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TEST REPORT IEC 61643-11 Low-voltage surge protective devices Part 11: Surge-protective devices connected to low-voltage power systems- Requirements and test methods	
Report Number.....	P2302220915
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Applicant's name.....	MUTLUSAN PLASTIK ELEKTRİK SAN.TİC.A.Ş
Address.....	İKİTELLİ OSB MAH. ENKOOP CAD. NO:7 BAŞAKŞEHİR İSTANBUL Türkiye 34480
Test specification:	
Standard.....	IEC 61643-11: 2011
Test procedure.....	Type test
Non-standard test method.....	N/A
Test Report Form No.....	IEC61643_11C
Test Report Form(s) Originator.....	OVE
Master TRF.....	Dated 2021-10-07
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Test item description.....	Surge Protective Devices
Trade Mark.....	
Manufacturer.....	MUTLUSAN PLASTIK ELEKTRİK SAN.TİC.A.Ş
Model/Type reference.....	Class III
Ratings.....	U _c : 250Vac, U _{oc} : 6kV, U _p : 1.3kV



Testing procedure and testing location:	
<input checked="" type="checkbox"/>	Testing Laboratory: Guangdong LNP Electrical Testing Technology Co., Ltd.
Testing location/ address.....: No. 101, Building B, Xinyongsheng Technology Park, Wenquan South Road No. 70, Xinwei Village, Shilong Town, Dongguan City, Guangdong Province, China.	
Tested by (name + signature).....: Jianyu Liu / Test Engineer	
Approved by (name + signature)....: Guoxiang Chen / Project Engineer	
List of Attachments (including a total number of pages in each attachment): Attachment 1: Test waveform (1 page) Attachment 2: Test waveform (1 page) Attachment 3: Photos of samples (1 page)	
Summary of testing:	
Tests performed (name of test and test clause): Identification and marking, 7.1.1/7.1.2/8.2 Terminals and connections 7.3.2/7.3.3/8.4.2 Testing for protection against direct contact 7.2.1/8.3.1 Environment, IP code 7.4.1/8.5.1 Residual current 7.2.2/8.3.2 Operating duty test 7.2.4/8.3.4 Thermal stability 7.2.5.2/8.3.5.2 Air clearances and creepage distances 7.3.4/8.4.3 Ball pressure test 7.4.2/8.5.3 Resistance to abnormal heat and fire 7.4.3/8.5.4 Tracking resistance 7.4.4/8.5.5 Voltage protection level 8.3.3 Insulation resistance 7.2.6/8.3.6 Dielectric withstand 7.2.7/8.3.7 Mechanical strength 7.3.5/8.4.4 Temperature withstand 7.2.5/8.3.5.1 Heat resistance 7.4.2/8.5.2 TOV tests 7.2.8/8.3.8 Short-circuit current behaviour 7.2.5.3/8.3.5.3 Rated load current (I_L) 7.5.1.1/8.6.1.1 Load-side short-circuit current behaviour 7.5.1.3	Testing location: Guangdong LNP Electrical Testing Technology Co., Ltd. No. 101, Building B, Xinyongsheng Technology Park, Wenquan South Road No. 70, Xinwei Village, Shilong Town, Dongguan City, Guangdong Province, China.

Copy of marking plate

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Test item particulars.....:	
Number of ports.....:	One port
SPD design topology.....:	See model list
SPD classified for test class.....:	III
Location.....:	Indoor
Accessibility.....:	Inaccessible
Mounting method.....:	Fixed
SPD Disconnecter.....:	Internal
Protection functions.....:	Thermal
Overcurrent protection.....:	No Specified
Degree of protection (IP code).....:	IP20
Temperature range.....:	-5°C to +40°C
Required SPD-disconnectors.....:	N/A
SPD failure behaviour:.....:	open circuit
Possible test case verdicts:	
- test case does not apply to the test object.....:	N/A
- test object does meet the requirement.....:	P (Pass)
- test object does not meet the requirement.....:	F (Fail)
Testing.....:	
Date of receipt of test item.....:	2023-04-06
Date (s) of performance of tests.....:	2023-04-06 to 2023-04-14
General remarks:	
<p>The test results presented in this report relate only to the object tested. This report shall not be reproduced, except in full, without the written approval of the Issuing testing laboratory. "(See Enclosure #)" refers to additional information appended to the report. "(See appended table)" refers to a table appended to the report.</p> <p>Throughout this report a <input type="checkbox"/> comma / <input checked="" type="checkbox"/> point is used as the decimal separator.</p>	
Summary of compliance with National Differences	
List of countries addressed:	
EU Group Differences	
<input checked="" type="checkbox"/> The product fulfills the requirements of EN 61643-11:2012+A11:2018.	

General product information:

Model list

Model No.	Protection Modes	U_c (V)	U_{oc} (kV)	U_p (kV)	SPD design
Class III	L-N	250	6	1.3	Voltage limiting
	L/N-PE	250	6	1.3	Combination type



If not otherwise specified all tests have been carried out on three samples per test sequence. Terminal tests have been carried out on three terminals of each construction used.

Impulse tests have been carried out according to chapters 8.1.1 to 8.1.4.

SPDs according test class I: Calculation of charge Q and specific energy W/R applied during additional duty test acc. to 8.3.4.4

I (kA)	Q (As) within 5 ms	W/R (kJ/Ω)
0,1* I _{imp} = _____	--	--
0,25* I _{imp} = _____	--	--
0,5* I _{imp} = _____	--	--
0,75* I _{imp} = _____	--	--
1,0* I _{imp} = _____	--	--

If the SPD is an integral part of a product covered by another standard, the requirements of the other standard were applied to those parts of the product, which do not belong to the SPD section of the product. The SPD section was judged according to the general (7.1), the electrical (7.2), the environmental and material (7.4) requirements. The mechanical requirements of other standards shall also be applied to the SPD.

Unless otherwise specified, a.c. values given in this report are r.m.s. values.

If not otherwise specified the tests have been performed in free air and at an ambient temperature of $(20 \pm 15)^\circ\text{C}$.

If not otherwise specified, for all tests where a power supply at U_{REF} or U_{C} is required, the voltage tolerance for testing was $+0/-5\%$.

If the SPD is supplied with integral cables, the full length of these cables forms part of the SPD under test, except for the determination of the measured limiting voltage 8.3.3, where a lead length of 150 mm was used.


SPD disconnectors have been selected according to the manufacturer's instructions and connected for testing according to Table 3.

For SPDs having more than one mode of protection, for which the manufacturer declares a voltage protection level, the tests have been performed on each mode, with the values chosen according to the manufacturer's declaration, using new samples each time. For three phase devices in which the protective component circuitry per given mode is identical, the testing may be performed on each of the three phases which fulfils the three sample requirement.

For SPDs with a designated N terminal which may be applied in systems without distributed neutral according to the manufacturer's instructions, separate testing has been performed for the L-PE mode of protection with the neutral being unconnected.

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 have been performed for every combination of required SPD disconnector(s) and corresponding prospective short-circuit currents.

Throughout the entire type testing procedure, the status shown by the indicator(s) give a clear sign of the status of the part to which it is linked. Where there is more than one method of status indication, for example local and remote indication, each type of indication was checked.

IEC 61643-11 - TEST SEQUENCE 1			
Clause	Requirement - Test	Result - Remark	Verdict
7.1.1/7.1.2	Identification and Marking		P
	Markings on the body or permanently attached to		P
	a1) Manufacturer/Trade mark/Model number	Trade mark:  Model number: Class III	P
	a2) Maximum continuous operating voltage U_c (one value for each mode of protection)	250Vac	P
	a3) Type of current: a.c. or “~” and/or frequency	~	P
	a4) Test classification and discharge parameters shall be printed next to each other for each mode of protection declared by the manufacturer For test class I: either “test class I” and “ I_{imp} ” and the value in kA, and/or “T1” (T1 in a square) and “ I_{imp} ” and the value in kA For test class II: either “test class II” and “ I_n ” and the value in kA, and/or “T2” (T2 in a square) and “ I_n ” and the value in kA For test class III: either “test class III” and “ U_{oc} ” and the value in kV, and/or “T3” (T3 in a square) and “ U_{oc} ” and the value in kV	Class III SPD ____ kA ____ kA U_{oc} : 6 kV	P
	a5) Voltage protection level U_p (one value for each mode of protection)	1.3 kV	P
	a6) Degree of protection if > IP20	IP20	N/A
	a7) Identification of terminals or leads	L, N, PE	P
	a8) Rated load current I_L	16 A	P
	Information provided with the products	See below	P
	b1) Location	Indoor use	P
	b2) Number of ports	One	P
	b3) Method of mounting	Fixed	P
	b4) Short circuit current rating I_{SCCR}	300 A	P
	b5) Ratings and characteristics for external disconnector	Manufacturer not specified	N/A
	b6) Indication of disconnector operation	LED light turns off	P
	b7) Orientation for normal installation	Fixed SPD	P
	b8) Installation instructions - type of LV systems (TN-, TT-, IT-system) - intended connection - nominal a.c. system voltages and maximum allowed voltage regulation for which the SPD is designed, mechanical dimensions, lead lengths, etc.	TN system	P
	b9) Temperature and humidity range	Normal range: -5°C to +40°C; 5% to 95%	P
	b10) Follow current interrupting rating I_{fi}		N/A
	b11) Residual current I_{PE}	1.0mA	P

IEC 61643-11 - TEST SEQUENCE 1			
Clause	Requirement - Test	Result - Remark	Verdict
	b12) Transition surge current rating for short-circuiting type SPD I_{trans}	No short-circuiting type SPD	N/A
	b13) The minimum distance from any earthed conductive surface at which the SPD can be installed	20 mm	P
	b14) I_{max} (optional)		N/A
	Information which shall be available in a datasheet	See below	P
	c1) Temporary overvoltage rating U_T and/or the type(s) of power system(s) the SPD is designed for according to Annex B and corresponding connection details	According to Annex B	P
	c2) Total discharge current I_{TOTAL} for multipole SPDs (if declared by the manufacturer) and the corresponding test class	Manufacturer no specified	N/A
	c3) Voltage drop for two port SPDs	One port SPD	N/A
	c4) Load-side surge withstand capability for two-port SPDs	One port SPD	N/A
	c5) Information about replaceable parts (indicators, fuses, etc.)	No such replaceable parts	N/A
	c6) Voltage rate of rise du/dt	Manufacturer no specified	N/A
	c7) Current factor k , if different from Table 20	1.1	P
	c8) Modes of protection (for SPDs with more than one mode of protection)	L-N mode andL/ N-PE mode	P
8.2	Indelibility of markings	See below	P
	This test shall be applied on markings of all types except those made by impressing, molding and engraving.	Molding	P
	The test is made by rubbing the marking by hand for 15s with a piece of cotton soaked with water and again for 15s 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 a specific gravity of 0,68 g/cm ³ .		N/A
	After this test, the marking shall be easily legible.		N/A
7.3.1	Mounting		P
	SPDs shall be provided with appropriate means for mounting that will ensure mechanical stability. Mechanical coding/interlock shall be provided to prevent incorrect combinations of plug-in SPD modules and sockets. Compliance is checked by visual inspection.		P
	Terminals and connections		P
7.3.2	Screws, current carrying parts and connections		N/A
8.4.1	Reliability of screws, current-carrying parts and connections		N/A
	Screws operated when connecting the SPD:		N/A

IEC 61643-11 - TEST SEQUENCE 1			
Clause	Requirement - Test	Result - Remark	Verdict
	The screws are tightened and loosened: - ten times for screws in engagement with a thread of insulating material - five times in all other cases		N/A
	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/A
	The test is made by means of a suitable test screwdriver or spanner applying a torque as shown in Table 10 or according to the manufacturer's specification, whichever is greater.		N/A
	The screws shall not be tightened in jerks.		N/A
	The conductor is moved each time the screw is loosened.		N/A
	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.		N/A
	Enclosures and covers shall not be damaged. This shall be verified by visual inspection.		N/A
7.3.3	External connections		N/A
8.4.2	Terminals for external conductors		N/A
	The SPD is mounted according to the manufacturer's recommendation on a dull, black-painted board of about 20mm thickness, and protected against undue external heating or cooling. SPD terminals wired with conductors according to: - table 11, for two-port devices and one port devices with separate input/output terminals or, - the manufacturer's instruction, for other one-port devices		N/A
	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 ²		N/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.		N/A
	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. The terminals shall be readily accessible under the intended conditions of use.		N/A
	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/A
	Terminals shall have adequate mechanical strength.		N/A

IEC 61643-11 - TEST SEQUENCE 1			
Clause	Requirement - Test	Result - Remark	Verdict
	Terminals shall be so designed that they clamp the conductor without undue damage to the conductor.		N/A
	Terminals shall be so designed that they clamp the conductor reliably and between metal surfaces.		N/A
	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/A
7.3.3.1	Terminals with screws		
	Screws and nuts for clamping the conductors shall have a metric ISO thread or a thread comparable in pitch and mechanical strength.		N/A
	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/A
	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/A
	The use of sealing compound or resin is considered to be sufficient for preventing a terminal from working loose, provided that: <ul style="list-style-type: none"> • The sealing compound or resin is not subject to stress during normal use, and • The effectiveness of the sealing compound or resin is not impaired by temperatures attained by the terminal under the least favourable conditions specified in this standard. 		N/A
	Clamping screws or nuts of terminals intended for the connection of protective conductors shall be adequately secured against accidental loosening.		N/A
	Screws shall not be made of metal that is soft or liable to creep, such as zinc or aluminium.		N/A
8.4.2.1.1	General		
	These tests are made by means of a suitable screwdriver or spanner applying a torque as shown in table 10.		N/A
	The terminals are fitted with copper conductors of the smallest or largest cross-sectional areas specified in 8.4.2, solid or stranded, whichever is least favourable		N/A
	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		N/A
	The clamping screws are then tightened with a torque to two-thirds of that shown in the appropriate column of table 10.		N/A
	Each conductor is then subjected to a pull of the value, in newtons, shown in table 12. The pull is applied without jerks, for 1 min, in the direction of the axes of the conductor space.		N/A
	During this test, the conductor shall not move noticeably in the terminal		N/A

IEC 61643-11 - TEST SEQUENCE 1			
Clause	Requirement - Test	Result - Remark	Verdict
8.4.2.1.2 a)	The terminals are fitted with cooper conductors (solid or stranded), of the smallest or largest-sectional areas as specified in 8.4.2, (whichever is the least favourable) and the terminal screws are tightened with a torque equal to two-thirds of the values shown in the appropriate column of table 10. The terminal screws are then loosened and the part of the conductor which may have been affected by the terminal is inspected.		N/A
	The conductors shall show neither undue damage nor severed wires		N/A
	Conductors are considered to be unduly damaged if they show deep or sharp indentations.		N/A
	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.		N/A
8.4.2.1.2 b)	The terminals are fitted with a rigid stranded cooper conductor according to table 13.		N/A
	Before insertion in the terminal, the wires of the conductors are suitably reshaped		N/A
	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 10		N/A
	After the test, no wire of the conductor shall have slipped out of the SPD terminal.		N/A
7.3.3.2	Screwless terminals	No screwless terminals	
	Terminals shall be so designed and constructed that: <ul style="list-style-type: none"> • each conductor is clamped individually. During the connection or disconnection the conductors can be connected or disconnected either at the same time or separately, • it is possible to clamp securely any number of conductors up to the maximum provided 		N/A
8.4.2.2	The terminals are fitted with new cooper conductors (solid or stranded), of the smallest or largest cross-sectional areas as specified in 8.4.2		N/A
	Each conductor is then subjected to a pull of the value shown in table 14. The pull is applied without jerks for 1 min in the direction of the axis of the conductor.		N/A
8.4.2.3	Insulation piercing connections	No insulation piercing connections	
8.4.2.3.1	Pull test on terminals designed for single core conductors		N/A
	The terminals are fitted with new cooper conductors (solid or stranded), of the smallest or largest cross-sectional areas as specified in 8.4.2, (whichever is the least favourable). Screws, if any, are tightened according to Table 10.		N/A

IEC 61643-11 - TEST SEQUENCE 1			
Clause	Requirement - Test	Result - Remark	Verdict
	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 14.		N/A
	During the test, there shall be no movement of the conductor in the terminal or any sign of damage.		N/A
8.4.2.3.2	Pull test on terminals designed for multi-core cables or cords	No such terminals	
	The pull-out test on the SPD terminals designed for multi-core cables or cords is carried out as for single core conductors, except that the pull force is applied to the entire multi-core cable or cord instead of to the individual core.		N/A
	The pull force is calculated according to the following formula: $F = F(x) \sqrt{n}$ F is the total force to apply n is the number of cores $F(x)$ is the force for one core according to the cross-section of one conductor (see table 9)		N/A
	During the test, the cable or cord shall not slip out of the terminals.		N/A
8.4.2.4	Flat quick connect terminations	No flat quick connect terminations	
	Under consideration		
8.4.2.5	Pigtail connections (flying leads)		
8.4.2.5.1	Pull test on flying lead conductors		P
	A flying lead and anchorage shall withstand without damage or detachment a direct pull of 89N for one minute, applied to the lead from any angle which the construction or the device will allow.	89N, 1minute	P
	During the test, there shall be no movement of the conductor or any sign of damage.	No movement of the conductor	P
7.2.1	Protection against direct contact	Inaccessible SPD, no direct contact parts.	
	Test applied to SPDs with $U_C > 50V$ r.m.s.		P
	For protection against direct contact (inaccessibility of live parts), SPDs 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.		P
8.3.1.1	Insulated parts		
	The sample is mounted as for normal use and the test is conducted using conductors of the smallest cross-sectional area and then again using conductors of the largest cross-sectional area specified in 8.4.2.		P
	The standard test finger (in accordance with IEC 60529) is applied in every possible position.		P
	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 inserted or completely inserted in a socket outlet.	No plug-in SPD	N/A

IEC 61643-11 - TEST SEQUENCE 1			
Clause	Requirement - Test	Result - Remark	Verdict
	An electrical continuity indicator operating from a voltage of not less than 40V and not more than 50V, one side of which is connected to the test finger to check for the possibility of contact with any live part or the sample.		P
8.3.1.2	Metal parts	No accessible metal parts	
	Metal parts which are accessible when the SPD is wired and mounted as for normal use are 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
	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/A
	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 Ω .		N/A
7.4.1	Environment, IP code	IP20	
	SPDs shall be provided with an enclosure for protection against ingress of solid objects and water in accordance with the IP code declared by the manufacturer.		P
8.5.1	Test carried out acc. to IEC 60529 to check IP code	IP <u>20</u>	P
7.2.2	Residual current I_{PE}		
	For all SPDs with a terminal for the protective conductor, the residual current I _{PE} shall be measured when all SPD terminals are connected to a power supply at the reference test voltage (U _{REF}) according to the manufacturer's instructions.		P
8.3.2	The SPD shall be connected as for normal use according to the manufacturer's instructions. The voltage shall be adjusted to the reference test voltage of U _{REF} . The residual current flowing through the PE terminal is measured.	U _{REF} : 255Vac Measured residual current is 0.04mA < I _{PE} : 1mA	P
7.2.4/8.3.4	Operating duty		
	The SPD shall be capable of withstanding specified discharge currents during application of the maximum continuous operating voltage U _C without unacceptable changes in its characteristics. The test setup shall comply with the circuit diagram given in Figure 7.	L-N: U _C =250Vac; N-PE: U _C =250Vac	P
	Determination of the measured limiting voltage:	See below	
	according to 8.3.3.1, but only at a crest value corresponding to I _{imp} for test class I	Class III SPD	N/A
	according to 8.3.3.1, but only at I _n for test class II	Class III SPD	N/A
	according to 8.3.3.3, but only at U _{OC} for test class III	L-N: Max. 971.0V N-PE: Max. 536.3V	P

IEC 61643-11 - TEST SEQUENCE 1			
Clause	Requirement - Test	Result - Remark	Verdict
	SPDs tested acc. to class I and II containing switching components: Front-of-wave sparkover voltage acc. to 8.3.3.2 All measured peak values (5 pos./5 neg.) below U_P		N/A
	Sample connected to power frequency source at U_C	L-N: $U_C=250Vac$; N-PE: $U_C=250Vac$	P
8.3.4.2.1	SPDs with follow current < 500A: Voltage at SPD terminals does not fall below the peak value of U_C by more than 10% during flow of follow current		P
8.3.4.2.2	SPDs with follow current > 500A: 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 8, or 500A, whichever is greater. For SPDs connected between neutral and protective earth only, the prospective short-circuit current shall be at least 100A.		N/A
8.3.4.3	Class I and II operating duty tests		N/A
	Three groups of five impulses of 8/20 current impulses with positive polarity shall be applied. The test samples are connected to a power source according to 8.3.4.2. Each impulse shall be increased in steps of 30° with a tolerance of ± 5° for each synchronisation angle. time interval between the impulses 50s – 60s time interval between the groups 30 min – 35 min	Class III SPD	N/A
	The SPD shall be energized at U_C . The prospective short-circuit current of the power source shall comply with 8.3.4.2 during the application of groups of impulses. After the application of each group of impulses and after the interruption of the last follow current (if any) the SPD shall remain energized without interruption for at least 1 min to check for reignition. After the last group of impulses and the 1 min period the SPD either remains applied or is reapplied within less than 30s to U_C for another 15 min to check for stability. For that purpose, the short-circuit capability of the power source (at U_C) may be reduced to 5A.		N/A
	When testing SPDs to class I, 8/20 current impulses with a crest corresponding to I_{imp} shall be applied.		N/A
	When testing SPDs to class II, 8/20 current impulses with I_n shall be applied.		N/A
	Current records show no sign of puncture or flashover of the sample		N/A
8.3.4.5	Class III operating duty tests	Class III SPD	P
	The SPD is tested with three groups of impulses corresponding to UOC with: five positive impulses initiated at crest value of positive half cycle (±5°) five negative impulses initiated at crest value of positive half cycle (±5°) five positive impulses initiated at crest value of positive half cycle (±5°)	Detail waves see Attachment 1.	P

IEC 61643-11 - TEST SEQUENCE 1			
Clause	Requirement - Test	Result - Remark	Verdict
8.3.4.4	Additional duty test for test class I	Class III SPD	N/A
	This test is carried out with current impulses in steps up to I_{imp} passing through the SPD. SPD energized at U_C by a voltage source having a nominal current capability of 5A during the application of impulses.		N/A
	Current impulses of positive polarity shall be initiated in the corresponding positive crest value of the power frequency voltage source to the energized test sample as follows: a) One current impulse at $0,1 I_{imp}$ b) One current impulse at $0,25 I_{imp}$ c) One current impulse at $0,5 I_{imp}$ d) One current impulse at $0,75 I_{imp}$ e) One current impulse at $1,0 I_{imp}$		N/A
	After each impulse cool down to ambient temperature		N/A
8.3.4.6	Pass criteria	See below	
A	After the application of each impulse and after interruption of each follow current (if any) the SPD shall remain energized without interruption for at least 1 min to check for re-ignition. After that period the SPD either remains applied or is reapplied within less than 30s to U_C for another 15 min to check for stability. For that purpose the short-circuit capability of the power source shall also be 5A.	L-N: 0.91mA N-PE:0.04mA	P
B	Voltage and current records and visual inspection show no sign of puncture or flashover.	No sign of puncture and flashover	P
C	No mechanical damage	No damaged	P
D	Determination of the measured limiting voltage:	$U_p \leq 1.3 \text{ kV}$	P
	according to 8.3.3.1, but only at a crest value corresponding to I_{imp} for test class I	Class III SPD	N/A
	according to 8.3.3.1, but only at I_n for test class II	Class III SPD	N/A
	according to 8.3.3.3, but only at U_{OC} for test class III	L-N : Max. 971.4V N-PE : Max. 534.4V	P
	SPDs tested acc. to class I and II containing switching components: Front-of-wave sparkover voltage acc. to 8.3.3.2 All measured peak values (5 pos./5 neg.) below U_P		N/A
E	No excessive leakage currents shall occur after the test		P
	If there is more than one possible connection arrangement for normal use, this check shall be performed for all arrangements		N/A

IEC 61643-11 - TEST SEQUENCE 1			
Clause	Requirement - Test	Result - Remark	Verdict
	<p>The SPD shall be connected as for normal use according to the manufacturer's instructions to a power supply at the reference test voltage (U_{REF}). The current that flows through each terminal is measured. Its resistive component (measured at the crest of the sine wave)</p> <ul style="list-style-type: none"> • shall not exceed a value of 1 mA <p>or</p> <ul style="list-style-type: none"> • the current shall not have changed by more than 20% compared to the initial value determined at the beginning of the test sequence 	<p>$U_{REF} = 255 \text{ V}$</p> <p>Before current is: L-N: 0.91mA; N-PE: 0.04mA</p> <p>After test the current is: L-N: 0.91mA; N-PE: 0.04mA</p> <p>Current not changed by more than 20%</p>	P
	<p>Any resettable or rearmable disconnecter shall be switched off and dielectric withstand shall be checked by application of two times U_C or 1000V a.c. whichever is greater.</p> <p>During the test, no flashover, breakdown of insulation or any other manifestation of disruptive discharge shall occur.</p>	No such disconnecter	N/A
	<p>For SPD modes connected N-PE only, the current through the PE-terminal shall be measured, whereas the terminals are connected to a power supply at U_C.</p> <p>Its resistive component (measured at the crest of the sine wave)</p> <ul style="list-style-type: none"> • shall not exceed a value of 1 mA <p>or</p> <ul style="list-style-type: none"> • the current shall not have changed by more than 20% compared to the initial value determined at the beginning of the test sequence 	<p>N-PE $U_C = 250 \text{ V(N-PE)}$</p> <p>Before current is: $I_{PE} = 0.04 \text{ mA}$</p> <p>After test the current is: $I_{PE} = 0.04 \text{ mA}$</p> <p>Current not changed by more than 20%</p>	P
F	External disconnectors shall not operate during the test and shall be in working order after the test.	No external disconnecter	N/A
G	Internal disconnectors shall not operate during the test and shall be in working order after the test.	Internal disconnectors not operated	P
M	There shall be no explosion or other hazard to either personnel or the facility.	No explosion and other hazard	P
7.2.5.2	Thermal protection		
	SPDs shall be protected against overheating due to degradation or overstress		P
	This test is not performed on SPDs containing only switching components and/or ABD devices.		N/A
7.2.5.4	Status indicator	LED Light	P
	The manufacturer shall provide information about the function of the indicator and the actions to be taken after change of status indication.	LED light off when SPD breakdown	P
	A status indicator may be composed of two parts (one of which is not replaced on replacement of the SPD), linked by a coupling mechanism which can be mechanical, optical, audio, electromagnetic, etc. The part of the status indicator which is not replaced shall be capable of operating at least 50 times.		P
	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.	No appropriate standard	N/A

IEC 61643-11 - TEST SEQUENCE 1			
Clause	Requirement - Test	Result - Remark	Verdict
8.3.5.2	Thermal stability	See below	
	If 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 path. If components of the same type and parameters are connected in parallel, they shall be tested as one current path.	No such circuit	N/A
	Any voltage switching component within the current path under test, which is connected in series with a voltage limiting component shall be short-circuited by a cooper dummy with a diameter such that it does not melt during the test.	No such circuit	N/A
	Test for SPDs containing only voltage limiting components - procedure a)	L-N mode	
	Sample connected to power frequency source with a voltage high enough to drive a constant current, which is increased by the following steps – 2mA or 5% of the previously adjusted test current, whichever is greater – with a tolerance of $\pm 10\%$: <u>2</u> mA r.m.s. or corresponding crest value <u>4</u> mA r.m.s. or corresponding crest value <u>6</u> mA r.m.s. or corresponding crest value <u>8</u> mA r.m.s. or corresponding crest value <u>10</u> mA r.m.s. or corresponding crest value <u>12</u> mA r.m.s. or corresponding crest value <u>14</u> mA r.m.s. or corresponding crest value	duration min.:sec. <u>19:31</u> <u>19:32</u> <u>19:29</u> <u>19:33</u> <u>18:08</u> <u>11:33</u> <u>00:54</u>	P
	Each step is maintained until thermal equilibrium is reached – temperature variation < 2K within 10 min		P
	Surface temperature of the hottest spot and current through the SPD are monitored continuously		P
	Test interrupted if all non-linear components under test are disconnected. The voltage is not increased further in order to avoid any malfunction of the disconnectors.		P
	For the other two samples the starting point shall be changed from 2 mA to a current corresponding to 5 steps below the current value at which the first sample disconnected		P
	If the voltage across the SPD falls below U_{REF} during the test, the current regulation is discontinued and the voltage is adjusted back to U_{REF} and maintained for a duration of 15 min. Continuous current monitoring is no longer required. Source short-circuit current capability does not limit the current before any disconnector operates. The maximum available current value does not exceed the short circuit withstand capability declared by the manufacturer.	No occur this status	N/A

IEC 61643-11 - TEST SEQUENCE 1			
Clause	Requirement - Test	Result - Remark	Verdict
	Test for SPDs having a voltage switching component in series with other components – procedure b)	No such construction	
	SPD energized with a power frequency source at U_{REF} having a short-circuit current capability which will not limit the current before any disconnector operates. The maximum available current value does not exceed the short-circuit withstand capability declared by the manufacturer.		N/A
	If no significant current flows – test procedure a) shall be followed		N/A
	Pass criteria	See below	
C	No mechanical damage	No damaged	P
H	Disconnection shall be provided by one or more internal or external disconnector(s). Their correct indication shall be checked.	Internal disconnector have operated	P
I	SPDs having an IP degree \geq IP 2X – no live parts accessible with standardised test finger applied with a force of 5N, except the ones which are accessible when the SPD is fitted as in normal use.	No live parts could be accessible	P
J	If disconnection occurs during the test, there shall be clear evidence of effective disconnection of the corresponding protective component(s). If internal disconnection occurs, the test sample is connected at U_C and rated frequency for 1 min. The current flow shall not exceed a value of 1 mA.	<u>250</u> Vac <u>0</u> mA	P
	Currents through components connected in parallel to the relevant protective component(s), are disregarded for this measurement.		P
	Current through the PE-terminal shall not exceed 1mA If there is more than one possible connection arrangement for normal use, this check shall be performed for all arrangements.	<u>0</u> mA	P
M	There shall be no explosion or other hazard to either personnel or the facility	No explosion and other hazard	P
O	After completion of this test the samples shall be allowed to return to room temperature and be connected to a power source at U_C for 2 hours. The residual current shall be monitored and not exceed the value measured at the beginning of the test by more than 10%.	$U_C=250$ Vac, 2hours, Measured residual current is 0mA Beginning of test measure residual current is 0.91mA Current not changed by more than 20%	P
	In addition for indoor SPDs the surface temperature rise shall not exceed 120K during and after the test. 5 min. after disconnection of all non-linear components under test the surface temperature rise shall not exceed 80K.	<u>46.2</u> K <120K <u>26.0</u> K < 80K	P
7.3.4/8.4.3	Verification of air clearances and creepage distances		
	SPDs for domestic and similar applications shall be designed for pollution degree 2.	Pollution degree 2	P
	SPDs for more stringent environmental applications may require special precautions, e.g. an appropriate SPD housing or an additional enclosure, which will ensure pollution degree 2 for the SPD	Pollution degree 2	N/A

IEC 61643-11 - TEST SEQUENCE 1			
Clause	Requirement - Test	Result - Remark	Verdict
	For SPDs for outdoor and out of reach applications pollution degree 4 applies. This may be reduced to pollution degree 3 for internal distances, if they are covered by an adequate housing ensuring pollution degree 3 conditions.	Indoor SPD	N/A
	The electrode spacing of spark gaps shall not be considered for the determination of air clearances and creepage distances.		P
	The air clearances and creepage distances shall not be smaller than the values indicated in Table 15 and Table 16.		N/A
	<p>Air clearances in millimetres</p> <p>1) Between live parts of different polarity</p> <p>2) Between live parts and</p> <ul style="list-style-type: none"> – screws and other means to fasten a covering, having to be detached for mounting the SPD – fastening surfaces (note 2) – screws or other means for fastening the SPD (note 2) – bodies (notes 1 and 2) <p>3) Between the metal parts of the disconnecting mechanism and</p> <ul style="list-style-type: none"> – bodies (note 1) – screws or other means for fastening the SPD <p>NOTE 1 – Definition see 8.3.6 a)</p> <p>NOTE 2 – If clearances between live parts of the device and the metallic screen or the surface on which the SPD is mounted are dependent on the design of the SPD only and cannot be reduced when the SPD is mounted in the least favourable position (even in a metallic enclosure), the values of lines 1 are sufficient.</p> <p>Creepage distances in millimetres</p> <ul style="list-style-type: none"> – r.m.s. voltage – Material group – Pollution – distances required <p>Printed wiring material</p> <ul style="list-style-type: none"> – r.m.s. voltage – Material group – Pollution – distances required 	<p><u>U_{max} 971.0V</u> measured / required <u>3.78mm / 3mm</u></p> <p>____ / ____ ____ / ____ ____ / ____ ____ / ____</p> <p>____ / ____ ____ / ____</p> <p>250Vac IIIb 2 3mm</p> <p>250Vac IIIb 2 <u>3.78mm / 2.5mm</u></p>	P
7.4.2/8.5.3	Ball pressure test		
	Outer parts of SPDs, consist of insulating material, are submitted to a ball pressure test by means of a tester as shown on Figure 20 and 21.		P
	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.	Plastic Enclosure 125°C	P
	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/A

IEC 61643-11 - TEST SEQUENCE 1			
Clause	Requirement - Test	Result - Remark	Verdict
	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.	5 mm, 20 N	P
	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.		P
	Pass criteria		
	The diameter of the ball indentation is measured and shall not exceed 2 mm.	Measured: <u>1.72</u> mm	P
7.4.3/8.5.4	Resistance to abnormal heat and fire		
	Insulating parts of the housing shall be either non-flammable or self-extinguishing. The glow wire test is performed in accordance with Clauses 4 to 10 of IEC 60695-2-11 under the following conditions: <ul style="list-style-type: none"> 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 °C ± 15 K. for all other external parts made of insulating material, by the test made at a temperature of 650 °C ± 10 K. 	Plastic Enclosure: 850°C	P
	The test is not made on parts of ceramic material and parts with lower size than defined in 3.1 of IEC 60695-2-11.	No such material	N/A
	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.	Plastic enclosure was made of the same material	P
	The test is made on one sample		P
	In case of doubt, the test is repeated on two additional samples.	No doubt	N/A
	The test is made by applying the glow-wire once.		P
	The sample shall be positioned during the test in the least favourable position of its intended use (with the surface tested in a vertical position).		P
	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.		P
	Pass criteria		P
	The sample is regarded as having passed the glow-wire test if <ul style="list-style-type: none"> there is no visible flame and no sustained glowing or if, flames and glowing parts on the sample extinguish themselves within 30 s after the removal of the glow-wire. 	Flames and glowing parts on the sample extinguish themselves within 30 s after the removal of the glow-wire	P
	There shall be no ignition of the tissue paper or scorching of the pinewood board.	No ignition of the tissue paper and scorching of the pinewood board.	P

IEC 61643-11 - TEST SEQUENCE 1			
Clause	Requirement - Test	Result - Remark	Verdict
7.4.4/8.5.5	Tracking resistance		
	The test is performed according to IEC 60112, solution A with a test voltage depending on the measured creepage distances and the required material group according to 8.3.4.	Enclosure IIIb test voltage is 175V	P



IEC 61643-11 - TEST SEQUENCE 2			
Clause	Requirement - Test	Result - Remark	Verdict
7.2.3/8.3.3	Voltage protection level		
	The measured limiting voltage of the SPDs shall not exceed the voltage protection level that is specified by the manufacturer.	$U_p \leq 1.3 \text{ kV}$	P
	All one-port SPDs shall be tested unenergized.	One-port SPD	P
	All two-port SPDs shall be tested energized for the tests according 8.3.3.1 and 8.3.3.3 by means of a voltage source having a nominal current of at least 5 A at U_c . Positive impulses are applied at the $(90 \pm 5)^\circ$ point and negative impulses at $(270 \pm 5)^\circ$ point on the sinusoidal voltage waveform.	One-port SPD	N/A
	For a one-port SPD having terminals, the test is performed without external disconnectors and the voltage is measured at the terminals. For a one-port SPD having connecting leads the voltage is measured with external lead lengths of 150mm. For a two-port SPD, and a one-port SPD having separate load terminals, the voltage for determining the measured limiting voltage is measured at the output/load port or load terminals of the SPD and the voltage for determining U_{max} is measured at the input/line port or terminals of the SPD.		P
8.3.3.1	Residual voltage with 8/20 current impulses	Class III SPD	
	Class I, 8/20 current impulses with a sequence of crest values of 0,1; 0,2; 0,5; 1,0 times the crest value of I_{imp} shall be applied. 0,1 times I_{imp} 0,2 times I_{imp} 0,5 times I_{imp} 1,0 times I_{imp} Class II, 8/20 current impulses with a sequence of crest values of 0,1; 0,2; 0,5; 1,0 times I_n shall be applied. 0,1 times I_n 0,2 times I_n 0,5 times I_n 1,0 times I_n If the SPD contains only voltage-limiting components, this test needs only to be performed at a crest values of I_{imp} for test class I or I_n for test class II.		N/A
	When I_{max} is declared by the manufacturer an additional 8/20 current impulse with a crest value of I_{max} shall be applied and the residual voltage shall be measured and recorded.		N/A
	One sequence of positive polarity and one sequence of negative polarity are applied to the SPD		N/A
	The interval between individual impulses shall be long enough for the sample to cool down to ambient temperature.		N/A
	Current and voltage oscillogram		N/A
	Crest values – discharge current versus residual voltage diagram to I_n or I_{imp}		N/A

IEC 61643-11 - TEST SEQUENCE 2			
Clause	Requirement - Test	Result - Remark	Verdict
	The residual voltage used for determining the measured limiting voltage is the highest voltage value corresponding to the range of currents for: <ul style="list-style-type: none"> class I: up to I_{imp} class II: up to I_n 		N/A
	The value for determining U_{max} is the highest residual voltage measured at I_n , I_{max} or I_{imp} , as applicable depending on the SPD test class.		N/A
8.3.3.2	Front-of-wave sparkover voltage		
	The 1,2/50 voltage impulse is used. The generator 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/A
	The interval between individual impulses shall be long enough for the sample to cool down to ambient temperature.		N/A
	If sparkover is not observed during each of the 10 impulses on the front of wave, then the above procedure are repeated with the generator output voltage increased up to a maximum 10 kV.		N/A
	Voltage oscillograms		N/A
	The value for determining the measured limiting voltage and U_{max} is the maximum sparkover voltage recorded during this test.		N/A
8.3.3.3	Limiting voltage with the combination wave	Class III SPD	
	To perform this test a combination wave generator is used. The interval between the individual impulses shall be long enough for the sample to cool down to ambient temperature.		P
	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} . If the SPD only contains voltage-limiting components this test needs to be carried out at U_{oc} only. 0,1 times U_{oc} <u>0.6</u> kV 0,2 times U_{oc} <u>1.2</u> kV 0,5 times U_{oc} <u>3</u> kV 1,0 times U_{oc} <u>6</u> kV		P
	With these generator settings four surges will be applied to the SPD at each amplitude: two with positive and two with negative polarity.		P
	Current-voltage oscillograms; voltage at the output port of the SPD		P
	The value for determining the measured limiting voltage and U_{max} is the maximum voltage recorded during the test.	Measured residual voltage: L-N: Max. <u>971.0</u> V N-PE: Max. <u>536.3</u> V Detail waves see Attachment 2.	P
8.3.3.4	Pass criteria for all measured limiting voltage tests	See below	
B	Voltage and current records and visual inspection show no sign of puncture or flashover.	No sign of puncture and flashover	P

IEC 61643-11 - TEST SEQUENCE 2			
Clause	Requirement - Test	Result - Remark	Verdict
C	No mechanical damage	No damaged	P
I	SPDs having an IP degree \geq IP 2X – no live parts accessible with standardised test finger applied with a force of 5N, except the ones which are accessible when the SPD is fitted as in normal use.	IP20	P
M	There shall be no explosion or other hazard to either personnel or the facility	No explosion and other hazard	P



IEC 61643-11 - TEST SEQUENCE 2a			
Additional tests if declared by the manufacturer			
Clause	Requirement - Test	Result - Remark	Verdict
7.6.2.2/8.7.3	Load-side surge withstand capability	Manufacturer not specified	
	For this test: <ul style="list-style-type: none"> • 15 current impulses 8/20 or, • 15 combination wave impulses with an open-circuit voltage U_{OC} 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° the synchronization angle shall be increased in steps of $(30 \pm 5)^\circ$.		N/A
	The interval between the impulses is 50 s to 60 s and the interval between the groups is 30 min to 35 min.		N/A
	The test sample shall be energized during the whole test sequence. The voltage on the output terminals shall be recorded.		N/A
	Pass criteria		
A	Thermal stability shall be achieved		N/A
B	Voltage and current records and visual inspection show no sign of puncture or flashover.		N/A
C	No mechanical damage		N/A
D	Determination of the measured limiting voltage:		
	according to 8.3.3.1, but only at a crest value corresponding to I_{imp} for test class I		N/A
	according to 8.3.3.1, but only at I_n for test class II		N/A
	according to 8.3.3.3, but only at U_{OC} for test class III		N/A
	SPDs tested acc. to class I and II containing switching components: Front-of-wave sparkover voltage acc. to 8.3.3.2 All measured peak values (5 pos./5 neg.) below U_P		N/A
E	No excessive leakage currents shall occur after the test		
	If there is more than one possible connection arrangement for normal use, this check shall be performed for all arrangements		N/A
	The SPD shall be connected as for normal use according to the manufacturer's instructions to a power supply at the reference test voltage (U_{REF}). The current that flows through each terminal is measured. Its resistive component (measured at the crest of the sine wave) <ul style="list-style-type: none"> • shall not exceed a value of 1 mA or <ul style="list-style-type: none"> • the current shall not have changed by more than 20% compared to the initial value determined at the beginning of the test sequence 		N/A
	Any resettable or rearmable disconnecter shall be switched off and dielectric withstand shall be checked by application of two times U_C or 1000V a.c. whichever is greater. During the test, no flashover, breakdown of insulation or any other manifestation of disruptive discharge shall occur.		N/A

IEC 61643-11 - TEST SEQUENCE 2a			
<i>Additional tests if declared by the manufacturer</i>			
Clause	Requirement - Test	Result - Remark	Verdict
	<p>For SPD modes connected N-PE only, the current through the PE-terminal shall be measured, whereas the terminals are connected to a power supply at U_C.</p> <p>Its resistive component (measured at the crest of the sine wave)</p> <ul style="list-style-type: none"> • shall not exceed a value of 1 mA <p>or</p> <ul style="list-style-type: none"> • the current shall not have changed by more than 20% compared to the initial value determined at the beginning of the test sequence 		N/A
F	External disconnectors shall not operate during the test and shall be in working order after the test.		N/A
G	Internal disconnectors shall not operate during the test and shall be in working order after the test.		N/A



IEC 61643-11 - TEST SEQUENCE 2b			
Additional tests for two-port SPDs and one port-SPDs with separate input / output terminals			
Clause	Requirement - Test	Result - Remark	Verdict
7.5.1.3	Load-side short-circuit current behaviour		
	The SPD shall be able to carry the currents caused by a power short-circuit on the load side until it is interrupted either by the SPD itself or by an internal or external disconnecter.	Internal disconnecter have operated	P
8.6.1.3	This test applies to all SPDs, except those classified for outdoor use and mounted out of reach and those connected N-PE for use in TN and/or TT systems only.	Indoor SPD	P
	The test settings and the test procedure according to 8.3.5.3 (excluding 8.3.5.3.1) are repeated without short-circuiting any components, but with a short-circuit link connected to the following output terminals of the SPD as applicable: <ul style="list-style-type: none"> short-circuit link across all phase terminals and the neutral terminal (if applicable) on the load side short-circuit link across all terminals on the load side, with a conductors of the largest cross-section specified under 8.4.2 and with a length of 500 mm each. 		P
	Pass criteria	See below	
C	No mechanical damage	No damaged	P
E	No excessive leakage currents shall occur after the test		P
	If there is more than one possible connection arrangement for normal use, this check shall be performed for all arrangements		P
	The SPD shall be connected as for normal use according to the manufacturer's instructions to a power supply at the reference test voltage (U_{REF}). The current that flows through each terminal is measured. Its resistive component (measured at the crest of the sine wave) <ul style="list-style-type: none"> shall not exceed a value of 1 mA or <ul style="list-style-type: none"> the current shall not have changed by more than 20% compared to the initial value determined at the beginning of the test sequence 	$U_{REF} = 255 \text{ V}$ Before current is: L-N: 0.54mA; N-PE: 0.04mA After test the current is: L-N: 0mA; N-PE: 0mA Current not changed by more than 20%	P
	Any resettable or rearmable disconnecter shall be switched off and dielectric withstand shall be checked by application of two times U_C or 1000V a.c. whichever is greater. During the test, no flashover, breakdown of insulation or any other manifestation of disruptive discharge shall occur.	No such disconnecter	N/A
	For SPD modes connected N-PE only, the current through the PE-terminal shall be measured, whereas the terminals are connected to a power supply at U_C . Its resistive component (measured at the crest of the sine wave) <ul style="list-style-type: none"> shall not exceed a value of 1 mA or <ul style="list-style-type: none"> the current shall not have changed by more than 20% compared to the initial value determined at the beginning of the test sequence 	$U_C = 250 \text{ V (N-PE)}$ Before current is: $I_{PE} = 0.04 \text{ mA}$ After test the current is: $I_{PE} = 0 \text{ mA}$	P
H	Disconnection shall be provided by one or more internal or external disconnecter(s). Their correct indication shall be checked.		P

IEC 61643-11 - TEST SEQUENCE 2b			
Additional tests for two-port SPDs and one port-SPDs with separate input / output terminals			
Clause	Requirement - Test	Result - Remark	Verdict
I	SPDs having an IP degree \geq IP 2X – no live parts accessible with standardised test finger applied with a force of 5N, except the ones which are accessible when the SPD is fitted as in normal use.		P
J	If disconnection occurs during the test, there shall be clear evidence of effective disconnection of the corresponding protective component(s). If internal disconnection occurs, the test sample is connected at U_C and rated frequency for 1 min. The current flow shall not exceed a value of 1 mA.	<u>250</u> V <u>0</u> mA	P
	Currents through components connected in parallel to the relevant protective component(s), are disregarded for this measurement.		P
	Current through the PE-terminal shall not exceed 1mA If there is more than one possible connection arrangement for normal use, this check shall be performed for all arrangements.	<u>0</u> mA	P
K	The short-circuit current from the power source, if any, shall be interrupted within 5 s by one or more internal and/or external disconnector(s).		P
M	There shall be no explosion or other hazard to either personnel or the facility.	No explosion and other hazard	P
N	There shall be no flashover to the metallic screen and the 6 A gL/gG fuse connecting the screen shall not operate during the test.	No flashover and the fuse no operation	P
	a) Internal disconnector(s) have operated:		P
	After removing the short-circuit links from output terminals and with U_{REF} applied according to the circuit shown in Figure 22, there shall be no voltage on the output terminals.	No voltage on the output terminals	P
	With a power frequency voltage equal to two times U_C applied between all corresponding input and output phase terminals for 1 min there shall be no current flow in excess of 0,5 mA.	<u>0</u> mA	P
	b) No internal disconnector has operated:		
D	Determination of the measured limiting voltage:		N/A
	according to 8.3.3.1, but only at a crest value corresponding to I_{imp} for test class I		N/A
	according to 8.3.3.1, but only at I_n for test class II		N/A
	according to 8.3.3.3, but only at U_{oc} for test class III		N/A
	SPDs tested acc. to class I and II containing switching components: Front-of-wave sparkover voltage acc. to 8.3.3.2 All measured peak values (5 pos./5 neg.) below U_P		N/A

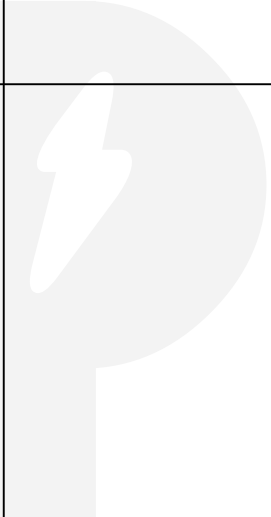
IEC 61643-11 - TEST SEQUENCE 3			
Clause	Requirement - Test	Result - Remark	Verdict
7.2.6/8.3.6	Insulation resistance		
	The insulation resistance of the SPD shall be sufficient with respect to leakage currents and protection against direct contact. This test is not applicable to SPDs having a metallic enclosure connected to protective earth.		P
	Additional entry holes for cables, if there are any, are left open. If there are any knockouts, one of them is opened. Coverings and other parts which are detachable without tools, are removed and undergo the same moisture treatment.	No such entry holes	N/A
	The moisture treatment is carried out in a humidity cabinet at a relative humidity of 93% ± 3% RH. The air temperature is kept at all points, where the test sample can be positioned, within ± 2 K at a suitable temperature 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.	Relative humidity: 93 % Temperature: 25°C	P
	The samples shall be kept in the humidity cabinet for 2 days (48 h).	48 h	P
	After a delay 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.	500 Vdc	P
	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 refitted the parts which might have been detached. a) between all interconnected live parts and the SPDs body accessible to accidental contact. The express "body" in the sense of this test means <ul style="list-style-type: none"> • all touchable metal parts and a metal foil on surfaces of insulating material, which are touchable after installation as for normal use, • the surface on which the SPD is mounted, if necessary covered with metal foil, • screws and other facilities for fastening the SPD on its support Fore these measurements, the metal foil is put on in such a way, that perhaps existing casting mass is effectively tested. Protective components connected to PE may be disconnected for this test b) between the live parts of the SPD main circuit and live parts of separate isolated circuits, if there are any.	Test between all interconnected live parts and the SPD's body	P
	Pass criteria		
	The insulation resistance shall not be lower than <ul style="list-style-type: none"> • 5 MΩ for the measurements according to a), • 2 MΩ for the measurements according to b). 	a) <u>1000</u> MΩ	P
7.2.7/8.3.7	Dielectric withstand		
	The dielectric withstand of the SPD shall be sufficient with respect to insulation breakdown and protection against direct contact.		P
	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.	Indoor use	N/A
	SPDs classified for indoor are tested as indicated in a) and b) of 8.3.6.		P

IEC 61643-11 - TEST SEQUENCE 3			
Clause	Requirement - Test	Result - Remark	Verdict
	<p>SPDs are tested with an a.c. voltage according to Table 9. Starting with not more than half the required a.c. voltage, this voltage is increased to the full value within 30 s which is maintained for 1 min.</p> <p>a) between all interconnected live parts and the SPDs body accessible to accidental contact. The express "body" in the sense of this test means</p> <ul style="list-style-type: none"> • all touchable metal parts and a metal foil on surfaces of insulating material, which are touchable after installation as for normal use, • the surface on which the SPD is mounted, if necessary covered with metal foil, • screws and other facilities for fastening the SPD on its support <p>Fore these measurements, the metal foil is put on in such a way, that perhaps existing casting mass is effectively tested.</p> <p>Protective components connected to PE may be disconnected for this test.</p> <p>b) between the live parts of the SPD main circuit and live parts of separate isolated circuits, if there are any.</p>	<p>the test voltage: 2.2 kV; Test between all interconnected live parts and the SPD's body</p>	P
	Pass criteria		
	Arcin, however, partial dischg or puncturing shall not occur charges are accepted if the voltage change the discharge is less than 5%.		P
	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 $\pm 3\%$.		P
7.3.5/8.4.4	Mechanical strength		
	All parts of the SPD relating to the protection against direct contact shall have sufficient mechanical strength.		P
	The samples are subjected to strikes by means of an impact-test apparatus as shown in Figure 18 and Figure 19.		P
	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.		P
	Portable SPDs are tested as fixed SPDs, but they are fixed to the plywood sheet by auxiliary means.		N/A
	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.)		P
	If wood is used for the block, the direction of the wood fibres shall be perpendicular to the direction of the impact.		N/A
	Flush-type screw fixing SPDs shall be fixed by means of screws to lugs recessed in the block.		N/A
	Flush-type claw fixing SPDs shall be fixed to the block by means of the claws.		N/A
	Before applying the strikes, fixing screw of bases and covers are tightened with a torque equal to two-thirds of that specified in Table 10.		P

IEC 61643-11 - TEST SEQUENCE 3									
Clause	Requirement - Test	Result - Remark	Verdict						
	<p>The samples are mounted so that the point of impact lies in the vertical plane through the axis of the pivot. The striking element is allowed to fall from a height which is specified in the following Table 18:</p> <table style="margin-left: 40px;"> <tr> <td>parts A and B</td> <td>h = 100 mm</td> </tr> <tr> <td>parts C</td> <td>h = 150 mm</td> </tr> <tr> <td>parts D</td> <td>h = 200 mm</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>	parts A and B	h = 100 mm	parts C	h = 150 mm	parts D	h = 200 mm	<p><u>100mm</u></p> <p>—</p> <p><u>200 mm</u></p>	P
parts A and B	h = 100 mm								
parts C	h = 150 mm								
parts D	h = 200 mm								
	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		P						
	The samples are subjected to strikes which are evenly distributed over the samples. The strikes are not applied to “knock-out” areas.		P						
	<p>The following blows are applied:</p> <ul style="list-style-type: none"> • 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; • for parts B (as far as applicable), C and D, four blows: <ul style="list-style-type: none"> – one on one side of the sample 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; – one blow on each of the other two sides of the sample, with the plywood sheet turned 60° in the opposite direction. 		P						
	Pass criteria								
	After the test, the sample shows no damage within the meaning of the standard. In particular, live parts have not become accessible with the standard test finger.		P						
	Damage to the finish small dents which do not reduce creepage distances or clearances and small chips which do not adversely affect the protection against electric shock or harmful ingress of water are neglected		P						
	Cracks not visible with the normal or corrected vision, without additional magnification, and surface cracks in fibre reinforced mouldings and the like are ignored.		P						

IEC 61643-11 - TEST SEQUENCE 3			
Clause	Requirement - Test	Result - Remark	Verdict
7.2.5/8.3.5.1	Temperature withstand		
	The SPD is kept in a heated cabinet at an ambient temperature of 80 °C ± 5 K for 24 h.	80°C, 24h	P
	Pass criteria		
C	No mechanical damage		P
G	Internal disconnectors shall not operate during the test and shall be in working order after the test.		P
Remarks:			



IEC 61643-11 - TEST SEQUENCE 3a			
Additional tests for SPDs with separate isolated circuits			
Clause	Requirement - Test	Result - Remark	Verdict
7.5.3	Where a SPD includes a circuit that 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 that the manufacturer is claiming conformity with.	SPD without separate isolated circuits.	N/A
	Where there are more than two circuits, declarations shall be made with regard to each combination of circuits.		N/A
8.3.6	Insulation resistance		
	The moisture treatment is carried out in a humidity cabinet at a relative humidity of 93% ± 3% RH. The air temperature is kept at all points, where the test sample can be positioned, within ± 2 K at a suitable temperature 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.		N/A
	The samples shall be kept in the humidity cabinet for 2 days (48 h).		N/A
	After a delay 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/A
	<p>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 refitted the parts which might have been detached.</p> <p>a) between all interconnected live parts of the separate circuits and the SPDs body accessible to accidental contact.</p> <p>The express "body" in the sense of this test means</p> <ul style="list-style-type: none"> • all touchable metal parts and a metal foil on surfaces of insulating material, which are touchable after installation as for normal use, • the surface on which the SPD is mounted, if necessary covered with metal foil, • screws and other facilities for fastening the SPD on its support <p>Fore these measurements, the metal foil is put on in such a way, that perhaps existing casting mass is effectively tested.</p> <p>Protective components connected to PE may be disconnected for this test</p> <p>b) between each combination of separate isolated circuits of the SPD, if there is more than one.</p>		N/A
	Pass criteria		
	The insulation resistance shall not be lower than <ul style="list-style-type: none"> • 5 MΩ for the measurements according to a), • 2 MΩ for the measurements according to b). 		N/A
8.3.7	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.		N/A
	SPDs classified for indoor are tested as indicated in a) and b) of 8.3.6.		N/A

IEC 61643-11 - TEST SEQUENCE 3a			
Additional tests for SPDs with separate isolated circuits			
Clause	Requirement - Test	Result - Remark	Verdict
	<p>SPDs are tested with an a.c. voltage according to Table 9. Starting with not more than half the required a.c. voltage, this voltage is increased to the full value within 30 s which is maintained for 1 min.</p> <p>a) between all interconnected live parts of the separate circuits and the SPDs body accessible to accidental contact.</p> <p>The express "body" in the sense of this test means</p> <ul style="list-style-type: none"> • all touchable metal parts and a metal foil on surfaces of insulating material, which are touchable after installation as for normal use, • the surface on which the SPD is mounted, if necessary covered with metal foil, • screws and other facilities for fastening the SPD on its support <p>Fore these measurements, the metal foil is put on in such a way, that perhaps existing casting mass is effectively tested.</p> <p>Protective components connected to PE may be disconnected for this test.</p> <p>b) between each combination of separate isolated circuits of the SPD, if there is more than one.</p>		N/A
	Pass criteria		
	Arcing or puncturing shall not occur, however, partial discharges are accepted if the voltage change the discharge is less than 5%.		N/A
	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 $\pm 3\%$.		N/A

IEC 61643-11 - TEST SEQUENCE 3b			
<i>Additional tests if declared by the manufacturer</i>			
Clause	Requirement - Test	Result - Remark	Verdict
7.6.2.1/8.7.2	Test to determine the voltage drop (two port SPDs)	One port SPD	
	U _c supplied at the input port SPD loaded with rated load current into a resistive load Input and output voltage measured simultaneously to determine the percentage voltage regulation $\Delta U\% = ((U_{in} - U_{out}) / U_{in}) * 100\%$		N/A
	Pass criteria		
C	No mechanical damage		N/A



IEC 61643-11 - TEST SEQUENCE 3c			
Additional tests for two-port SPDs and one-port SPDs with separate input / output terminals			
Clause	Requirement - Test	Result - Remark	Verdict
7.5.1.1/ 8.6.1.1	Rated load current (I_L)		P
	The SPD shall be powered at a voltage $U_C^{+0/-5\%}$ at ambient temperature, using a cable with a nominal cross-section as specified in Table 19. The test shall be conducted with rated load current into a resistive load until thermal stability is reached. Additional cooling of the SPD is not permitted.	250V 16A	P
	Pass criteria		
	Value complies with the manufacturers		P
	External disconnectors shall not operate during the test and shall be in working order after the test.	No external disconnectors	N/A
	Internal disconnectors shall not operate during the test and shall be in working order after the test.		P
	The temperature rise of surfaces which are accessible in normal use shall not exceed the values described in Annex G during the test. Parts of SPD: <ul style="list-style-type: none"> • Built-in components • Terminals for external insulated conductors • Busbars and conductors, plug-in contacts of removable or withdrawable parts which connect to busbars • Manual operating means of metal • Manual operating means of insulating material • Accessible external enclosures and covers <ul style="list-style-type: none"> – metal surfaces – insulating surfaces • Discrete arrangements of plug and socket-type connections 	Accessible external enclosures: Max.18.1 K / 40 K	P
7.5.1.2	Overload behaviour		
	The SPD shall be damaged or altered by overloads, which may occur in normal use.		P
8.6.1.2	The test is carried out at ambient temperature and the sample shall be protected against abnormal external heating or cooling.		P
	The test circuit and procedure shall be as described in 8.6.1.1, except that circuits other than the main circuit are disregarded for this test.		P
	The test is performed without any external disconnectors being connected (internal removable overcurrent protective devices are replaced by a link of negligible impedance).		P
	If a maximum overcurrent protection is specified by the manufacturer, the SPD shall be loaded for 1 h with a current equal to k times that maximum overcurrent protection. The factor k shall be selected from Table 20.	Maximum overcurrent protection is not specified by the manufacturer	N/A
	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 disconnector operates. If no disconnector 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 disconnector operates.	SPD was loaded with 1,1 times the rated load current for 1 h Test current: 17.6A	P

IEC 61643-11 - TEST SEQUENCE 3c			
Additional tests for two-port SPDs and one-port SPDs with separate input / output terminals			
Clause	Requirement - Test	Result - Remark	Verdict
	Pass criteria		
	<p>The temperature rise of surfaces which are accessible in normal use shall not exceed the values described in ANNEX G during the test.</p> <p>Parts of SPD:</p> <ul style="list-style-type: none"> • Built-in SPD: • Terminals for external insulated conductors • Busbars and conductors, plug-in contacts of removable or withdrawable parts which connect to busbars • Manual operating means of metal • Manual operating means of insulating material • Accessible external enclosures and covers <ul style="list-style-type: none"> – metal surfaces – insulating surfaces • Discrete arrangements of plug and socket-type connections 	<p>Accessible external enclosures: Max. 19.9 K / 40 K</p>	P
	a) Any internal disconnecter has operated:		
C	No mechanical damage		P
H	Disconnection shall be provided by one or more internal or external disconnecter(s). Their correct indication shall be checked.		P
I	SPDs having an IP degree \geq IP 2X – no live parts accessible with standardised test finger applied with a force of 5N, except the ones which are accessible when the SPD is fitted as in normal use.		P
J	<p>If disconnection occurs during the test, there shall be clear evidence of effective disconnection of the corresponding protective component(s).</p> <p>If internal disconnection occurs, the test sample is connected at U_C and rated frequency for 1 min.</p> <p>The current flow shall not exceed a value of 1 mA.</p>	<p><u>250</u> V</p> <p><u>0</u> mA</p>	P
	Currents through components connected in parallel to the relevant protective component(s), are disregarded for this measurement.		P
	<p>Current through the PE-terminal shall not exceed 1mA</p> <p>If there is more than one possible connection arrangement for normal use, this check shall be performed for all arrangements.</p>	<u>0</u> mA	P
M	There shall be no explosion or other hazard to either personnel or the facility.		P
	b) No internal disconnecter has operated:		N/A
C	No mechanical damage		N/A
D	Determination of the measured limiting voltage:		N/A
	according to 8.3.3.1, but only at a crest value corresponding to I_{imp} for test class I		N/A
	according to 8.3.3.1, but only at I_n for test class II		N/A
	according to 8.3.3.3, but only at U_{OC} for test class III		N/A
	<p>SPDs tested acc. to class I and II containing switching components:</p> <p>Front-of-wave sparkover voltage acc. to 8.3.3.2</p> <p>All measured peak values (5 pos./5 neg.) below U_P</p>		N/A
E	No excessive leakage currents shall occur after the test		N/A

IEC 61643-11 - TEST SEQUENCE 3c			
<i>Additional tests for two-port SPDs and one-port SPDs with separate input / output terminals</i>			
Clause	Requirement - Test	Result - Remark	Verdict
	If there is more than one possible connection arrangement for normal use, this check shall be performed for all arrangements		N/A
	The SPD shall be connected as for normal use according to the manufacturer's instructions to a power supply at the reference test voltage (U_{REF}). The current that flows through each terminal is measured. Its resistive component (measured at the crest of the sine wave) <ul style="list-style-type: none"> • shall not exceed a value of 1 mA or <ul style="list-style-type: none"> • the current shall not have changed by more than 20% compared to the initial value determined at the beginning of the test sequence 		N/A
	Any resettable or rearmable disconnecter shall be switched off and dielectric withstand shall be checked by application of two times U_C or 1000V a.c. whichever is greater. During the test, no flashover, breakdown of insulation or any other manifestation of disruptive discharge shall occur.		N/A
	For SPD modes connected N-PE only, the current through the PE-terminal shall be measured, whereas the terminals are connected to a power supply at U_C . Its resistive component (measured at the crest of the sine wave) <ul style="list-style-type: none"> • shall not exceed a value of 1 mA or <ul style="list-style-type: none"> • the current shall not have changed by more than 20% compared to the initial value determined at the beginning of the test sequence 		N/A
I	SPDs having an IP degree \geq IP 2X – no live parts accessible with standardised test finger applied with a force of 5N, except the ones which are accessible when the SPD is fitted as in normal use.		N/A


IEC 61643-11 - TEST SEQUENCE 4			
Clause	Requirement - Test	Result - Remark	Verdict
7.4.2/8.5.2	Heat resistance	See below	
	The SPD is kept in a heated cabinet at a temperature of $100\text{ }^{\circ}\text{C} \pm 2\text{ K}$ for the duration of 1 h.	100°C, 1 h	P
	Pass criteria	See below	
C	No mechanical damage	No damaged	P
I	SPDs having an IP degree \geq IP 2X – no live parts accessible with standardised test finger applied with a force of 5 N, except the ones which are accessible when the SPD is fitted as in normal use.	No live parts was accessed except lead wire.	P
	Any sealing compound (including potting) used in the internal assembly shall not move to such an extent as to create a problem for the functionality of the SPD.		P
	The SPD is deemed to have passed the test even if a disconnecter has opened.	Internal disconnecter had not opened	N/A
7.2.8	Behaviour under temporary overvoltages		
	SPDs for TT-systems between neutral and PE upstream the main RCD shall pass the TOV withstand mode criteria given 8.3.8.2.	TN-systems	N/A
7.2.8.1/8.3.8.1	TOVs caused by faults or disturbances in the low voltage system	Test only at L-N mode, the N-PE mode no testing required	
	For SPDs with a U_C greater than or equal to U_T there is no need to perform this test	U_C : 250V $U_T = 336.6\text{V}$ and <u>441.66V</u>	N/A
	SPDs shall be tested using either the <ul style="list-style-type: none"> TOV voltages U_T given in the relevant tables of Annex B, or, <ul style="list-style-type: none"> TOV voltages stated by the manufacturer according to 7.1.1 c1), whichever values are higher.	$U_T = 336.6\text{V}$ and <u>441.66V</u> Manufacturer not stated	P
	Table B.1 shall be applied to all SPDs Depending on the information given by the manufacturer on 7.1.1 c1), the additional tables according to Clause B.1 of Annex B shall also be applied. For North American systems – Table B.2 For Japanese systems – Table B.3	Table B.1 was be applied	P
	New samples shall be used and fitted as in normal use, according to the manufacturer's instructions		P
	The test sample shall be connected to a power frequency voltage of $U_T^{+0/-5\%}$ for a duration $t_T^{+5/-0\%}$.	336.6 V, 5s 441.66 V, 120 min	P
	Except for loss of neutral tests, this power source for U_T , shall be capable of delivering a current high enough to ensure that the voltage at the SPD terminals does not fall below U_T by more than 5 % during the test. For loss of neutral tests this voltage source shall be capable of delivering a prospective short-circuit current of 10A.	300A short-circuit current :10A	P P
	Immediately following the application of U_T , a voltage equal to $U_{REF}^{+0/-5\%}$ with the same current capability, shall be applied to the test sample for a period of 15 min $^{+5/-0\%}$.	$U_T = 335.1\text{ V}$ $U_T = 439.1\text{ V}$ $U_{REF} = 252.7\text{ V}$	P
	For loss of neutral tests, this power source for U_{REF} shall be capable of delivering a prospective short-circuit current equal to the declared short-circuit current rating of the SPD.	Short-circuit current: 300A	P

IEC 61643-11 - TEST SEQUENCE 4			
Clause	Requirement - Test	Result - Remark	Verdict
	The time interval between the test periods shall be as short as possible and shall in any case not exceed 100 ms.	<u><100</u> ms	P
a)	Pass criteria TOV failure mode	L-N mode $U_T = 441.66$ V	
C	No mechanical damage		P
H	Disconnection shall be provided by one or more internal or external disconnector(s). Their correct indication shall be checked.		P
I	SPDs having an IP degree \geq IP 2X – no live parts accessible with standardised test finger applied with a force of 5N, except the ones which are accessible when the SPD is fitted as in normal use.		P
J	If disconnection occurs during the test, there shall be clear evidence of effective disconnection of the corresponding protective component(s). If internal disconnection occurs, the test sample is connected at U_C and rated frequency for 1 min. The current flow shall not exceed a value of 1 mA.	250V 0mA	P
	Currents through components connected in parallel to the relevant protective component(s), are disregarded for this measurement.		N/A
	Current through the PE-terminal shall not exceed 1mA If there is more than one possible connection arrangement for normal use, this check shall be performed for all arrangements.	0mA	P
K	The short-circuit current from the power source, if any, shall be interrupted within 5 s by one or more internal and/or external disconnector(s).		P
L	The tissue paper shall not catch fire.		P
M	There shall be no explosion or other hazard to either personnel or the facility		P
b)	Pass criteria TOV withstand mode	L-N mode $U_T = 336.6$ V	
A	Thermal stability shall be achieved		P
B	Voltage and current records and visual inspection show no sign of puncture or flashover.		P
C	No mechanical damage	No damaged	P
D	Determination of the measured limiting voltage:	$U_P \leq 1.3$ kV	P
	according to 8.3.3.1, but only at a crest value corresponding to I_{imp} for test class I		N/A
	according to 8.3.3.1, but only at I_n for test class II		N/A
	according to 8.3.3.3, but only at U_{OC} for test class III	<u>979.1</u> V	P
	SPDs tested acc. to class I and II containing switching components: Front-of-wave sparkover voltage acc. to 8.3.3.2 All measured peak values (5 pos./5 neg.) below U_P		N/A
E	No excessive leakage currents shall occur after the test	See below	P
	If there is more than one possible connection arrangement for normal use, this check shall be performed for all arrangements		P

IEC 61643-11 - TEST SEQUENCE 4			
Clause	Requirement - Test	Result - Remark	Verdict
	<p>The SPD shall be connected as for normal use according to the manufacturer's instructions to a power supply at the reference test voltage (U_{REF}).</p> <p>The current that flows through each terminal is measured. Its resistive component (measured at the crest of the sine wave)</p> <ul style="list-style-type: none"> • shall not exceed a value of 1 mA <p>or</p> <ul style="list-style-type: none"> • the current shall not have changed by more than 20% compared to the initial value determined at the beginning of the test sequence 	<p>$U_{REF} = 255 \text{ V}$</p> <p>Before current is: L-N: 0.91mA; N-PE: 0.04mA</p> <p>After test the current is: L-N: 0.91mA; N-PE: 0.04mA</p> <p>Current not changed by more than 20%</p>	P
	<p>Any resettable or rearmable disconnecter shall be switched off and dielectric withstand shall be checked by application of two times U_C or 1000V a.c. whichever is greater.</p> <p>During the test, no flashover, breakdown of insulation or any other manifestation of disruptive discharge shall occur.</p>	No such disconnecter	N/A
	<p>For SPD modes connected N-PE only, the current through the PE-terminal shall be measured, whereas the terminals are connected to a power supply at U_C.</p> <p>Its resistive component (measured at the crest of the sine wave)</p> <ul style="list-style-type: none"> • shall not exceed a value of 1 mA <p>or</p> <ul style="list-style-type: none"> • the current shall not have changed by more than 20% compared to the initial value determined at the beginning of the test sequence 	L-N mode under tested.	N/A
F	External disconnectors shall not operate during the test and shall be in working order after the test.	No external disconnecter	N/A
G	Internal disconnectors shall not operate during the test and shall be in working order after the test.		P
I	SPDs having an IP degree \geq IP 2X – no live parts accessible with standardised test finger applied with a force of 5 N, except the ones which are accessible when the SPD is fitted as in normal use.		P
L	The tissue paper shall not catch fire.	No fire	P
M	There shall be no explosion or other hazard to either personnel or the facility	No hazard	P
7.2.8.2/8.3.8.2	TOVs caused by faults in the high (medium) voltage system	SPD only connected to TN power distribution system, no need test required	N/A
	<p>SPDs connected to PE and for use on power distribution systems</p> <ul style="list-style-type: none"> • TOV voltages U_T given in Annex B <p>or,</p> <ul style="list-style-type: none"> • TOV voltages stated by the manufacturer according to 7.1.1 c1) <p>whichever values are higher.</p>		N/A
	<p>Table B.1 shall be applied to all SPDs Depending on the information given by the manufacturer on 7.1.1 c1), the additional tables according to Clause B.1 of Annex B shall also be applied.</p> <p>For North American systems – Table B.2</p> <p>For Japanese systems – Table B.3</p>		N/A

IEC 61643-11 - TEST SEQUENCE 4			
Clause	Requirement - Test	Result - Remark	Verdict
	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 16 or equivalent		N/A
	The test voltage $U_T \pm 0.5\%$ is applied to the test sample at 90 electrical degrees of phase L1 by closing switch S1.		N/A
	After the TOV application time $t_T \pm 0.5\%$ switch S2 is closed automatically. This connects the SPD's PE-terminal to the neutral.		N/A
	Test circuit according to Figure 16 and Figure 17 or, alternative test circuit given in Annex E. Other test circuits are permitted as long as they ensure the same stress to the SPD.		N/A
	The prospective short-circuit current of the power source for U_{REF} shall be equal to five times the rated current of the maximum overcurrent protection is declared. The tolerance for the current is $\pm 10\%$.		N/A
	The prospective short-circuit current delivered by the TOV transformer shall be adjusted to $300A \pm 10\%$ by R2.		N/A
	With the exception of SPDs connected neutral to ground, U_{REF} remains applied to the test sample for 15 min without interruption until switch S1 is reopened.		N/A
a)	Pass criteria TOV failure mode		N/A
C	No mechanical damage		N/A
H	Disconnection shall be provided by one or more internal or external disconnector(s). Their correct indication shall be checked.		N/A
I	SPDs having an IP degree \geq IP 2X – no live parts accessible with standardised test finger applied with a force of 5N, except the ones which are accessible when the SPD is fitted as in normal use.		N/A
J	If disconnection occurs during the test, there shall be clear evidence of effective disconnection of the corresponding protective component(s). If internal disconnection occurs, the test sample is connected at U_C and rated frequency for 1 min. The current flow shall not exceed a value of 1 mA.		N/A
	Currents through components connected in parallel to the relevant protective component(s), are disregarded for this measurement.		N/A
	Current through the PE-terminal shall not exceed 1mA If there is more than one possible connection arrangement for normal use, this check shall be performed for all arrangements.		N/A
K	The short-circuit current from the power source, if any, shall be interrupted within 5 s by one or more internal and/or external disconnector(s).		N/A
L	The tissue paper shall not catch fire.		N/A
M	There shall be no explosion or other hazard to either personnel or the facility		N/A
b)	Pass criteria TOV withstand mode		
A	Thermal stability shall be achieved		N/A
B	Voltage and current records and visual inspection show no sign of puncture or flashover.		N/A

IEC 61643-11 - TEST SEQUENCE 4			
Clause	Requirement - Test	Result - Remark	Verdict
C	No mechanical damage		N/A
D	Determination of the measured limiting voltage:		N/A
	according to 8.3.3.1, but only at a crest value corresponding to I_{imp} for test class I		N/A
	according to 8.3.3.1, but only at I_n for test class II		N/A
	according to 8.3.3.3, but only at U_{OC} for test class III		N/A
	SPDs tested acc. to class I and II containing switching components: Front-of-wave sparkover voltage acc. to 8.3.3.2 All measured peak values (5 pos./5 neg.) below U_p		N/A
E	No excessive leakage currents shall occur after the test		N/A
	If there is more than one possible connection arrangement for normal use, this check shall be performed for all arrangements		N/A
	The SPD shall be connected as for normal use according to the manufacturer's instructions to a power supply at the reference test voltage (U_{REF}). The current that flows through each terminal is measured. Its resistive component (measured at the crest of the sine wave) <ul style="list-style-type: none"> shall not exceed a value of 1 mA or <ul style="list-style-type: none"> the current shall not have changed by more than 20% compared to the initial value determined at the beginning of the test sequence 		N/A
	Any resettable or rearmable disconnecter shall be switched off and dielectric withstand shall be checked by application of two times U_C or 1000V a.c. whichever is greater. During the test, no flashover, breakdown of insulation or any other manifestation of disruptive discharge shall occur.		N/A
	For SPD modes connected N-PE only, the current through the PE-terminal shall be measured, whereas the terminals are connected to a power supply at U_C . Its resistive component (measured at the crest of the sine wave) <ul style="list-style-type: none"> shall not exceed a value of 1 mA or <ul style="list-style-type: none"> the current shall not have changed by more than 20% compared to the initial value determined at the beginning of the test sequence 		N/A
G	Internal disconnectors shall not operate during the test and shall be in working order after the test.		N/A
I	SPDs having an IP degree \geq IP 2X – no live parts accessible with standardised test finger applied with a force of 5N, except the ones which are accessible when the SPD is fitted as in normal use.		N/A
K	The short-circuit current from the power source, if any, shall be interrupted within 5 s by one or more internal and/or external disconnector(s).		N/A
L	The tissue paper shall not catch fire.		N/A
M	There shall be no explosion or other hazard to either personnel or the facility		N/A

IEC 61643-11 - TEST SEQUENCE 5			
Clause	Requirement - Test	Result - Remark	Verdict
7.2.5.3	Short-circuit current behaviour		P
8.3.5.3	This test is not applied to SPDs which are either <ul style="list-style-type: none"> classified for outdoor use and for mounting out of reach, for connection N-PE in TN and/or TT systems only 	Indoor use	N/A
	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 8.4.2, keeping the cables connecting the sample to a maximum length of 0,5 m each.		P
	Sample preparation		P
	For SPDs with non-linear components connected in parallel, separate sets of three samples shall be prepared in the manner below for every current path of the SPD which contains one or more non-linear component in 3.1.4 and 3.1.5.		P
	Current paths containing voltage switching components with combined disconnecter function, having an impulse withstand voltage equal or greater than 6 kV and a dielectric withstand equal or greater than 2500 V/50 Hz for 1 min in normal operating condition, are tested without any preparation and only in conjunction with other current paths prepared in the manner described below. Voltage limiting components and voltage switching components described in 3.1.4 and 3.1.5 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.		N/A
	a) Test at the declared short-circuit current rating	300A	
	The sample is connected to a power frequency source at U_{REF} . The prospective short-circuit current as declared by the manufacturer and with the corresponding power factor as given in Table 8 are adjusted at the SPD terminals.	$\underline{252.7 V}$ $\underline{304.9 A}$ $\cos \varphi = \underline{0.94}$	P
	The test is carried out twice with U_{REF} applied at (45 ± 5) electrical degrees and at (90 ± 5) electrical degrees after the zero crossing of the voltage.		P
	If a replaceable or resettable internal or external disconnecter operates, the relevant disconnecter shall be replaced or reset each time. If the disconnecter cannot be replaced or reset, the test is stopped.	Internal disconnecter cannot be replaced and reset.	P
	Pass criteria	See below	
C	No mechanical damage	No damaged	P
H	Disconnection shall be provided by one or more internal or external disconnecter(s). Their correct indication shall be checked.		P
I	SPDs having an IP degree \geq IP 2X – no live parts accessible with standardised test finger applied with a force of 5N, except the ones which are accessible when the SPD is fitted as in normal use.		P
J	If disconnection occurs during the test, there shall be clear evidence of effective disconnection of the corresponding protective component(s). If internal disconnection occurs, the test sample is connected at U_C and rated frequency for 1 min. The current flow shall not exceed a value of 1 mA.	$\underline{250 V}$, $\underline{0mA}$	P

IEC 61643-11 - TEST SEQUENCE 5			
Clause	Requirement - Test	Result - Remark	Verdict
	Currents through components connected in parallel to the relevant protective component(s), are disregarded for this measurement.		P
	Current through the PE-terminal shall not exceed 1mA If there is more than one possible connection arrangement for normal use, this check shall be performed for all arrangements.	0 mA	P
K	The short-circuit current from the power source, if any, shall be interrupted within 5 s by one or more internal and/or external disconnector(s).	The current was interrupted in 18.4ms	P
M	There shall be no explosion or other hazard to either personnel or the facility	No explosion and hazard	P
N	There shall be no flashover to the metallic screen and the 6 A gL/gG fuse connecting the screen shall not operate during the test.		P
	b) Test at low short-circuit current		
	A power frequency source at U_{REF} , 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 8, 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.	$\frac{252.7\text{ V}}{304.9\text{ A}}$ $\cos \varphi = 0.94$	P
	The test is carried out once with U_{REF} applied at (45 ± 5) electrical degrees after the zero crossing of the voltage.		P
	Pass criteria		
C	No mechanical damage		P
I	SPDs having an IP degree \geq IP 2X – no live parts accessible with standardised test finger applied with a force of 5 N, except the ones which are accessible when the SPD is fitted as in normal use.		P
M	There shall be no explosion or other hazard to either personnel or the facility.	No explosion and other hazard	P
N	There shall be no flashover to the metallic screen and the 6 A gL/gG fuse connecting the screen shall not operate during the test.	No flashover and fuse not operate	P
	If disconnection occurs during the test:		
H	Disconnection shall be provided by one or more internal or external disconnector(s). Their correct indication shall be checked.	Internal disconnector was operated	P
J	If disconnection occurs during the test, there shall be clear evidence of effective disconnection of the corresponding protective component(s). If internal disconnection occurs, the test sample is connected at U_C and rated frequency for 1 min. The current flow shall not exceed a value of 1 mA.	Measure current: 250 V, 0mA	P
	Currents through components connected in parallel to the relevant protective component(s), are disregarded for this measurement.		P
	Current through the PE-terminal shall not exceed 1mA If there is more than one possible connection arrangement for normal use, this check shall be performed for all arrangements.	0 mA	P
K	The short-circuit current from the power source, if any, shall be interrupted within 5 s by one or more internal and/or external disconnector(s).	18.4ms	P

IEC 61643-11 - TEST SEQUENCE 5			
Clause	Requirement - Test	Result - Remark	Verdict
8.3.5.3.1	Additional test for SPDs with I_{fi} lower than the declared short-circuit current rating (I_{scCR})		
	This test is only performed if the declared follow current interrupt rating I_{fi} is smaller than the test current.		N/A
	The sample is connected to a power frequency source at U_{REF} . The prospective short-circuit current as declared by the manufacturer and with the corresponding power factor as given in Table 8 are adjusted at the SPD terminals.		N/A
	The voltage switching component(s) of the SPD is triggered with a positive surge current (8/20 or other appropriate waveshape) at (35 ± 5) electrical degrees after the zero crossing of the voltage on the positive half wave. The surge current shall be high enough to initiate a follow current but shall in no case exceed I_n . The test is carried out twice.		N/A
	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 11.		N/A
	If a replaceable or resettable internal disconnecter operates, the relevant disconnecter shall be replaced or reset each time. If the disconnecter cannot be replaced or reset, the test is stopped.		N/A
	Pass criteria		
C	No mechanical damage		N/A
H	Disconnection shall be provided by one or more internal or external disconnecter(s). Their correct indication shall be checked.		N/A
I	SPDs having an IP degree \geq IP 2X – no live parts accessible with standardised test finger applied with a force of 5 N, except the ones which are accessible when the SPD is fitted as in normal use.		N/A
J	If disconnection occurs during the test, there shall be clear evidence of effective disconnection of the corresponding protective component(s). If internal disconnection occurs, the test sample is connected at U_C and rated frequency for 1 min. The current flow shall not exceed a value of 1 mA.		N/A
	Currents through components connected in parallel to the relevant protective component(s), are disregarded for this measurement.		N/A
	Current through the PE-terminal shall not exceed 1mA If there is more than one possible connection arrangement for normal use, this check shall be performed for all arrangements.		N/A
K	The short-circuit current from the power source, if any, shall be interrupted within 5 s by one or more internal and/or external disconnecter(s).		N/A
M	There shall be no explosion or other hazard to either personnel or the facility		N/A
N	There shall be no flashover to the metallic screen and the 6 A gL/gG fuse connecting the screen shall not operate during the test.		N/A
8.3.5.3.2	Additional test for SPD's failure mode simulation	See below	
	For this test any electronic indicator circuitry may be disconnected.		P

IEC 61643-11 - TEST SEQUENCE 5			
Clause	Requirement - Test	Result - Remark	Verdict
	New samples shall be used and fitted as in normal use, acc. to the manufacturer's instructions and connected with conductors of the maximum cross section acc. to 8.4.2. The maximum length of the cables connection the sample shall be of 0,5 m each.		P
	External disconnectors, if recommended by the manufacturer, shall be used.		N/A
	The test sample shall be connected to a power frequency voltage source at the following conditioning voltages: <ul style="list-style-type: none"> SPDs rated U_C up to 440V, apply a voltage equal to $1200 V_{rms} \pm 5\%$ SPDs with U_C rated above 440V, apply a voltage equal to 3 times $U_C \pm 5\%$ 	L-N: $U_C=250Vac$ 1200V	P
	The conditioning voltage is applied for a duration of $5 s \pm 5\%$. The prospective short-circuit current of this power source for conditioning shall be adjusted to a value between 1 A and $20 A_{rms} \pm 5\%$, as provided by the manufacturer according to 7.1.1 d5).	1A	P
	Following the application of the conditioning voltage equal to $U_{REF} \pm 0,5\%$ with a short-circuit current capability as given below, shall be applied to the sample for a period of $5 min \pm 5\%$ or for at least 0,5 s after interruption of the current by an internal or external disconnector.		P
	The transition from conditioning voltage application to U_{REF} application shall be performed without interruption. The current flow through the SPD shall be monitored. An appropriate test circuit and timing diagram is shown in Figure 12 and Figure 13.		P
	The prospective short-circuit current of the power source at U_{REF} shall have a tolerance of $\pm 5\%$ at the location where the SPD is connected. The power factor of the power source shall comply with Table 8.	Power factor is 0.94	P
	Each of the following tests shall be performed on a new set of three preconditioned samples as above at U_{REF} with a short-circuit current of 100A, 500A and 1000A, respectively, unless these values exceed the declared short-circuit rating of the SPD.	250Vac, 100A	P
	A further test shall be performed on three preconditioned samples as above and at U_{REF} with a prospective short-circuit current equal to the manufacturer's declared short-circuit current rating. For this test, the time interval between the completion of the conditioning test and the application of U_{REF} shall be as short as possible and shall not exceed 100 ms.		P
	If all oscillograms of the tests on the first set of samples (100 A test set up) show a disconnection within 5 s during the application of the conditioning voltage, no further test is performed.	Samples were test at 100A and disconnection with 5 s, no need other further test.	P
	Pass criteria		
	For this test any damage to electronic indicator circuitry during the conditioning test is not regarded as a failure.		P
C	No mechanical damage	No damaged	P
I	SPDs having an IP degree \geq IP 2X – no live parts accessible with standardised test finger applied with a force of 5 N, except the ones which are accessible when the SPD is fitted as in normal use.		P

IEC 61643-11 - TEST SEQUENCE 5			
Clause	Requirement - Test	Result - Remark	Verdict
M	There shall be no explosion or other hazard to either personnel or the facility		P
N	There shall be no flashover to the metallic screen and the 6 A gL/gG fuse connecting the screen shall not operate during the test.		P
	Additional pass criteria except for: <ul style="list-style-type: none"> • short circuiting type SPDs • SPDs where the current is interrupted during the application of U_{REF} where no disconnection occurs. 		N/A
H	Disconnection shall be provided by one or more internal or external disconnector(s). Their correct indication shall be checked.	Disconnection by internal disconnector when applied U_T	P
J	If disconnection occurs during the test, there shall be clear evidence of effective disconnection of the corresponding protective component(s). If internal disconnection occurs, the test sample is connected at U_C and rated frequency for 1 min. The current flow shall not exceed a value of 1 mA.	L-N, 250V, 0mA	P
	Currents through components connected in parallel to the relevant protective component(s), are disregarded for this measurement.		P
	Current through the PE-terminal shall not exceed 1mA If there is more than one possible connection arrangement for normal use, this check shall be performed for all arrangements.	Measured the current through the PE-terminal is 0mA	P


IEC 61643-11 - TEST SEQUENCE 6			
<i>Additional tests if declared by the manufacturer</i>			
Clause	Requirement - Test	Result - Remark	Verdict
7.6.1.1/8.7.1	Total discharge current test for multipole SPDs	Manufacturer no specified	
	One side of the test generator is connected to the PE or PEN terminal of the multipole SPD. Each of the remaining SPD terminals is connected via a typical series impedance consisting of a resistance of 30 mΩ and an inductance of 25 μH, to the other side of the generator. Smaller impedances may be used if the tolerances for the proportional surge currents according to Table 21 are met.		N/A
	The multipole SPD shall be tested once with the total discharge current I_{Total} declared by the manufacturer.		N/A
	Pass criteria		
B	Voltage and current records and visual inspection show no sign of puncture or flashover.		N/A
C	No mechanical damage		N/A
D	Determination of the measured limiting voltage:		
	according to 8.3.3.1, but only at a crest value corresponding to I_{imp} for test class I		N/A
	according to 8.3.3.1, but only at I_n for test class II		N/A
	according to 8.3.3.3, but only at U_{OC} for test class III		N/A
	SPDs tested acc. to class I and II containing switching components: Front-of-wave sparkover voltage acc. to 8.3.3.2 All measured peak values (5 pos./5 neg.) below U_P		N/A
E	No excessive leakage currents shall occur after the test		N/A
	If there is more than one possible connection arrangement for normal use, this check shall be performed for all arrangements		N/A
	The SPD shall be connected as for normal use according to the manufacturer's instructions to a power supply at the reference test voltage (U_{REF}). The current that flows through each terminal is measured. Its resistive component (measured at the crest of the sine wave) <ul style="list-style-type: none"> • shall not exceed a value of 1 mA or <ul style="list-style-type: none"> • the current shall not have changed by more than 20% compared to the initial value determined at the beginning of the test sequence 		N/A
	Any resettable or rearmable disconnecter shall be switched off and dielectric withstand shall be checked by application of two times U_C or 1000V a.c. whichever is greater. During the test, no flashover, breakdown of insulation or any other manifestation of disruptive discharge shall occur.		N/A
	For SPD modes connected N-PE only, the current through the PE-terminal shall be measured, whereas the terminals are connected to a power supply at U_C . Its resistive component (measured at the crest of the sine wave) <ul style="list-style-type: none"> • shall not exceed a value of 1 mA or <ul style="list-style-type: none"> • the current shall not have changed by more than 20% compared to the initial value determined at the beginning of the test sequence 		N/A

IEC 61643-11 - TEST SEQUENCE 6			
<i>Additional tests if declared by the manufacturer</i>			
Clause	Requirement - Test	Result - Remark	Verdict
G	Internal disconnectors shall not operate during the test and shall be in working order after the test.		N/A
I	SPDs having an IP degree \geq IP 2X – no live parts accessible with standardised test finger applied with a force of 5N, except the ones which are accessible when the SPD is fitted as in normal use.		N/A
M	There shall be no explosion or other hazard to either personnel or the facility		N/A



IEC 61643-11 - TEST SEQUENCE 7			
Additional tests for outdoor use SPDs			
Clause	Requirement - Test	Result - Remark	Verdict
7.5.2/8.6.2	Environmental tests for outdoor SPDs (informative)	Indoor use SPD	
F.1	Accelerated aging test with UV radiation		
	Expose three complete SPDs, as to be installed for outdoor use, to 1000 h of UV radiation (UV-B) and water spray as follows: 500 cycles of 120 min each, consisting of 102 min of UV light at 60 °C, 18 min of UV light and water spray at 65 °C and 65 % RH. The UV radiation shall be according to ISO 4892-2, method A. ISO 4892-1 and ASTM 151 are to be used for general guidance for the test.		N/A
	The samples shall be connected to a power source at U_c during the test and residual current shall be monitored at 120 min intervals. After completion of this test, the samples shall be tested according to F.2.		N/A
	Pass criteria		
	During and after the test the samples shall be visually inspected for voids, cracks, tracking and surface erosion. The residual currents shall not increase by more than 10%. The degree of tracking, surface erosion and cracking shall be assessed to determine if this will compromise the enclosure of the product to meet the other electrical and mechanical performance requirements of this standard.		N/A
F.2	Water immersion test		
	The test is performed in accordance with Figure 8 of IEC 60099-4. The test samples shall kept immersed in a vessel, in boiling de-ionized water with 1 kg/m ³ of NaCl, for 42 h.		N/A
	At the end of boiling, the SPD shall remain in the vessel until the water has cooled down to approximately 20 °C (\pm 15 °C) and shall be maintained in the water till the verification tests are performed. After the water immersion test the samples shall be subjected the dielectric test (see F.3).		N/A

IEC 61643-11 - TEST SEQUENCE 7			
Additional tests for outdoor use SPDs			
Clause	Requirement - Test	Result - Remark	Verdict
F.3	Dielectric test		
	<p>The test samples shall be subjected to a dielectric test at a power frequency sinusoidal voltage of 1000 V plus twice the reference test voltage U_{REF} for 1 min and the leakage current shall be measured. The test voltage shall be applied as follows:</p> <p>a) SPD with metallic housing with or without mounting bracket The voltage shall be applied between all terminals or external leads which are not internally connected to the housing, neither directly nor through surge protective components, connected together, and the metallic housing. If all terminals and external leads are connected directly or through components to the conductive housing, this test is not performed.</p> <p>b) SPD with non-conductive housing with non-conductive or without mounting bracket The non-conductive housing shall be tightly wrapped in conductive foil to within 15 mm of any non-insulated lead or terminal. The voltage shall be applied between the conductive foil and all terminals or external leads connected together.</p> <p>c) SPD with non-conductive housing with metallic mounting bracket The non-conductive housing shall be tightly wrapped in conductive foil to within 15 mm of any non-insulated lead, terminal and the metallic mounting bracket. The voltage shall be applied between the conductive foil and all terminals, external leads and mounting bracket connected together.</p>	Indoor use SPD	N/A
	Pass criteria		
	The leakage current measured during this test shall not exceed 25 mA.		N/A
F.4	Temperature cycle test		
	The test shall be performed according to IEC 60068-2-14 with 5 cycles with a lower temperature of -40 °C and with an upper temperature of +100 °C. The time duration for each half cycle is 3 h and the temperature change shall occur within 30 s.		N/A
	Pass criteria		
	During and after the test, the samples shall be visually inspected for voids, cracks, tracking and surface erosion. The residual currents shall not increase by more than 10 %. The degree of tracking, surface erosion and cracking shall be assessed to determine if this will compromise the enclosure of the product to meet the other electrical and mechanical performance requirements of this standard.		N/A

IEC 61643-11 - TEST SEQUENCE 7			
Additional tests for outdoor use SPDs			
Clause	Requirement - Test	Result - Remark	Verdict
F.5	Verification of resistance to corrosion		
	<p>SPDs with exposed metal parts shall be subjected to the test and shall be mounted as for normal use according to the manufacturer's instructions.</p> <p>The enclosure or samples shall be new and in a clean condition. The samples shall be subjected to the following test:</p> <ul style="list-style-type: none"> • 12 cycles of 24 h, damp heat cycling test according to test Db of IEC 60068-2-30 at 40 °C and relative humidity of 95 %; • 14 cycles of 24 h, salt mist test according to test Ka of IEC 60068-2-11 at a temperature of (35 ± 2) °C. <p>After the test, the samples shall be washed in running tap water for 5 min, rinsed in distilled or demineralized water then shaken or subjected to air blast to remove water droplets. The specimen under test shall then be stored under normal service conditions for 2 h.</p>		N/A
	Pass criteria		
	<p>Compliance is checked by visual inspection to ensure that:</p> <ul style="list-style-type: none"> • there is no evidence of rust, cracking or other deterioration. However, surface deterioration of any protective coating is allowed. In case of doubt, reference shall be made to ISO 4628-3 to verify that the samples conform to the specimen Ri1; • seals are not damaged; • any moving parts (disconnectors) work without abnormal effort. 		N/A

IEC 61643-11 - TEST SEQUENCE 8			
Additional tests for short-circuiting type SPDs			
Clause	Requirement - Test	Result - Remark	Verdict
7.5.4/8.6.4	Short-circuiting type SPDs		
	These SPDs shall be capable of withstanding a short-circuit current test at their declared short-circuit current rating after having been overstressed by a surge current according to their transition rating I_{trans} . For such SPD's a conditioning into an intentional short-circuit according 8.6.4.1 is carried out, followed by a surge withstand test according 8.6.4.2 and a short-circuit current behaviour test according 8.6.4.3.	Open circuiting type SPD	N/A
8.6.4.1	Change of characteristic procedure (conditioning test)		
	One impulse of I_{trans} with positive polarity is applied to the de-energised SPD to change of characteristic of the SPD into an internal short-circuit. To check for the internal short-circuit an appropriate measurement shall be performed after this test.		N/A
8.6.4.2	Surge withstand test (in short-circuited condition)		
	One impulse of I_{trans} with positive polarity is applied to the de-energised SPD.		N/A
	Pass criteria		
C	No mechanical damage		N/A
I	SPDs having an IP degree \geq IP 2X – no live parts accessible with standardised test finger applied with a force of 5N, except the ones which are accessible when the SPD is fitted as in normal use.		N/A
M	There shall be no explosion or other hazard to either personnel or the facility		N/A
8.6.4.3	Short-circuit current behaviour test (in short-circuited condition)		
	The test is performed according to 8.3.5.3 excluding 8.3.5.1 and 8.3.5.3.2, but without any sample preparation.		N/A
8.3.5.3	This test is not applied to SPDs which are either <ul style="list-style-type: none"> • classified for outdoor use and for mounting out of reach, • for connection N-PE in TN and/or TT systems only 		N/A
	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 8.4.2, keeping the cables connecting the sample to a maximum length of 0,5 m each.		N/A
	a) Test at the declared short-circuit current rating		
	The sample is connected to a power frequency source at U_{REF} . The prospective short-circuit current as declared by the manufacturer and with the corresponding power factor as given in Table 8 are adjusted at the SPD terminals.		N/A
	The test is carried out twice with U_{REF} applied at (45 ± 5) electrical degrees and at (90 ± 5) electrical degrees after the zero crossing of the voltage.		N/A
	If a replaceable or resettable internal or external disconnecter operates, the relevant disconnecter shall be replaced or reset each time. If the disconnecter cannot be replaced or reset, the test is stopped.		N/A

IEC 61643-11 - TEST SEQUENCE 8			
Additional tests for short-circuiting type SPDs			
Clause	Requirement - Test	Result - Remark	Verdict
	b) Test at low short-circuit current		
	A power frequency source at U_{REF} , 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 8, 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/A
	The test is carried out twice with U_{REF} applied at (45 ± 5) electrical degrees after the zero crossing of the voltage.		N/A
	Pass criteria		
C	No mechanical damage		N/A
H	Disconnection shall be provided by one or more internal or external disconnector(s). Their correct indication shall be checked.		N/A
I	SPDs having an IP degree \geq IP 2X – no live parts accessible with standardised test finger applied with a force of 5N, except the ones which are accessible when the SPD is fitted as in normal use.		N/A
J	If disconnection occurs during the test, there shall be clear evidence of effective disconnection of the corresponding protective component(s). If internal disconnection occurs, the test sample is connected at U_C and rated frequency for 1 min. The current flow shall not exceed a value of 1 mA.		N/A
	Currents through components connected in parallel to the relevant protective component(s), are disregarded for this measurement.		N/A
	Current through the PE-terminal shall not exceed 1mA If there is more than one possible connection arrangement for normal use, this check shall be performed for all arrangements.		N/A
K	The short-circuit current from the power source, if any, shall be interrupted within 5 s by one or more internal and/or external disconnector(s).		N/A
M	There shall be no explosion or other hazard to either personnel or the facility		N/A
N	There shall be no flashover to the metallic screen and the 6 A gL/gG fuse connecting the screen shall not operate during the test.		N/A

IEC61643_11C - ATTACHMENT			
Clause	Requirement + Test	Result - Remark	Verdict
ATTACHMENT TO TEST REPORT IEC 61643_11C EUROPEAN GROUP DIFFERENCES AND NATIONAL DIFFERENCES Low-voltage surge protective devices- Part 11: Surge protective devices connected to low-voltage power systems – Requirements and test methods			
Differences according to.....: EN 61643-11:2012+A11:2018			
TRF template used.....: IEC61643-11:2012+A11:2018, Ed. 1.1			
Attachment Form No.....: EU_GD_IEC61643_11C			
Attachment Originator.....: OVE			
Master Attachment ..: Date 2021-10-07			
Copyright © 2021 IEC System for Conformity Testing and Certification of Electrical Equipment (IECEE), Geneva, Switzerland. All rights reserved.			
CENELEC COMMON MODIFICATIONS (EN)			P
IEC 61643-11 - TEST SEQUENCE 1			
Clause	Requirement - Test	Result - Remark	Verdict
7.1.1/7.1.2	Identification and Marking		P
	<u>Markings on the body or permanently attached to</u>		P
	a4) The SPD type and discharge parameters for each mode of protection declared by the manufacturer and printed next to each other: <u>For Type 1:</u> "Type 1" and "I _{imp} " and the value in kA, and/or "T1" (T1 in a square) and "I _{imp} " and the value in kA <u>For Type 2:</u> "Type 2" and "I _n " and the value in kA, and/or "T2" (T2 in a square) and "I _n " and the value in kA <u>For Type 3:</u> "Type 3" and "U _{OC} " and the value in kV, and/or "T3" (T3 in a square) and "U _{OC} " and the value in kV	U _{OC} : 6kV	P
	b14) I _{max} (if declared by the manufacturer)		N/A
7.2.2	Residual current I_{PE}		P
	This test is not performed on SPDs for connection N-PE only		P
	For all SPDs with a terminal for the protective conductor, the residual current I _{PE} shall be measured when all SPD terminals are connected to a power supply at the reference test voltage (U _{REF}) according to the manufacturer's instructions.		P

IEC61643_11C - ATTACHMENT			
Clause	Requirement + Test	Result - Remark	Verdict
8.3.2	<p>All modes of protection of the SPD shall be connected as for normal use according to the manufacturer's instructions.</p> <p>The line to PE voltage of the supply system shall be adjusted to the reference test voltage U_{REF}.</p>	<p>U_{REF} <u>255V</u></p> <p>I_{PE} <u>0.04mA</u></p>	P
7.2.4/8.3.4	Operating duty		P
	<p>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.</p> <p>In addition voltage switching type SPDs or combination type SPDs shall be able to interrupt any follow current up to the short-circuit current rating (I_{scsr})</p> <p>The test setup shall comply with the circuit diagram given in Figure 7.</p>		P
8.3.4.2.2	<p>SPDs with follow current > 500A:</p> <p>The test sample shall be connected to a power frequency voltage at U_C with a prospective short-circuit current equal to the short circuit current rating I_{scsr} declared by the manufacturer and with a power factor in accordance with Table 8, except for SPDs which are only connected between neutral and protective earth in TT- and/or TN-systems, for which the prospective short-circuit current shall be at least 100A.</p>		N/A
7.3.4/8.4.3	Verification of air clearances and creepage distances		P
	The air clearances and creepage distances shall not be smaller than the values indicated in Table 15 and Table 16, whereby Table 16 shall be applied to items 1), 2) and 3) according to Table 15.		P
	<p>Creepage distances in millimetres</p> <ul style="list-style-type: none"> – r.m.s. voltage – Material group – Pollution <p>1) Between live parts of different polarity</p> <p>2) Between live parts and</p> <ul style="list-style-type: none"> – screws and other means to fasten a covering, having to be detached for mounting the SPD – fastening surfaces (note 2) – screws or other means for fastening the SPD (note 2) – bodies (notes 1 and 2) <p>3) Between the metal parts of the disconnecter mechanism</p>	<p><u>250Vac</u></p> <p><u>IIIa</u></p> <p><u>2</u></p> <p>measured / required</p> <p><u>3.69mm / 3mm</u></p>	P

IEC61643_11C - ATTACHMENT			
Clause	Requirement + Test	Result - Remark	Verdict
	<p>and</p> <ul style="list-style-type: none"> – bodies (note 1) – screws or other means for fastening the SPD <p>Printed wiring material</p> <ul style="list-style-type: none"> – r.m.s. voltage – Material group – Pollution <p>1) Between live parts of different polarity</p> <p>2) Between live parts and</p> <ul style="list-style-type: none"> – screws and other means to fasten a covering, having to be detached for mounting the SPD – fastening surfaces (note 2) – screws or other means for fastening the SPD (note 2) – bodies (notes 1 and 2) <p>3) Between the metal parts of the disconnecter mechanism and</p> <ul style="list-style-type: none"> – bodies (note 1) – screws or other means for fastening the SPD <p>NOTE 1 – Definition see 8.3.6 a)</p> <p>NOTE 2 – If clearances between live parts of the device and the metallic screen or the surface on which the SPD is mounted are dependent on the design of the SPD only and cannot be reduced when the SPD is mounted in the least favourable position (even in a metallic enclosure), the values of lines 1 are sufficient.</p>	<p><u>250Vac</u></p> <p><u>IIIb</u></p> <p><u>PD 2</u></p> <p>measured / required</p> <p><u>3.69mm / 2.5mm</u></p>	
7.2.5.4	Status indicator		
	The manufacturer shall provide information about the function of the indicator and the actions to be taken after change of status indication.		P
	A status indicator may be composed of two parts (one of which is not replaced when e.g. a plug module is changed), linked by a coupling mechanism which can be mechanical, optical, audio, electromagnetic, etc. The part of the status indicator which is not replaced (e.g. base part of socket) shall be capable of operating at least 50 times.		N/A
	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.		N/A

IEC61643_11C - ATTACHMENT			
Clause	Requirement + Test	Result - Remark	Verdict
8.3.3.1	Residual voltage with 8/20 current impulses		
	<p>Class I, 8/20 current impulses with a sequence of crest values of 0,1; 0,2; 0,5; 1,0 times the crest value of I_{imp} shall be applied.</p> <p>0,1 times I_{imp} 0,2 times I_{imp} 0,5 times I_{imp} 1,0 times I_{imp}</p> <p>Class II, 8/20 current impulses with a sequence of crest values of 0,1; 0,2; 0,5; 1,0 times I_n shall be applied.</p> <p>0,1 times I_n 0,2 times I_n 0,5 times I_n 1,0 times I_n</p> <p>If the SPD contains only voltage-limiting components, this test needs only to be performed at a crest values of I_{imp} for test class I or I_n for test class II.</p>		N/A
	One sequence of positive polarity and one sequence of negative polarity are applied to the SPD		N/A
	When I_{max} is declared by the manufacturer an additional 8/20 current impulse with a crest value of I_{max} shall be applied and the polarity that showed higher residual voltages in the previous tests.		N/A
	The interval between individual impulses shall be long enough for the sample to cool down to ambient temperature.		N/A
	Current and voltage oscillogram		N/A
	Crest values – discharge current versus residual voltage diagram to I_n or I_{imp}		N/A
	<p>The residual voltage used for determining the measured limiting voltage is the highest voltage value corresponding to the range of currents for:</p> <ul style="list-style-type: none"> • class I: up to I_{imp} • class II: up to I_n 	_____ V	N/A
	The value for determining U_{max} is the highest residual voltage measured at surge currents up to I_n , I_{max} or I_{imp} , as applicable depending on the SPD test class.		N/A

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Clause	Requirement + Test	Result - Remark	Verdict
7.5.1.2	Overload behaviour		
	If an external maximum overcurrent protection is specified by the manufacturer, the SPD shall be loaded for 1 h with a current equal to 1,6 times the rated current of that maximum overcurrent protection.	SPD was loaded with 1,6 times the rated load current for 1 h Test current: 25.6A	P
8.3.5.3	a) Test at the declared short-circuit current rating		
	The test is carried out twice with U_{REF} applied once at (45 ± 5) electrical degrees and once at (90 ± 5) electrical degrees after the zero crossing of the voltage.		P
8.3.5.3.2	Additional test for SPD's failure mode simulation		
	For this test any electronic indicator circuitry may be disconnected.		P
	New samples shall be used and fitted as in normal use, acc. to the manufacturer's instructions and connected with conductors of the maximum cross section acc. to 8.4.2. The maximum length of the cables connection the sample shall be of 0,5 m each.		P
	External disconnectors, if recommended by the manufacturer, shall be used.		N/A
	The test sample shall be connected to a power frequency voltage source at the following conditioning voltages: <ul style="list-style-type: none"> SPDs rated U_C up to 440V, apply a voltage equal to $1200 V_{rms}^{+5/-0\%}$ SPDs with U_C rated above 440V, apply a voltage equal to 3 times $U_C^{+5/-0\%}$ 	1200 V	P
	For all types of SPDs with U_C up to 180V, the conditioning voltage may be reduced to 600V if for voltage switching type SPDs and for combination type SPDs, any voltage switching components operate at this voltage.		N/A
	The conditioning voltage is applied for a duration of $5 s^{+5/-0\%}$. The prospective short-circuit current of this power source for conditioning shall be adjusted to a value between 1 A and $20 A_{rms}^{+5/-0\%}$, as provided by the manufacturer according to 7.1.1 d5).	1 A	P
	Following the application of the conditioning voltage equal to $U_{REF}^{+0/-5\%}$ with a short-circuit current capability as given below, shall be applied to the sample for a period of $5 min^{+5/-0\%}$ or for at least 0,5 s after interruption of the current by an internal or external disconnector.	255V	P

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Clause	Requirement + Test	Result - Remark	Verdict
	The transition from conditioning voltage application to U_{REF} application shall be performed without interruption. The current flow through the SPD shall be monitored. An appropriate test circuit and timing diagram is shown in Figure 12 and Figure 13.		P
	The prospective short-circuit current of the power source at U_{REF} shall have a tolerance of $+5/-0\%$ at the location where the SPD is connected. The power factor of the power source shall comply with Table 8.		P
	Each of the following tests shall be performed on a new set of three preconditioned samples as above at U_{REF} with a short-circuit current of 100A, 500A and 1000A, respectively, unless these values exceed the declared short-circuit rating of the SPD.	100A	P
	A further test shall be performed on three preconditioned samples as above and at U_{REF} with a prospective short-circuit current equal to the manufacturer's declared short-circuit current rating. For this test, the time interval between the completion of the conditioning test and the application of U_{REF} shall be as short as possible and shall not exceed 100 ms.		P
	<p>If all measurements of the test on the first set of samples (100A test set up):</p> <ul style="list-style-type: none"> either show a disconnection within 5s during the application of the conditioning voltage or the current through the sample during the application of U_{REF} after conditioning does not exceed a value of 1mA or the current through the sample during the application or U_{REF} after conditioning does not exceed the initial value determined at U_{REF} before the test by more than 20% <p>no further test is performed</p>	disconnection within 5s during the application of the conditioning voltage	P
	Pass criteria		
	For this test any damage to electronic indicator circuitry during the conditioning test is not regarded as a failure.		P
C	No mechanical damage	No damaged	P
I	SPDs having an IP degree \geq IP 2X – no live parts accessible with standardised test finger applied with a force of 5 N, except the ones which are accessible when the SPD is fitted as in normal use.		P

IEC61643_11C - ATTACHMENT			
Clause	Requirement + Test	Result - Remark	Verdict
M	There shall be no explosion or other hazard to either personnel or the facility		P
N	There shall be no flashover to the metallic screen and the 6 A gL/gG fuse connecting the screen shall not operate during the test.		P
	<p>Additional pass criteria except for:</p> <ul style="list-style-type: none"> short circuiting type SPDs SPDs where the current is interrupted or no significant current flows during the application of U_{REF}. <p>where no disconnection occurs.</p>		N/A
H	Disconnection shall be provided by one or more internal or external disconnector(s). Their correct indication shall be checked.	Disconnection by internal disconnector when applied U_T	P
J	<p>If disconnection occurs during the test, there shall be clear evidence of effective disconnection of the corresponding protective component(s).</p> <p>If internal disconnection occurs, the test sample is connected at U_C and rated frequency for 1 min. The current flow shall not exceed a value of 1 mA.</p>	L-N, 250V, 0mA	P
	Currents through components connected in parallel to the relevant protective component(s), are disregarded for this measurement.		P
	<p>Current through the PE-terminal shall not exceed 1mA</p> <p>If there is more than one possible connection arrangement for normal use, this check shall be performed for all arrangements.</p>	Measured the current through the PE-terminal is 0mA	P
7.6.1.3	Vibration and shock (informative)		
	<p>Vibration and shock tests shall be performed according to</p> <ul style="list-style-type: none"> EN 60068-2-6 for sinusoidal vibration test EN 60068-2-64 for broadband random vibration test EN 60068-2-27 for shock test 	<u>Fixed installation</u>	N/A
ZB-2.2	Transportation		
	Usually SPDs within their packaging are subjected to mechanical stress due to transportation. This should be checked by a vibration and shock test in accordance with EN 60721-3-2		N/A
ZB.2.3	Special applications		N/A

IEC61643_11C - ATTACHMENT			
Clause	Requirement + Test	Result - Remark	Verdict
	Special applications of SPDs may require additional vibration and shock tests, on the device itself. Typical values can be found in EN 60721-3-3 and can be as shown in Table ZB.1.		N/A
	Furthermore other applications like railway may require different parameters that are given in corresponding standards or directly from application. For instance required parameters for railway vibration and shock tests are given in EN 61373.		N/A
	During the sinusoidal and random vibration tests (if requested), the sample should be powered under U_C with a short circuit capability of at least 5A.		N/A
ZB.3	Pass criteria		
C	No mechanical damage		N/A
D	Determination of the measured limiting voltage:		N/A
	according to 8.3.3.1, but only at a crest value corresponding to I_{imp} for test class I		N/A
	according to 8.3.3.1, but only at I_n for test class II		N/A
	according to 8.3.3.3, but only at U_{OC} for test class III		N/A
	SPDs tested acc. to class I and II containing switching components: Front-of-wave sparkover voltage acc. to 8.3.3.2 All measured peak values (5 pos./5 neg.) below U_P		N/A
E	No excessive leakage currents shall occur after the test		
	If there is more than one possible connection arrangement for normal use, this check shall be performed for all arrangements		N/A
	The SPD shall be connected as for normal use according to the manufacturer's instructions to a power supply at the reference test voltage (U_{REF}). The current that flows through each terminal is measured. Its resistive component (measured at the crest of the sine wave) <ul style="list-style-type: none"> • shall not exceed a value of 1 mA or <ul style="list-style-type: none"> • the current shall not have changed by more than 20% compared to the initial value determined at the beginning of the test sequence 		N/A

IEC61643_11C - ATTACHMENT			
Clause	Requirement + Test	Result - Remark	Verdict
	Any resettable or rearmable disconnecter shall be switched off and dielectric withstand shall be checked by application of two times U_C or 1000V a.c. whichever is greater. During the test, no flashover, breakdown of insulation or any other manifestation of disruptive discharge shall occur.		N/A
	For SPD modes connected N-PE only, the current through the PE-terminal shall be measured, whereas the terminals are connected to a power supply at U_C . Its resistive component (measured at the crest of the sine wave) <ul style="list-style-type: none"> • shall not exceed a value of 1 mA or <ul style="list-style-type: none"> • the current shall not have changed by more than 20% compared to the initial value determined at the beginning of the test sequence 		N/A
G	Internal disconnectors shall not operate during the test and shall be in working order after the test.		N/A
I	SPDs having an IP degree \geq IP 2X – no live parts accessible with standardised test finger applied with a force of 5 N, except the ones which are accessible when the SPD is fitted as in normal use.		N/A
Annex ZC (normative)	Additional requirements for portable SPDs Classified as pluggable equipment type A	Fixed SPD, The product was not portable SPD.	N/A
	Annex ZC applies to portable SPDs classified as pluggable equipment type A according to EN 62368-1.		N/A
	NOTE A pluggable equipment type A is an equipment that is intended for connection to the mains via a non-industrial plug and socket-outlet or via a non-industrial appliance coupler, or both. These equipment are dedicated to household and similar uses.		N/A
	It does not apply to		N/A
	— portable SPDs for industrial and similar use,		N/A
	— portable SPDs that are designed to be permanently connected to the fixed installation with a reliable earth (e.g. mounted in 19' racks).		N/A
	If not otherwise mentioned, Annex ZC amends specific requirements of this European Standard. All requirements not mentioned in this annex shall be applied unchanged as provided in Table 3.		N/A
	In Clause ZC.x below, the same numbering of the sub-clauses has been kept as in the main document.		N/A

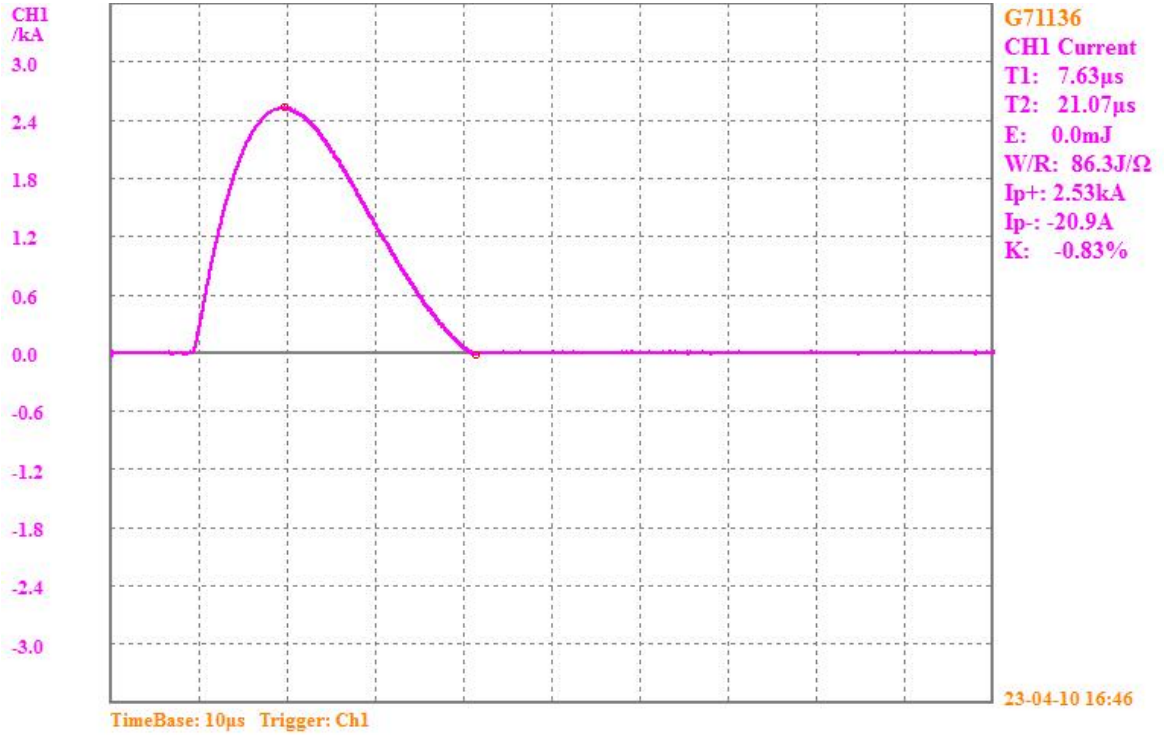
IEC61643_11C - ATTACHMENT			
Clause	Requirement + Test	Result - Remark	Verdict
ZC.7.7	Specific requirements for portable SPDs classified as pluggable equipment type A	Fixed SPD, The product was not portable SPD.	N/A
	For portable SPDs considered as pluggable equipment type A, the following specific requirements apply.		N/A
	— Every mode of protection shall be provided with an appropriate internal disconnecter(s). No external disconnecters shall be required. All tests shall be passed by the SPD itself.		N/A
	— Live terminals shall not be specifically assigned to a line terminal or to a neutral terminal. All live terminals shall be tested in the same way (due to possible inversion).		N/A
	— No exceptions related to N-PE mode of protection of the main document apply to portable SPDs.		N/A
	— Wherever disconnecter operation is required, it shall be provided by internal disconnecter(s)		N/A
	— Internal disconnecters dedicated to the SPD function shall not be resettable or replaceable		N/A
	— The short circuit current rating I_{sc} shall not be lower than 1 500 A.		N/A
	— All possible protection modes shall be tested, i.e. live to live and live to PE, when applicable.		N/A
	— Voltage limiting components shall be rated to a minimum value of 1,25 times the nominal rated voltage of the system for which the SPD is designed, e.g. 230 V + 25 % min. for 230 V AC systems. When a mode of protection contains more than one voltage limiting component in series, this requirement applies to the sum of the voltage ratings of all voltage limiting components connected in series.		N/A
	For SPDs with no protection mode connected to PE, no additional requirement applies		N/A
	For SPDs with a protection mode connected to PE, this protection mode shall consist of at least one voltage limiting component (e.g. MOV) and one voltage switching component (e.g. GDT) connected in series.		N/A
	Portable multiservice SPDs designed to protect more than one kind of service e.g. power, data, and telecom system, shall be provided with modes of protection referring to a common reference point.		N/A

IEC61643_11C - ATTACHMENT			
Clause	Requirement + Test	Result - Remark	Verdict
	NOTE: This common reference point is normally connected to PE or the equipotential bonding system of the fixed installation		N/A
	All clearances and creepage distances, including distances along outer surfaces of components, shall comply with the requirements for basic insulation of overvoltage category II and pollution degree 2		N/A
	Compliance is checked by visual inspection and the relevant tests of Clause 8 in conjunction with this Annex ZC		N/A
ZC.8.3.5.3	Short-circuit current behaviour tests		N/A
	b) Test at low short-circuit current		N/A
	The prospective short-circuit current shall be set to 100 A		N/A
	Pass criteria		N/A
	Pass criteria C, H, I, J, K, M and N according to Table 4 shall apply.		N/A
ZC.8.3.5.3.2	Additional test for SPD's failure mode simulation		N/A
	Pass criteria		N/A
	Pass criteria C, H, I, J, M and N according to Table 4 shall apply		N/A
ZC.8.3.8	Behaviour under temporary overvoltages (TOVs)		N/A
	Tests are applied:		N/A
	— between live terminals;		N/A
	— between live terminals and PE, if applicable		N/A
	Table B.1 is replaced by Table ZC.B.1 with conditions corresponding to the worse conditions of TT and TN systems. Uref is set to minimum 255 V AC		N/A
	NOTE For household and similar use, installations fed by IT system are limited to the line-to-line a.c system voltages (without distributed neutral conductor).		N/A

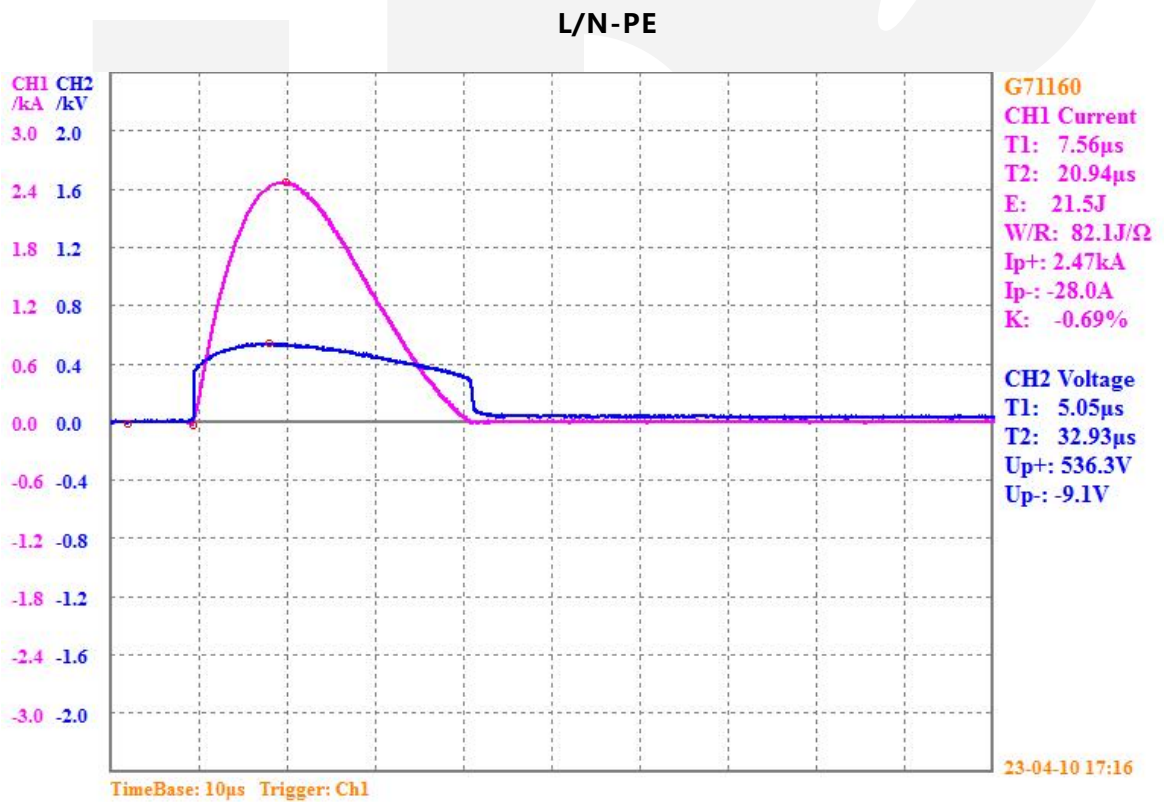
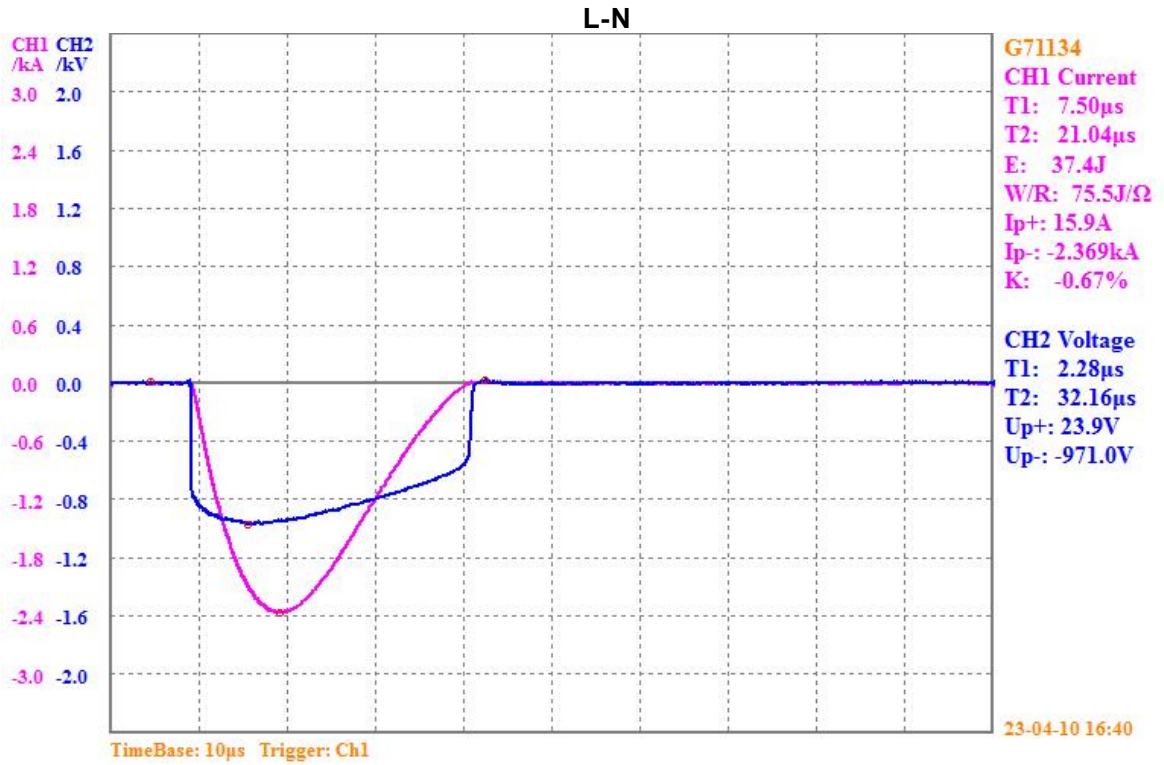
IEC61643_11C - ATTACHMENT																			
Clause	Requirement + Test	Result - Remark	Verdict																
	<p>Table ZC.B.1 – TOV test values for systems complying with IEC 60364 series for portable SPDs</p> <table border="1"> <thead> <tr> <th></th> <th>For $t_f = 5$ s (LV-system faults in consumer installation)</th> <th>For $t_f = 120$ min (LV-system faults in distribution system and loss of neutral)</th> <th>For $t_f = 200$ ms (HV-system faults) (requirement in 7.2.8.2 and test in 8.3.8.2)</th> </tr> </thead> <tbody> <tr> <td></td> <td>Withstand mode required</td> <td>Withstand mode or safe failure mode required</td> <td>Safe failure mode required^a</td> </tr> <tr> <td>Tests between live terminals</td> <td>$1,32 \times U_{REF}$</td> <td>$\sqrt{3} \times U_{REF}$</td> <td>Not applicable</td> </tr> <tr> <td>Tests between live – PE^a</td> <td>$\sqrt{3} \times U_{REF}$</td> <td>$\sqrt{3} \times U_{REF}$</td> <td>$1\,200 + U_{REF}$</td> </tr> </tbody> </table> <p>^a Applicable for SPDs with protection mode connected to PE</p>		For $t_f = 5$ s (LV-system faults in consumer installation)	For $t_f = 120$ min (LV-system faults in distribution system and loss of neutral)	For $t_f = 200$ ms (HV-system faults) (requirement in 7.2.8.2 and test in 8.3.8.2)		Withstand mode required	Withstand mode or safe failure mode required	Safe failure mode required ^a	Tests between live terminals	$1,32 \times U_{REF}$	$\sqrt{3} \times U_{REF}$	Not applicable	Tests between live – PE^a	$\sqrt{3} \times U_{REF}$	$\sqrt{3} \times U_{REF}$	$1\,200 + U_{REF}$		N/A
	For $t_f = 5$ s (LV-system faults in consumer installation)	For $t_f = 120$ min (LV-system faults in distribution system and loss of neutral)	For $t_f = 200$ ms (HV-system faults) (requirement in 7.2.8.2 and test in 8.3.8.2)																
	Withstand mode required	Withstand mode or safe failure mode required	Safe failure mode required ^a																
Tests between live terminals	$1,32 \times U_{REF}$	$\sqrt{3} \times U_{REF}$	Not applicable																
Tests between live – PE^a	$\sqrt{3} \times U_{REF}$	$\sqrt{3} \times U_{REF}$	$1\,200 + U_{REF}$																
ZC.8.3.8.2	TOVs caused by faults in the high (medium) voltage system		N/A																
	The prospective short-circuit current of the power source for U_{REF} shall be set to 100 A		N/A																




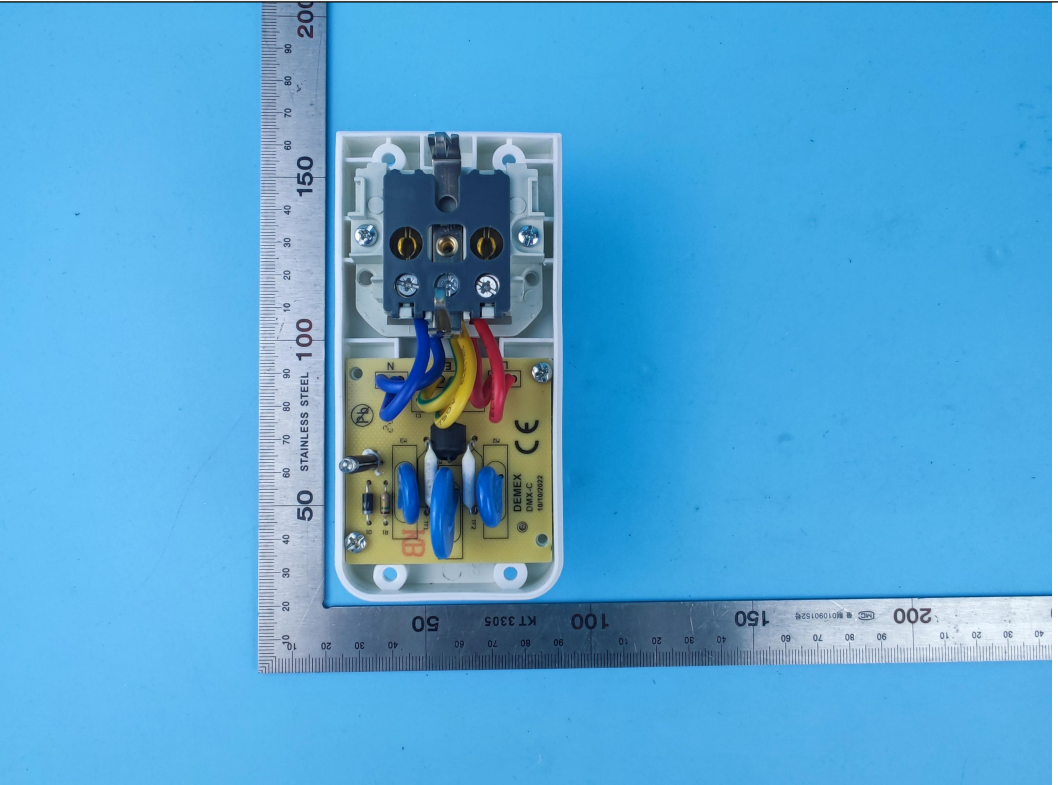
Attachment 1: Test waveform



Attachment 2: Test waveform



Attachment 3: Photos of samples

<p>Details of:</p> <p>View:</p> <p><input type="checkbox"/> General</p> <p><input checked="" type="checkbox"/> Front</p> <p><input type="checkbox"/> Rear</p> <p><input type="checkbox"/> Right</p> <p><input type="checkbox"/> Left</p> <p><input type="checkbox"/> Top</p> <p><input type="checkbox"/> Bottom</p>	<p style="text-align: center;">Class III External view</p>  <p>The image shows the external view of a white Class III electrical outlet. The outlet is rectangular with a circular opening at the top. A ruler is placed vertically to the left of the outlet, showing a scale from 0 to 200 mm. The outlet has the 'Mufuscan electric' logo and a 'Protected' label. The background is a solid blue surface.</p>
<p>Details of:</p> <p>View:</p> <p><input checked="" type="checkbox"/> General</p> <p><input type="checkbox"/> Front</p> <p><input type="checkbox"/> Rear</p> <p><input type="checkbox"/> Right</p> <p><input type="checkbox"/> Left</p> <p><input type="checkbox"/> Top</p> <p><input type="checkbox"/> Bottom</p>	<p style="text-align: center;">Class III Internal view</p>  <p>The image shows the internal view of the Class III electrical outlet. It reveals the internal wiring, including blue, yellow, and red wires connected to a terminal block. A yellow printed circuit board (PCB) is visible, featuring a blue switch and various electronic components. A ruler is placed vertically to the left of the outlet, showing a scale from 0 to 200 mm. The background is a solid blue surface.</p>

END OF REPORT