

Section 16196

LOW VOLTAGE AC SURGE PROTECTIVE DEVICES (SPDs)

PART 1 GENERAL

1.01 SUMMARY

- A. This Section describes the requirements for low voltage AC surge protective devices (SPDs), to be furnished under other Specification Sections as listed in the Related Work paragraph of this Section.
- B. All equipment described herein shall be submitted, and factory installed, as an integral part of equipment specified elsewhere in these Specifications.

1.02 MEASUREMENT AND PAYMENT

No separate payment for work performed under this Section. Include cost of same in Contract price bid for work of which this is a component part.

1.03 REFERENCES

This specification references the following publications in their current editions. The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

- A. DLA MIL-STD-220C: Method of Insertion Loss Measurement
- B. IEEE C37.90.1: Surge Withstand Capability (SWC) Tests for Relays and Relay Systems Associated with Electric Power Apparatus
- C. IEEE C62.41.2: Recommended Practice on Characterization of Surges in Low Voltage (1,000 V and Less) AC Power Circuits
- D. IEEE C62.45: Recommended Practice on Surge Testing for Equipment Connected to Low-Voltage (1,000 V and Less) AC Power Circuits.
- E. NFPA 70: National Electrical Code (NEC) - Article 285
- F. UL 67: UL Standard for Safety Panelboards
- G. UL 845: UL Standard for Safety Motor Control Centers
- H. UL 891: UL Standard for Safety Switchboards
- I. UL 1283: UL Standard for Safety Electromagnetic Interference Filters
- J. UL 1449: UL Standard for Safety Surge Protective Devices

- K. UL 1558: UL Standard for Safety Metal-Enclosed Low Voltage Power Circuit Breaker Switchgear
- L. All SPDs and their installation shall comply with the requirements of the National Electric Code and Underwriters Laboratories (UL) where applicable.
- M. Each specified device shall also conform to the standards and codes listed in the individual device paragraphs.

1.04 SUBMITTALS

Submit the following in accordance with Section 01330 – “Submittal Procedures:”

- A. Submittals for equipment specified herein shall be made as a part of equipment furnished under other Sections. Individual submittals for equipment specified herein will not be accepted and will be returned unreviewed.
- B. Submit catalog data for all items supplied from this Section as applicable. Submittal shall include catalog data, functions, ratings, inputs, outputs, displays, etc., sufficient to confirm that the SPD provides every specified requirement.
- C. The submittals shall include:
 - 1. Dimensional drawing of each SPD type
 - 2. UL 1449 documentation
 - 3. Provide verification that the SPD complies with the required UL 1449 listing by Underwriters Laboratories (UL) or other Nationally Recognized Testing Laboratory (NRTL).
 - 4. UL 1283 documentation
 - 5. IEEE C62.41.2 and IEEE C62.45, Category C3 (20kV-1.2/50, 10kA-8/20 μ s waveform) clamping voltage test results.
- D. Operation and Maintenance Manuals.
 - 1. Operation and Maintenance manuals shall include the following information:
 - a. Manufacturer’s contact address and telephone number for parts and service.
 - b. Instruction books and/or leaflets
 - c. Recommended renewal parts list
 - d. Record Documents for the information required by the Submittals above.

1.05 RELATED REQUIREMENTS

- A. Review relevant installation procedures under other sections and coordinate with the work related to this Section.
- B. Section 01330 – “Submittal Procedures”

1.06 QUALITY ASSURANCE

- A. The Manufacturer of this equipment shall have produced similar electrical equipment for a minimum period of five (5) years. When requested by the Project Manager, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement.
- B. The Manufacturer of the SPD shall be the same as the manufacturer of the service entrance and distribution equipment in which the devices are installed and shipped. The protected electrical equipment, after installation of the SPD, shall be fully tested and certified to the following UL standards:
 - 1. UL 67: UL Standard for Safety Panelboards
 - 2. UL 845: UL Standard for Safety Motor Control Centers
 - 3. UL 891: UL Standard for Safety Switchboards
 - 4. UL 1558: UL Standard for Safety Metal-Enclosed Low Voltage Power Circuit Breaker Switchgear
- C. For the equipment specified herein, the manufacturer shall be ISO 9001 or 9002 certified.

1.07 – 1.12 (NOT USED)

1.13 WARRANTY

The Manufacturer shall warrant the equipment to be free from defects in material and workmanship for 10 years from date of acceptance of the equipment containing the items specified in this Section. Within such period of warranty the Manufacturer shall promptly furnish all material and labor necessary to return the equipment to new operating condition. Any warranty work requiring shipping or transporting of the equipment shall be performed by the Manufacturer at no expense to the Owner.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the following Manufacturers are acceptable (Type 1 and Type 2):
1. Cutler Hammer
 2. General Electric Co.
 3. Square D
 4. Allen Bradley
 5. Or Approved Equal
- B. Subject to compliance with the Contract Documents, the following Manufacturers are acceptable (Type 3):
1. Edco SLAC Series
 2. Phoenix Contact
 3. Brick Wall Model PWOM20
 4. Or Approved Equal

2.02 SERVICE ENTRANCE AND DISTRIBUTION EQUIPMENT

- A. General
1. All SPDs shall be internal to the equipment being protected. Externally housed SPDs will not be acceptable.
 2. UL 1449 Usage Classifications:
 - a. Type 1 – Permanently connected SPDs intended for installation between the secondary of the service transformer and the line side of the service equipment overcurrent device, and intended to be installed without an external overcurrent protective device.
 - b. Type 2 – Permanently connected SPDs intended for installation on the load side of service equipment overcurrent device; including SPDs located at the branch panel.
 - c. 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. The distance (10 meters) is exclusive of conductors provided with or used to attach SPDs.

3. Construction of Type 1 and Type 2:

a. Fully Integrated Component Design:

All of the SPD's components and diagnostics shall be contained within one discrete assembly. SPDs or individual SPD modules that must be ganged together in order to achieve higher surge current ratings or other functionality will not be accepted.

b. Overcurrent Protection:

The unit shall contain thermally protected metal-oxide varistors (MOVs). The thermally protected MOVs shall have a thermal protection element packaged together with the MOV in order to achieve overcurrent protection of the MOV. The thermal protection element shall disconnect the MOVs from the system in a fail-safe manner should a condition occur that would cause them to enter a thermal runaway condition.

c. Maintenance Free Design:

The SPD shall be maintenance free and shall not require any user intervention throughout its life. SPDs containing items such as replaceable modules, replaceable fuses, or replaceable batteries are not acceptable. SPDs requiring any maintenance of any sort such as periodic tightening of connections are not acceptable.

d. 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 SPD modules are not acceptable.

e. Electrical Noise Filter:

Each unit shall include a high-performance EMI/RFI noise rejection filter. Noise attenuation for electric line noise shall be up to 50 dB from 10 kHz to 100 MHz using the DLA MIL-STD-220C insertion loss test method.

f. Internal Connections:

No plug-in component 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.

g. Power and ground connections shall be prewired within the protected equipment.

h. Local Monitoring:

Visible indication of proper SPD connection and operation shall be provided. The indicator lights shall indicate which phase as well as which module is fully operable. The status of each SPD module shall be monitored on the front cover of the enclosure as well as on the module. A push-to-test button shall be provided to test each phase indicator. Push-to-test button shall activate a state change of dry contacts for testing purposes.

i. Surge Counter:

The SPD shall indicate 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. 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. The ongoing surge count shall be stored in non-volatile memory or UPS backup.

j. Remote Monitoring:

For remote monitoring, the SPDs shall provide the same discrete and analog signal and control functions as specified for local monitoring and the surge counter, to a terminal strip for outgoing connection to a PLC as shown on the Plans. The functions shall be converted as specified for interface to the monitored equipment.

k. The voltage surge 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. 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.

l. SPD shall be listed in accordance with UL 1449 and UL 1283

m. Integrated surge protective devices (SPD) shall be Component Recognized in accordance with UL 1449, Section 37.3.2 and 37.4 at the

standard's highest short circuit current rating (SCCR) of 200 kA, including intermediate level of fault current testing.

- n. SPD shall be tested with the ANSI/IEEE Category C High exposure waveform (20kV-1.2/50 μ s, 10kA-8/20 μ s).
 - o. SPD shall provide suppression for all modes of protection: L-N, L-G, and N-G in WYE systems (7 Mode).
4. Construction of Type 3:
- a. Fully Integrated Component Design:

All of the SPD's components and diagnostics shall be contained within one discrete assembly. SPDs or individual SPD modules that must be ganged together in order to achieve higher surge current ratings or other functionality will not be accepted.
 - b. Maintenance Free Design:

The SPD shall be maintenance free and shall not require any user intervention throughout its life. SPDs containing items such as replaceable modules, replaceable fuses, or replaceable batteries are not acceptable. SPDs requiring any maintenance of any sort such as periodic tightening of connections are not acceptable.
 - c. Electrical Noise Filter:

Each unit shall include a high-performance EMI/RFI noise rejection filter. Noise attenuation for electric line noise shall be up to 50 dB from 10 kHz to 100 MHz using the DLA MIL-STD-220C insertion loss test method.
 - d. Internal Connections:

No plug-in component 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.
 - e. Power and ground connections shall be prewired within the protected equipment.
 - f. Local Monitoring:

Visible indication of proper SPD connection and operation shall be provided. The indicator light shall indicate that the module is fully operable. The status of each SPD module shall be monitored on the front cover of the module.

- g. SPD shall be listed in accordance with UL 1449 and UL 1283
- h. SPD shall be tested with the ANSI/IEEE Category C High exposure waveform (20kV-1.2/50 μ s, 10kA-8/20 μ s).

B. Applications

1. Service Entrance Rated Equipment (Type 1)

- a. This applies to switchgear, switchboards, panelboards, motor control centers, and other devices installed as service entrance equipment where the SPD is to be permanently connected between the secondary of the service transformer and the line side of the service equipment overcurrent device.
- b. Where a Type 1 SPD is installed on service entrance equipment, it shall not be required to install an additional Type 2 SPD unless specifically shown on the design Plans.
- c. Service entrance located SPDs shall be tested and demonstrate suitability for application within IEEE C62.41.2 Category C environments.
- d. The SPD shall be of the same manufacturer as the equipment
- e. The SPD shall be factory installed inside the equipment, at the assembly point, by the original equipment manufacturer
- f. Locate the SPD on the load side of the main disconnect device, as close as possible to the phase conductors and the ground/neutral bars.
- g. The SPD shall be connected through a UL approved disconnecting means. The disconnect shall be located in immediate proximity to the SPD. Connection shall be made via bus, conductors, or other connections originating in the SPD and shall be kept as short as possible.
- h. The SPD shall be integral to the equipment as a factory standardized design.
- i. All monitoring and diagnostic features shall be visible from the front of the equipment.

2. Distribution Equipment Applications (Type 2)

- a. This applies to switchgear, switchboards, panelboards, motor control centers, and other non-service entrance equipment where the SPD is to be permanently connected on the load side of the equipment overcurrent device.

- b. The SPD shall be of the same manufacturer as the equipment.
 - c. The SPD shall be included and mounted within the equipment by the manufacturer.
 - d. The manufacturer shall size and provide the overcurrent and disconnecting means for the SPD.
 - e. The SPD units shall be tested and demonstrate suitability for application within IEEE C62.41.2 Category B environments.
 - f. The SPD shall be located within the panelboard, unless otherwise shown on the Plans. SPDs shall be installed immediately following the load side of the main breaker. SPDs installed in main lug only panelboards shall be installed immediately following the incoming main lugs.
 - g. The SPD shall not limit the use of through-feed lugs, sub-feed lugs, and sub-feed breaker options.
 - h. All monitoring and diagnostic features shall be visible from the front of the equipment.
3. Individual Control Panel and Related Equipment Protection (Type 3)
- a. Locate the SPD on the load side of the ground and neutral connections.
 - b. The SPD shall be connected through a disconnect circuit breaker or fuse as shown on the Plans. The disconnect shall be located in immediate proximity to the SPD. Connection shall be made via bus, conductors, or other connections originating in the SPD and shall be kept as short as possible.
 - c. All monitoring and diagnostic features shall be visible from the front of the equipment.
4. Mechanical Equipment Manufacturer's Provided Control Panels (MEMs) and Electrical Manufacturer's Provided Control Panels (OEMs) Applications (Type 1, Type 2, and Type 3)
- a. Where any such panel is installed as service entrance equipment, a Type 1 SPD shall be installed.

The same requirements for other service entrance equipment listed above apply to this application except for the requirement that the Type 1 SPD shall not be required to be of the same manufacturer as the panel.

- b. Where any such panel is installed as non-service entrance equipment, but within 50’ of wire length of the incoming power line when that line is overhead.
 - (1) The same requirements for other non-service entrance equipment listed above apply to this application except for the requirement that the Type 2 SPD shall not be required to be of the same manufacturer as the panel.
 - (2) Where a Type 1 SPD is installed, a Type 2 SPD is not required on the same panel unless otherwise specifically shown on the Plans.
- c. Where any such panel includes a PLC, a Type 3 SPD shall be installed.
 - (1) The same requirements for other individual control panel and related equipment listed above apply to this application.
 - (2) The SPD shall be integral to the MEM or OEM panel, as a factory standardized design.

C. Ratings

- 1. Unit Operating Voltage: Refer to Plans for operating voltage and unit configuration.
- 2. SPD shall be designed to withstand a maximum continuous operating voltage (MCOV) of not less than 115% of nominal RMS voltage.
- 3. Minimum surge current rating shall be 240 kA per phase (120 kA per mode) for service entrance and 120 kA per phase (60 kA per mode) for distribution applications.
- 4. UL 1449 clamping voltage must not exceed the following: Voltage Protection Rating (VPR)

<u>Voltage</u>	<u>L-N</u>	<u>L-G</u>	<u>N-G</u>
240/120	1200/800V	800V	800V
208Y/120	800V	800V	800V
480Y.277	1200V	1200V	1200V
600Y/347	1500V	1500V	1500V

5. Pulse life test:

Capable of protecting against and surviving 5000 ANSI/IEEE Category C High transients without failure or degradation of clamping voltage by more than 10%.

6. Minimum UL 1449 withstand Nominal Discharge Current (In) rating to be 20kA per mode

2.03 ACCESSORIES

Furnish nameplates for each device as indicated on Plans. Color schemes shall be as indicated on Plans.

PART 3 EXECUTION

3.01 – 3.02 (NOT USED)

3.03 INSTALLATION

- A. All equipment specified herein shall be factory installed, field adjusted, tested and cleaned as an integral part of equipment specified elsewhere in the individual equipment Specification.

Types 1 and 2 shall be grounded and bonded as a part of the individual equipment as specified in the individual equipment Section. Type 3 shall be grounded and bonded in accordance with the SPD manufacturer's instructions.

3.04 – 3.10 (NOT USED)

END OF SECTION