

UL 1449 and the 2008 NEC

Significant changes have been made in the requirements for identifying and evaluating surge protective devices

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The use of surge protective devices (SPDs) within residential, commercial, and industrial applications has sharply increased over the last decade with the prevalence of computers, other electronics, and the increase in audio/video entertainment systems. As a result, service entrance, branch panel, and cord-connected SPDs have all become commonly used equipment in homes and businesses as well as a necessity for buildings containing critical systems and/or essential services.

The electrical construction industry has seen its primary safety standard for SPDs undergo some major revisions in the past three years. In February of 2005, UL 1449 2nd Edition underwent a major revision, requiring additional safety testing at medium fault current levels. Compliance to this update became mandatory on February 9, 2007. Underwriters Laboratories then published UL 1449 3rd Edition in September 2006, with compliance required by September 2009. Let's see what this latest edition entails.

UL 1449, 3rd edition. The 3rd edition of UL 1449, "Standard for Safety for Surge Protective Devices," replaces the 2nd edition, "Standard for Transient Voltage Surge Suppressors" (TVSSs), and combines TVSSs with surge arresters rated 600V or less that are currently evaluated to ANSI/IEEE C62.11 or IEEE C62.1-1989. The 3rd edition of UL 1449 will place these products under a single certification service. The SPDs certified to the 3rd edition of UL 1449 have type designations as follows:

Type 1. These are permanently connected SPDs 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 (including watt-hour meter adapters). Previously known as surge arresters, these devices are intended to be installed without an external overcurrent protective device.

Type 2. These are permanently connected SPDs intended for installation on the load side of the service equipment overcurrent device, including SPDs located at the branch panel.

Type 3. These are point-of-utilization SPDs, which are installed at a minimum conductor length of 10 meters (approximately 30 feet) from the electrical service panel to the point of utilization (e.g., cord-connected, direct plug-in, receptacle type, and SPDs installed at the utilization equipment being protected). The distance (10 meters) is exclusive of conductors provided with or used to attach SPDs.



UL 96A is used to evaluate an installation to qualify for the UL Lightning Protection certificate.

Note: Type 2 and 3 SPDs were previously known as TVSSs.

The 2008 NEC. The 2008 National Electrical Code (NFPA 70) includes revisions to Articles 280 and 285 that reflect changes that were incorporated into the 3rd edition of UL 1449.

Article 280. The title of Art. 280 was amended so that the term "surge arrester" references only those devices installed in circuits with voltages greater than 1kV. In addition, a new Sec 280.2 (Uses Not Permitted) states, "A surge arrester shall not be installed where the rating of the surge arrester is less than the maximum continuous phase-to-ground power frequency voltage available at the point of application." New wording in Sec. 280.4(A) details surge arrester ratings for solidly grounded and "impedance or ungrounded" systems.

Finally, a new Sec. 280.5 mandates that these surge arresters be listed. As defined in the NEC, this essentially means that the surge arrester is evaluated and marked (and also appears in a published list) by an independent certification and

testing organization that is acceptable to the authority having jurisdiction (AHJ).

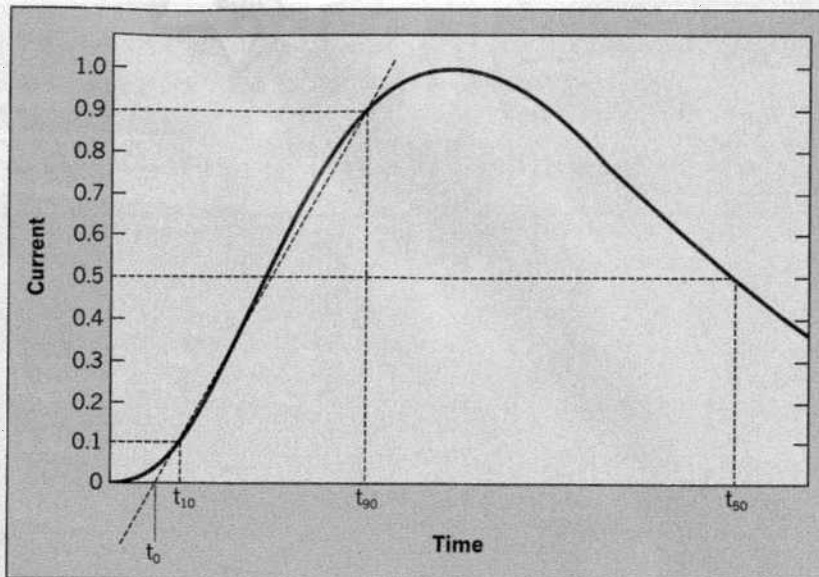
With the prevalence of high-voltage pad-mounted transformers and substations installed on customer premises, installed surge arresters will now come under the jurisdiction of the local electrical inspector, applying Art. 280.

UL evaluates surge arresters for listing using ANSI/IEEE C62.11-2005, "Standard for Metal-Oxide Surge Arresters for AC Power Circuits (>1 kV)." Additionally, surge arresters and type 1 and 2 SPDs currently required within lightning protection systems also need to be listed as specified in NFPA 780, "Standard for the Installation of Lightning Protection Systems," as well as UL 96A, "Standard for Installation Requirements for Lightning Protection Systems." UL 96A is used to evaluate an installation to qualify for the UL Lightning Protection Inspection Certificate.

Article 285. TVSSs have been redefined as "Surge Protective Devices (SPDs) 1kV or Less." Previously titled "Transient Voltage Surge Suppressors: TVSSs," this Article now uses the "type" designations that parallel the new requirements in UL 1449, 3rd Edition. It also includes general, installation, and connection requirements for these SPD types installed on premises wiring systems rated 1kV or less.

Testing requirements. Under UL 1449, 3rd Edition, all SPD types are investigated to verify that the average transient voltage surge is limited to the voltage protection rating (VPR) as marked on the SPD. This rating is verified before and after surge testing. This VPR value, referred to as the "let-through voltage," is determined during surge testing using a combination wave generator at a setting of 6kV, 3kA.

Type 1 and type 2 SPDs are subjected to a nominal discharge current (I_n) test, where 15 of the 8×20 microsecond surge currents, with a magnitude specified by the manufacturer and as high as 20kA, are impressed through the SPD. This test represents a surge that would be seen at the service equipment, such as a lightning flash to the utility power line or a surge that is coupled inductively



Shown is the plot of an 8/20 current impulse. The callout "8/20" designates a current impulse having a virtual front time of 8 microseconds (0.000008 seconds) and a time to half-value of 20 microseconds (0.000020 seconds). The duration of the current impulse is the time occurring between its virtual origin (t_0) and the 50% point on its tail (t_{50}). The term "virtual origin" denotes the intersection of the line connecting t_{90} and t_{30} with $I=0$. The term "front time" denotes a value equal to $1.25 \times (t_{90} - t_{10})$, where t_{90} and t_{10} are times to the 90% and 10% amplitude points, respectively, on the leading edge of a waveform.

into the building wiring system.

Type 3 SPDs are subjected to an operating duty cycle test with a combination wave at 6 kV/3kA. This test represents a typical surge encountered at a distance of 10 meters from the main service panel.

All SPD types are subjected to a surge sequence test on three samples, including initial VPR, followed by I_n testing or an operating duty cycle, followed by repeated VPR, and an overvoltage test at 115% of nominal operating voltage. SPDs must not only survive this surge testing, but also function afterward to suppress surges at the VPR. During this testing sequence, the overcurrent protection is not allowed to operate, as this would defeat the purpose of the SPD.

Additionally, all type 1 and type 2 SPDs are tested to verify the manufacturer's short-circuit current rating as required by Art. 285. In the field, the AHJ would verify that the SPD is installed at a point on the system where the available fault current is not in excess of the rating.

SPDs are required to be marked with SPD type, electrical ratings that include the operating voltage rating (volts),

AC power frequency (Hz), number of phases, and the voltage protection rating (VPR) in volts. For 2-port SPDs, the ratings would also include the load current rating (amperes). For type 1 and type 2 SPDs, the I_n rating in amps or kA, the maximum continuous operating voltage rating (MCOV) in volts, and the short-circuit current rating (SCCR) in amps or kA are also required on the product.

Third edition effective date. The new "surge protective devices" terminology and "type" marking requirements in UL 1449, 3rd Edition have an effective date of September 2009. In the meantime, manufacturers will be starting the redesign process and can introduce products with the new markings immediately. Until the effective date, products marked as "surge arresters" and "transient voltage surge suppressors" will continue to be produced and UL listed. **EC&M**

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