current capability of at least 5 A. After this impulse, UC remains applied and thermal stability shall be achieved within 30 min.	Pass. It meet the requirement.
	Once thermal stability is achieved, either:	-
	the current which flows through the test sample is measured. Its resistive component (measured at the crest of the sine wave) shall not exceed a value of 1 mA.	Pass. It meet the requirement.
	or in case of this current exceeds 1 mA	-
	the stand-by power consumption shall not be greater than 20 % above the value measured in 7.7.5	Pass. It meet the requirement.
	Following this complete test sequence and after the sample has cooled down to near ambient temperature, the measured limiting voltage test, which was made at the beginning of the test sequence, shall be repeated. The SPD has passed the test, if the values measured before and after the test are below or equal to $U_p$ .	Pass. It meet the requirement.
7.6.7	Class III operating duty test	-
	For the operating duty test of class III SPDs, a power frequency voltage source according to 7.6.3 is used.	Pass. It meet the requirement.

	The combination wave generator is connected to the SPD via a coupling capacitor (see 7.1.4). The tolerance on waveform parameters as shown in table 4 shall be met at the point where the SPD will be connected. The value of $U_{oc}$ is declared by the manufacturer.	Pass. It meet the requirement.
	The SPD is preconditioned according to the test procedure of 7.6.4. For the purpose of this test, the nominal discharge current is replaced by values of $U_{oc}$ .	Pass. It meet the requirement.
	The current impulse shall be initiated at the peak value of the corresponding half cycle and in the same polarity of the power frequency voltage.	Pass. It meet the requirement.
	The operating duty test is performed according to 7.6.5 using the combination wave generator with the following generator settings $U_{oc}$ .	Pass. It meet the requirement.
	a) One positive and one negative impulse at $0,1 U_{oc}$ ; check	Pass.

	thermal stability; cool down to ambient temperature.	
	b) One positive and one negative impulse at $0,25 U_{oc}$ ; check thermal stability; cool down to ambient temperature.	Pass.
	c) One positive and one negative impulse at $0,50 U_{oc}$ ; check thermal stability; cool down to ambient temperature.	Pass.
	d) One positive and one negative impulse at $0,75 U_{oc}$ ; check thermal stability; cool down to ambient temperature.	Pass.
	e) One positive and one negative impulse at $1,0 U_{oc}$ ; check thermal stability; cool down to ambient temperature.	Pass.
	The SPD has passed the test if the criteria of 7.6.6 are fulfilled.	-
7.7	SPD disconnectors and safety performance of overstressed SPDs	-
7.7.1	Operating duty withstand test of SPD disconnectors	-
	The SPD disconnector(s) is(are) tested during the operating duty test (see 7.6). The disconnectors, as specified by the manufacturer, shall not operate during the test and shall be in working order after this test.	Pass. It meet the requirement.
	For the purpose of this clause, working order means that the disconnector is not visibly damaged and is still operational. Operation can be checked either manually (where possible) or by a simple electrical test agreed between the manufacturer and the laboratory.	Pass. It meet the requirement.
7.7.2	Test of thermal stability of SPDs	-
7.7.2.1	Temperature withstand test	-
	The SPD is kept in a heated cabinet at an ambient temperature of $80^{\circ}\text{C} \pm 5\text{ K}$ for 24 h. No internal SPD disconnector shall operate during this time.	Pass. It meet the requirement.
7.7.2.2	Thermal stability test	-



	This test is not performed on SPDs containing only voltage switching components.	Pass. It meet the requirement.
	Test settings	-
	This test shall be performed on each mode of protection; however, if some modes of protection have identical circuitry, one single test can be performed on the mode of protection which presents the most vulnerable configuration. This test procedure addresses two different designs:	Pass. It meet the requirement.
	– SPDs containing only voltage limiting components. In this case, the following procedure a) applies;	Pass.
	– SPDs containing both voltage limiting and voltage switching components. In this case, the following procedure b) applies. ,	Pass.
	<b>Sample preparation</b>	-
	Any voltage switching component which is connected in series with a voltage limiting component shall be short-circuited by a	Pass. It meet the requirement.

	copper wire with a diameter such that it does not melt during the test.	
	For SPDs with different non-linear components connected in parallel, this test has to be performed for every current path of the SPD by disconnecting/interrupting all the remaining current paths. If components of the same type and parameters are connected in parallel, they shall be tested as one current path.	Pass. It meet the requirement.
	The manufacturer shall provide samples prepared according to the above requirements.	Pass.
a)	Test procedure for SPDs having no switching component in series with other components	Pass.
	The test samples shall be connected to a power frequency source.	Pass. It meet the requirement.
	The voltage shall be high enough to allow a current to flow through the SPD. For this test, the current is set to a constant value. The tolerance for the test current is $\pm 10 \%$ . The test is started at a value of 2 mA r.m.s.	Pass. It meet the requirement.
	The starting point may be changed from 2 mA to a current corresponding to the maximum power dissipation of the component, if it is known.	Pass.
	This value of current is then increased in steps of either 2 mA or 5 % of the previously adjusted test current, whichever is greater.	Pass. It meet the requirement.
	Each step is maintained until thermal equilibrium is reached (i.e. variation of temperature less than 2 K within 10 min).	Pass.



	The surface temperature on the hottest spot of the SPD (for accessible SPDs only) and the current through the SPD are monitored continuously. The hottest spot of the SPD may be determined by an initial test or alternatively many points may be monitored in order to determine the hottest spot.	Pass. It meet the requirement.
	This test is interrupted if all non-linear components under test are disconnected. The voltage shall not be increased further in order to avoid any malfunction of the disconnecter.	Pass. It meet the requirement.
	If the voltage across the SPD falls below $U_{cs}$ during the test, the current regulation is discontinued and the voltage is adjusted back to $U_{cs}$ and maintained for a duration of 15 min. Continuous current monitoring is therefore no longer required. The source shall have a short-circuit current capability which will not limit the current before any disconnecter operates. The maximum available current value shall not exceed the short-circuit withstand capability declared by the manufacturer.	Pass. It meet the requirement.
b)	Test procedure for SPDs having a switching component in series with other components	Pass.
	The SPD is energized with a power frequency source at $U_C$ s	Pass.

	and having a short-circuit current capability which will not limit the current before any disconnecter operates. The maximum available current value shall not exceed the short-circuit withstand capability declared by the manufacturer.	It meet the requirement.
	If no significant current flows, test procedure a) shall be followed.	Pass.
	<b>Pass criteria</b>	-
	If a disconnecter operates, there shall be clear evidence of effective and permanent disconnection by the device. To check this, a power frequency voltage equal to $U_c$ shall be applied for 1 min without current flow in excess of 0,5 mA r.m.s.	Pass. It meet the requirement.
	Indoor SPDs: The surface temperature rise shall be less than 120 K during the test. The surface temperature shall not exceed 80 K above ambient temperature 5 min after the disconnecter has operated. During the test there shall be no expulsion of solid material.	Pass. It meet the requirement.
	Outdoor SPDs: There shall be no evidence of burning and there shall be no expulsion of solid material.	Pass. It meet the requirement.
	Accessible SPDs: After the test, SPDs having an IP degree equal or greater than IP20 shall not have live parts accessible with the standardized test finger applied with a force of 5 N (see EN 60529), except the live parts which were already accessible before the test when the SPD is fitted as in normal use.	Pass. It meet the requirement.

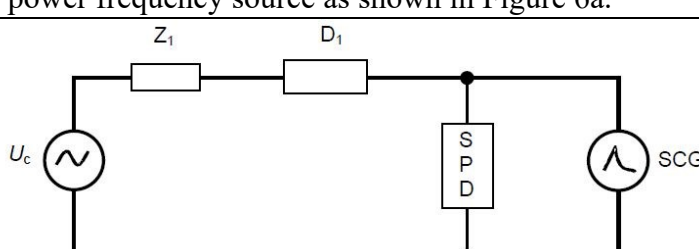
7.7.3	Short-circuit withstand capability	-
	This test is not applied to SPDs which are either <ul style="list-style-type: none"> <li>classified for outdoor use and mounted out of reach, or</li> <li>for connection N-PE in TN- and/or TT-systems only.</li> </ul>	Pass.
	Test settings	-
	Power frequency source characteristic: The prospective short-circuit current and power factor at the SPD terminals, are given by the manufacturer according to Table 11. The test voltage is set to UCS.	Pass.

	<table><tr><th colspan="2">Table 11 – Prospective short-circuit current and power factor</th></tr><tr><th><math>I_p \begin{smallmatrix} +5 \\ 0 \end{smallmatrix} \%</math> kA</th><th><math>\text{Cos}\varphi \begin{smallmatrix} 0 \\ -0,05 \end{smallmatrix}</math></th></tr><tr><td><math>I_p \leq 1,5</math></td><td>0,95</td></tr><tr><td><math>1,5 &lt; I_p \leq 3,0</math></td><td>0,9</td></tr><tr><td><math>3,0 &lt; I_p \leq 4,5</math></td><td>0,8</td></tr><tr><td><math>4,5 &lt; I_p \leq 6,0</math></td><td>0,7</td></tr><tr><td><math>6,0 &lt; I_p \leq 10,0</math></td><td>0,5</td></tr><tr><td><math>10,0 &lt; I_p \leq 20,0</math></td><td>0,3</td></tr><tr><td><math>20,0 &lt; I_p \leq 50,0</math></td><td>0,25</td></tr><tr><td><math>50,0 &lt; I_p</math></td><td>0,2</td></tr><tr><td colspan="2">NOTE Recovery voltage according to IEC 60947-1.</td></tr></table>	Table 11 – Prospective short-circuit current and power factor		$I_p \begin{smallmatrix} +5 \\ 0 \end{smallmatrix} \%$ kA	$\text{Cos}\varphi \begin{smallmatrix} 0 \\ -0,05 \end{smallmatrix}$	$I_p \leq 1,5$	0,95	$1,5 < I_p \leq 3,0$	0,9	$3,0 < I_p \leq 4,5$	0,8	$4,5 < I_p \leq 6,0$	0,7	$6,0 < I_p \leq 10,0$	0,5	$10,0 < I_p \leq 20,0$	0,3	$20,0 < I_p \leq 50,0$	0,25	$50,0 < I_p$	0,2	NOTE Recovery voltage according to IEC 60947-1.		-
Table 11 – Prospective short-circuit current and power factor																								
$I_p \begin{smallmatrix} +5 \\ 0 \end{smallmatrix} \%$ kA	$\text{Cos}\varphi \begin{smallmatrix} 0 \\ -0,05 \end{smallmatrix}$																							
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$20,0 < I_p \leq 50,0$	0,25																							
$50,0 < I_p$	0,2																							
NOTE Recovery voltage according to IEC 60947-1.																								
	The SPD itself and its disconnectors shall be placed in the centre of a cube shaped wooden box with sides that are $(500 \pm 50)$ mm away from the SPD external surfaces. The internal surface of the box is covered with muslin paper or cheese cloth. One of the box sides (not the bottom one) remains open in order that the supply cables can be connected according to the manufacturer's instructions.	Pass. It meet the requirement.																						
	The test sample shall be mounted in accordance with the manufacturer's published recommendations and connected with conductors of the maximum cross section according to 7.3.1, keeping the cables inside the box to a maximum length of 0,5 m each	Pass. It meet the requirement.																						
	Sample preparations	-																						
	For SPDs with non-linear components connected in parallel, separate sets of three samples shall be prepared in the manner described below for every current path of the SPD, which contains one or more non-linear components described in 3.4 and 3.5	Pass. It meet the requirement.																						

	Voltage limiting components and voltage switching components described in 3.4 and 3.5 shall be replaced by appropriate copper blocks, (dummies), ensuring that the internal connections and their cross-section and surrounding material (e.g. resins) and packaging are not changed.	Pass. It meet the requirement.
	Samples according to the above requirement shall be provided by the manufacturer.	Pass.
	<b>Test procedure</b>	-
	This test shall be performed at two different test settings with a separate set of prepared test samples for each setting a) and b):	Pass.
a)	Test of the declared short circuit withstand capability:	-
	The sample is connected to a power frequency source at UCs, having a prospective short-circuit current according to the	Pass.

	declared short-circuit withstand capability and power factor according to Table 11.	
	The test is carried out twice with the short-circuit initiated at 45 electrical degrees and at 90 electrical degrees after the zero crossing of the voltage. If a replaceable or resettable internal or external disconnector operates, the relevant disconnector shall be replaced or reset each time. If the disconnector cannot be replaced or reset, the test is stopped.	Pass. It meet the requirement.
b)	Test at low short-circuit current:	-
	A power frequency source at UCs, having a prospective short-circuit current of five times the rated current of the maximum overcurrent protection (if declared by the manufacturer), and a power factor according to Table 11, shall be applied for $5 \text{ s} \pm 0,5 \text{ s}$ . If no external overcurrent protection is required by the manufacturer, a prospective short-circuit current of 300 A is used. The test is carried out once with the short-circuit initiated at 45 electrical degrees after the zero crossing of the voltage.	Pass. It meet the requirement.
	<b>Pass criteria</b>	-
	During the above two short-circuit tests, neither the muslin paper nor the cheese cloth shall catch fire.	Pass. It meet the requirement.
	In addition, during the test for the short circuit withstand capability, the power short-circuit current shall be interrupted by one of the disconnectors (internal or external) required by the manufacturer.	Pass. It meet the requirement.
	Internal and/or special disconnectors not covered by another IEC standard: If they operate there shall be clear evidence of effective and permanent disconnection. To check this, a power frequency voltage equal to $U_c$ shall be applied for 1 min to the	Pass. It meet the requirement.

	disconnecter(s) having operated. The current flow shall not exceed 0,5 mA r.m.s. ,	
	<p>Accessible SPDs:</p> <p>After the test, SPDs having an IP degree equal or greater than IP20 shall not have live parts accessible with the standardized test finger applied with a force of 5 N (see EN 60529), except for those live parts which were already accessible before the test when the SPD is fitted as in normal use.</p>	<p>Pass.</p> <p>It meet the requirement.</p>
7.7.3.1	Additional test for SPDs with $I_{fi}$ lower than the declared short-circuit withstand capability	Pass.
	The tests according to 7.7.3 are repeated but without voltage switching components being shortcircuited. The short-circuit is initiated by triggering the SPD with a positive surge current (8/20 or other appropriate waveshape) at 30 to 40 electrical degrees after the zero crossing of the voltage on the positive	<p>Pass.</p> <p>It meet the requirement.</p>

	half wave. The surge current shall be high enough to initiate a follow current but shall in no case exceed $I_n$ .	
	To ensure that no external disconnecter operates due to the trigger surge, all external disconnectors shall be placed in series with the power frequency source as shown in Figure 6a.	<p>Pass.</p> <p>It meet the requirement.</p>
	 <p><b>Key</b></p> <p><math>Z_1</math> impedance to adjust the prospective short-circuit current, according to Table 11</p> <p><math>D_1</math> external SPD disconnecter</p> <p>SCG surge current generator with coupling device</p> <p><b>Figure 6a – Test circuit for SPDs with <math>I_{fi}</math> lower than the declared short-circuit withstand capability</b></p>	-
7.7.4	Test under TOVs caused by faults in the high (medium) voltage-system	
	New samples shall be used and fitted as in normal use, according to the manufacturer's instructions, and connected to a test circuit according to Figure 13 or equivalent.	<p>Pass.</p> <p>It meet the requirement.</p>

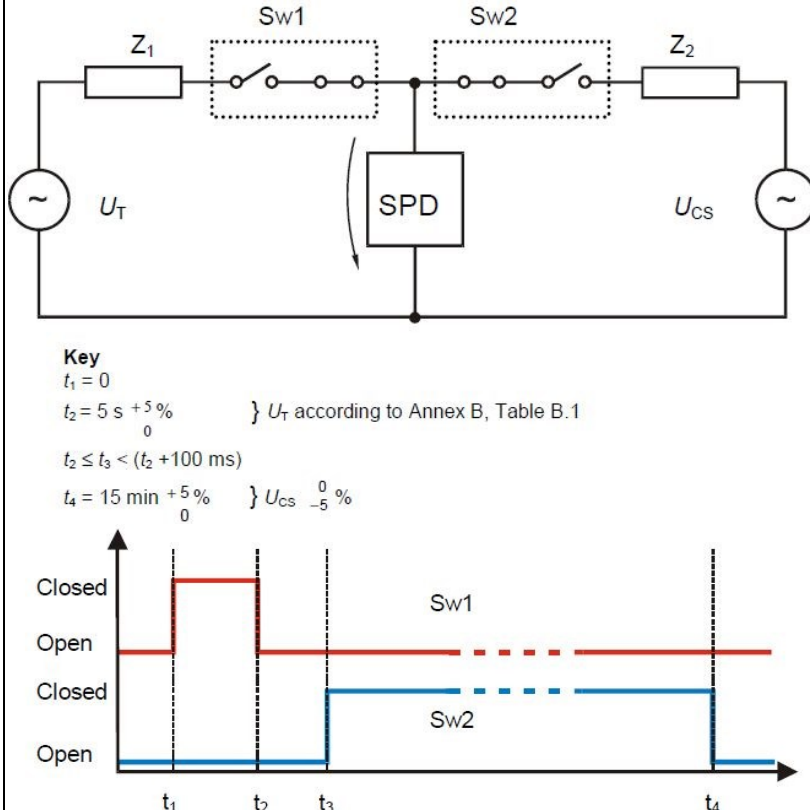
	The SPD shall be mounted in a cube-shaped wooden box as described in 7.7.3. The internal surface of the box shall be covered with muslin paper or cheese cloth. One of the box sides (not the bottom) shall remain open in order that the supply cables can be connected according to the manufacturer's instructions.	Pass. It meet the requirement.
7.7.4.1	Test procedure	-
	$U_T$ $^{0}_{-5}\%$ is applied to the test sample at 90 electrical degrees of phase L1 by closing switch S1. $^{0}_{+10}\%$ After 200 ms switch S2 is closed automatically. This connects the SPD's PE-terminal to the neutral (via the current limiting resistor R2) by short-circuiting the TOV-transformer's (T2) secondary winding. This results in the operation of fuse F2 protecting the TOV transformer.	Pass.
	The prospective short circuit current of the power source for $U_{CS}$ shall be equal to five times the rated current of the maximum overcurrent protection declared by the manufacturer, or 300 A if no maximum overcurrent protection is declared. The tolerance for the current $^{0}_{+10}\%$ is	Pass.
	The prospective short-circuit current delivered by the TOV transformer shall be adjusted to $^{0}_{+10}\%$ 300 A by R2.	Pass.
	With the exception of SPDs connected neutral to ground, $U_{CS}$ remains applied to the test sample for 15 min without	Pass.

	interruption until switch S1 is reopened.	
	Other test circuits are permitted as long as they ensure the same stress to the SPD.	Pass.
7.7.4.2	Pass criteria	-
	The muslin paper or cheese cloth shall not catch fire during the test.	Pass.
	SPDs having an IP degree equal or greater than IP20 shall not have live parts accessible with the standardized test finger applied with a force of 5 N, except for those live parts which were already accessible before the test when the SPD is fitted as in normal use.	Pass. It meet the requirement.
	SPDs, for which the manufacturer declares in his installation instructions that they may be installed in TT systems between Neutral and PE upstream the main RCD, shall pass the TOV withstand mode criteria given below.	Pass. It meet the requirement.
	a) TOV failure mode	-
	If the manufacturer claims a TOV failure mode, the following additional pass criteria shall be fulfilled:	Pass.
	If a disconnector has operated, there shall be clear evidence of effective and permanent disconnection by the device. To check	Pass. It meet the requirement.

	this, a power frequency voltage equal to UC shall be applied for 1 min without current flow in excess of 0,5 mA r.m.s.	
	b) TOV withstand mode	-
	If the manufacturer claims a TOV withstand capability, the following additional pass criteria shall be fulfilled:	Pass.
	The SPD shall maintain thermal stability during the application of $U_{CS}$ (following the application of UT). The SPD is considered to be thermally stable if the current flowing through it or its power dissipation do not continue to increase during the total time of application of $U_{CS}$ .	Pass. It meet the requirement.
	The test sample is then connected to $U_C$ . The test transformer shall have a short-circuit current capability of at least 200 mA.	Pass. It meet the requirement.
	The current which flows through the test sample is measured. Its resistive component (measured at the crest of the sine wave) shall not exceed a value of 1 mA	-Pass. It meet the requirement.
	Or the stand-by power consumption shall not increase by more than 20 % of the value measured in 7.7.5.	Pass. It meet the requirement.
	After the test sample has cooled down to near ambient temperature, the measured limiting voltage shall be determined, using the tests described in 7.5, in order to check if the voltage protection level specified by the manufacturer has been maintained. However, the test of 7.5.2. is performed only at $I_n$ and the tests of 7.5.4 and 7.5.5 only at $U_{oc}$ . Auxiliary circuits, like status indicators, shall be in working order.	Pass. It meet the requirement.
	For the purpose of this subclause, 'working order' means	Pass.

	that there is no visible damage of the disconnecter and that it is still operational. Operation can be checked either manually (where possible) or by a simple electrical test agreed between the manufacturer and the laboratory.	
	Visual inspection of the test sample shall reveal no evidence of any damage.	-
7.7.5	Standby power consumption and residual current test	-
	The SPD is connected to a voltage source at its maximum continuous operating voltage (UC) in accordance with the manufacturer ' s instructions. The apparent power (Volt-Amperes) consumed by the SPD is measured. The current flowing through the PE terminal is called the residual current.	Pass. It meet the requirement.
7.7.6	Test under TOVs caused by faults in the low voltage system	-
7.7.6.1	Test procedure	-
	New samples shall be used and fitted as in normal use, according to the manufacturer's instructions.	Pass.

	The SPD shall be mounted in a cube shaped wooden box as described 7.7.3. The internal surface of the box shall be covered with muslin paper or cheese cloth. One of the box sides (not the bottom) shall remain open in order that the supply cables can be connected according to the manufacturer's instructions.	Pass. It meet the requirement.
	The test sample shall be connected for a duration of $t_T = 5 \text{ s}^{+5\%}_0$ to a power frequency voltage $^{0\%}_{-5\%}$ of $U_T$ as given in Table B.1, or greater TOV-voltages which the manufacturer has declared in accordance with 6.1.1 w). This voltage source shall be capable of delivering a current either high enough to ensure that the voltage at the SPD terminals does not fall below $U_T - 5\%$ during the test, or equal to the declared short-circuit withstand of the SPD, whichever is lower.	Pass. It meet the requirement.
	Immediately following the application of $U_T$ , a voltage $^{0\%}_{-5\%}$ equal to $U_{CS}$ with the same current capability, shall be applied to the test sample for a period of 15 min. The time interval between the test periods shall be as short as possible and shall in any case not exceed 100 ms.	Pass. It meet the requirement.

	 <p><b>Key</b>  <math>t_1 = 0</math>  <math>t_2 = 5 \text{ s}^{+5\%}_0</math> } <math>U_T</math> according to Annex B, Table B.1  <math>t_2 \leq t_3 &lt; (t_2 + 100 \text{ ms})</math>  <math>t_4 = 15 \text{ min}^{+5\%}_0</math> } <math>U_{CS}^{0\%}_{-5\%}</math></p> <p><b>Figure 7 – Example of a test circuit and corresponding timing diagram to perform the test under TOVs caused by faults in the low voltage system</b></p>	-
7.7.6.2	Pass criteria	-
	The following pass criteria shall be fulfilled	Pass.



	The muslin paper or cheese cloth shall not catch fire during the test.	Pass. It meet the requirement.
	SPDs having an IP degree equal or greater than IP20 shall not have live parts accessible with the standardized test finger applied with a force of 5 N, except for those live parts which were already accessible before the test when the SPD is fitted as in normal use.	Pass. It meet the requirement.
	The SPD shall maintain thermal stability during the application of $U_{CS}$ (following the application of $U_T$ ). The SPD is considered to be thermally stable if the current flowing through it or its power dissipation do not continue to increase during the total time of application of $U_{CS}$ .	Pass. It meet the requirement.
	The test sample is then connected to UC. The test transformer shall have a short-circuit current capability of at least 200 mA.	Pass. It meet the requirement.
	The current which flows through the test sample is measured. Its resistive component (measured at the crest of the sine wave) shall not exceed a value of 1 mA	Pass. It meet the requirement.

	or the stand-by power consumption shall not increase by more than 20 % of the value measured in 7.7.5.	
	After the test sample has cooled down to near ambient temperature, the measured limiting voltage shall be determined, using the tests described in 7.5, in order to check if the voltage protection level specified by the manufacturer has been maintained. However, the test of 7.5.2. is performed only at $I_n$ and the tests of 7.5.4 and 7.5.5 only at $U_{oc}$ . Auxiliary circuits, like status indicators, shall be in working order.	Pass. It meet the requirement.
	For the purpose of this subclause, 'working order' means that there is no visible damage of the disconnecter and that it is still operational. Operation can be checked either manually (where possible) or by a simple electrical test agreed between the manufacturer and the laboratory.	Pass.
	Visual inspection of the test sample shall reveal no evidence of any damage.,	Pass. It meet the requirement.
7.8	Test for two-port SPDs and one-port SPDs with separate input/output terminals	-
7.8.1	Test to determine the percentage voltage regulation	-
	A voltage $U_c$ is supplied at the input port and shall be constant within - 5 %. The test shall be conducted with rated load current into a resistive load. Input and output voltage shall be measured simultaneously with load connected. Use the following formula to determine the percentage voltage regulation.	Pass. It meet the requirement.
	$\Delta U \% = ((U_{in} - U_{out}) / U_{in}) 100 \%$	-



	This value shall be recorded and comply with the manufacturer's declaration.	Pass.
7.8.2	Rated load current $I_L$	-
	The SPD shall be powered, as in 7.8.1 at ambient temperature using a cable with the minimum cross-sectional area specified in 7.3.1. The load current shall be set to the rated load current specified by the manufacturer. Forced cooling of the SPD is not permitted.	Pass. It meet the requirement.
	The SPD passes the test if the enclosure has reached thermal stability and the temperature of the parts which are accessible in normal use shall be not more than 40 K above the ambient temperature of the room (see 2.1).	Pass. It meet the requirement.
7.8.3	Load-side short circuit withstand capability test (in conjunction with SPD disconnectors required by the manufacturer, if any).	Pass.
	The test, according to 7.7.3, is repeated without the short-circuiting of any component but by short-circuiting all load terminals with a conductor of the largest cross section specified under 7.3.1 and of length 0,5 m.	Pass.

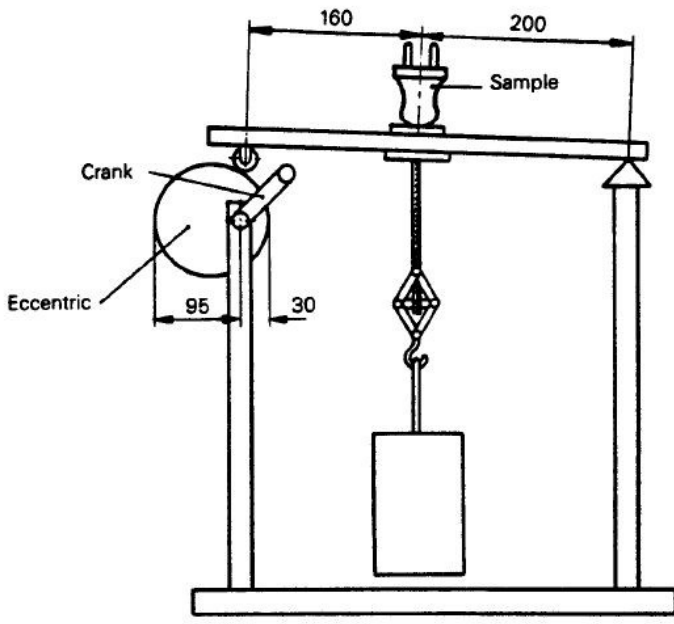
	Pass criteria	-
	During the test the power short-circuit current shall be interrupted within 5 s. During the test the muslin paper, or cheesecloth, shall not catch fire. In addition, there shall be no explosion or hazard for either personnel or facility.	Pass. It meet the requirement.
	Accessible SPDs	-
	After the test, SPDs having an IP degree equal or greater than IP2X shall not have live parts accessible with the standardized test finger applied with a force of 5 N (see IEC 60529). If no internal disconnector has operated, the SPD shall fulfil the requirements according to 7.4.1 and 7.5. If an SPD internal disconnector has operated, there shall be clear evidence of effective and permanent disconnection.	Pass. It meet the requirement.
	In checking for disconnection:	-
	a) confirm that there is no voltage on the output terminals b) apply a power frequency voltage equal to two times UC, between the corresponding input and output terminals for 1 minute without current flow in excess of 0,5 mA r.m.s.	Pass.
	The test shall include all the auxiliary parts in series with the SPD as declared by the manufacturer.	Pass.
7.8.4	Load-side surge withstand capability	-
	- 15 current impulses 8/20	Pass.
	- or 15 combination wave impulses with an open circuit voltage $U_{oc}$	Pass.

	with a value equal to the load-side surge withstand capability declared by the manufacturer are applied in three groups of five impulses to the output port of the test sample. The SPD is energized at $U_c$ by means of a voltage source having a nominal current of at least 5 A. Each impulse shall be synchronized to the power frequency. Starting from $0^\circ$ the synchronization angle shall be increased in steps of $30^\circ \pm 5^\circ$ .	Pass. It meet the requirement.
	The interval between the impulses is 50 s - 60 s and the interval between the groups is 25 min - 30 min.	Pass.
	The test sample shall be energized during the whole test sequence. The voltage on the output terminals shall be recorded.	Pass. It meet the requirement.
	<b>Pass criteria</b>	-
	The SPD has passed the test if the criteria according to 7.6.6 are fulfilled.	Pass.
7.8.5	Overload behaviour	-
	This test is performed on all two-port SPDs, but shall only be performed on one-port SPDs if the internal connections between input and output terminals have a smaller cross-section than the conductors specified to perform the test.	Pass. It meet the requirement.

	The test is carried out at ambient temperature and the sample shall be protected against abnormal external heating or cooling.	Pass.
	The test circuit and procedure shall be as described in 7.8.2, except that circuits other than the main circuit are disregarded for this test.	Pass.
	The test is performed without any external overcurrent protective devices being connected (internal removable overcurrent protective devices are replaced by a link of negligible impedance).	Pass.
	If a maximum overcurrent protection is specified by the manufacturer, the SPD shall be loaded for 1 h with a current equal to 1,6 times that maximum overcurrent protection.	Pass. It meet the requirement.
	If no maximum overcurrent protection is specified by the manufacturer, the SPD shall be loaded with 1,1 times the rated load current for 1 h or until an internal disconnecter operates. If no disconnecter operates within 1 h, the test is continued by increasing the previous value of test current by a factor of 1,1 every hour, until an internal disconnecter operates.	Pass. It meet the requirement.
	<b>Pass criteria</b>	-
	For touchable surfaces, the temperature rise shall always be less than 60 K during the test.	Pass. It meet the requirement.
a)	No internal disconnecter has operated:	-

	Visual inspection of the test sample shall reveal no evidence of any damage.	Pass. It meet the requirement.
	SPDs having an IP degree equal or greater than IP20 shall not have live parts accessible with the standardized test finger applied with a force of 5 N, except for those live parts which were already accessible before the test when the SPD is fitted as in normal use.	Pass. It meet the requirement.
	The test sample is then connected to UC. The test transformer shall have a short-circuit current capability of at least 200 mA.	Pass. It meet the requirement.
	The current which flows through the test sample is measured. Its resistive component (measured at the crest of the sine wave) shall not exceed a value of 1 mA. or the stand-by power consumption shall not increase by more than 20 % of the value measured in 7.7.5.	Pass. It meet the requirement.
	After the test sample has cooled down to ambient temperature, the measured limiting voltage shall be determined, using the tests described in 7.5, to check, if the voltage protection level specified by the manufacturer has been maintained. The test of 7.5.2. is performed only at $I_n$ and the tests of 7.5.4 and 7.5.5 only at $U_{oc}$ . Auxiliary circuits, such as status indicators, shall be in working order.	Pass. It meet the requirement.
b)	Any internal disconnecter has operated:	-

	SPDs having an IP degree equal or greater than IP20 shall not have live parts accessible with the standardized test finger applied with a force of 5 N, except for those live parts which were already accessible before the test when the SPD is fitted as in normal use.	Pass. It meet the requirement.
	There shall be clear evidence of effective and permanent disconnection by the device. To check this, a power frequency voltage equal to UC shall be applied for 1 min without current flow in excess of 0,5 mA r.m.s.	Pass. It meet the requirement.
	There shall be no evidence of burning and there shall be no expulsion of solid material during and after the test.	Pass. It meet the requirement.
7.9	Additional tests	-
	The entire subclause 7.9 is a safety issue. In some countries other national regulations may apply.	Pass.
7.9.1	Portable SPDs with flexible cables and cords and their connection	Pass.
7.9.1.1	Portable SPDs shall be provided with a cord anchorage such that the conductors are relieved from strain, including twisting, where they are connected to the terminals or terminations, and that their covering is protected from abrasion.	Pass. It meet the requirement.
	The sheath, if any, of the cord shall be clamped within the cord anchorage.	Pass.

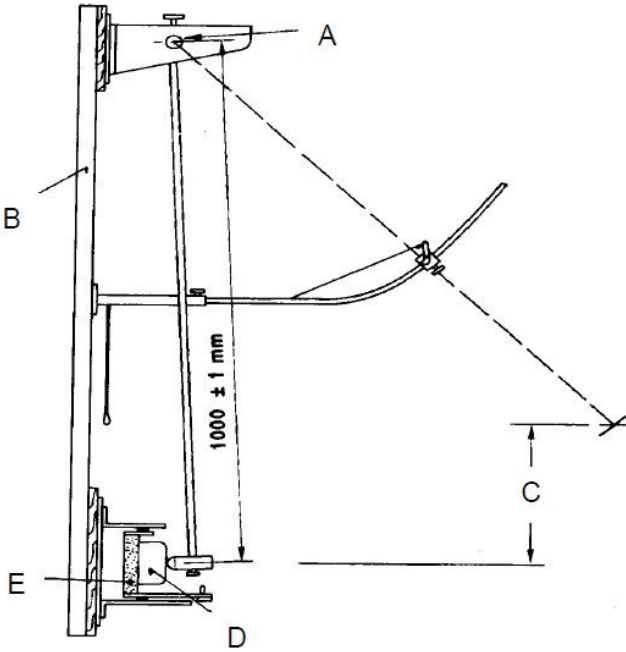
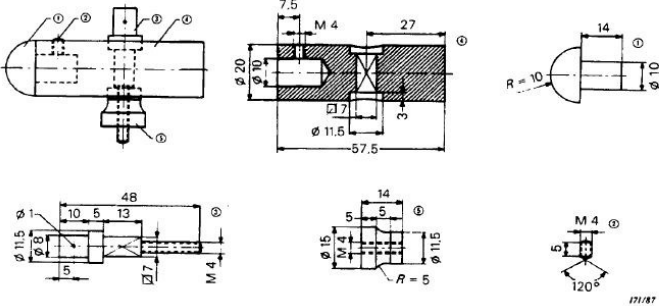
7.9.1.2	The effectiveness of the retention is checked by the following test by means of an apparatus as shown in Figure 8 Dimensions are in millimetres.	Pass.
	 <p>Figure 8 – Apparatus for testing the cord retention</p>	
	Non-rewireable SPDs are tested as delivered; the test is made	Pass.

	on new samples.																																		
	Rewireable SPDs are tested with the cable having the nominal cross-sectional area as declared by the manufacturer.	Pass. See the related document.																																	
	Conductors of the flexible cable or cord of rewireable accessories are introduced into the terminals, screws being tightened just sufficiently to prevent the position of the conductors from easily changing.	Pass.																																	
	The cord anchorage is used in the normal way, clamping screws, if any, being tightened with a torque equal to two-thirds of that specified in table 12.	Pass.																																	
	<b>Table 12 – Tightening requirements for clamping screws</b>																																		
	<table><tr><th>Nominal diameter of thread mm</th><th colspan="3">Torque Nm</th></tr><tr><td>Up to and including 2,8</td><td>0,2</td><td>0,4</td><td>-</td></tr><tr><td>Over 2,8 up to including 3,0</td><td>0,25</td><td>0,5</td><td>-</td></tr><tr><td>Over 3,0 up to including 3,2</td><td>0,3</td><td>0,6</td><td>-</td></tr><tr><td>Over 3,2 up to including 3,6</td><td>0,4</td><td>0,8</td><td>-</td></tr><tr><td>Over 3,6 up to including 4,1</td><td>0,7</td><td>1,2</td><td>1,2</td></tr><tr><td>Over 4,1 up to including 4,7</td><td>0,8</td><td>1,8</td><td>1,2</td></tr><tr><td>Over 4,7 up to including 5,3</td><td>0,8</td><td>2,0</td><td>1,4</td></tr></table>			Nominal diameter of thread mm	Torque Nm			Up to and including 2,8	0,2	0,4	-	Over 2,8 up to including 3,0	0,25	0,5	-	Over 3,0 up to including 3,2	0,3	0,6	-	Over 3,2 up to including 3,6	0,4	0,8	-	Over 3,6 up to including 4,1	0,7	1,2	1,2	Over 4,1 up to including 4,7	0,8	1,8	1,2	Over 4,7 up to including 5,3	0,8	2,0	1,4
Nominal diameter of thread mm	Torque Nm																																		
Up to and including 2,8	0,2	0,4	-																																
Over 2,8 up to including 3,0	0,25	0,5	-																																
Over 3,0 up to including 3,2	0,3	0,6	-																																
Over 3,2 up to including 3,6	0,4	0,8	-																																
Over 3,6 up to including 4,1	0,7	1,2	1,2																																
Over 4,1 up to including 4,7	0,8	1,8	1,2																																
Over 4,7 up to including 5,3	0,8	2,0	1,4																																

	After reassembly of the sample, the component parts shall fit snugly and it shall not be possible to push the cable or cord into the sample to any appreciable extent.	Pass. It meet the requirement.
	The sample is placed in the test apparatus so that the axis of the cable or cord is vertical where it enters the sample.	Pass.
	The cable or cord is then subjected 100 times to a pull of	Pass.
	– 60 N if the rated current is not more than 16 A and the rated voltage is up to and including 250 V;	Pass.
	– 80 N if the rated current is not more than 16 A and the rated voltage is above 250 V;	Pass.
	– 100 N if the rated current is more than 16 A.	Pass.
	The pulls are applied practically without jerks each time for 1 s.	Pass. It meet the requirement.
	Care shall be taken to exert the same pull on all parts (core, insulation and sheath) of the flexible cable simultaneously.	Pass.
	After the tests, the cable or cord shall not have been displaced by more than 2 mm. For rewirable accessories, the end of the conductors shall not have moved noticeably in the terminals; for non-rewirable accessories, there shall be no break in the electrical connections.	Pass. It meet the requirement.
	For measurement of the longitudinal displacement, a mark is made on the cable or cord while it is subjected to the pull, at a distance of approximately 20 mm from the end of the sample	Pass.

	or the cord guard, before starting the tests. If, for non-rewirable accessories, there is no definite end to the sample or the cord guard, an additional mark is made on the body of the sample.	
	After these tests, the displacement of the mark on the cable or cord in relation to the sample or the cord guard is measured while the cable or cord is subjected to the pull.	Pass.
7.9.1.3	Non-rewirable SPDs shall be provided with a flexible cable or cord complying with IEC 60227 and IEC 60245 with a cross-sectional area of the conductors suitable for the maximum rating of the SPD and associated equipment.	Pass. It meet the requirement.
	Compliance is checked by inspection, by measurement, and by checking that the flexible cables or cords are in accordance with IEC 60227 or IEC 60245, as applicable.	Pass.
7.9.1.4	Non-rewirable SPDs shall be so designed that the flexible cable or cord is protected against excessive bending where it enters the accessory.	Pass. It meet the requirement.
	Guards provided for this purpose shall be of insulating material and shall be fixed in a reliable manner.	Pass. It meet the requirement.
	Helical metal springs, whether bare or covered with insulating material, shall not be used as core guards.	Pass. It meet the requirement.

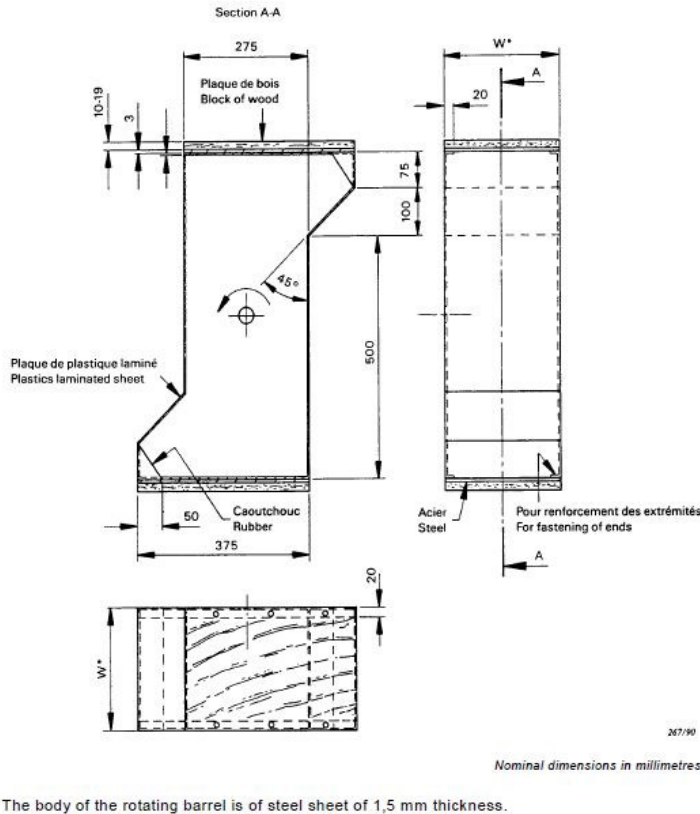
7.9.2	Mechanical strength	-
7.9.2.1	SPDs shall have adequate mechanical strength so as withstand to the stresses imposed during installation and use.	Pass.
	Compliance is checked by the appropriate tests as follows:	-
	The samples are subjected to strikes by means of impact-testan apparatus as shown in figure 10.	Pass.

	 <p style="text-align: right;">Dimensions in millimetres</p> <p><b>Key</b>  A Pendulum B Frame C Height of fall D Specimen  E Mounting fixture</p> <p style="text-align: center;"><b>Figure 10a - Test apparatus</b></p>  <p style="text-align: right;">Dimensions in millimetres</p> <p style="text-align: center;"> <b>Figure 10b – Striking element of the pendulum hammer</b>  <b>Figure 10 - Impact test apparatus</b> </p>	-
	The striking element has a hemispherical face, 10 mm radius, made of polyamide having a Rockwell hardness of HR 100, and has a mass of 150 g ± 1 g.	Pass.

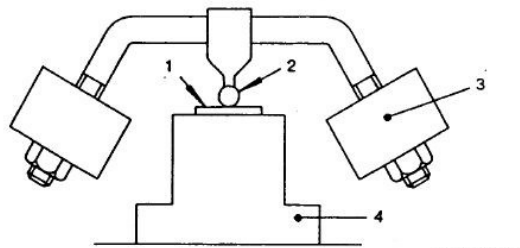
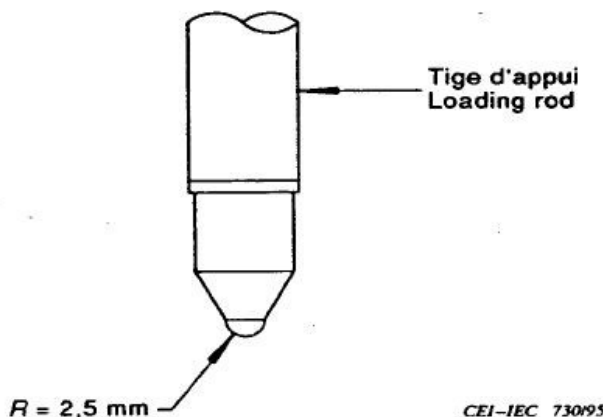

	It is rigidly fixed to the lower end of a steel tube with an external diameter of 9 mm and a wall thickness of 0,5 mm, which is pivoted at its upper end in such a way that it swings only in a vertical plane.	Pass.
	The axis of the pivot is $1\,000\text{ mm} \pm 1\text{ mm}$ above the axis of this striking element.	Pass.
	The Rockwell hardness of the polyamide striking element is determined by using a ball having a diameter of 12,700 mm $0,0025\text{ mm}$ , the initial load $100\text{ N} \pm 2\text{ N}$ and the extra load $500\text{ N} \pm 2,5\text{ N}$ .	Pass.
	The design of the apparatus is such that a force of between 1,9 N and 2,0 N has to be applied to the face of the striking element to maintain the tube in a horizontal position.	Pass.
	The samples are mounted on a sheet of plywood, 8 mm thick and 175 mm square, secured at its top and bottom edges to a ridged bracket.	Pass.
	Portable SPDs are tested as fixed SPDs, but they are fixed to the plywood sheet by auxiliary means.	Pass.
	The mounting support shall have a mass of $10\text{ kg} \pm 1\text{ kg}$ and shall be mounted on a rigid frame.	Pass. It meet the requirement.
	The design of the mounting is such that	Pass.
	– the sample can be so placed that the point of impact lies in the vertical plane through the axis of the pivot,	Pass.
	– the sample can be displaced horizontally and turned about an axis perpendicular to the surface of the plywood,	Pass.
	– the plywood can be turned around a vertical axis.	Pass.
	Flush-type SPDs are mounted in a recess provided in a block of hornbeam or material having similar mechanical characteristics, which is fixed to a sheet of plywood. (They are not tested in their relevant mounting boxes.)	Pass.
	If wood is used for the block, the direction of the wood fibres shall be perpendicular to the direction of the impact.	NA.
	Flush-type screw fixing SPDs shall be fixed by means of screws to lugs recessed in the block. Flush-type claw fixing SPDs shall be fixed to the block by means of the claws.	Pass. It meet the requirement.
	Before applying the strikes, fixing screws of bases and covers are tightened with a torque equal to two-thirds of that specified in table 12.	Pass.
	The samples are mounted so that the point of impact lies in the vertical plane through the axis of the pivot.	Pass.
	The striking element is allowed to fall from a height which is specified in the following table 13.	Pass.



	<p><b>Table 13 – Fall distance for impact requirement</b></p> <table> <tr> <th rowspan="2">Height of fall mm</th><th colspan="2">Parts of enclosures to be subjected to the impacts</th></tr> <tr> <th>Ordinary accessory</th><th>Other accessories</th></tr> <tr> <td>100</td><td>A and B</td><td>A and B</td></tr> <tr> <td>150</td><td>C</td><td>C</td></tr> <tr> <td>200</td><td>D</td><td>D</td></tr> </table> <p> A: parts on the front surface, including parts which are recessed.  B: parts which do not project more than 15 mm from the mounting surface (distance from the wall) after mounting as in normal use, with the exception of the above parts A.  C: parts which project more than 15 mm and not more than 25 mm from the mounting surface (distance from the wall) after mounting as in normal use, with the exception of the above parts A.  D: parts which project more than 25 mm from the mounting surface (distance from the wall) after mounting as in normal use, with the exception of the above parts A. </p>	Height of fall mm	Parts of enclosures to be subjected to the impacts		Ordinary accessory	Other accessories	100	A and B	A and B	150	C	C	200	D	D	-
Height of fall mm	Parts of enclosures to be subjected to the impacts															
	Ordinary accessory	Other accessories														
100	A and B	A and B														
150	C	C														
200	D	D														
	The heights of the fall determined by the part of the sample which projects most from the mounting surface is applied on all parts of the sample, with the exception of parts A.	Pass.														
	The height of fall is the vertical distance between the position of a checking point when the pendulum is released, and the position of that point at the moment of impact. The checking point is marked on the surface of the striking element where the line through the point of intersection of the axes of the steel tube of the pendulum and the striking element and perpendicular to the plane through both axes, meets the surface.	Pass.														
	The samples are subjected to strikes which are evenly distributed over the samples. The strikes are not applied to "knock-out" areas.	Pass.														
	The following blows are applied:	-														
	– for parts A, five strikes: one in the centre. After the sample has been moved horizontally: one each on the unfavourable points between the centre and the edges; and then, after the sample has been turned 90° about its axis perpendicular to the plywood, one each on similar points;	Pass.														
	– for parts B (as far as applicable), C and D, four blows:	-														
	one on one side of the sample after the plywood sheet has been turned 60° and one blow on another side of the sample after it has been turned 90° about its axis perpendicular to the plywood sheet, keeping the position of the plywood sheet unchanged;	Pass.														
	one blow on each of the other two sides of the sample, with the plywood sheet turned 60° in the opposite direction.	Pass.														
	After the test, the sample shall show no damage within the meaning of the standard. In particular, live parts shall not become accessible with the standard test finger.	Pass. No damage.														
	Damage to the finish, small dents which do not reduce creepage distances or clearances and small chips which do not	Pass.														

	adversely affect the protection against electric shock or harmful ingress of water are neglected.	
	Cracks, not visible with the normal or corrected vision, without additional magnification, and surface cracks in fibre reinforced mouldings and the like, are ignored.	Pass.
7.9.2.2	Portable SPDs are tested in a tumbling barrel as shown in figure 11.	Pass.
	 <p>Figure 11 – Tumbling barrel</p>	
	Rewireable SPDs are fitted with the flexible cable or cord specified by the manufacturer and a free length of approximately 100 mm.	Pass.
	Terminal screws and assembly screws are tightened with a torque equal to two-thirds of that specified in table 12.	Pass.
	Non-rewireable SPDs are tested as delivered, the flexible cable or cord being cut so that a free length of about 100 mm projects from the accessory.	Pass.
	The samples fall from a height of 500 mm onto a steel plate, 3 mm thick, the number of falls being the following:	Pass.
	– 1 000 if the mass of the sample without cable or cord does not exceed 100 g;	Pass.
	– 500 if the mass of the sample without cable or cord exceeds 100 g, but does not exceed 200 g;	Pass.

	– 100 if the mass of the sample without cable or cord exceeds 200 g.	Pass.
	The barrel is turned at a rate of five revolutions per minute, ten falls per minute thus taking place. Only one sample is tested in the barrel at a time.	Pass.
	After the test, the samples shall show no damage. In particular	-
	– no part shall have become detached or loosened,	Pass. It meet the requirement.
	– it should not be possible to touch any live parts, even if the standard test finger is applied with a force not exceeding 10 N.	Pass. It meet the requirement.
	During the examination after the test, special attention is paid to the connection of the flexible cable or cord. Small pieces may be broken off without rejection, provided that the protection against electric shock is not affected.	Pass.
	Damage to the finish and small dents which do not reduce the creepage distances or clearances are neglected.	Pass.
	The measured limiting voltage shall be determined using the tests described in 7.5.	Pass.
	The test of 7.5.2 is performed only at In and the tests of 7.5.4 and 7.5.5 only at U <sub>oc</sub> . For the test of 7.5.3, the maximum of 10 measured peak values shall be used.	Pass.
	The sample has passed the test if the measured limiting voltage is below or equal to U <sub>p</sub> .	Pass.
	The test sample is then connected to a voltage source with a maximum continuous operating voltage U <sub>c</sub> and the rated frequency. The test transformer shall have a short circuit current capability of at least 200 mA unless other values are provided by the manufacturer.	Pass. It meet the requirement.
	Whilst this power source is applied either	Pass.
	the resistive component of the current which flows through the test sample (measured at the crest of the sine wave) shall not exceed a value of 1 mA.	Pass. It meet the requirement.
	or in case of this current exceeds 1 mA,	Pass.
	the stand-by power consumption shall not be greater than 20 % above the value measured in 7.7.5.	Pass. It meet the requirement.
7.9.3	Heat resistance	-
7.9.3.1	For 1 h the SPD is kept in a heating cabinet at a temperature of 100 ° C ± 2 K. Any sealing compound used in the internal assembly shall not flow out to any significant extent.	Pass. It meet the requirement.
	After cooling, it should not be possible to touch any live parts when the test sample is mounted as for normal use even if the standard test finger is applied with a force not exceeding 5 N.	Pass. It meet the requirement.

	The SPD is deemed to have passed the test even if the SPD disconnecter is open.	Pass.								
7.9.3.2	Outer parts of SPDs, consisting of insulating material, are submitted to a ball thrust test by means of a tester as shown in Figure 12.	Pass.								
	<div><p>CEI-IEC 72995</p><table><tr><td>1 Epreuve d'essai</td><td>1 Test specimen</td></tr><tr><td>2 Bille</td><td>2 Pressure ball</td></tr><tr><td>3 Poids</td><td>3 Weight</td></tr><tr><td>4 Support</td><td>4 Specimen support</td></tr></table></div> <p>Figure 12a - Ball thrust test apparatus</p> <div><p>CEI-IEC 73095</p></div> <p>Figure 12b - Loading rod for ball thrust tester</p> <p>Figure 12 - Ball thrust tester </p>	1 Epreuve d'essai	1 Test specimen	2 Bille	2 Pressure ball	3 Poids	3 Weight	4 Support	4 Specimen support	-
1 Epreuve d'essai	1 Test specimen									
2 Bille	2 Pressure ball									
3 Poids	3 Weight									
4 Support	4 Specimen support									
	Parts of insulating material necessary to retain current carrying parts and parts of the earthing circuit in position are tested in a heating cabinet at 125 °C ± 2 K.	Pass.								
	Parts of insulating material not necessary to retain current carrying parts and parts of the earthing circuit in position, even though they are in contact with them, are tested at 70 °C ± 2 K.	Pass.								
	The sample to be tested is fastened accordingly, its surface being positioned horizontally; a steel ball having a diameter of 5 mm is pressed against the surface with a force of 20 N.	Pass.								
	After 1 h, the steel ball is taken away from the sample; by	Pass.								

	dipping it into cold water, the temperature of the sample is reduced to ambient temperature within 10 s.	
	The diameter of the ball indentation is measured and shall not exceed 2 mm.	Pass. It meet the requirement.
7.9.4	Resistance to abnormal heat and fire	-
	The glow wire test is performed in accordance with clauses 4 to 10 of IEC 60695-2-1/1 under the following conditions:	Pass.
	– for external parts of SPDs made of insulating material necessary to retain in position current-carrying parts and parts of the protective circuit, by the test made at a temperature of $850^{\circ}\text{C} \pm 15\text{ K}$ ;	Pass.
	– for all other external parts made of insulating material, by the test made at a temperature of $650^{\circ}\text{C} \pm 10\text{ K}$ .	Pass.
	For the purpose of this test, bases of surface-type SPDs are considered as external parts.	Pass.
	The test is not made on parts of ceramic material.	-
	If the insulating parts are made of the same material, the test is carried out only on one of these parts, according to the appropriate glow-wire test temperature.	Pass.
	The glow-wire test is applied to ensure that an electrically heated test wire under defined test conditions does not cause ignition of insulating parts, or to ensure that a part of insulating material, which might be ignited by the heated test wire under defined conditions, has a limited time to burn without spreading fire by flame or burning parts or droplets falling down from the tested part.	Pass.
	The test is made on one sample.	Pass.
	In case of doubt, the test is repeated on two further samples.	Pass.
	The test is made by applying the glow-wire once.	Pass.
	The sample shall be positioned during the test in the most unfavourable position of its intended use (with the surface tested in a vertical position).	Pass.
	The tip of the glow-wire shall be applied to the specified surface of the test sample taking into account the conditions of intended use under which a heated or glowing element may come into contact with the sample.	Pass. It meet the requirement.
	The sample is regarded as having passed the glow-wire test if	Pass.
	– there is no visible flame and no sustained glowing, or if	Pass.
	– flames and glowing parts on the sample extinguish themselves within 30 s after the removal of the glow-wire.	Pass.

	There shall be no ignition of the tissue paper or scorching of the pinewood board.	Pass. It meet the requirement.
7.9.5	Verification of air clearances and creepage distances	Pass.
	The electrode spacing of spark gaps shall not be considered for	Pass.

	the determination of air clearances and creepage distances.	It meet the requirement.																																		
7.9.5.1	SPDs category outdoor	-																																		
	Between live parts and earth, the air clearances and creepage distances shall not be smaller than the values indicated in table 14.	Pass. It meet the requirement.																																		
	<table><tr><th colspan="4">Table 14 – Air clearances and creepage distances for SPDs category outdoor</th></tr><tr><th rowspan="2">SPD maximum continuous operating voltage V</th><th rowspan="2">Minimum air clearance in mm</th><th colspan="2">Creepage distance in mm for insulating materials with *</th></tr><tr><th>CTI ≥ 600</th><th>400 ≤ CTI ≤ 600</th></tr><tr><td>Up to 450</td><td>3</td><td>6</td><td>7,5</td></tr><tr><td>450 – 600</td><td>5,5</td><td>12</td><td>15,5</td></tr><tr><td>600 – 1 200</td><td>8</td><td>20</td><td>25</td></tr><tr><td>1 200 – 1 500</td><td>10</td><td>30</td><td>40</td></tr><tr><td colspan="4">* Other values are possible if the pollution degree is lower than 4 or a pollution test is performed.</td></tr><tr><td colspan="4">Ⓒ These values are based on IEC 60664-1 for heights up to 2 000 m above sea level, pollution degree 4 and inhomogeneous field conditions. Comparative Tracking Index (CTI) value according to IEC 60112, solution A. Ⓒ</td></tr></table>	Table 14 – Air clearances and creepage distances for SPDs category outdoor				SPD maximum continuous operating voltage V	Minimum air clearance in mm	Creepage distance in mm for insulating materials with *		CTI ≥ 600	400 ≤ CTI ≤ 600	Up to 450	3	6	7,5	450 – 600	5,5	12	15,5	600 – 1 200	8	20	25	1 200 – 1 500	10	30	40	* Other values are possible if the pollution degree is lower than 4 or a pollution test is performed.				Ⓒ These values are based on IEC 60664-1 for heights up to 2 000 m above sea level, pollution degree 4 and inhomogeneous field conditions. Comparative Tracking Index (CTI) value according to IEC 60112, solution A. Ⓒ				-
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7.9.5.2	SPDs category indoor	-																																		
	Air clearances and creepage distances shall not be smaller than the values indicated in table 15.	Pass. It meet the requirement.																																		
7.9.5.2.1	Test: Measurement	-																																		
	The measurements are carried out without conductors as well as with conductors of the greatest cross-sectional area indicated by the manufacturer. Nuts and screws with out-of-round heads are assumed to be in the most unfavourable tightening position. If there is a partition, the air clearance is measured across the partition; where the partition consists of two parts which are not joined together, the air clearance is measured through the separating gap. Distances due to slits or holes in outer parts out of isolating material are measured against a metal foil on the touchable surface: for this purpose the foil is not pressed into the holes. By means of the test finger (see 7.9.1) it shall be pushed into corners and similar.	Pass. It meet the requirement.																																		
	In the case that there is a cavity in the course of the creepage distance, its profile is only considered, if it is at least 1mm wide; cavities smaller than 1mm are only considered in their width.	Pass.																																		



	In the case that there is a partition made out of two parts which are not glued together, the creepage distance is measured through the separating gap. If the air gap between a live part and a partition with fitting surfaces is smaller than 1 mm, only the distance through the separating surface is considered, which is then looked upon as creepage distance. If not, the whole distance, namely the sum out of air gap and the distance through the separating surface, is taken as air clearance. If metal parts are covered with self-hardening resin of a least 2	Pass.
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	mm thickness, or if they are covered with an insulation, withstanding a test voltage according to 7.9.8, creepage distances and air clearances are not necessary.																																																																																																																																						
	<table><tr><th colspan="7">Table 15 – Air clearances and creepage distances for SPDs category indoor</th></tr><tr><th>SPD continuous operating voltage</th><th>Up to 100 V</th><th>100 V – 200 V</th><th>200 V – 450 V</th><th>450 V – 600 V</th><th>600 V – 1 200 V</th><th>1 200 V – 1 500 V</th></tr><tr><td colspan="7"><b>Air clearances in millimetres</b></td></tr><tr><td>1) Between live parts of different polarity</td><td>1</td><td>2</td><td>3</td><td>5,5</td><td>8</td><td>12</td></tr><tr><td>2) Between live parts and</td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>– screws and other means to fasten a covering, having to be detached for mounting the SPD</td><td>1</td><td>2</td><td>3</td><td>5,5</td><td>8</td><td>12</td></tr><tr><td>– fastening surfaces (note 2)</td><td>2</td><td>4</td><td>6</td><td>11</td><td>16</td><td>24</td></tr><tr><td>– screws or other means for fastening the SPD (note 2)</td><td>2</td><td>4</td><td>6</td><td>11</td><td>16</td><td>24</td></tr><tr><td>– bodies (notes 1 and 2)</td><td>1</td><td>2</td><td>3</td><td>5,5</td><td>8</td><td>12</td></tr><tr><td>3) Between the metal parts of the disconnector mechanism and</td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>– bodies (note 1)</td><td>1</td><td>2</td><td>3</td><td>5,5</td><td>8</td><td>12</td></tr><tr><td>– screws or other means for fastening the SPD</td><td>1</td><td>2</td><td>3</td><td>5,5</td><td>8</td><td>12</td></tr><tr><td colspan="7"><b>Creepage distances in millimetres</b></td></tr><tr><td>4) Between live parts of different polarity</td><td>1</td><td>2</td><td>3</td><td>5,5</td><td>8</td><td>12</td></tr><tr><td>5) Between live parts and</td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>– screws and other means to fasten a covering, having to be detached for mounting the SPD</td><td>1</td><td>2</td><td>3</td><td>5,5</td><td>8</td><td>12</td></tr><tr><td>– screws or other means for fastening the SPD (note 2)</td><td>2</td><td>4</td><td>6</td><td>11</td><td>16</td><td>24</td></tr><tr><td>– bodies (note 1)</td><td>1</td><td>2</td><td>3</td><td>5,5</td><td>8</td><td>12</td></tr><tr><td colspan="7">NOTE 1 Definition see 7.9.7.2. NOTE 2 If clearances and creepage distances between live parts of the device and the metallic screen or the surface on which the SPD is mounted are dependant on the design of the SPD only, they cannot be reduced when the SPD is mounted in the most unfavourable position (even in a metallic enclosure), the values of lines 1 and 4 are sufficient.</td></tr></table>	Table 15 – Air clearances and creepage distances for SPDs category indoor							SPD continuous operating voltage	Up to 100 V	100 V – 200 V	200 V – 450 V	450 V – 600 V	600 V – 1 200 V	1 200 V – 1 500 V	<b>Air clearances in millimetres</b>							1) Between live parts of different polarity	1	2	3	5,5	8	12	2) Between live parts and							– screws and other means to fasten a covering, having to be detached for mounting the SPD	1	2	3	5,5	8	12	– fastening surfaces (note 2)	2	4	6	11	16	24	– screws or other means for fastening the SPD (note 2)	2	4	6	11	16	24	– bodies (notes 1 and 2)	1	2	3	5,5	8	12	3) Between the metal parts of the disconnector mechanism and							– bodies (note 1)	1	2	3	5,5	8	12	– screws or other means for fastening the SPD	1	2	3	5,5	8	12	<b>Creepage distances in millimetres</b>							4) Between live parts of different polarity	1	2	3	5,5	8	12	5) Between live parts and							– screws and other means to fasten a covering, having to be detached for mounting the SPD	1	2	3	5,5	8	12	– screws or other means for fastening the SPD (note 2)	2	4	6	11	16	24	– bodies (note 1)	1	2	3	5,5	8	12	NOTE 1 Definition see 7.9.7.2. NOTE 2 If clearances and creepage distances between live parts of the device and the metallic screen or the surface on which the SPD is mounted are dependant on the design of the SPD only, they cannot be reduced when the SPD is mounted in the most unfavourable position (even in a metallic enclosure), the values of lines 1 and 4 are sufficient.							-
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7.9.5.2.2	The casting shall not come over the rim of the deepening, it shall stick strongly to the walls of the cavity and the metal parts in it.	Pass. It meet the requirement.																																																																																																																																					
	Testing: examination and trial to detach the casting mass without a tool.	Pass.																																																																																																																																					
7.9.6	Tracking resistance	-																																																																																																																																					
	Testing is not applicable in case of insulating materials made out of ceramic, or if the creepage distances are at least equal to double the values indicated in 7.9.5.	Pass.																																																																																																																																					
	Testing according to IEC 60112, solution A with a test voltage of 175 V.	Pass.																																																																																																																																					
7.9.7	Insulation resistance	-																																																																																																																																					



	This test is not applicable to SPDs having a metallic enclosure connected to protective earth.	Pass.
7.9.7.1	The test samples shall be prepared as follows:	-
	Additional entry holes for cables – if there are any – are left open; if there are any knock-outs, one of them is opened. Coverings and other parts, detachable without tools, are removed and – if necessary – undergo the same moisture	Pass.

	treatment. The moisture treatment is carried out in a humidity cabinet with a relative humidity between 91 % and 95 %. The air temperature is kept at all points, where the test sample can be positioned, within $\pm 1$ K at a suitable value T between 20 °C and 30 °C. Before putting the test samples into the humidity cabinet, they shall have a temperature between T and (T+4) in °C.	
	The test samples shall be kept in the humidity cabinet for 2 days (48 h).	Pass.
7.9.7.2	After a delay period of between 30 min and 60 min following the humidity treatment, the insulation resistance is measured 60 s after having applied a d.c. voltage of 500 V.	Pass.
	This measurement is carried out in the humidity cabinet or in the room into which the specimens were brought to reach the determined temperature, after having fixed again the parts which might have been detached.	Pass.
	The measuring has to be done as follows:	Pass.
a)	between all interconnected live parts and the SPDs body accessible to accidental contact The expression "body" in the sense of this test means	Pass.
	– all touchable metal parts and a metal foil on surfaces of insulating material, which are touchable after installation as for normal use,	Pass.
	– the surface on which the SPD is mounted, if necessary, covered with metal foil,	Pass.
	– screws and other facilities for fastening the SPD on its support.	Pass.
	For these measurements, the metal foil is put on in such a way, that perhaps existing casting mass is effectively tested.	Pass.
	Protective components connected to PE may be disconnected for this test.	Pass.
b)	between the live parts of the SPD main circuit and live parts of auxiliary circuits, if there are any.	Pass.
	The insulation resistance shall not be lower than	Pass.
	5 MS for the measurements according to a),	Pass.

	2 MS for the measurements according to b).	Pass.
7.9.8	Dielectric withstand	-
	SPDs classified for outdoor use are tested between the terminals with the internal parts removed. During this test, the SPD is subjected to sprinkling according to 9.1 of IEC 60060-1.,	Pass.
	SPDs category indoor are tested as indicated in a) and b) of 7.9.7.2.	Pass.
	SPDs are tested with an a.c. voltage according to table 16.	Pass.

	Starting with not more than half the required a.c. voltage, this voltage is increased to the full value within 30 s which is then held for 1 min.																			
	<table><tr><th colspan="2">Table 16 – Dielectric withstand</th></tr><tr><th>SPD continuous operating voltage</th><th>AC test voltage</th></tr><tr><td>V</td><td>kV</td></tr><tr><td>Up to <math>U_c = 100</math></td><td>1,1</td></tr><tr><td>Up to <math>U_c = 200</math></td><td>1,7</td></tr><tr><td>Up to <math>U_c = 450</math></td><td>2,2</td></tr><tr><td>Up to <math>U_c = 600</math></td><td>3,3</td></tr><tr><td>Up to <math>U_c = 1\,200</math></td><td>4,2</td></tr><tr><td>Up to <math>U_c = 1\,500</math></td><td>5,8</td></tr></table>	Table 16 – Dielectric withstand		SPD continuous operating voltage	AC test voltage	V	kV	Up to $U_c = 100$	1,1	Up to $U_c = 200$	1,7	Up to $U_c = 450$	2,2	Up to $U_c = 600$	3,3	Up to $U_c = 1\,200$	4,2	Up to $U_c = 1\,500$	5,8	-
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Up to $U_c = 1\,500$	5,8																			
	Arcing or puncturing shall not occur, however, partial discharges are accepted if the voltage change during the discharge is less than 5 %.	Pass. It meet the requirement.																		
	The power transformer used for testing shall be designed in such a way that after having been adjusted to the test voltage at its open terminals it will generate a short-circuit current of at least 200 mA after short-circuiting the terminals. An overcurrent relay, if any, shall only react if the test circuit current exceeds 100 mA. The device for measuring the test voltage shall have a precision of $\pm 3\%$ .	Pass. It meet the requirement.																		
	Auxiliary circuits are tested according to IEC 60947-5-1.	Pass.																		
7.9.9	Resistance to ingress of solid objects and to harmful ingress of water	-																		
	Testing shall be carried out in accordance with IEC 60529 to check the IP code.	Pass.																		
7.9.10	Total discharge current test for multipole SPDs	-																		
	Test settings	-																		

	One side of the test generator is connected to the PE or PEN terminal of the multipole SPD. Each of the remaining terminals is connected via a typical series impedance consisting of a resistance of 30 m Ω and an inductance of 25 μ H, to the other side of the generator.	Pass.										
	Smaller impedances may be used if the tolerances for the proportional surge currents according to Table 17 are met.	Pass.										
	<table><tr><th colspan="2">Table 17 – Tolerances for proportional surge currents</th></tr><tr><th>Test classification</th><th>Proportional currents and tolerances</th></tr><tr><td rowspan="3">Test class I</td><td><math>I_{\text{peak}(1)} = I_{\text{peak}(2)} = I_{\text{peak}(N)} = I_{\text{peak}} / N \quad \pm 10 \%</math></td></tr><tr><td><math>Q_{(1)} = Q_{(2)} = Q_{(N)} = Q(I_{\text{Total}}) / N \quad \pm 20 \%</math></td></tr><tr><td><math>W/R_{(1)} = W/R_{(2)} = W/R_{(N)} = W/R(I_{\text{Total}}) / N^2 \pm 35 \%</math></td></tr><tr><td>Test class II</td><td><math>I_{8/20(1)} = I_{8/20(2)} = I_{8/20(N)} = I_{\text{Total}} / N \quad \pm 10\%</math></td></tr></table>	Table 17 – Tolerances for proportional surge currents		Test classification	Proportional currents and tolerances	Test class I	$I_{\text{peak}(1)} = I_{\text{peak}(2)} = I_{\text{peak}(N)} = I_{\text{peak}} / N \quad \pm 10 \%$	$Q_{(1)} = Q_{(2)} = Q_{(N)} = Q(I_{\text{Total}}) / N \quad \pm 20 \%$	$W/R_{(1)} = W/R_{(2)} = W/R_{(N)} = W/R(I_{\text{Total}}) / N^2 \pm 35 \%$	Test class II	$I_{8/20(1)} = I_{8/20(2)} = I_{8/20(N)} = I_{\text{Total}} / N \quad \pm 10\%$	-
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Test class II	$I_{8/20(1)} = I_{8/20(2)} = I_{8/20(N)} = I_{\text{Total}} / N \quad \pm 10\%$											

	<b>Test procedure</b>	-
	The multipole SPD shall be tested once with the total discharge current $I_{\text{Total}}$ declared by the manufacturer.	Pass.
	<b>Pass criteria</b>	-
	Each mode of the test sample is then connected to UC. The test transformer shall have a short circuit current capability of at least 200 mA.	Pass. It meet the requirement.
	The current which flows through the test sample is measured. Its resistive component (measured at the crest of the sine wave) shall not exceed a value of 1 mA or the stand-by power consumption shall not increase by more than 20 % of the value measured in 7.7.5.	Pass. It meet the requirement.
	After the test sample has cooled down to near ambient temperature, the measured limiting voltage shall be determined using the tests described in 7.5 to check if the voltage protection level specified by the manufacturer has been maintained. The test of 7.5.2. is performed only at In. Auxiliary circuits, like status indicators, shall be in working order.	Pass. It meet the requirement.
	Visual inspection of the test sample shall reveal no evidence of any damage. ,	Pass. It meet the requirement.
7.10	Electromagnetic compatibility	-
7.10.1	Electromagnetic immunity	-
	SPDs either incorporating no electronic circuits or incorporating electronic circuits in which all components are passive (for example diodes, resistors, capacitors, inductors, varistors and other surge protective components) are not sensitive to normal electromagnetic disturbances and therefore no immunity tests are required.	Pass. It meet the requirement.

	The requirements for SPDs containing electronic circuits are under consideration	Pass. SPDs containing electronic circuits are under consideration.
7.10.2	Electromagnetic emission	-
	For SPDs not incorporating electronic circuits, or incorporating electronic circuits that do not generate fundamental frequencies greater than 9 kHz in normal operation, electromagnetic disturbances can only be generated during protective operations. The duration of these disturbances is in the order of microseconds to milliseconds.	Pass. It meet the requirement.
	The frequency, level and the consequences of these emissions are considered as part of the normal electromagnetic environment of low-voltage installations. Therefore, the requirements for electromagnetic emissions are deemed to be satisfied and no verification is necessary.	Pass.
	The requirements for SPDs containing electronic circuits	Pass.

	generating fundamental frequencies greater than 9 kHz are under consideration.	It meet the requirement.
<b>8</b>	<b>Routine and acceptance tests</b>	-
8.1	Routine and acceptance tests	-
	Appropriate test(s) shall be conducted to verify that the SPD is capable of meeting its performance. The manufacturer shall declare the test method(s).	Pass. It meet the requirement.
	Check that $I_c$ is below a specified value determined by the manufacturer at a specified $U_c$ .	Pass.
8.2	Acceptance tests	-
	Acceptance tests are made upon agreement between manufacturer and purchaser. When the purchaser specifies acceptance tests in the purchase agreement, the following tests shall be made on the nearest lower whole number to the cube root of the number of SPDs to be supplied. Any alteration in the number of test samples or type of test shall be negotiated between the manufacturer and purchaser.	Pass. It meet the requirement.
	If not otherwise specified, the following tests are specified as acceptance tests:	-
	a) verification of identification by inspection as per 7.2;	Pass.
	b) verification of marking by inspection as per 7.2;	Pass.
	c) verification of electrical parameters (e.g. measured limiting voltage as per 7.5).	Pass.

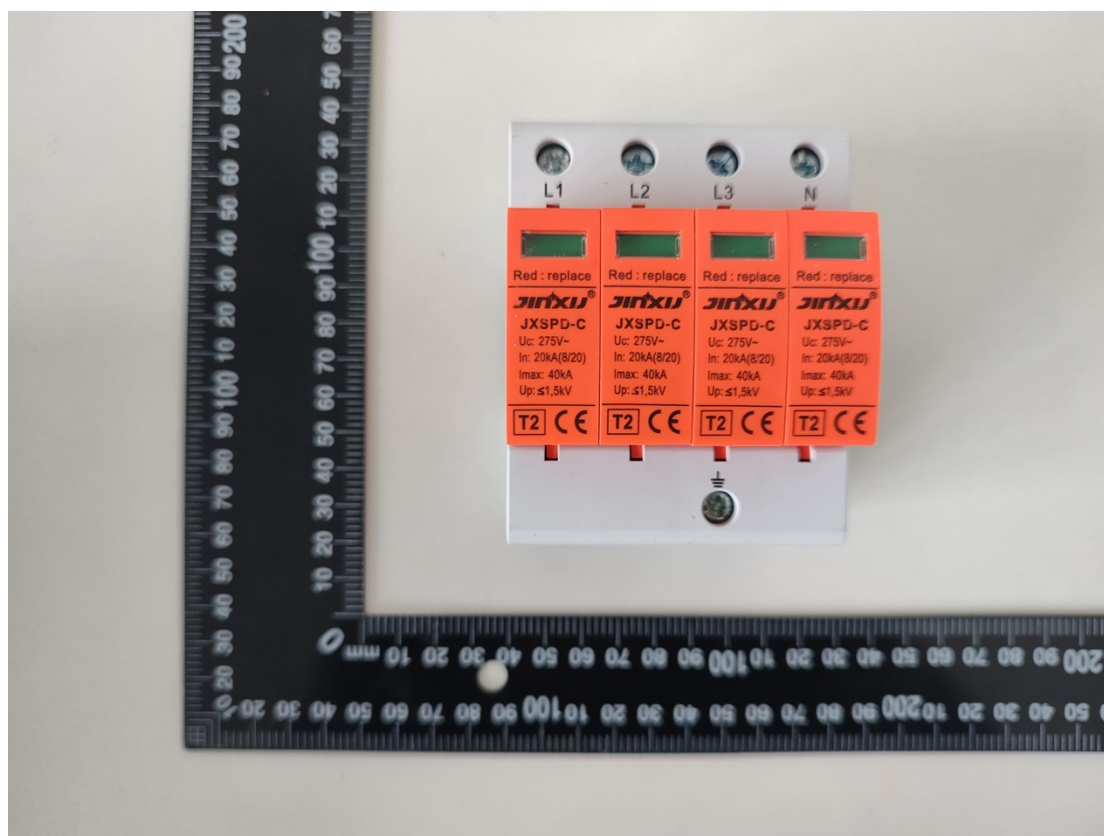
## Annex: Technical Information

### (1) Product Photos

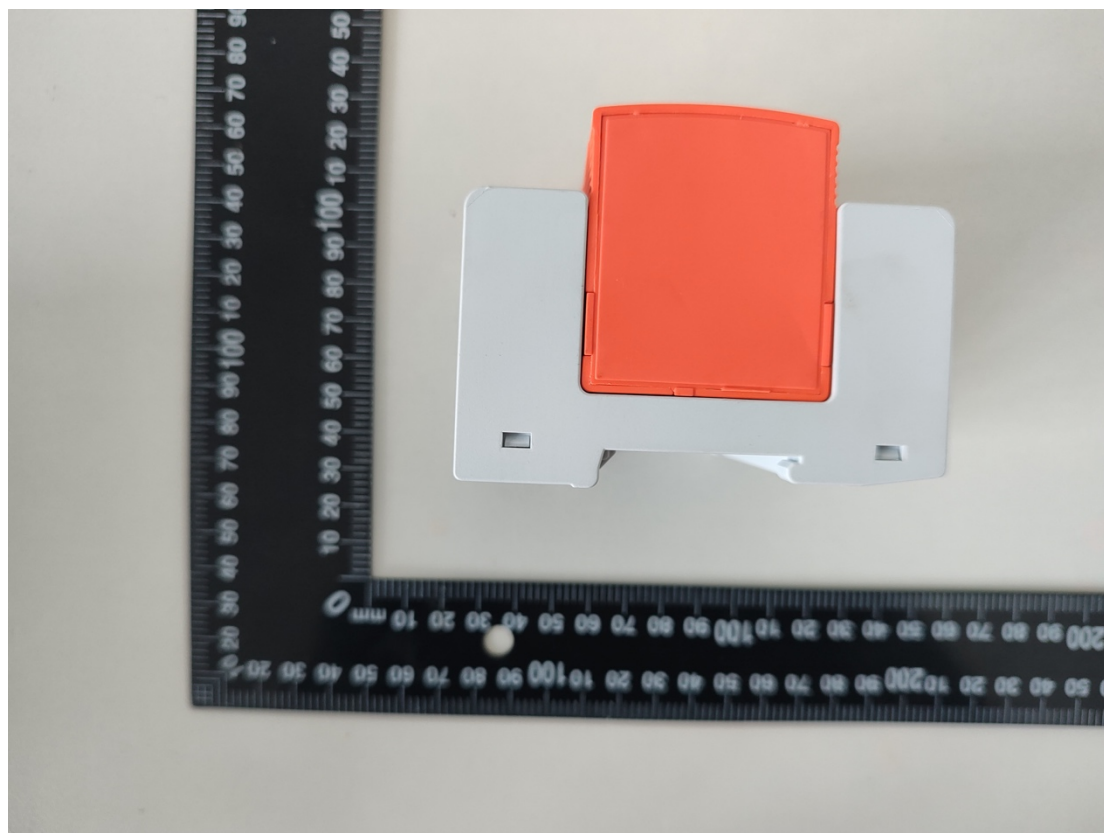


A.1





A.2



A.3