

**Technical Construction File**  
**EN 61643-11:2012+A11:2018**

**Low-voltage Surge Protection Device – Part 11: Surge Protection Device connected to low-voltage power systems -Requirements and tests**

Report reference No.....: TLZJ20120728251

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Date of issue.....: December 09,2020



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Manufacturer.....: Changcheng Electrical Group Zhejiang Technology Co., Ltd.

Address.....: DianHou Village, Liushi Town, Yueqing City, Zhejiang P.R. China

Factory.....: The same as Manufacturer

Address.....: The same as Manufacturer

Standard.....:  EN 61643-11:2012+A11:2018

Review Report Form No.....: EN 61643-11

TRF originator.....: GTS

Master TRF.....: Reference No. EN 61643-11:2012+A11:2018

Review procedure .....: GTS

Type of Review object.....: Surge Protection Device

Trademark.....: /

Model/type reference.....: YCS6-D, YCS6-C, YCS6-B

Rating.....: UC:460V, UC:440V, UC:385V, UC:275V, UC:255V

In:5kA, I<sub>max</sub>:10kA, In:10kA, I<sub>max</sub>:20kA, In:15kA, I<sub>max</sub>:30kA,  
In:20kA, I<sub>max</sub>:40kA, In:30kA, I<sub>max</sub>:60kA, In:40kA, I<sub>max</sub>:80kA,  
In:60kA, I<sub>max</sub>:100kA, In:80kA, I<sub>max</sub>:120kA, In:100kA, I<sub>max</sub>:160kA,  
In:160kA, I<sub>max</sub>:200kA, Limp:15KA, Limp:25KA,  
Limp:50KA , 1P,1P+N,2P,3P,3P+N,4P(+NPE)

Possible review case verdicts:

- review case does not apply to the test object..... : N(.A.)
- review object does meet the requirement..... : P(ass)
- review object does not meet the requirement.....: F(ail)

General remarks:

"(see remark #)" refers to a remark appended to the report.

"(see appended table)" refers to a table appended to the report.

Throughout this report a comma is used as the decimal separator.

The review results presented in this report relate only to the object reviewed.

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**Testing:**

Date of receipt of review item:

December 02,2020

Date(s) of performance of review:

December 02,2020 to December 09,2020

**General product information:**

Surge Protection Device

**Summary of reviewing:**

This review report includes:

Annex I: 3 page(s) of photo documentation.

Copy of marking plate

Surge Protection Device,  
Model YCS6-D, YCS6-C, YCS6-B

Marking



Changcheng Electrical Group Zhejiang  
Technology Co., Ltd.

EN 61643-11:2012+A11:2018			
Cl.	Requirement – Test	Result	Verdict
<b>6</b>	<b>Requirements</b>		—
<b>6.1</b>	<b>General requirements</b>		-
<b>6.1.1</b>	<b>Marking</b>		-
	Markings a), e), f), g), h), j), l), o) and q) in 6.1.1 are 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.		P
	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.		P
<b>6.2</b>	<b>Electrical requirements</b>		-
<b>6.2.1</b>	<b>Electrical connections</b>		-
	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).		P
	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.		P
<b>6.2.2</b>	<b>Voltage protection level <math>U_p</math></b>		-
	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.		P
<b>6.2.3</b>	<b>Class I impulse current test(s)</b>		-
	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.		N
<b>6.2.4</b>	<b>Class II nominal discharge current test(s)</b>		-
	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.		P
<b>6.2.5</b>	<b>Class III combination wave test(s)</b>		-

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Cl.	Requirement – Test	Result	Verdict
	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.		N
<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.		P
<b>6.2.7</b>	<b>SPD disconnectors</b>		-
	The SPD may have SPD disconnectors (which can be either internal, external or both). Their operation shall be indicated.		P
	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 are not tested during the operating duty test according to 7.7.1.		P
<b>6.2.8</b>	<b>Air clearances and creepage distances</b>		-
	The SPD shall have sufficient air clearances and creepage distances. Testing is in accordance with 7.9.5.		N
<b>6.2.9</b>	<b>Tracking resistance</b>		-
	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.		P
<b>6.2.10</b>	<b>Dielectric withstand</b>		-
	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.		P
<b>6.2.11</b>	<b>Short-circuit withstand capability</b>		-
	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.		P

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Cl.	Requirement – Test	Result	Verdict
<b>6.2.13</b>	<b>Isolation between separate circuits</b>		-
	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 voltages between the circuits as well as the relevant standards with which the manufacturer is claiming conformity.		P
	Where there are more than two circuits, declarations shall be made with regard to each combination of circuits.		N
	The isolation and dielectric withstand of the separate circuits shall be tested according to the manufacturer's declaration.		N
<b>6.3</b>	<b>Mechanical requirements</b>		-
	SPDs shall be provided with appropriate means for mounting that will ensure mechanical stability. Testing in accordance with 7.9.2.		N
<b>6.3.1</b>	<b>General</b>		-
	The SPD shall be equipped with terminals where electrical connection is possible by means of:		-
	– terminal with screw		P
	–nuts		P
	– plugs		N
	– socket		N
	– screwless terminal		P
	– insulation piercing connections		N
	– or equal effective means		N
<b>6.3.2</b>	<b>Mechanical connections</b>		-
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.		P
b)	Plugs and socket outlets shall correspond to the relevant national requirements, and those clauses of IEC 60884-1 that may apply.		N
c)	Screws, current-carrying parts and connections		P

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Cl.	Requirement – Test	Result	Verdict
1)	Connections, whether electrical or mechanical, shall withstand the mechanical stresses occurring in normal use.		P
	Screws operated when mounting the SPD during installation shall not be of the threadcutting type.		P
	Compliance is checked by inspection and tested in accordance with 7.3.2.1.		N
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.		N
	Compliance is checked by inspection..		P
	The suitability of the material is considered in respect of the stability of the dimensions		P
3)	Current-carrying parts and connections including parts intended for protective conductors, if any, shall be of either		P
	– copper, or		P
	– an alloy containing at least 58 % copper for parts worked cold, or at least 50 % copper for other parts, or		P
	– other metal or suitably coated metal, no less resistant to corrosion than copper and having mechanical properties no less suitable.		P
	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.		
	The requirements of this sub clause 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.		N
d)	Terminals with screw for external conductors		N

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Cl.	Requirement – Test	Result	Verdict
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.		N
	Such arrangements may be either of the plug-in or of the bolt-on type.		N
	The terminals shall be readily accessible under the intended conditions of use.		N
	Compliance is checked by inspection and tested in accordance with 7.3.2.2.2.		N
	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.		N
	Compliance is checked by inspection and tested in accordance with 7.3.2.2.2.		N
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.		P
	Compliance is checked by inspection and tested in accordance with 7.3.2.1 and 7.3.2.2. Provisionally, SI, BA and UN threads may be used as they are virtually equivalent in pitch and mechanical strength to metric ISO threads.		N
4)	Terminals shall be so designed that they clamp the conductor without undue damage to the conductor.		N
	Compliance is checked by inspection and tested in accordance with 7.3.2.2.2.		N
5)	Terminals shall be so designed that they clamp the conductor reliably and between metal surfaces.		P
	Compliance is checked by inspection and tested in accordance with 7.3.2.1 and 7.3.2.2.1.		N

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Cl.	Requirement – Test	Result	Verdict
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.		N
	This requirement does not apply to lug terminals.		N
	Compliance is checked by inspection and tested in accordance with 7.3.2.2.3.		P
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.		N
	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.		N
	The use of sealing compound or resin is considered to be sufficient for preventing a terminal from working loose, provided that		P
	– the sealing compound or resin is not subject to stress during normal use, and		N
	– 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.		N
	Compliance is checked by inspection, by measurement and tested in accordance with 7.3.2.1.		N
8)	Clamping screws or nuts of terminals intended for the connection of protective conductors shall be adequately secured against accidental loosening.		N
	Compliance is checked by manual test.		N
e)	Screwless terminals for external conductors		N
1)	Terminals shall be so designed and constructed that		N
	– Each conductor is clamped individually. During the connection or disconnection the conductors can be connected or disconnected either at the same time or separately;		P



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Cl.	Requirement – Test	Result	Verdict
	– it is possible to clamp securely any number of conductors up to the maximum provided.		N
	Compliance is checked by inspection and tested in accordance with 7.3.3.		N
2)	Terminals shall be so designed and constructed that they clamp the conductor without undue damage to the conductor		N
	Compliance is checked by inspection.		N
f)	Insulation pierced connections for external conductors		N
1)	The insulation pierced connections shall make a reliable mechanical connection.		N
	Compliance is checked by inspection and tested in accordance with 7.3.4.		-
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.		N
	Compliance is checked by inspection.		P
3)	Screws shall not be of metal which is soft or liable to creep. Compliance is checked by inspection.		-
<b>6.3.3</b>	<b>Corrosive resistant metals</b>		-
	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 EN 60999).		N
<b>6.4</b>	<b>Environmental requirements</b>		-
	SPDs shall be designed in such a way that they operate satisfactorily under the environmental conditions given by the normal service conditions.		N
	Compliance is tested in accordance with 7.9.9.		N
	Outdoor SPDs shall be contained in a weather shield of glass, glazed ceramic or other acceptable material that is resistant to UV radiation, corrosion, erosion, and tracking.		P
	They shall have sufficient surface creepage distance between any two parts of different potential.		N
<b>6.5</b>	<b>Safety requirements</b>		-

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Cl.	Requirement – Test	Result	Verdict
	SPDs shall be safe when operated under normal service conditions in accordance with the recommendation.		N
<b>6.5.1</b>	<b>Protection against direct contact</b>		-
	These requirements are valid for accessible SPDs where the maximum continuous operating voltage $U_c$ is above 50 V r.m.s. a.c.		N
	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.		N
	Compliance is verified by standardized test methods of EN 60529 and to 7.4.		N
	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.		N
	Compliance is checked by inspection and, if necessary, by the tests of 7.4.1.		P
	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.		N
<b>6.5.1.1</b>	<b>Mechanical strength</b>		-
	All parts of the SPD relating to the protection against direct contact shall have sufficient mechanical strength.		N
	Compliance is tested in accordance with 7.9.2.		N
<b>6.5.1.2</b>	<b>Heat resistance</b>		-
	All parts relating to the protection against direct contact shall be sufficiently heat resistant. Compliance is tested in accordance with 7.9.3.		N
<b>6.5.1.3</b>	<b>Insulation resistance</b>		-
	The insulation resistance of the SPD shall be sufficient. Compliance is tested in accordance with 7.9.7.		N
<b>6.5.2</b>	<b>Fire resistance</b>		-

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Cl.	Requirement – Test	Result	Verdict
	Insulating parts of the housing shall be either nonflammable or self-extinguishing.		N
	Compliance is tested in accordance with 7.9.4		N
<b>6.5.3</b>	<b>Standby power consumption <math>P_c</math></b>		-
	For all SPDs, the $P_c$ shall be measured at the SPD's maximum continuous operating voltage ( $U_c$ ) when connected according to the manufacturer's instructions without a load.		
<b>6.5.4</b>	<b>Residual current</b>		-
	For all SPDs with a terminal for the protective conductor, the residual current shall be measured at the SPD's maximum continuous operating voltage ( $U_c$ ) when connected according to the manufacturer's instructions, without a load.		P
<b>6.5.5</b>	<b>Behaviour under temporary over-voltages</b>		-
	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.		N
<b>6.5.5.1</b>	<b>TOVs caused by faults in the high (medium) voltage system</b>		-
	SPDs connected to PE and for use on power distribution systems shall be tested at $U_T$ in accordance with 7.7.4 and Table B.1.		P
<b>6.5.5.2</b>	<b>TOVs caused by faults or disturbances in the low voltage system</b>		-
	If $U_c$ is greater or equal to $U_T$ there is no need to perform this test.		P
	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.		N
<b>6.5.6</b>	<b>Total discharge current <math>I_{total}</math></b>		-
	This test is only conducted if the manufacturer claims a total discharge current in accordance with 7.9.10.		N
<b>6.6</b>	<b>Additional test requirements for two-port SPDs and one-port SPDs with separate input/output terminals</b>		-

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Cl.	Requirement – Test	Result	Verdict
<b>6.6.1</b>	<b>Percent of voltage regulation</b>		N
	The percent of voltage regulation shall be declared by the manufacturer and tested in accordance with 7.8.1.		N
<b>6.6.2</b>	<b>Rated load current <math>I_L</math></b>		-
	The rated load current shall be declared by the manufacturer and tested in accordance with 7.8.2.		P
<b>6.6.3</b>	<b>Load-side surge withstand capability</b>		-
	When the value for load-side surge withstand capability is declared by the manufacturer it shall be tested in accordance with 7.8.4.		
<b>6.6.4</b>	<b>Overload behaviour</b>		—
	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.		—
<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.		P
	If all samples pass a test series, the design of the SPD is acceptable for that test series.		P
	If two or more test samples fail a test series, the SPD does not comply with this standard.		P
	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.		-
	A set of three samples may be used for more than one test series, if agreed by the manufacturer.		P

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Cl.	Requirement – Test	Result	Verdict
	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 which do not belong to the SPD section of the product.,		P
<b>7.1</b>	<b>General testing procedures</b>		-
	The SPD shall be mounted and electrically connected in accordance with the manufacturer's installation procedures. Neither external cooling nor heating shall be employed.	Fixed installation	P
	When not otherwise specified, the test shall be performed in free air and the ambient temperature shall be $20\text{ }^{\circ}\text{C} \pm 15\text{ }^{\circ}\text{C}$ .		P
	If not otherwise specified, for all tests where a power supply at $U_c$ is required, the voltage tolerance for testing shall be $U_c \pm 5\%$ .		P
	When testing SPDs for which the manufacturer supplies integral cables, the full length of those cables shall form part of the SPD under test.		P
	During the test, no maintenance or dismantling of the SPD is allowed.		P
	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.		-
	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.		N

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Cl.	Requirement – Test	Result	Verdict
	If the manufacturer sets different requirements for the external SPD disconnectors depending upon the prospective short-circuit current of the supply system, all relevant test sequences shall be performed for every combination of required SPD disconnectors and corresponding prospective short-circuit currents.		N
<b>7.1.1</b>	<b>Class I impulse current test</b>		-
	The test impulse current $i_{imp}$ is defined by its parameters peak value $I_{peak}$ , charge $Q$ and specific energy $W/R$ .		P
	The unipolar test impulse current shall obtain $I_{peak}$ within 50 $\mu$ s and the charge $Q$ and the specific energy $W/R$ within 10 ms.		P
	Table 3 gives values of $Q$ (A.s) and $W/R$ (kJ/_ ) for example values of $I_{peak}$ (kA).		p
	The relationship between $I_{peak}$ (A), $Q$ (A.s) and $W/R$ (J/_ ) in Table 3 is as follows:		P
	$Q = I_{peak}.a$ $a = 5*10^{-4}$ s $W/R = I^2_{peak}.b$ $b = 2,5*10^{-4}$ s		N
<b>7.1.2</b>	<b>Class I and class II nominal discharge current test</b>		-
	The standard waveshape is 8/20. The tolerances on the current waveshape are the following:		N
	- peak value $\pm 10$ %		-
	- front time $\pm 10$ %		P
	- time to half value $\pm 10$ %		-
	A small overshoot or oscillation is tolerated provided that the amplitude of any oscillation is not more than 5 % of the peak value.		N
	Any polarity reversal after the current has fallen to zero shall not be more than 20 % of the peak value.		N
	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.		P
<b>7.1.3</b>	<b>Class I and II voltage impulse test</b>		-

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Cl.	Requirement – Test	Result	Verdict
	The standard voltage waveshape is 1,2/50. The tolerances on the voltage waveshape are the following:		P
	– peak value $\pm 3$ %		P
	– front time $\pm 30$ %		–
	– time to half value $\pm 20$ %		P
	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.		P
	Oscillations exceeding 3 % of the peak value are not allowed at the rising portion of the voltage impulse.		N
	The measuring devices shall have an overall bandwidth of at least 25 MHz and the overshoot shall be less than 3 %.		P
	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.,		N
<b>7.1.4</b>	<b>Class III combination wave test</b>		-
	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.		N
	The open-circuit voltage shall have a front time of 1,2 $\mu$ s and a time to half value of 50 $\mu$ s.		N
	The short-circuit current shall have a front time of 8 $\mu$ s and a time to half value of 20 $\mu$ s.		N
	The following values are measured on the generator without a back filter.		N
	The tolerances on open circuit voltage $U_{oc}$ shall be the following:		N
	– peak value $\pm 3$ %		N
	– front time $\pm 30$ %		N

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Cl.	Requirement – Test	Result	Verdict
	– time to half value $\pm 20\%$		P
	The voltage waveform shall be essentially unidirectional.		N
	The tolerances on the short-circuit current shall be the following:		N
	– peak value $\pm 10\%$		–
	– front time $\pm 10\%$		P
	– time to half value $\pm 10\%$		
	Any polarity reversal after the current has fallen to zero shall be less than 20 % of the peak value.		N
	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.		P
	The maximum values for peak open-circuit voltage $U_{oc}$ and peak short-circuit current $I_{sc}$ are 20 kV and 10 kA respectively.		N
	Above these values (20 kV /10 kA), type II tests shall be performed.		P
	Insert a decoupling network (back filter) according to figures 1 or 2.		N
	This circuit configuration will be used only for determining the measured limiting voltage of the SPD.		N
	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.		N
	During the verification of the waveshape, the impedance of the mains is simulated by connecting together the L, N and PE conductors.		P
<b>7.1.5</b>	<b>Testing of SPDs classified outdoor only and for mounting out of reach</b>		-
	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.		P
<b>7.2</b>	<b>Identification and marking</b>		-
<b>7.2.1</b>	<b>Verification of the identification and markings</b>		-



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Cl.	Requirement – Test	Result	Verdict
	Verification of the identification and markings shall be checked against the respective requirements of 6.1.1 and 6.1.2 by inspection.		N
<b>7.2.2</b>	<b>Test of indelibility of markings</b>		-
	This test shall be applied on markings of all types except those made by impressing, molding and engraving.		-
	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/cm³).		N
	After this test, the marking shall be easily legible.		P
<b>7.3</b>	<b>Terminals and connections</b>		-
	Verification of the incorporated terminals and their conformity is met by the requirements of 7.3.1.		N
<b>7.3.1</b>	<b>General testing procedure</b>		-
	The SPD is mounted according to the manufacturer s recommendation, and is protected against undue external heating or cooling.		-
	Unless otherwise specified, the SPD terminals (3 samples of each construction used) shall be wired with conductors according to		P
	– table 6 for two-port devices and one-port devices with separate input/output terminals		N
	– the manufacturer's instruction for other one-port devices		N
	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.		N

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Cl.	Requirement – Test	Result	Verdict
	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> .		N
	During the test, no maintenance or dismantling of the sample is allowed.		N
<b>7.3.2</b>	<b>Terminals with screws</b>		-
<b>7.3.2.1</b>	<b>Test of reliability of screws, current-carrying parts and connections</b>		-
	Compliance is checked by inspection and for screws which are operated when connecting up the SPD by the following test.		N
	The screws are tightened and loosened		N
	– ten times for screws in engagement with a thread of insulating material,		–
	– five times in all other cases.		N
	Screws or nuts in engagement with a thread of insulating material are completely removed and reinserted each time unless the construction of the screw prevents this.		N
	The test is made by means of a suitable test screwdriver or spanner applying a torque as shown in table 5.		P
	The screws shall not be tightened in jerks.		P
	The conductor is moved each time the screw is loosened.		P
<b>7.3.2.2</b>	<b>Test of reliability of terminals for external conductors</b>		-
	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.		—
	These tests are made by means of a suitable screwdriver or spanner applying a torque as shown in table 5.		P
<b>7.3.2.2.1</b>	The terminals are fitted with copper conductors of the smallest or largest cross-sectional areas specified in 7.3.1, solid or stranded, whichever is most unfavourable.		P

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Cl.	Requirement – Test	Result	Verdict
	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.		P
	The clamping screws are then tightened with a torque equal to two-thirds of that shown in the appropriate column of table 5.		N
	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.		P
	During this test, the conductor shall not move noticeably in the terminal.		-
<b>7.3.2.2.2</b>	The terminals are fitted with copper conductors of the smallest or largest cross-sectional 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.		P
	The conductors shall show neither undue damage nor severed wires.		P
	Conductors are considered to be unduly damaged if they show deep or sharp indentations.		P
	During the test, terminals 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 terminal.		P
<b>7.3.2.2.3</b>	The terminals are fitted with a rigid stranded copper conductor conforming to table 8.		N
	Before insertion in the terminal, the wires of the conductors are suitably reshaped.		P

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Cl.	Requirement – Test	Result	Verdict
	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.		P
	After the test, no wire of the conductor shall have escaped from the SPD terminal.		P
<b>7.3.3</b>	<b>Screwless terminals</b>		P
	<b>Pull out test</b>		P
	Compliance is checked by the following tests.		P
	The terminals are fitted with new conductors of the type and of the minimum and maximum cross-sectional areas as specified in 7.3.1, solid or stranded, whichever is the most unfavourable.		P
	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.		N
	During the test there shall be no movement of the conductor in the terminal or any indication of damage.		N
<b>7.3.4</b>	<b>Insulation pierced connections</b>		-
<b>7.3.4.1</b>	<b>Pull out test on SPD terminals designed for single core conductors</b>		-
	Compliance is checked by the following tests.		N
	The terminals are fitted with new copper conductors of the smallest or largest cross-sectional area specified in 7.3.1. solid or stranded, whichever is most unfavourable.		N
	Screws, if any, are tightened according to table 5.		N
	The conductors are connected and disconnected five times, new conductors being used each time.		N

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Cl.	Requirement – Test	Result	Verdict
	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.		N
	During the test, there shall be no movement of the conductor in the terminal or any sign of damage.		N
<b>7.3.4.2</b>	<b>Pull out test on SPD terminals designed for multi-core cables or cords</b>		-
	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.		N
	The pull force is calculated according to the following formula: $F = F(x) n$		N
	During the test, the cable or cord shall not slip out of the terminals.		N
<b>7.3.5</b>	<b>Nuts, plug, socket</b>		-
	Compliance is checked by inspection and trial mounting.		N
<b>7.4</b>	<b>Testing for protection against direct contact</b>		-
<b>7.4.1</b>	<b>Insulated parts</b>		-
	The sample is mounted as for normal use and fitted with conductors of the smallest crosssectional area and the test repeated using conductors of the largest cross-sectional area specified in 7.3.1.		P
	The standard test finger (in accordance with EN 60529) is applied in every possible position.		-
	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.		P
	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.		P
<b>7.4.2</b>	<b>Metal parts</b>		-

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Cl.	Requirement – Test	Result	Verdict
	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.		N
	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.		N
	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		N
<b>7.5</b>	<b>Determination of the measured limiting voltage</b>		-
	The tests to be performed on the different SPD types to determine their measured limiting voltages are according to the following table 10 and the flow chart in figure 3.		N
<b>7.5.1</b>	<b>Test procedure to determine the presence of a switching (crowbar) component in an SPD</b>		-
	For class III test of an SPD, a combination wave generator shall be used with an open-circuit voltage equal to the $U_{oc}$ declared by the manufacturer.		N
<b>7.5.2</b>	<b>Test procedure to measure the residual voltage with 8/20 current impulses</b>		-
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 $I_n$ .		P
b)	One sequence of positive polarity and one sequence of negative polarity are applied to the SPD.		P

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Cl.	Requirement – Test	Result	Verdict
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.		N
d)	The interval between individual impulses shall be long enough for the sample to cool down to ambient temperature.		N
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.		N
	A curve which best fits the data points shall be drawn.		N
	There shall be sufficient points on the curve to ensure that there are no significant deviations on the curve up to $I_{max}$ or $I_{peak}$ .		N
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:		P
	– class I: up to $I_{peak}$ or $I_n$ whichever is greater;		P
	– class II: up to $I_n$ .		P
<b>7.5.3</b>	<b>Test procedure to measure the front-of-wave sparkover voltage</b>		-
	The 1,2/50 voltage impulse is used.		P
	The generator voltage is set to an open circuit output voltage of 6 kV.		N
a)	10 impulses are applied to the SPD, five of positive and five of negative polarity.		N
b)	The interval between individual impulses shall be long enough to allow the sample to cool down to ambient temperature.		P
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.		P
d)	The voltage at the SPD shall be recorded with an oscilloscope.		P
e)	The measured limiting voltage is the maximum value of the sparkover voltages recorded during the whole test sequence		N

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Cl.	Requirement – Test	Result	Verdict
<b>7.5.4</b>	<b>Test procedure to measure the limiting voltage with the combination wave</b>		-
	To perform this test a combination wave is used.		N
a)	The combination wave will be applied to an energized SPD, with the mains voltage at $U_c$ .		P
b)	For SPDs rated <i>only</i> on a.c. power systems, positive impulses are applied at the $90^\circ \pm 10^\circ$ point and negative impulses at $270^\circ \pm 10^\circ$ point on the sinusoidal voltage waveform.		N
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. $U_c$ .		P
d)	The interval between the individual impulses shall be long enough for the sample to cool down to ambient temperature.		N
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.		N
	If the SPD contains only voltage limiting components then this test need only be carried out at $U_{oc}$ .		P
f)	With these generator settings four surges will be applied to the SPD at each amplitude: two of positive and two of negative polarity.		N
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.		N
h)	The measured limiting voltage is the maximum magnitude of the peak voltage recorded during the whole test sequence.		-
<b>7.5.5</b>	<b>Alternate test to the combination wave test (7.5.4), without a decoupling network</b>		-
	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.		N



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Cl.	Requirement – Test	Result	Verdict
	Tests in such cases shall use the alternative test method in figure 4.		P
	For two-port SPDs with reactive components the following test procedure shall be adopted in addition to that of 7.5.4.		N
a)	The test generator shall be configured as in figure 4.		–
b)	For a.c. rated SPDs a d.c. voltage of $U_c 2$ , for d.c. rated SPDs a d.c. voltage of $U_c$ , shall be applied to the SPD via a diode.		N
	The impulse shall be applied via a diode, gas discharge tube, or varistor according to figure 4.		P
c)	The application of the impulse should occur at least 100 ms after closure of S1.		N
	The d.c. voltage should be disconnected within 10 ms after impulse application.		N
d)	Reverse polarity tests can be conducted by reversing the SPD connection to the generator.		N
e)	The interval between individual impulses shall be long enough for the sample to cool down to ambient temperature.		N
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.		–
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.		N
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.		N
i)	The measured limiting voltage is the maximum magnitude of the voltage recorded at the output of the SPD for the whole test sequence.		N
<b>7.6</b>	<b>Operating duty test</b>		-
	These tests are applicable only for SPDs used on a.c. (SPDs used on d.c. are under consideration).		N

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Cl.	Requirement – Test	Result	Verdict
<b>7.6.1</b>	<b>General</b>		-
	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 $U_{oc}$ .		N
<b>7.6.2</b>	<b>Preliminary test to determine the magnitude of the follow current</b>		-
	If the internal design and the peak value of the follow current of the SPD are known, this preliminary test is not required.		N
a)	The test shall be made with a separate test sample.		N
b)	The prospective short circuit current shall be $I_p \geq 1,5 \text{ kA}$ with a power factor $\cos \varphi = 0,95 \text{ } 0 -0,05$		N
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 $0,5 \cdot U_c$ .		N
d)	The follow current shall be initiated with an impulse current 8/20 or a combination wave.		-
e)	The peak value shall correspond to $I_{max}$ or $I_{peak}$ or $U_{oc}$ .		N
f)	The current impulse shall be initiated 60 electrical degrees before the peak of the power frequency voltage.		N
	Its polarity shall coincide with the polarity of the half wave of the power frequency voltage in which it is initiated.		N
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.		N
<b>7.6.3</b>	<b>Power frequency source characteristics for preconditioning</b>		-
<b>7.6.3.1</b>	<b>SPDs with follow current below 500 A</b>		-

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Cl.	Requirement – Test	Result	Verdict
	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 %.		P
<b>7.6.3.2</b>	<b>SPDs with follow current above 500 A</b>		-
	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.		P
	For SPDs connected between neutral and protective earth only, the prospective short-circuit current shall be at least 100 A.		P
<b>7.6.4</b>	<b>Class I and II preconditioning tests</b>		-
	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.		N
	Each impulse shall be synchronized to the power frequency.		P
	Starting from 0 ° the synchronization angle shall be increased in steps of (30 +/- 5)° intervals.		P
	The tests are described in Figure 6.		-
	When testing SPDs to class I, current impulses with values equal to $I_{peak}$ or $I_n$ , whichever is greater, are applied.		N
	When testing SPDs to class II, current impulses with values equal to $I_n$ , are applied.		P
	The interval between the impulses is 50 s – 60 s, the interval between the groups 25 min – 30 min.		P
	It is not required that the test sample be energized between groups.		P

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Cl.	Requirement – Test	Result	Verdict
	The current shall be recorded at each impulse and the current records shall show no sign of puncture or flashover of the samples.		P
<b>7.6.5</b>	<b>Class I and II operating duty test</b>		-
	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.		P
	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.		N
	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.		p
a)	One current impulse at 0,1 ( $I_{peak}$ or $I_{max}$ ); check thermal stability; cool down to ambient temperature.		P
b)	One current impulse at 0,25 ( $I_{peak}$ or $I_{max}$ ); check thermal stability; cool down to ambient temperature.		P
c)	One current impulse at 0,5 ( $I_{peak}$ or $I_{max}$ ); check thermal stability; cool down to ambient temperature.		N
d)	One current impulse at 0,75 ( $I_{peak}$ or $I_{max}$ ); check thermal stability; cool down to ambient temperature.		N
e)	One current impulse at 1,0 ( $I_{peak}$ or $I_{max}$ ); check thermal stability; cool down to ambient temperature.		N
<b>7.6.6</b>	<b>Pass criteria</b>		-
	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 self extinguished.		P

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Cl.	Requirement – Test	Result	Verdict
	Both the voltage and current records and visual inspection shall show no indication of puncture or flashover of the samples.		P
	Mechanical damage shall not occur during these tests.		P
	One more impulse at $I_n$ or $U_{oc}$ 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.		P
	After this impulse, $U_c$ remains applied and thermal stability shall be achieved within 30 min.		N
	Once thermal stability is achieved, either:		N
	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.		N
	or in case of this current exceeds 1 mA		N
	the stand-by power consumption shall not be greater than 20 % above the value measured in 7.7.5		N
	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.		P
	The SPD has passed the test, if the values measured before and after the test are below or equal to $U_p$ .		-
<b>7.6.7</b>	<b>Class III operating duty test</b>		-
	For the operating duty test of class III SPDs, a power frequency voltage source according to 7.6.3 is used.		N
	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.		P

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Cl.	Requirement – Test	Result	Verdict
	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 $U_{oc}$ .		P
	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.		P
	The operating duty test is performed according to 7.6.5 using the combination wave generator with the following generator settings $U_{oc}$ .		P
a)	One positive and one negative impulse at 0,1 $U_{oc}$ ; check thermal stability; cool down to ambient temperature.		N
b)	One positive and one negative impulse at 0,25 $U_{oc}$ ; check thermal stability; cool down to ambient temperature.		P
c)	One positive and one negative impulse at 0,50 $U_{oc}$ ; check thermal stability; cool down to ambient temperature.		P
d)	One positive and one negative impulse at 0,75 $U_{oc}$ ; check thermal stability; cool down to ambient temperature.		P
e)	One positive and one negative impulse at 1,0 $U_{oc}$ ; check thermal stability; cool down to ambient temperature.		P
	The SPD has passed the test if the criteria of 7.6.6 are fulfilled.		P
<b>7.7</b>	<b>SPD disconnectors and safety performance of overstressed SPDs</b>		-
	These tests shall be made on every SPD.		P
	Tests are performed on each mode of protection of the SPD using new samples each time.		P
<b>7.7.1</b>	<b>Operating duty withstand test of SPD disconnectors</b>		-
	The SPD disconnector(s) is(are) tested during the operating duty test (see 7.6).		P

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Cl.	Requirement – Test	Result	Verdict
	The disconnectors, as specified by the manufacturer, shall not operate during the test and shall be in working order after this test.		P
	For the purpose of this clause, working order means that the disconnector is not visibly damaged and is still operational.		N
	Operation can be checked either manually (where possible) or by a simple electrical test agreed between the manufacturer and the laboratory.		P
<b>7.7.2</b>	<b>Test of thermal stability of SPDs</b>		-
<b>7.7.2.1</b>	<b>Temperature withstand test</b>		-
	The SPD is kept in a heated cabinet at an ambient temperature of 80 °C ± 5 K for 24 h.		P
	No internal SPD disconnector shall operate during this time.		P
<b>7.7.2.2</b>	<b>Thermal stability test</b>		-
	This test is not performed on SPDs containing only voltage switching components.		P
	<b>Test settings</b>		-
	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:		P
	– SPDs containing only voltage limiting components. In this case, the following procedure a) applies;		P
	– SPDs containing both voltage limiting and voltage switching components. In this case, the following procedure b) applies..		N
	<b>Sample preparation</b>		-
	Any voltage switching component which is connected in series with a voltage limiting component shall be short-circuited by a copper wire with a diameter such that it does not melt during the test.		P

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Cl.	Requirement – Test	Result	Verdict
	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.		P
	If components of the same type and parameters are connected in parallel, they shall be tested as one current path.		N
	The manufacturer shall provide samples prepared according to the above requirements.		N
<b>a)</b>	<b>Test procedure for SPDs having no switching component in series with other components</b>		-
	The test samples shall be connected to a power frequency source.		N
	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.		N
	The tolerance for the test current is $\pm 10\%$ . The test is started at a value of 2 mA r.m.s.		N
	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.		N
	This value of current is then increased in steps of either 2 mA or 5 % of the previously adjusted test current, whichever is greater.		N
	Each step is maintained until thermal equilibrium is reached (i.e. variation of temperature less than 2 K within 10 min).		N
	The surface temperature on the hottest spot of the SPD (for accessible SPDs only) and the current through the SPD are monitored continuously.		N
	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.		N
	This test is interrupted if all non-linear components under test are disconnected.		N



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Cl.	Requirement – Test	Result	Verdict
	The voltage shall not be increased further in order to avoid any malfunction of the disconnecter.		N
	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 duration of 15 min.		N
	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.		N
	The maximum available current value shall not exceed the short-circuit withstand capability declared by the manufacturer.		P
<b>b)</b>	<b>Test procedure for SPDs having a switching component in series with other components</b>		-
	The SPD is energized with a power frequency source at $U_{cs}$ and having a short-circuit current capability which will not limit the current before any disconnecter operates.		P
	The maximum available current value shall not exceed the short-circuit withstand capability declared by the manufacturer.		P
	If no significant current flows, test procedure a) shall be followed.		P
	<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.		N
	Indoor SPDs: The surface temperature rise shall be less than 120 K during the test.		P
	The surface temperature shall not exceed 80 K above ambient temperature 5 min after the disconnecter has operated.		P
	During the test there shall be no expulsion of solid material.		P

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Cl.	Requirement – Test	Result	Verdict
	Outdoor SPDs: There shall be no evidence of burning and there shall be no expulsion of solid material.		N
	Accessible SPDs:		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 the life parts which were already accessible before the test when the SPD is fitted as in normal use.		N
<b>7.7.3</b>	<b>Short-circuit withstand capability</b>		-
	This test is not applied to SPDs which are either		P
	– classified for outdoor use and mounted out of reach, or		P
	– for connection N-PE in TN- and/or TT-systems only.		P
	Test settings		—
	Power frequency source characteristic:		P
	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 $U_{cs}$ .		P
	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.		P
	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.		P
	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		P
	<b>Sample preparations</b>		-

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Cl.	Requirement – Test	Result	Verdict
	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		P
	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.		P
	Samples according to the above requirement shall be provided by the manufacturer.		N
	<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)		N
<b>a)</b>	<b>Test of the declared short circuit withstand capability:</b>		-
	The sample is connected to a power frequency source at $U_{cs}$ , having a prospective short-circuit current according to the declared short-circuit withstand capability and power factor according to Table 11.		N
	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.		N
	If a replaceable or resettable internal or external disconnecter operates, the relevant disconnecter shall be replaced or reset each time.		N
	If the disconnecter cannot be replaced or reset, the test is stopped.		N
<b>b)</b>	<b>Test at low short-circuit current:</b>		-

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Cl.	Requirement – Test	Result	Verdict
	A power frequency source at $U_{Cs}$ , 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.		N
	The test is carried out once with the short-circuit initiated at 45 electrical degrees after the zero crossing of the voltage.		N
	<b>Pass criteria</b>		-
	During the above two short-circuit tests, neither the muslin paper nor the cheese cloth shall catch fire.		P
	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.		P
	Internal and/or special disconnectors not covered by another EN standard: If they operate there shall be clear evidence of effective and permanent disconnection.		P
	To check this, a power frequency voltage equal to $U_c$ shall be applied for 1 min to the disconnector(s) having operated. The current flow shall not exceed 0,5 mA r.m.s.		N
<b>7.7.3.1</b>	<b>Additional test for SPDs with <math>I_n</math> lower than the declared short-circuit withstand capability</b>		-
	The tests according to 7.7.3 are repeated but without voltage switching components being shortcircuited.		N
	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 half wave.		N

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Cl.	Requirement – Test	Result	Verdict
	The surge current shall be high enough to initiate a follow current but shall in no case exceed $I_n$ .		N
	To ensure that no external disconnector operates due to the trigger surge, all external disconnectors shall be placed in series with the power frequency source as shown in Figure 6a.		N
<b>7.7.4</b>	<b>Test under TOVs caused by faults in the high (medium) voltage system</b>		-
	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.		N
	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..		N
	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		P
<b>7.7.4.1</b>	<b>Test procedure</b>		-
	With the exception of SPDs connected neutral to ground, $U_{CS}$ remains applied to the test sample for 15 min without interruption until switch S1 is reopened.		P
	Other test circuits are permitted as long as they ensure the same stress to the SPD.		P
<b>7.7.4.2</b>	<b>Pass criteria</b>		-
	The muslin paper or cheese cloth shall not catch fire during the test.		N
	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.		N

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Cl.	Requirement – Test	Result	Verdict
	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.		N
<b>7.7.5</b>	<b>Standby power consumption and residual current test</b>		-
	The SPD is connected to a voltage source at its maximum continuous operating voltage ( $U_c$ ) in accordance with the manufacturer's instructions.		P
	The apparent power (Volt-Amperes) consumed by the SPD is measured.		N
	The current flowing through the PE terminal is called the residual current.		N
<b>7.7.6.1</b>	<b>Test procedure</b>		-
	New samples shall be used and fitted as in normal use, according to the manufacturer's instructions.		N
	The SPD shall be mounted in a cube shaped wooden box as described 7.7.3.		N
	The internal surface of the box shall be covered with muslin paper or cheese cloth.		N
	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.		N
<b>7.7.6.2</b>	<b>Pass criteria</b>		-
	The following pass criteria shall be fulfilled		N
	The muslin paper or cheese cloth shall not catch fire during the test.		N
	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.		N
	The SPD shall maintain thermal stability during the application of $U_c$ s (following the application of $U_T$ ).		N

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Cl.	Requirement – Test	Result	Verdict
	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 $U_{cs}$ .		N
	The test sample is then connected to UC. The test transformer shall have a short-circuit current capability of at least 200 mA.		N
	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		N
	the stand-by power consumption shall not increase by more than 20 % of the value measured in 7.7.5.		N
<b>7.8</b>	<b>Test for two-port SPDs and one-port SPDs with separate input/output terminals</b>		-
<b>7.8.1</b>	<b>Test to determine the percentage voltage regulation</b>		-
	A voltage $U_c$ is supplied at the input port and shall be constant within -5 %.		P
	The test shall be conducted with rated load current into a resistive load. Input and output voltage shall be measured simultaneously with load connected..		N
	Use the following formula to determine the percentage voltage regulation		N
	$\Delta U \% = ((U_{in} - U_{out}) / U_{in}) 100 \%$		N
	This value shall be recorded and comply with the manufacturer's declaration.		N
<b>7.8.2</b>	<b>Rated load current <math>I_L</math></b>		-
	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.		N
	The load current shall be set to the rated load current specified by the manufacturer. Forced cooling of the SPD is not permitted		N

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Cl.	Requirement – Test	Result	Verdict
	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		N
<b>7.8.3</b>	<b>Load-side short circuit withstand capability test (in conjunction with SPD disconnectors required by the manufacturer, if any).</b>		-
	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.		N
	<b>Pass criteria</b>		-
	During the test the power short-circuits 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.		N
	<b>Accessible SPDs</b>		-
	After the test, SPDs having an IP degree equal or greater than IP 2X shall not have live parts accessible with the standardized test finger applied with a force of 5 N (see EN 60529).		N
	If no internal disconnector has operated, the SPD shall fulfil the requirements according to 7.4.1 and 7.5.		N
	If an SPD internal disconnector has operated, there shall be clear evidence of effective and permanent disconnection.		N
<b>7.8.4</b>	<b>Load-side surge withstand capability</b>		-
	The interval between the impulses is 50 s - 60 s and the interval between the groups is 25 min - 30 min.		N
	The test sample shall be energized during the whole test sequence. The voltage on the output terminals shall be recorded.		N
<b>7.8.5</b>	<b>Overload behaviour</b>		-



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Cl.	Requirement – Test	Result	Verdict
	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.		N
	The test is carried out at ambient temperature and the sample shall be protected against abnormal external heating or cooling.		N
	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.		N
	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).		N
	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.		N
	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.		N
	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.		N
	<b>Pass criteria</b>		-
	For touchable surfaces, the temperature rise shall always be less than 60 K during the test.		N
a)	No internal disconnecter has operated:		N
	Visual inspection of the test sample shall reveal no evidence of any damage.		N

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Cl.	Requirement – Test	Result	Verdict
	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.		N
	The test sample is then connected to $U_c$ .		P
	The test transformer shall have a short-circuit current capability of at least 200 mA.		P
	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.		N
	the stand-by power consumption shall not increase by more than 20 % of the value measured in 7.7.5.		P
	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.		N
	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.		N
<b>7.9</b>	<b>Additional tests</b>		-
	The entire subclause 7.9 is a safety issue. In some countries other national regulations may apply.		N
<b>7.9.1</b>	<b>Portable SPDs with flexible cables and cords and their connection</b>		-
<b>7.9.1.1</b>	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.		N
	The sheath, if any, of the cord shall be clamped within the cord anchorage.		P
	Compliance is checked by inspection.		P

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Cl.	Requirement – Test	Result	Verdict
<b>7.9.1.2</b>	The effectiveness of the retention is checked by the following test by means of an Apparatus as shown in Figure 8		N
	Non-rewire able SPDs are tested as delivered; the test is made on new samples.		N
	Rewire able SPDs are tested with the cable having the nominal cross-sectional area as declared by the manufacturer.		P
	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.		N
	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.		N
	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.		P
	The sample is placed in the test apparatus so that the axis of the cable or cord is vertical where it enters the sample.		P
	The cable or cord is then subjected 100 times to a pull of		N
	- 60 N if the rated current is not more than 16 A and the rated voltage is up to and including 250 V;		N
	- 80 N if the rated current is not more than 16 A and the rated voltage is above 250 V;		N
	- 100 N if the rated current is more than 16 A.		P
	The pulls are applied practically without jerks each time for 1 s.		N
	After the tests, the cable or cord shall not have been displaced by more than 2 mm.		P
	For rewire able accessories, the end of the conductors shall not have moved noticeably in the terminals; for non-rewire able accessories, there shall be no break in the electrical connections.		N

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Cl.	Requirement – Test	Result	Verdict
	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.		N
<b>7.9.1.3</b>	Non-rewire able 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.		N
	Compliance is checked by inspection, by measurement, and by checking that the flexible cables or cords are in accordance with EN 60227 or EN 60245, as applicable.		N
<b>7.9.1.4</b>	Non-rewire able SPDs shall be so designed that the flexible cable or cord is protected against excessive bending where it enters the accessory.		N
	Guards provided for this purpose shall be of insulating material and shall be fixed in a reliable manner.		P
	Helical metal springs, whether bare or covered with insulating material, shall not be used as core guards.		N
	Compliance is checked by inspection and by a flexing test made by means of an apparatus as shown in figure 9.		N
	During the flexing test, there shall be		N
	- no interruption of the current,		N
	- no short-circuit between conductors.		N
	The voltage drop between each contact and the corresponding conductor, with a test current flowing having a value of the rated current, shall not exceed 10 mV.		N
	After the test the guard, if any, shall not have separated from the body and the insulation of the flexible cable or cord shall show no sign of abrasion or wear; broken strands of the conductor shall not have pierced the insulation so as to become accessible.		N
	<b>7.9.2 Mechanical strength</b>		-

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Cl.	Requirement – Test	Result	Verdict
	7.9.2.1 SPDs shall have adequate mechanical strength so as to withstand the stresses imposed during installation and use.		N
	Compliance is checked by the appropriate tests as follows:		N
	The samples are subjected to strikes by means of an impact-test apparatus as shown in figure 10.		N
	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.		N
	If wood is used for the block, the direction of the wood fibres shall be perpendicular to the direction of the impact.		N
	Flush-type screw fixing SPDs shall be fixed by means of screws to lugs recessed in the block		N
	Flush-type claw fixing SPDs shall be fixed to the block by means of the claws.		N
	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		N
	The samples are mounted so that the point of impact lies in the vertical plane through the axis of the pivot.		N
	The striking element is allowed to fall from a height which is specified in the following table 13.		N
	The samples are subjected to strikes which are evenly distributed over the samples. The strikes are not applied to "knock-out" areas.		N
	After the test, the sample shall show no damage within the meaning of the standard.		N
	In particular, live parts shall not become accessible with the standard test finger.		N
<b>7.9.2.2</b>	Portable SPDs are tested in a tumbling barrel as shown in figure 11.		N
	The body of the rotating barrel is of steel sheet of 1,5 mm thickness.		N
	After the test, the samples shall show no damage. In particular		N

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Cl.	Requirement – Test	Result	Verdict
	– no part shall have become detached or loosened,		N
	– 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.		N
<b>7.9.3</b>	<b>Heat resistance</b>		-
<b>7.9.3.1</b>	For 1 h the SPD is kept in a heating cabinet at a temperature of 100 °C ± 2 K..		N
	Any sealing compound used in the internal assembly shall not flow out to any significant extent.		N
	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		N
	The SPD is deemed to have passed the test even if the SPD disconnecter is open.		N
<b>7.9.3.2</b>	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.		N
	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.		N
	After 1 h, the steel ball is taken away from the sample; by dipping it into cold water, the temperature of the sample is reduced to ambient temperature within 10 s.		N
	The diameter of the ball indentation is measured and shall not exceed 2 mm.		N
<b>7.9.4</b>	<b>Resistance to abnormal heat and fire</b>		-
	The sample is regarded as having passed the glow-wire test if		P
	– there is no visible flame and no sustained glowing, or if		N
	– flames and glowing parts on the sample extinguish themselves within 30 s after the removal of the glow-wire.		N

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Cl.	Requirement – Test	Result	Verdict
	There shall be no ignition of the tissue paper or scorching of the pinewood board.		N
<b>7.9.5</b>	<b>Verification of air clearances and creepage distances</b>		-
	The electrode spacing of spark gaps shall not be considered for the determination of air clearances and creepage distances.		
<b>7.9.5.1</b>	<b>SPDs category outdoor</b>		-
	Between live parts and earth, the air clearances and creepage distances shall not be smaller than the values indicated in table 14.		P
<b>7.9.5.2</b>	<b>SPDs category indoor</b>		-
	Air clearances and creepage distances shall not be smaller than the values indicated in table 15.		P
<b>7.9.5.2.1</b>	<b>Test: Measurement</b>		-
<b>7.9.5.2.2</b>	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.		N
<b>7.9.6</b>	<b>Tracking resistance</b>		-
	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.		N
<b>7.9.7</b>	<b>Insulation resistance</b>		-
	This test is not applicable to SPDs having a metallic enclosure connected to protective earth.		N
<b>7.9.7.1</b>	The test samples shall be prepared as follows:		-
	The test samples shall be kept in the humidity cabinet for 2 days (48 h).		N
<b>7.9.7.2</b>	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.		N
<b>7.9.8</b>	<b>Dielectric withstand</b>		-
	SPDs classified for outdoor use are tested between the terminals with the internal parts removed.		N

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Cl.	Requirement – Test	Result	Verdict
	During this test, the SPD is subjected to sprinkling according to 9.1 of IEC 60060-1		N
<b>7.9.9</b>	<b>Resistance to ingress of solid objects and to harmful ingress of water</b>		-
	Testing shall be carried out in accordance with IEC 60529 to check the IP code.		N
<b>7.9.10</b>	<b>Total discharge current test for multiple SPDs</b>		-
	Each mode of the test sample is then connected to $U_c$ . The test transformer shall have a shortcircuit current capability of at least 200 mA.		N
	Visual inspection of the test sample shall reveal no evidence of any damage.,		N
<b>7.10</b>	<b>Electromagnetic compatibility</b>		-
<b>7.10.1</b>	<b>Electromagnetic immunity</b>		-
	The requirements for SPDs containing electronic circuits are under consideration		N
<b>7.10.2</b>	<b>Electromagnetic emission</b>		-
	The requirements for SPDs containing electronic circuits generating fundamental frequencies greater than 9 kHz are under consideration.		N
<b>8</b>	<b>Routine and acceptance tests</b>		-
<b>8.1</b>	<b>Routine tests</b>		-
	Appropriate test(s) shall be conducted to verify that the SPD is capable of meeting its performance.		N
	The manufacturer shall declare the test method(s).		N
	Check that $I_c$ is below a specified value determined by the manufacturer at a specified $U_c$ .		N
<b>8.2</b>	<b>Acceptance tests</b>		-
	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.		N



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Cl.	Requirement – Test	Result	Verdict
	Any alteration in the number of test samples or type of test shall be negotiated between the manufacturer and purchaser.		-
	If not otherwise specified, the following tests are specified as acceptance tests:		N
a)	verification of identification by inspection as per 7.2;		N
b)	verification of marking by inspection as per 7.2;		-
c)	verification of electrical parameters (e.g. measured limiting voltage as per 7.5).		-

- End of Test Report -

Type of equipment, model: Surge Protection Device,  
YCS6-D, YCS6-C, YCS6-B

Details of:

View:

- general
- front
- rear
- right
- left
- top
- bottom



Details of:

View:

- general
- front
- rear
- right
- left
- top
- bottom



Details of:

View:

general

front

rear

right

left

top

bottom



Details of:

View:

general

front

rear

right

left

top

bottom



Details of:

View:

general

front

rear

right

left

top

bottom



Details of:

View:

general

front

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top

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