

SURGE PROTECTIVE DEVICES (SPDs)
LOW VOLTAGE AC EXTERNAL SIDEMOUNT SURGE PROTECTION FOR ELECTRICAL DISTRIBUTION
SYSTEMS
SECTION 16671B

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SURGE PROTECTIVE DEVICES (SPDs)
EXTERNAL SIDEMOUNT UNITS
LOW VOLTAGE AC SURGE PROTECTION FOR ELECTRICAL DISTRIBUTION SYSTEMS

PART 1 GENERAL

1.01 SCOPE

1. The Contractor shall furnish and install the Surge Protective Device (SPD) equipment having the electrical characteristics, ratings, and modifications as specified herein and as shown on the contract drawings. To maximize performance and reliability and to obtain the lowest possible let-through voltages, the ac surge protection shall be installed external to the electrical distribution equipment such as switchgear, switchboards, panelboards, control panels, or motor control centers (MCC). Refer to related sections for surge requirements in:

1.02 RELATED SECTIONS

1. Section 16426A – Metal Enclosed Drawout Switchgear (Magnum DS) – Low Voltage
2. Section 16426B – Metal Enclosed Drawout Switchgear (DSII) – Low Voltage
3. Section 16428 – Switchboards – Low Voltage (Compartmentalized Feeders – Pow-R-Line I)
4. Section 16429 – Switchboards – Low Voltage (Group Mounted Feeders – Pow-R-Line C)
5. Section 16431 – Switchboards – Low Voltage (Commercial Metering)
6. Section 16470 – Panelboards
7. Section 16482A & B – Motor Control Centers – Low Voltage (Freedom and Advantage)

1.03 REFERENCES

1. SPD units and all components shall be designed, manufactured, and tested in accordance with the latest applicable standards
 - A. ANSI/UL 1449 4th Edition or later
 - B. ANSI/UL 1283 5th Edition or later (Type 2 applications)
 - C. CSA C22.2 NO. 269.1
 - D. CSA C22.2 NO. 269.2
 - E. IEEE C62.41.1
 - F. IEEE C62.41.2
 - G. IEEE C62.43-2005
 - H. IEEE C62.45-2002
 - I. IEEE C62.48-2005
 - J. IEEE C62.62-2010

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K. MIL-STD-220A

L. UL 96A

M. NFPA 780

1.04 SUBMITTALS – FOR REVIEW/APPROVAL

1. The following information shall be submitted to the Engineer:
 - A. Provide verification that the SPD complies with the required ANSI/UL 1449 4th Edition or later listing by Underwriters Laboratories (UL). Compliance may be in the form of a file number that can be verified on [UL's website](http://www.ul.com), www.UL.com, the website should contain the following information at a minimum: model number, SPD Type, system voltage, phases, modes of protection, Voltage Protection Rating (VPR), and Nominal Discharge Current (I_n).
 - B. Electrical/mechanical drawings showing unit dimensions, weights, installation instruction details, and wiring configuration.
2. Where applicable the following additional information shall be submitted to the engineer:
 - A. Descriptive bulletins
 - B. Product sheets

1.05 SUBMITTALS – FOR CONSTRUCTION

1. The following information shall be submitted for record purposes:
 - A. Instruction manuals for the units to be installed

1.06 QUALIFICATIONS

1. The manufacturer of the assembly shall be the manufacturer of the major components within the assembly.
2. For the equipment specified herein, the manufacturer shall be ISO 14001 and ISO 9001 or 9002 certified.
3. The manufacturer of this equipment shall have produced similar electrical equipment for a minimum period of twenty-five (25) years. When requested by the Engineer, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement.
4. The SPD shall be compliant with the Restriction of Hazardous Substances (RoHS) Directive 2011/65/EU and have a visible label showing compliance.
5. The SPD shall be UL 1449 current edition listed, 20 kA I_n Type 1 or Type 2 for use in UL 96A systems.

1.07 DELIVERY, STORAGE AND HANDLING

1. Equipment shall be handled and stored in accordance with manufacturer's instructions. One (1) copy of manufacturer's instructions shall be included with the equipment at time of shipment.

1.08 OPERATION AND MAINTENANCE MANUALS

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1. Operation and maintenance manuals shall be provided with each SPD shipped.

PART 2 PRODUCTS

2.01 MANUFACTURERS

1. Eaton
2. _____
3. _____

The listing of specific manufacturers above does not imply acceptance of their products that do not meet the specified ratings, features, and functions. Manufacturers listed above are not relieved from meeting these specifications in their entirety. Products in compliance with the specification and manufactured by others not named will be considered only if pre-approved by the Engineer ten (10) days prior to bid date.

2.02 VOLTAGE SURGE SUPPRESSION – GENERAL

1. Electrical Requirements
 - A. Unit Operating Voltage – Refer to drawings for operating voltage and unit configuration.
 - B. Maximum Continuous Operating Voltage (MCOV) – The MCOV shall not be less than 115% of the nominal system operating voltage.
 - C. The suppression system shall incorporate thermally protected metal-oxide varistors (MOVs) as the core surge suppression component for the service entrance and all other distribution levels. Each thermally protected MOV shall have an end of life indicator and the suppression system shall be continuously self-monitoring. End of life mode to be open circuit. Unit with end of life short-circuit mode are not acceptable The system shall not utilize silicon avalanche diodes, selenium cells, air gaps, or other components that may crowbar the system voltage leading to system upset or create any environmental hazards. End of life mode to be open circuit. Unit with end of life short-circuit mode are not acceptable
 - D. Unit shall operate without the need for an external overcurrent protection device (OCPD), and be listed by UL as such. Unit must not require external OCPD or replaceable internal OCPD for the UL Listing.
 - E. Protection Modes – The SPD must protect all modes of the electrical system being utilized. The required protection modes are indicated by bullets in the following table:

Configuration	Protection Modes			
	L-N	L-G	L-L	N-G
Wye	•	•	•	•
Delta	N/A	•	•	N/A

· Note to Spec. Writer – Insert data in blanks

Single Split Phase	•	•	•	•
High Leg Delta	•	•	•	•

- F. Nominal Discharge Current (I_n) – All SPDs applied to the distribution system shall have a 20kA I_n rating regardless of their SPD Type (includes Types 1 and 2) or operating voltage. SPDs having an I_n less than 20kA shall be rejected.
- G. ANSI/UL 1449 4th Edition or later Voltage Protection Rating (VPR) – The maximum ANSI/UL 1449 4th Edition or later VPR for the device shall not exceed the following:

Modes	208Y/120	480Y/277	600Y/347
L-N; L-G; N-G	700	1200	1500
L-L	1200	2000	3000

2. SPD Design

- A. Balanced Suppression Platform – The surge current shall be equally distributed to all MOV components to ensure equal stressing and maximum performance. The surge suppression platform must provide equal impedance paths to each matched MOV. Designs incorporating replaceable single-mode modules shall not be accepted.
- B. SPDs containing items such as single-mode replaceable modules, replaceable fuses, or replaceable batteries shall not be accepted. SPDs requiring user intervention to test the unit via a diagnostic test kit or similar device shall not be accepted. Each thermally protected MOV shall have an end of life indicator and the suppression system shall be continuously self-monitoring.
- C. Units with removable covers or doors shall be equipped with internal safety barriers having lockout provisions to prevent contact with energized components.
- D. Electrical Noise Filter – Each Type 2 unit shall include a high-performance EMI/RFI noise rejection filter. Noise attenuation for electric line noise shall be (Engineer to select one, 50 dB or 40 dB) minimum from 10 kHz to 100 MHz using the MIL-STD-220A insertion loss test method. Products unable to meet this specification shall not be accepted.
 - a. Type 2 units with filtering shall be co-listed to UL 1283 5th Edition or later.
 - b. Type 1 units shall not contain filtering nor can they have a UL 1283 5th Edition Listing.
- E. Internal Connections – No plug-in single-mode modules or printed circuit boards shall be used as surge current conductors. All internal components shall be soldered, hardwired with connections utilizing low impedance conductors.

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- F. Monitoring Diagnostics – Each SPD shall provide the following integral monitoring options:
- a. Protection Status Indicators - Each unit shall have a green / red solid-state indicator light that reports the status of the protection on each phase.
 - i. For wye configured units, the indicator lights must report the status of all protection elements and circuitry in the L-N and L-G modes. Wye configured units shall also contain solid-state indicator lights that report the status of the protection elements and circuitry in the N-G mode. SPDs that indicate only the status of the L-N and L-G modes shall not be accepted.
 - ii. For delta configured units, the indicator lights must report the status of all protection elements and circuitry in the L-G and L-L modes.
 - iii. The absence of a green light and the presence of a red/yellow light shall indicate that damage has occurred on the respective phase or mode. All protection status indicators must indicate the actual status of the protection on each phase or mode. If power is removed from any one phase, the indicator lights must continue to indicate the status of the protection on all other phases and protection modes. Diagnostics packages that simply indicate whether power is present on a particular phase shall not be accepted.
 - b. Remote Status Monitor (optional) – The SPD must include Form C dry contacts (one NO and one NC) for remote annunciation of its status. Both the NO and NC contacts shall change state under any fault condition.
 - c. Audible Alarm and Silence Button (optional) – The SPD shall contain an audible alarm that will be activated under any fault condition. There shall also be an audible alarm silence button used to silence the audible alarm after it has been activated.
 - d. Surge Counter (optional) – The SPD shall be equipped with an LCD display that indicates to the user how many surges have occurred at the location. The surge counter shall trigger each time a surge event with a peak current magnitude of a minimum of $50 \pm 20A$ occurs. A reset pushbutton shall also be standard, allowing the surge counter to be zeroed. The reset button shall contain a mechanism to prevent accidental resetting of the counter via a single, short-duration button press. In order to prevent accidental resetting, the surge counter reset button shall be depressed for a minimum of 2 seconds in order to clear the surge count total.
 - i. The ongoing surge count shall be stored in non-volatile memory. If power to the SPD is completely interrupted, the ongoing count indicated on the surge counter's display prior to the interruption shall be stored in non-volatile memory and displayed after power is restored. The surge counter's memory shall not require a backup battery in order to achieve this functionality.
- G. Thermal MOV Protection
- a. The unit shall contain thermally protected MOVs. These self-protected MOVs shall have a thermal protection element integrated with the MOV and a mechanical disconnect with arc quenching capabilities in order to achieve overcurrent protection of the MOV. The thermal protection assembly shall disconnect the MOV(s) from the system in a fail-safe manner should a condition occur that would cause them to enter a thermal runaway condition. Each thermally protected MOV shall have an end of life indicator and the suppression system shall be continuously self-monitoring.

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H. Overcurrent Protection

- a. The unit shall not require external overcurrent protection as part of the UL 1449 listing. Local electrical code may require overcurrent protection of the conductors connecting the SPD to the system. OCPD shall be sized based on local electrical code requirements.

- I. Fully Integrated Component Design – All of the SPD's components and diagnostics shall be contained within one discrete assembly. The use of plug in single-mode modules that must be ganged together in order to achieve higher surge current ratings or other functionality shall not be accepted.

J. Safety Requirements

- a. The SPD shall minimize potential arc flash hazards by containing no single-mode plug in user serviceable / replaceable parts and shall not require periodic maintenance. SPDs containing items such as replaceable single-mode plug in modules, replaceable fuses, or replaceable batteries shall not be accepted. SPDs requiring user intervention to test the unit via a diagnostic test kit or similar device can pose a safety hazard and shall not be accepted.
- b. SPDs designed to interface with the electrical assembly via conductors shall require no user contact with the inside of the unit or shall have barriers that block access to harmful voltages. Lockout provisions, capable of accepting a padlock, shall be provided on units with a disconnecting internal breaker if applicable. Units without barriers or lockout provisions shall be factory sealed to reduce exposure to harmful voltages. Factory sealed units shall have installed phase, neutral, ground and remote status contact conductors and shall have a pigtail set of conductors protruding outside of the enclosure for field installation.

K. Feeder Tap Rule

- a. The unit shall comply with the NEC 240.21(B)(1)(b) requirements for tap rule when using conductors not over 10 feet on the line side of the service entrance.
- b. The disconnect shall be integral to the unit and be protected by barriers to ensure no exposure to harmful voltages.
- c. The unit shall have barriers and lockout provisions inside the enclosure in order to safely replace the SPD unit when an end of life condition occurs.
- d. Units shall have barriers and lockout provisions to enable replacement of the SPD without requiring a system shutdown.

2.03 SYSTEM APPLICATION

1. The SPD applications covered under this section include distribution and branch panel locations, MCC, switchgear, and switchboard assemblies. All SPDs shall be tested and demonstrate suitability for application within ANSI/IEEE C62.41 Category C, B, and A environments.
2. Surge Current Capacity – The peak surge current capacity of the device is capable of withstanding shall be as shown in the following table:

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Surge current capacity based on ANSI / IEEE C62.41 location category			
Category	Application	Per Phase (kA)	Per Mode (kA)
C	Service Entrance Locations (Switchboards, Switchgear, MCC, Main Entrance)	200	100
		250	125
		300	150
B	High Exposure Roof Top Locations (Distribution Panelboards)	120	60
		160	80
		200	100
A	Branch Locations (Panelboards, MCCs)	50	25
		80	40
		100	50
		120	60

Actual surge current capacity depends on customer site conditions (*Engineers to select from above*)

3. SPD Type – all SPDs installed on the line side of the service entrance disconnect shall be Type 1 SPDs. All SPDs installed on the load side of the service entrance disconnect shall be Type 1 or Type 2 SPDs.

2.04 LIGHTING AND DISTRIBUTION PANELBOARD REQUIREMENTS

1. The SPD application covered under this section includes lighting and distribution panelboards. The SPD units shall be tested and demonstrate suitability for application within ANSI/IEEE C62.41 Category B environments.
 - A. The SPD shall not limit the use of through-feed lugs, sub-feed lugs, and sub-feed breaker options.
 - B. SPDs shall be installed on the load side of the main breaker to a feeder breaker sized appropriately based on the SPD conductor.
 - C. Lead length between the breaker and SPD shall be kept as short as possible to ensure optimum performance. Any excess conductor length shall be trimmed in order to minimize let-through voltage. The installer shall comply with the manufacturer's recommended installation and wiring practices.

2.05 SWITCHGEAR, SWITCHBOARD, AND MCC REQUIREMENTS

- A. The SPD application covered under this section is for switchgear, switchboard, and MCC locations.
- B. The SPD shall be fabricated by a manufacturer that also manufactures switchgear, switchboard, and MCC assemblies, to fully understand the application of SPDs on power distribution assemblies.
- C. Locate the SPD on the load side of the main disconnect device, as close as possible to the phase conductors and the ground/neutral bar.
- D. The SPD shall be connected according to local electrical code. Connection shall be kept as short as possible.

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- E. When utilizing tap rule per the NEC 240.4 and any local electric code, the SPD shall contain an integrated disconnect and overcurrent protection device with lockout provisions.
- F. All monitoring and diagnostic features shall be visible from the front of the equipment.

2.06 SERVICE ENTRANCE REQUIREMENTS

- A. Service entrance located SPDs shall be tested and designed for applications within ANSI/IEEE C62.41 Category C environments.

2.07 ENCLOSURES

- 1. All enclosed equipment shall have either NEMA 1, NEMA 4, or NEMA 4X stainless steel enclosures as suitable for locations indicated on the drawings and as described below:
 - A. NEMA 1 – Constructed of ANSI 61 painted steel, intended for indoor use to provide a degree of protection to personal access to hazardous parts and provide a degree of protection against the ingress of solid foreign objects (falling dirt). (Available for SPD Series only)
 - B. NEMA 4 – Constructed of ANSI 61 painted steel intended for either indoor or outdoor use to provide a degree of protection against access to hazardous parts; to provide a degree of protection of the equipment inside the enclosure against ingress of solid foreign objects (dirt and windblown dust); to provide a degree of protection with respect to the harmful effects on the equipment due to the ingress of water (rain, sleet, snow, splashing water, and hose directed water); and that will be undamaged by the external formation of ice on the enclosure. (Available for SPD and SPM Series only)
 - C. NEMA 4X – Constructed of 304 stainless steel providing the same level of protection as the NEMA 4 enclosure with the addition of corrosion protection. (Available for SPD and SPM Series only)
 - D. NEMA 4X – Constructed of polycarbonate providing the same level of protection as the NEMA 4 enclosure. (Available for SPC Series only)

PART 3 EXECUTION

3.01 EXAMINATION

3.02 FACTORY TESTING

- 1. Standard factory tests shall be performed on the equipment under this section. All tests shall be in accordance with the latest version of NEMA, IEEE, and UL standards.

3.03 INSTALLATION

- 1. The Contractor shall install all equipment per the manufacturer's recommendations, applicable electrical codes and the contract drawings.

3.04 WARRANTY

- 1. The manufacturer shall provide a: [select one option]

- A. (for the SPD Series) ten (10) year warranty (15 year warranty with optional registration) that covers replacement of the complete unit, including damage from lightning, from the date of shipment against any surge device part failure when installed in compliance with manufacturer's written instructions and any applicable national or local electrical code.
- B. (for the SPM Series) fifteen (15) year warranty (20 year warranty with optional registration) that covers replacement of the multi-mode module from the date of shipment against any surge device part failure when installed in compliance with manufacturer's written instructions and any applicable national or local electrical code.
- C. (for the SPC Series) five (5) year warranty (10 year warranty with optional registration) that covers replacement of the complete unit, including damage from lightning, from the date of shipment against any surge device part failure when installed in compliance with manufacturer's written instructions and any applicable national or local electrical code.