

How is Everyone Doing Today ?



A photograph of a suspension bridge at night, illuminated with warm yellow lights. The sky is dark and filled with several bright, jagged lightning bolts striking downwards. The bridge's towers and cables are visible against the dark background.

UL1449 Surge Protective Devices

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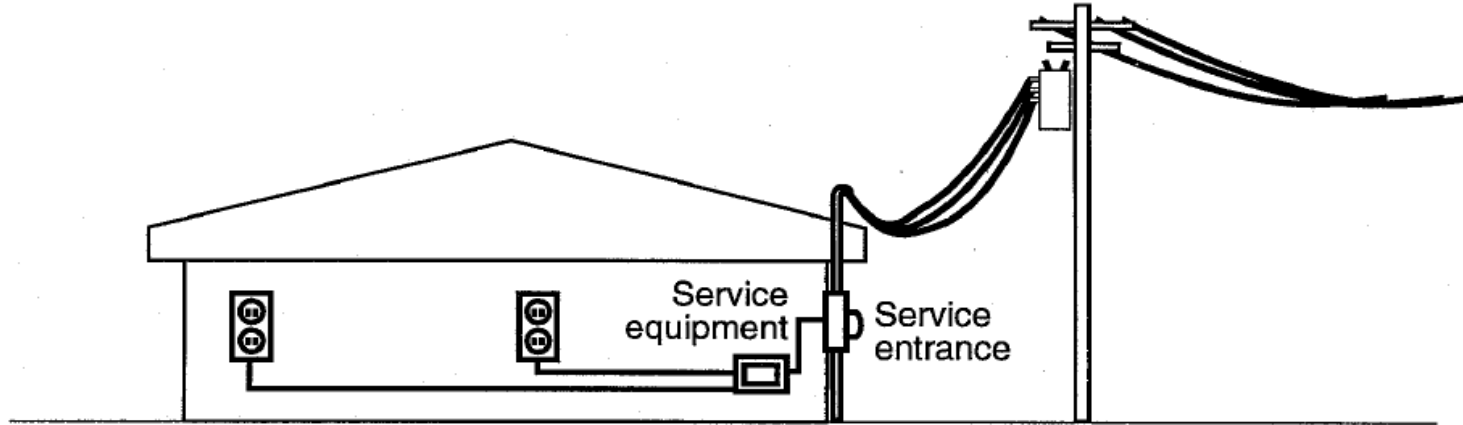


UL1449 - Standard for Surge Protective Devices-Scope

- Surge Protective Devices (SPDs) designed for 50 or 60 Hz power circuits not exceeding 1000 V or 1500 V dc, including:
 - ✓ Type 1,2,3 - Complete SPDs
 - ✓ Type 1,2,3 - Component Assemblies(CA)
 - ✓ Type 4 - Component Assemblies,
 - ✓ Type 5 - Discrete Components



Locations of SPD Types



Type 3

Type 2

Type 1

SPD Types

Type 1 - One port, intended for installation between the secondary of the service transformer and the line side of the service equipment overcurrent device, as well as the load side.

Type 2 - Intended for installation on the load side of the service equipment overcurrent device.



SPD Types - continued

Type 3 - Point of utilization SPDs, installed at a minimum conductor length of 10 meters (30 feet) from the electrical service panel to the point of utilization, for example cord connected, direct plug-in, receptacle type and SPDs installed at the utilization equipment being protected.



SPD Types, Component – continued

Type 4 - Component Assemblies - consisting of one or more Type 5 components together with a disconnect (integral or external) or a means of complying with the limited current tests.

Type 5 - Discrete component, such as MOVs, Gas Discharge Tubes, etc.



Component Assemblies

Type 1, 2, 3 Component Assemblies - Consists of a Type 4 component assembly with internal or external short circuit protection.

Essentially a complete SPD without an enclosure.



Overview of the UL 1449 Test Program

- Voltage Protection Rating (VPR)
- Surge Testing
- Current Testing



VPR

- VPR is determined by a 6 kV/3kA combination wave (CW) surge and also to benchmark the samples prior to the Nominal Discharge Current (I_n) Test for Type 1, 2 SPDs and the CW Surge testing for Type 3 SPDs
- VPR is assigned to Type 1, 2, 3 SPDs and Type 1, 2, 3 Component Assemblies

Surge Testing

- **Type 1, 2 & PV SPDs** - 15 surges at the Nominal Discharge Current (I_n) selected by the manufacturer:
 - ✓ Type 1 SPDs - 10 kA or 20 kA
 - ✓ Type 2 SPDs - 3 kA, 5 kA, 10 kA or 20 kA
 - ✓ PV SPDs - 20KA

Surge Testing - continued

- **Type 3 SPDs** - 15, 6 kV/3 kA CW Surges Eight surges shall be positive polarity at a phase angle of 90 (+0, -15) degrees and 7 shall be negative polarity at a phase angle of 90 (+0, -15) degrees. The surges are to be conducted in succession with a maximum 60 second period between each surge.

Surge Testing - Type 4 CA and Type 5 - continued

- **Type 4 CA & 5 SPDs** - Measure V_n for MOVs or breakdown voltage for GDT, before and after applying 15 surges at a selected nominal discharge current (I_n) value: (.01, .05, .1, .15, .25, .5, 1, 1.5, 2, 2.5, 3, 5, 10 or 20 kA) Measure MLV during each surge and compute the average for the MLV rating



Current Testing

- Intended to simulate an abnormal overvoltage condition with available Short Circuit Current at 3 levels
- Short Circuit - Type 1, 2 SPDs and permanently connected Type 3 SPDs, Intermediate - all SPDs & Limited - all SPDs

Current Testing – continued

- **Type 1 & 2 SPDs** - Forced conduction for permanently connected SPDs, SCC and Intermediate

Options, include:

- a) Increase the test voltage*
- b) Use lower voltage rated nonlinear voltage limiting and/or voltage switching components and test until disconnection occurs.*



Current Levels - continued

- Type 1, 2 SPDs - Short Circuit Current Rating
5KA - 200KA

Intermediate Levels

1000A

500A

100A

Limited Levels

10A

5A

2.5A

0.5A

Current Testing for Type 3 SPDs, Cord Connected or Direct Plug-In

- No Forced Conduction
- Apply Overvoltage, usually at full L-L voltage with the following available current:

<u>Intermediate</u>	<u>Limited</u>
SCC level(1, 2KA)	5
100A	2.5
50A	.5
	.125



Current Testing - PV SPDs

- MOV based SPDs- at all test levels use lower voltage rated MOVs with a V_n @ 1ma equal to, or lower than, 95% of the maximum DC voltage, V_{pvdc}
- For voltage switching-type, a CW surge on the DC power source to turn on SPD or increase test voltage to 105% of V_{pvdc}



Current Testing - DC SPDs

- For MOV based DC SPDs, at all test levels, use lower voltage rated MOV(s) with $V_n @ 1\text{ma}$ equal to 60 - 80% of the max dc voltage, V_{dcmcov}
- For voltage switching -type, a voltage impulse shall be superimposed on the DC power source to trigger the SPD or apply 125% of V_{dcmcov}



2020 NEC Proposals

- Requirements in Articles 280, Surge Arresters over 1KV and 285, SPDs 1KV or less, will be incorporated into a new Article 242, titled “Overvoltage Protection”
No changes anticipated



2020 NEC Proposals - continued

➤ First Revision No. 8546- New 230.67 Surge Protection.

(A) Surge Protective Device. All services in dwelling units shall be provided with a surge protective device (SPD).

(B) Location. The surge protective device shall be an integral part of the service equipment or shall be located immediately adjacent thereto.



230.67 - Continued

Exception. The surge protective device shall not be required to be located in the service equipment as required in (B), if located at each next level distribution equipment downstream toward the load.

(C) Type. The surge protective device shall be a Type 1 or Type 2 SPD.

(D) Replacement. Where service equipment is replaced, all of the requirements of this section shall apply.



NFPA780 and UL96A, Installation of Lightning Protection Systems

- SPDs at the service entrance shall have a nominal discharge current (I_n) rating of at least 20 kA 8/20 μ s per phase.
- UL1449, Type 1, 2, SPD rated 20KA would satisfy the NFPA780 and UL96A requirement



Communication Protectors - NFPA780

- Signal, data, and communications SPDs shall have a maximum discharge current (I_{max}) rating of at least 10 kA 8/20 μ s when installed at the entrance



Communication Protectors - continued

- The following Communication Protectors would comply:
 - ✓ QVGV, UL497, Primary Protectors, Marked 10KA
 - ✓ QVKC, UL497C, Primary Protectors for Coaxial Communications Circuits, Marked 10KA
 - ✓ QVLA, Subject 497E, Protectors for Antenna Lead-in Conductors



NFPA780-Chapter 12, Protection of Solar Arrays, SPD Requirements

- 12.4.2.2 PV surge protective devices shall have a nominal discharge current rating (I_n) of 20kA 8/20 μ s per mode.
- 12.4.2.3 PV surge protective devices shall be listed for use on PV systems and marked “DC” or “PV SPD.”



New UL1449 SPD Evaluations

- Open Type- Type 1, 2 or 3 SPD, with an incomplete or partial enclosure and with field wiring terminals and/or leads, suitable for field installation, in accordance with the National Electrical Code, ANSI/NFPA 70, within a suitable enclosure.



New UL1449 SPD Evaluations - continued

- High-Altitude- Rated for use in an altitude greater than 2000 m
- Flammability for coated MOVs for end use applications, such as, IEC 62368-1, "Audio/Video, ITE
- PV SPDs-Supplement SA of UL1449



New UL1449 SPD Evaluations - continued

- DC SPDs-Supplement SB of UL1449
- CSA C22.2 N0. 269 .1-.5 Updates



UL1449 SPD Evaluations - continued

- UL Verification Mark or Letter Report, for example, Increased Surge Rating or other SPD Attribute or Feature







New Surge Generator for UL1449/IEC61643-11 Testing – Q4'2018

- ✓ 8/20 impulse current generator, up to 60KA
- ✓ Energized surge testing up to 1KV,ac and 1.5KV, dc with 100A SCC
- ✓ Combination waveform, 20kV/10kA





Overview of UL Global SPD Services

UL Services	Standard	SPD Product Types	Mark ³	Market Access
UL Certification (Listing)	UL 1449	Types 1, 2, and 3		US
UL Certification (Recognition)		Types 1, 2, 3 and 4 Component Assemblies and Type 5 Component		US
cUL Certification (Listing)	C22.2 No. 269-1	Type 1		Canada
	CSA C22.2 No. 269-2	Type 2		
	CSA C22.2 No. 269-3	Type 3		
cUL Certification (Recognition)	CSA C22.2 No. 269-4	Type 4 Component Assembly		Canada
	CSA C22.2 No. 269-5	Type 5 Component		



UL Global SPD Services

UL Certification to IEC Publications	IEC 61643-11	Test Class T1 , T2 and T3		International
	IEC 61643-311	Gas Discharge Tubes		
	IEC 61643-321	Avalanche Breakdown Diodes (ABDs)		
	IEC 61643-331	Metal Oxide Varistors (MOVs)		
UL EU and/or Demko "D" Marks	EN 61643-11	Types T1 , T2 and T3		Europe and/or Denmark
	EN 61643-311	Gas Discharge Tubes		
	EN 61643-321	Avalanche Breakdown Diodes (ABDs)		
	EN 61643-331	Metal Oxide Varistors (MOVs)		
Type Examination Certificate¹	IEC 61643-11	Test Class T1 , T2 and T3		
	IEC 61643-311	Gas Discharge Tubes		
	IEC 61643-321	Avalanche Breakdown Diodes (ABDs)		
	IEC 61643-331	Metal Oxide Varistors (MOVs)		
Informative Test Report²	IEC 61643-11 and/or EN 61643-11	Test Class T1 , T2 and T3 Types T1 , T2 and T3		International
	IEC 61643-311 and/or EN 61643-311	Gas Discharge Tubes		
	IEC 61643-321 and/or EN 61643-321	Avalanche Breakdown Diodes (ABDs)		
	IEC 61643-331 and/or EN 61643-331	Metal Oxide Varistors (MOVs)		

Notes: 1. A Certificate & Test Report issued by UL, an Independent Third Party Certification Body, for a product evaluated and in compliance with the relevant IEC Product Standards.
 2. Test Report issued by UL, as an Independent Third Party Certification Body, for a product evaluated to the relevant IEC and/or EN Product Standards.
 3. The UL Certification Mark can be a combination Mark for US and Canada and/or a country code.

**Q2'2018
IEC Audit
Melville**



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