

## Manufacturing & Test Standards for SPDs

PQ Global TVSS/SPDs are manufactured and tested in accordance with applicable industry standards.

The following standards are the basis of design, manufacture, and test of SPD equipment:

### IEEE C62.41.1-2002: Guide on the Surge Environment in Low-Voltage (1000V and Less) AC Power Circuits

This document is a comprehensive collection of historical research and data concerning transients, energy levels, lightning, occurrence rates, related databases, etc. It outlines definitions, temporary over voltages (TOVs), isokeraunic maps and addresses physical limitations due to sparkover of clearances. It is 163 pages of data leading to Recommended Practices addressed in C62.41.2. This document includes an outstanding bibliography section.

### IEEE C62.41.2 – 2002 : Recommended Practice on Characterization of Surges in Low Voltage (1000V and Less) AC power circuits

This IEEE standards product is part C62 Family on Surge Protection and supersedes C62.41-1991. The scope of this recommended practice is to characterize the surge environment at locations on ac power circuits described in IEEE Std C62.41.1-2002 by means of standardized waveforms and other stress parameters. The surges considered in this recommended practice do not exceed one half-cycle of the normal mains waveform (fundamental frequency) in duration. They can be periodic or random events and can appear in any combination of line, neutral, or grounding conductors. They include surges with amplitudes, durations, or rates of change sufficient to cause equipment damage or operational upset.

### IEEE C62.45 – 2002: Recommended Practice on Surge Testing For Equipment Connected To Low-Voltage (1000V and Less) AC Power Circuits

This IEEE standards product is from part C62 Family on Surge Protection. The scope of this recommended practice is the performance of surge testing on electrical and electronic equipment connected to low-voltage ac power circuits, specifically using the recommended test waveforms defined in IEEE Std C62.41.2 -2002. Nevertheless, these recommendations are applicable to any surge testing, regardless of the specific surges that may be applied.

### IEEE C62.62 – 2000 : IEEE Standard Test Specification for Surge Protective Devices For Low-Voltage AC Power Circuitry

This standard establishes methods for testing and measuring the performance characteristics for surge-protective devices used in low-voltage ac power circuits. Definitions are stated that apply specifically to surge-protective devices. The testing requirements are categorized into two groups, in which a minimum set of basic tests (BTs) are prescribed for all surge-protective devices within the scope of its documents, supplemented by additional tests (ATs) that might be needed to establish particular application requirements.

### ANSI/IEEE C62.11 – 1993 : Standard for metal-oxide surge arrestors for AC power circuits

This standard applies to metal oxide surge arresters designed to repeatedly limit the voltage surges on 48Hz to 62Hz power circuits by passing surge discharge current and automatically limiting the flow of system power current. This standard applies to devices for separate mounting and to those supplied integrally with other equipment.

### ANSI/IEEE C62.33 – 1982 : Test Specification for Varistors surge-protective devices

This standard applies to varistors for surge protective applications on systems with dc to 420Hz frequency and voltages equal to or less than 1000V RMS or 1200V dc. This standard contains definitions, services conditions, and a series of test criteria for determining the electrical characteristics of these varistors. If the characteristics differ from the direction of conduction, then the tests determine the characteristics for both polarities. Arresters covered by ANSI/IEEE C62.1 – 1984 are excluded from this standard.

### IEEE STD 1100 – 2005 Emerald Book : Recommended Practice for Power & Grounding Electronic Equipment

IEEE Recommended Practice for Powering and Grounding Sensitive Electronic Equipment. Section 8.6.5 provides guidelines for installations utilizing UPS systems. Specifying surge suppression should be placed on the rectifier/charge input circuit and the bypass circuits including the manual bypass. The Emerald book also contains information concerning the installation of suppressors within a facility in section 9.8.5.

### IEEE STD 446 – 1995 Orange Book : Emergency & Standby Power

IEEE Recommended Practice for Emergency and Standby Power Systems for Industrial and Commercial Applications. Sections 6.4.2.2 and 6.7.5 recommend fundamental practices for overvoltage and transient voltage protection.

### IEEE C62.72 : IEEE Standards Guide for Application of Surge Protective Devices for Low Voltage (1000 Volts or Less) AC Power Circuits

Information is provided to specifiers and users of surge-protective devices (SPDs) about the application considerations of SPDs associated with power distribution systems within North America. This guide applies to SPDs to be connected to the load side of the service entrance main over current protective device of 50 Hz or 60 Hz ac power circuits rated at 100 V to 1000 V rms. The effects and side effects on the presence and operation of SPDs in low-voltage power distribution systems are described. The coordination of multiple SPDs on the same circuit is described.

### UL 1449 Second Edition Revision (Rev 4.0) – 2014 : UL Standard for Safety for TVSS

The current revision is Rev. 4, effective August 2014. These UL test procedures incorporate recommendations from IEEE C62.41, C62.45, and UL designed safety tests. The safety testing focuses on mechanical and electrical failure mode and insures that the suppressor being evaluated fails safely. The UL MARK for TVSS 1449 cannot be used if the unit fails the safety test. Additional requirements for the UL MARK include performance testing. Performance testing does not include a pass/fail performance grade, but results in a suppression rating assigned to the specific product. The performance test is a let through test that measures the amount of transient voltage remaining when a specific magnitude transient is injected at the input of the suppressor. A pulse life test is also performed as part of the 1449 listing; this is a pass/fail test and measures the ability of a suppressor to survive multiple transients in succession.

### UL 1283 – 2007 : Electromagnetic Interference filters

This UL listing is the safety testing procedure for EMI/RFI filters. This is a safety only standard, not a performance standard. Some surge suppressors include a capacitive filter as part of the suppression circuit.

### UL 67 – 2000 : Panelboards

This UL listing is for panelboard interiors. This is a safety listing describing clearances, heat dissipation, and conductor material, and sizes. This standard covers panelboards 600 volts and less. This would pertain to suppressors mounted internal to panelboards.

### UL 50 – 2003 : Enclosures for electrical equipment

This UL listing is for panelboard enclosures. This is a safety listing that describes the size and material used for panelboard enclosures.

### UL 845 – 2005 : Motor control Center

This UL listing is for motor control centers and pertains to suppressors mounted internal to a motor control center bucket.

### UL 857 – 2001 : Busways This is the UL listing for busplug devices and pertains to a suppressor mounted internally to a busplug unit. UL 1414 – 2007 : UL Standard for Safety Across-The-Line Antenna Coupling and Line Bypass Capacitors for Radio- and Television- Type Appliances

Safety standard for capacitors and suppressors for radio- and television- type appliances. These requirements cover capacitors rated not more than 1.0 microfarad, 85°C, 250V, and 60 Hz that are employed in radio, television receiving, and similar appliance circuits where breakdown of the capacitor results in a risk of fire, electric shock, or injury to persons.

### NEMA Standards Publication No. LS 1 – 2000 : Low voltage surge protection devices

This document is the National Electrical Manufacturers Association standardized surge suppression specification format. The document provides standard definitions and specification format.

### IEC 61643-1 – 2005 : Low voltage surge protective devices – requirements and tests

This part of IEC 61643 is applicable to devices for surge protection against indirect and direct effects of lightning or other transient over voltages. These devices are packaged to be connected to 50/60 Hz a.c. and d.c. power circuits, and equipment rated up to 1000 V r.m.s. or 1500 V d.c. Performance characteristics, standard methods for testing, and ratings are established for these devices that contain at least one nonlinear component that is intended to limit surge voltages and divert surge currents.

### IEC 61643-12 – 2002 : Low voltage surge protective devices – Selection and Application Principles

This part of IEC 61643 describes the principles for selection, operation, location and coordination of SPDs to be connected to 50 Hz to 60 Hz a.c. and to d.c. power circuits and equipment rated up to 1 000 V r.m.s. or 1 500 V d.c.

### CSA C22.2M – 2000 : Bonding of Electrical Equipment

This is the CSA guideline for compliance with Canadian Electrical Code for bonding and grounding and surge suppressors. CSA and UL have a reciprocal agreement allowing the sharing of testing information to accommodate CSA Certification and UL listing of surge suppressors.

### FIPS PUB 94 – 1983 : Guidelines on Electrical Power for ADP Installations

Federal Information Standards Publication 94 guidelines for Federal data processing centers and covers the complete environment for installing computers. Topics covered include air conditioning, grounding, transformers, lightning protection, and surge suppression.

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