IEC 61643-11 - TEST SEQUENCE 1			
Clause	Requirement - Test	Result - Remark	Verdict
7.3.3.2	**Screwless terminals**		
	Terminals shall be so designed and constructed that: • 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 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.	_____ to _____ mm² _____ N	N/A
8.4.2.3	**Insulation piercing connections**		
8.4.2.3.1	Pull test on terminals designed for single core conductors		
	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.	_____ mm∅ _____ Nm	N/A
	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.	_____ to _____ mm² _____ N	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**		
	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.	min. _____ mm² max. _____ mm	N/A

IEC 61643-11 - TEST SEQUENCE 1			
Clause	Requirement - Test	Result - Remark	Verdict
	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)	$F(x)$ = _____ N n = _____ F = _____ N	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**		
	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.		P
	During the test, there shall be no movement of the conductor or any sign of damage.		P
7.2.1	**Protection against direct contact**		
	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.		P

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**		
	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.	No metal parts are accessible	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.	_____ A	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.	_____ mV _____ Ω	N/A
7.4.1	**Environment, IP code**		
	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 65	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} 255V I_{PE} 0.16 µA	P

IEC 61643-11 - *TEST SEQUENCE 1*			
Clause	Requirement - Test	Result - Remark	Verdict
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.		P
	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	__ kA / __V	N/A
	according to 8.3.3.1, but only at I_n for test class II	__ kA / __V	N/A
	according to 8.3.3.3, but only at U_{OC} for test class III	L-N/PE: 5 kA / 1.26kV N-PE: 5 kA / 1.92kV	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	__kV	N/A
	Sample connected to power frequency source at U_C	320V	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.	_____ kA cos φ = _____	N/A N/A

IEC 61643-11 - TEST SEQUENCE 1			
Clause	Requirement - Test	Result - Remark	Verdict
8.3.4.3	**Class I and II operating duty tests**		
	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	_ kA sync. 0°, 30°, 60°, 90°, 120°, 150°, 180°, 210°, 240°, 270°, 300°, 330°, 0°, 30°, 60° el.	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.	U_C: _V	N/A N/A 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**		
	The SPD is tested with three groups of impulses corresponding to U_{OC} 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°)		P
8.3.4.4	**Additional duty test for test class I**		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.	U_C: _V	N/A

IEC 61643-11 - *TEST SEQUENCE 1*			
Clause	Requirement - Test	Result - Remark	Verdict
	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}	__ kA/__ kA __ kA/__ kA __ kA/__ kA __ kA/__ kA __ kA/__ kA	N/A
	After each impulse cool down to ambient temperature		N/A
8.3.4.6	**Pass criteria**		
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.		P P
B	Voltage and current records and visual inspection show no sign of puncture or flashover.		P
C	No mechanical damage		P
D	Determination of the measured limiting voltage:	U_P L-N: 1.3kV L/N-PE: 2.0kV	
	according to 8.3.3.1, but only at a crest value corresponding to I_{imp} for test class I	_ kA / _V	N/A
	according to 8.3.3.1, but only at I_n for test class II	_ kA / _V	N/A
	according to 8.3.3.3, but only at U_{OC} for test class III	L-N/PE: 5 kA / 1.26kV N-PE: 5 kA / 1.95kV	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	_ kV	N/A
E	No excessive leakage currents shall occur after the test		

IEC 61643-11 - TEST SEQUENCE 1a			
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		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) • shall not exceed a value of 1 mA or • 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 V 1.17µA	P P N/A
	Any resettable or rearmable disconnector 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.	U_C= _____ V test voltage _____ V	N/A 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) • shall not exceed a value of 1 mA or • 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= 320 V 0.23 µA	P P 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.		P
M	There shall be no explosion or other hazard to either personnel or the facility.		P
7.2.5.2	**Thermal protection**		
	SPDs shall be protected against overheating due to degradation or overstress.		N/A

IEC 61643-11 - TEST SEQUENCE 1			
Clause	Requirement - Test	Result - Remark	Verdict
	This test is not performed on SPDs containing only switching components and/or ABD devices.		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 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.		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
8.3.5.2	**Thermal stability**		
	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.		N/A P
	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.		P

IEC 61643-11 - *TEST SEQUENCE 1*			
Clause	Requirement - Test	Result - Remark	Verdict
	Test for SPDs containing only voltage limiting components - procedure a)		
	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 ± 10%: Sample 1: 2 mA r.m.s. or corresponding crest value 4 mA r.m.s. or corresponding crest value 6 mA r.m.s. or corresponding crest value 8 mA r.m.s. or corresponding crest value 10 mA r.m.s. or corresponding crest value Sample 2: 2 mA r.m.s. or corresponding crest value 4 mA r.m.s. or corresponding crest value 6 mA r.m.s. or corresponding crest value 8 mA r.m.s. or corresponding crest value 10 mA r.m.s. or corresponding crest value Sample 3. 2 mA r.m.s. or corresponding crest value 4 mA r.m.s. or corresponding crest value 6 mA r.m.s. or corresponding crest value 8 mA r.m.s. or corresponding crest value 10 mA r.m.s. or corresponding crest value	Duration 41min 31min 30min 39min 13min 29min 33min 29min 30min 15min 22min 27min 45min 39min 13min	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.		N/A
	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

IEC 61643-11 - TEST SEQUENCE 1			
Clause	Requirement - Test	Result - Remark	Verdict
	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.	U_{REF} = _____ V _____ V _____ kA cos phi = _____	N/A
	Test for SPDs having a voltage switching component in series with other components – procedure b)		
	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.	_____ V _____ kA cos phi = _____	N/A
	If no significant current flows – test procedure a) shall be followed		N/A
	Pass criteria		
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 ≥ 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.	320 V 0 mA	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.	_____ mA	N/A N/A

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IEC 61643-11 - TEST SEQUENCE 1			
Clause	Requirement - Test	Result - Remark	Verdict
M	There shall be no explosion or other hazard to either personnel or the facility		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%.		P N/A
	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.	115 K 65.8 K	P 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.		N/A
	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.		N/A
	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.		N/A
	The electrode spacing of spark gaps shall not be considered for the determination of air clearances and creepage distances.		N/A
	The air clearances and creepage distances shall not be smaller than the values indicated in Table 15 and Table 16.		N/A

IEC 61643-11 - *TEST SEQUENCE 1*

Clause	Requirement - Test	Result - Remark	Verdict
	Air clearances in millimetres	U_{max}: __ V required / measured	
	1) Between live parts of different polarity	__ mm / __ mm	N/A
	2) Between live parts and		
	– screws and other means to fasten a covering, having to be detached for mounting the SPD		N/A
	– fastening surfaces (note 2)	____ / ____	
	– screws or other means for fastening the SPD (note 2)		N/A
	– bodies (notes 1 and 2)	____ / ____	N/A
	3) Between the metal parts of the disconnector mechanism and	____ / ____	N/A
	– bodies (note 1)	__ mm / __ mm	
	– screws or other means for fastening the SPD		N/A
	NOTE 1 – Definition see 8.3.6 a)	____ / ____	N/A
	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.	____ / ____	
	Creepage distances in millimetres		
	– r.m.s. voltage		
	– Material group		
	– Pollution	__ V	
	– distances required		N/A
	Printed wiring material		
	– r.m.s. voltage	__ mm / __ mm	
	– Material group		
	– Pollution	____	
	– distances required	____	
		____	N/A
		____ / ____	
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.		N/A

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IEC 61643-11 - *TEST SEQUENCE 1*			
Clause	Requirement - Test	Result - Remark	Verdict
	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.		P
	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.		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.	0.58 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: • 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.		N/A 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.		P
	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.		P
	The test is made on one sample		P
	In case of doubt, the test is repeated on two additional samples.		N/A
	The test is made by applying the glow-wire once.		P

IEC 61643-11 - TEST SEQUENCE 1			
Clause	Requirement - Test	Result - Remark	Verdict
	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		
	The sample is regarded as having passed the glow-wire test if • 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.	s	P N/A
	There shall be no ignition of the tissue paper or scorching of the pinewood board.		P
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	CTI: 275V	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.		P
	All one-port SPDs shall be tested unenergized.		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 ± 5)° point and negative impulses at (270 ± 5)° point on the sinusoidal voltage waveform.		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 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}	_kA / _kV	N/A
	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	_kA / _kV	N/A
	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

IEC 61643-11 - TEST SEQUENCE 2			
Clause	Requirement - Test	Result - Remark	Verdict
	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.	_____ kA / _____ V	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
	The residual voltage used for determining the measured limiting voltage is the highest voltage value corresponding to the range of currents for: • 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 I_n, I_{max} or I_{imp}, as applicable depending on the SPD test class.	_V	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.	_V	N/A

IEC 61643-11 - TEST SEQUENCE 2			
Clause	Requirement - Test	Result - Remark	Verdict
8.3.3.3	**Limiting voltage with the combination wave**		
	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} 1 kV 0,2 times U_{oc} 2 kV 0,5 times U_{oc} 5 kV 1,0 times U_{oc} 10 kV	L-N/PE 0.5 kA / 1.04kV 1.0 kA / 1.22kV 2.5 kA / 1.26kV 5.0 kA / 1.06kV N-PE 5.0 kA / 1.92kV	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	see Annex 1	P
	The value for determining the measured limiting voltage and U_{max} is the maximum voltage recorded during the test.	L-N/PE: 1.26kV N-PE: 1.92kV	P
8.3.3.4	**Pass criteria for all measured limiting voltage tests**		
B	Voltage and current records and visual inspection show no sign of puncture or flashover.		P
C	No mechanical damage		P
I	SPDs having an IP degree ≥ 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
M	There shall be no explosion or other hazard to either personnel or the facility		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**		
	For this test: • 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 ± 5)°.	_____ kA _____ kV	N/A
	The interval between the impulses is 50 s to 60 s and the internal 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:	$U_P \leq$ _____ V	
	according to 8.3.3.1, but only at a crest value corresponding to I_{imp} for test class I	_____ kA / _____ V	N/A
	according to 8.3.3.1, but only at I_n for test class II	_____ kA / _____ V	N/A
	according to 8.3.3.3, but only at U_{OC} for test class III	_____ kA / _____ V	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	_____ kV	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

IEC 61643-11 - *TEST SEQUENCE 2a* ***Additional tests if declared by the manufacturer***			
Clause	Requirement - Test	Result - Remark	Verdict
	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) • shall not exceed a value of 1 mA or • 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}= _____ V	N/A N/A N/A
	Any resettable or rearmable disconnector 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.	U_C= _____ V test voltage _____ V	N/A 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) • shall not exceed a value of 1 mA or • 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= _____ V I_{PE} = _____ mA	N/A N/A 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 disconnector.		
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.		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: • 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.	255 V 300 A m a l cos φ= 0.95	P N/A P
	Pass criteria		
C	No mechanical damage		P
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) • shall not exceed a value of 1 mA or • 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 V 1.23 µ A	P P 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
	Any resettable or rearmable disconnector 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.	U_C= _____ V test voltage _____ V	N/A 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) • shall not exceed a value of 1 mA or • 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= ___ V I_{PE} = ___ µ A	N/A N/A N/A
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 ≥ 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.	320 V 0.17µA	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.	_____ mA	N/A 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).		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
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
	a) Internal disconnector(s) have operated:		
	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.		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.		P
	a) No internal disconnector has operated:		
D	Determination of the measured limiting voltage:	$U_P \leq$ _____ V	N/A
	according to 8.3.3.1, but only at a crest value corresponding to I_{imp} for test class I	_____ kA / _____ V	N/A
	according to 8.3.3.1, but only at I_n for test class II	_____ kA / _____ V	N/A
	according to 8.3.3.3, but only at U_{OC} for test class III	_____ kA / _____ V	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	 _____ kV	 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.		P
	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.	25°C, 93RH%	P
	The samples shall be kept in the humidity cabinet for 2 days (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.		P

IEC 61643-11 - *TEST SEQUENCE 3*			
Clause	Requirement - Test	Result - Remark	Verdict
	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 • 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.	Between enclosure and live parts	P N/A
	Pass criteria		
	The insulation resistance shall not be lower than • 5 MΩ for the measurements according to a), • 2 MΩ for the measurements according to b).	≥2000 MΩ	P N/A
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.		
	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.		P

IEC 61643-11 - *TEST SEQUENCE 3*			
Clause	Requirement - Test	Result - Remark	Verdict
	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. a) between all interconnected live parts and the SPDs body accessible to accidental contact. The express "body" in the sense of this test means • 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.	a) Between enclosure and live parts, the AC test voltage(rms): 2.2kV	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%.		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 ±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.		
	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

IEC 61643-11 - *TEST SEQUENCE 3*			
Clause	Requirement - Test	Result - Remark	Verdict
	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.)		N/A
	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:	____ Nm	N/A
	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: parts A and B h = 100 mm parts C h = 150 mm parts D h = 200 mm 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.	100mm ____ ____	P N/A N/A

IEC 61643-11 - TEST SEQUENCE 3			
Clause	Requirement - Test	Result - Remark	Verdict
	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
	The following blows are applied: • for parts A, five strikes: one in the centre. After the sample has been moved horizontally: one each on the unfavourable points between the centre and the edges; and then, after the sample has been turned 90° about its axis perpendicular to the plywood, one each on similar points; • for parts B (as far as applicable), C and D, four blows: – 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 P 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
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.	100 °C for 24 h	P
	Pass criteria		
C	No mechanical damage		P

IEC 61643-11 - TEST SEQUENCE 3			
Clause	Requirement - Test	Result - Remark	Verdict
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.	____	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

IEC 61643-11 - *TEST SEQUENCE 3a* ***Additional tests for SPDs with separate isolated circuits***			
Clause	Requirement - Test	Result - Remark	Verdict
	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 of the separate circuits and the SPDs body accessible to accidental contact. The express "body" in the sense of this test means • 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 each combination of separate isolated circuits of the SPD, if there is more than one.		N/A N/A
	Pass criteria		
	The insulation resistance shall not be lower than • 5 MΩ for the measurements according to a), • 2 MΩ for the measurements according to b).	_ MΩ _MΩ	N/A 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
	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. a) between all interconnected live parts of the separate circuits and the SPDs body accessible to accidental contact. The express "body" in the sense of this test means • 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 each combination of separate isolated circuits of the SPD, if there is more than one.		N/A 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 ± 3 %.		N/A

IEC 61643-11 - *TEST SEQUENCE 3b* ***Additional tests if declared by the manufacturer***			
Clause	Requirement - Test	Result - Remark	Verdict
7.6.2.1/8.7.2	**Test to determine the voltage drop** (two port SPDs)		
	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 $\Delta U\% = ((U_{in} - U_{out}) / U_{in}) * 100\%$	____ V ____ A ____ %	N/A
	Pass criteria		
C	No mechanical damage		N/A

IEC 61643-11 - *TEST SEQUENCE 3c* ***Additional tests for two-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)**		
	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.	320 V 7 A 1.0 mm²	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.		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: • 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 – metal surfaces – insulating surfaces • Discrete arrangements of plug and socket-type connections	Temperature rise: ____ K / ____ K ____ K / ____ K ____ K / ____ K ____ K / ____ K ____ K / ____ K ____ K / ____ K ____ K / ____ K 21.7 K / 31.2 K ____ K / ____ K	P
7.5.1.2	**Overload behaviour**		
	The SPD shall be damaged or altered by overloads, which may occur in normal use.		
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

IEC 61643-11 - TEST SEQUENCE 3c *Additional tests for two-port SPDs with separate input / output terminals*			
Clause	Requirement - Test	Result - Remark	Verdict
	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.	k = 1.6 I = 16 A	P
	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.	_ A 1h → __ A 12h → _ A	N/A N/A
	Pass criteria		
	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: • 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 – metal surfaces – insulating surfaces • Discrete arrangements of plug and socket-type connections	Temperature rise: _____ K / _____ K _____ K / _____ K _____ K / _____ K _____ K / _____ K _____ K / _____ K _____ K / _____ K _____ K / _____ K 21.7 K / 56.8 K _____ K / _____ K	P

IEC 61643-11 - TEST SEQUENCE 3c *Additional tests for two-port SPDs with separate input / output terminals*			
Clause	Requirement - Test	Result - Remark	Verdict
	a) Any internal disconnector has operated:		
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 ≥ 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.	_ V __ µA	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.	_____ mA	N/A N/A
M	There shall be no explosion or other hazard to either personnel or the facility.		N/A
	b) No internal disconnector has operated:		
C	No mechanical damage		P
D	Determination of the measured limiting voltage:	$U_P \leq$ 1.3k V	P
	according to 8.3.3.1, but only at a crest value corresponding to I_{imp} for test class I	_____ kA / _____ V	N/A
	according to 8.3.3.1, but only at I_n for test class II	_____ kA / _____ V	N/A
	according to 8.3.3.3, but only at U_{OC} for test class III	5 kA / 1.22k 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	_____ kV	N/A

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IEC 61643-11 - TEST SEQUENCE 3c *Additional tests for two-port SPDs with separate input / output terminals*			
Clause	Requirement - Test	Result - Remark	Verdict
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
	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) • shall not exceed a value of 1 mA or • 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 V 1.23 µ A	P P N/A
	Any resettable or rearmable disconnector 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.	U_C= _____ V test voltage _____ V	N/A 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) • shall not exceed a value of 1 mA or • 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= _____ V I_{PE} = _____ mA	N/A N/A N/A
I	SPDs having an IP degree ≥ 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

IEC 61643-11 - *TEST SEQUENCE 4*			
Clause	Requirement - Test	Result - Remark	Verdict
7.4.2/8.5.2	**Heat resistance**		
	The SPD is kept in a heated cabinet at a temperature of 100 °C ± 2 K for the duration of 1 h.	100 °C for 1 h	P
	Pass criteria		
C	No mechanical damage		P
I	SPDs having an IP degree ≥ 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
	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 disconnector has opened.		P
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.		N/A
7.2.8.1/8.3.8.1	**TOVs caused by faults or disturbances in the low voltage system**		
	For SPDs with a U_C greater than or equal to U_T there is no need to perform this test	U_C= 320V U_T= 441V (120min)	N/A
	SPDs shall be tested using either the • TOV voltages U_T given in the relevant tables of Annex B, or, • TOV voltages stated by the manufacturer according to 7.1.1 c1), whichever values are higher.	U_T = 441.66 V (120min)	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	under consideration	P N/A N/A

IEC 61643-11 - TEST SEQUENCE 4a			
Clause	Requirement - Test	Result - Remark	Verdict
	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 $^{+5}/_{-0}$ %.		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.		N/A
	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= 441V (120min) U_{REF} = 255 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.		P
	The time interval between the test periods shall be as short as possible and shall in any case not exceed 100 ms.	30 ms	P
a)	**Pass criteria TOV failure mode**		
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 ≥ 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.	___ V _____ mA	N/A
	Currents through components connected in parallel to the relevant protective component(s), are disregarded for this measurement.		N/A

IEC 61643-11 - TEST SEQUENCE 4			
Clause	Requirement - Test	Result - Remark	Verdict
	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.	_____ mA	N/A 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**	U_T= 441V (120min)	
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		P
D	Determination of the measured limiting voltage:	U_P L-N/PE: 1.3kV	
	according to 8.3.3.1, but only at a crest value corresponding to I_{imp} for test class I	__ kA / __V	N/A
	according to 8.3.3.1, but only at I_n for test class II	__ kA / __V	N/A
	according to 8.3.3.3, but only at U_{OC} for test class III	L-N: 5 kA / 1.26kV L-PE: 5 kA / 1.10kV	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	_ kV	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		P

IEC 61643-11 - TEST SEQUENCE			
Clause	Requirement - Test	Result - Remark	Verdict
	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) • shall not exceed a value of 1 mA or • 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 V 1.37 µ A	P P N/A
	Any resettable or rearmable disconnector 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.	U_C= _____ V test voltage _____ V	N/A 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) • shall not exceed a value of 1 mA or • 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= 320 V I_{PE} = 0.19 µA	P P N/A
F	External disconnectors shall not operate during the test and shall be in working order after the test.		P
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 ≥ 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.		P
M	There shall be no explosion or other hazard to either personnel or the facility		P

IEC 61643-11 - *TEST SEQUENCE 4*			
Clause	Requirement - Test	Result - Remark	Verdict
7.2.8.2/8.3.8.2	**TOVs caused by faults in the high (medium) voltage system**	SPD for TN system	
	SPDs connected to PE and for use on power distribution systems • TOV voltages U_T given in Annex B or, • TOV voltages stated by the manufacturer according to 7.1.1 c1) whichever values are higher.	U_T = __ V U_T = __ V	N/A
	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	 under consideration	N/A N/A N/A
	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 $^{+0}/_{-5}$ % 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 $^{+0}/_{-5}$ % 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 N/A 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 $^{+10}/_{-0}$%.	_____A	N/A
	The prospective short-circuit current delivered by the TOV transformer shall be adjusted to 300A $^{+10}/_{-0}$% by R2.	_____A	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

IEC 61643-11 - TEST SEQUENCE 4			
Clause	Requirement - Test	Result - Remark	Verdict
a)	**Pass criteria TOV failure mode**		
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 ≥ 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.	_____ V _____ 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.	_____ mA	N/A 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
C	No mechanical damage		N/A
D	Determination of the measured limiting voltage:	$U_P \leq$ __ kV	
	according to 8.3.3.1, but only at a crest value corresponding to I_{imp} for test class I	_____ kA / _____ V	N/A

IEC 61643-11 - TEST SEQUENCE 4			
Clause	Requirement - Test	Result - Remark	Verdict
	according to 8.3.3.1, but only at I_n for test class II	_____ kA / _____ V	N/A
	according to 8.3.3.3, but only at U_{OC} for test class III	_____ kA / _____ V	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	 _ kV	 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) • shall not exceed a value of 1 mA or • 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}= _ V _ µA	N/A N/A N/A
	Any resettable or rearmable disconnector 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.	U_C= _____ V test voltage _____ V	N/A 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) • shall not exceed a value of 1 mA or • 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= _ V I_{PE} = _ µA	N/A N/A N/A

IEC 61643-11 - TEST SEQUENCE 4			
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 ≥ 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**		
8.3.5.3	This test is not applied to SPDs which are either • classified for outdoor use and for mounting out of reach, • for connection N-PE in TN and/or TT systems only		N/A 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		
	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 disconnector 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 cooper blocks (dummies) ensuring that the internal connections and their cross-section and surrounding material (e.g. resins) and packaging are not changed.		P
	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.	255 V 300 A cos φ= 0.95	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 disconnector operates, the relevant disconnector shall be replaced or reset each time. If the disconnector cannot be replaced or reset, the test is stopped.	internal	P

IEC 61643-11 - *TEST SEQUENCE 5*			
Clause	Requirement - Test	Result - Remark	Verdict
	Pass criteria		
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 ≥ 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.	320 V 0.17 µA	P 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.	_____ mA	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).	84.5 ms	P
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
	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 s ± 0,5 s. If no external overcurrent protection is required by the manufacturer, a prospective short-circuit current of 300 A is used.	_ V _ A cos φ=	N/A

IEC 61643-11 - TEST SEQUENCE 5			
Clause	Requirement - Test	Result - Remark	Verdict
	The test is carried out once 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
I	SPDs having an IP degree ≥ IP2X – 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
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
	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.		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.	_ V _____ mA	N/A 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.	_____ mA	N/A 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).	_ ms	N/A
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

IEC 61643-11 - TEST SEQUENCE 5			
Clause	Requirement - Test	Result - Remark	Verdict
	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.	_____ V _____ kA cos φ= _____	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 N/A
	To ensure that no external disconnector operates due to the trigger surge, all external disconnectors shall be placed in series with the power frequency source as shown in Figure 11.		N/A
	If a replaceable or resettable internal disconnector operates, the relevant disconnector shall be replaced or reset each time. If the disconnector 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 disconnector(s). Their correct indication shall be checked.		N/A
I	SPDs having an IP degree ≥ 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.	_____ V _____ mA	N/A
	Currents through components connected in parallel to the relevant protective component(s), are disregarded for this measurement.		N/A

IEC 61643-11 - TEST SEQUENCE 5			
Clause	Requirement - Test	Result - Remark	Verdict
	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.	_____ mA	N/A 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
8.3.5.3.2	**Additional test for SPD's failure mode simulation**		
	For this test any electronic indicator circuitry may be disconnected.		N/A
	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: • 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 _____ V	P 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.		P

IEC 61643-11 - *TEST SEQUENCE 5*			
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.	100 A	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 internal 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.		N/A
	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.		P
	Pass criteria		
	For this test any damage to electronic indicator circuitry during the conditioning test is not regarded as a failure.		
C	No mechanical damage		P
I	SPDs having an IP degree ≥ 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		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