

**American Railway Engineering and Maintenance of Way Association
Letter Ballot 38 21-12**

1. Committee and Subcommittee:

AREMA C&S Committee 38

2. Letter Ballot Number: 38 21-12

3. Assignment:

MP's revised at Fall 2021 meeting.

4. Ballot Item:

Ballot 38 21-12: This ballot contains the MP approved at the Fall 2021 meeting:

11.3.2 - Recommended Design Criteria and Functional/Operating Guidelines for Secondary Surge Protectors for Electrical Surge Protection of Signal Systems

Rationale:

Revised Manual Parts

Recommended Design Criteria and Functional/Operating Guidelines for Secondary Surge Protectors for Electrical Surge Protection of Signal Systems

~~Revised 2018~~ Revised/affirmed 2023 (4 Pages)

A. Purpose

This Manual Part recommends design criteria and functional/operating guidelines for secondary surge protectors for track circuits, line circuits, and ac or dc power circuits for railroad signal systems.

B. General

1. Staged or multiple levels of surge protectors are recommended for line-to-line protection of electronic equipment in signal enclosures, train control rooms, etc. Staged protection consists of primary, secondary, and tertiary levels. Primary surge protection should be provided closest to the entrance point and should be rated to withstand the brunt of the exposure. Secondary protection should be provided close to or within the protected equipment. Tertiary Protection is usually incorporated internal to the protected equipment.
2. Secondary protection is designed to absorb or divert ~~from the protected equipment, that the~~ surge energy which is passed through by the primary ~~protector protection stage.~~
3. Effective secondary protection typically requires isolation impedance between the primary and secondary protectors, to ensure staged operation. Normally, this is provided within the secondary surge protector.
4. Secondary surge protection may be provided within electronic signal equipment. If provided, the manufacturer shall state that no external secondary surge protection is required.
5. Secondary surge protector requirements are line-to-line unless otherwise specified.

C. Secondary Signal Surge Protector Design

1. Electrical construction
 - a. Secondary surge protection ~~erion~~ for all applications shall incorporate isolation impedance between the primary and secondary protection devices. The design goal is to actuate the primary protection before the secondary protection actuates, allowing for the two protection stages to share the surge energy appropriately. ~~or other design~~

~~means to assure that the primary surge protector actuates on a surge which that exceeds the withstand ability of the secondary surge protector and with impulse voltage exceeding sparkover voltage of the primary surge protector.~~

- b. When supplied as a ~~four terminal~~four-terminal device for AC Power protection, designated neutral shall not have added impedance where used with commercial power systems conforming to Manual Part 11.1.1 Recommended Functional/Operating Guidelines for Electrical Safety.
2. AC signal power secondary protection (120/240 or 120/208 volt nominal circuits).
 - a. Secondary surge protector shall be designed to pass sufficiently low current at maximum rated circuit voltage of the device~~(per the datasheet)~~ as to not adversely affect the function of any circuit to which it is applied or damage the surge protector itself.
 - b. If secondary surge protection can fail as a short circuit, a means of interrupting a short circuit current of more than four times the rated current, but no less than 15 amperes continuous, shall be provided.
 - c. Secondary surge protector shall be designed to have a dc breakdown or clamping voltage of 340 to 510 volts for 120 volt applications (twice to three times the peak line voltage), and 680 to 1,020 volts for 208 or 240 volt applications unless specified differently by the end-user.
 - d. Secondary surge protector shall be designed to withstand a maximum impulse breakdown voltage not exceeding 1,000 volts peak for an impulse with a 10 kV/ μ s risetime.
 - e. Secondary surge protector should be capable of discharging 6,000 volts, 3,000 amperes when tested with a standard 1.2/50 μ s - 8/20 μ s combination waveform as defined in ANSI/IEEE Standard C62.41.2-2002 (Recommended Practice on Characterization of Surges in Low-Voltage (1000V and Less) AC Power Circuits).
 - f. When ac power secondary surge protectors are tested as described in C-2-e above, the secondary surge protector under breakdown test conditions shall have a let-through voltage of no more than 400 volts into any load for 120 volt applications and no more than 800 volts for 208 or 240 volt applications.

3. Vital signal track circuit and line circuit line-to-line secondary surge protectors
 - a. Secondary surge protector shall be designed to pass no more than 1 mA at rated circuit voltage.
 - b. Secondary surge protector should be suitable for use on circuits of 0 to 30 volts dc for line or coded track circuits, and 0 to 5 volts dc for steady energy track circuits.
 - c. Secondary surge protector shall be designed to have a dc breakdown or clamping voltage not exceeding 50 volts.
 - d. Secondary surge protector shall be designed to have a maximum impulse breakdown or clamping voltage not exceeding 100 volts for an impulse with a 10 kV/ μ s risetime.
 - e. Secondary surge protector shall be capable of discharging 2,000 volt, 1,000 amperes when tested with a standard 1.2/50 μ s - 8/20 μ s combination waveform as defined in ANSI/IEEE Standard C62.41.
 - f. When secondary surge protectors are tested as described in C-3-e, the secondary surge protector under breakdown test conditions shall have a ~~let-let~~-through voltage of no more than 100 volts into any load.
4. DC power secondary protection for vital battery systems
 - a. Secondary surge protector shall be designed to pass no more than 1 mA at rated circuit voltage.
 - b. If the secondary surge protector can fail as a short circuit, a means of interrupting a short circuit current of not more than four times rated current shall be provided.
 - c. Secondary surge protector for nominal 12 or 24 volt systems shall be designed to have a dc breakdown or clamping voltage above the maximum system voltage, but not more than 1.5 times the maximum system voltage.
 - d. Secondary surge protector shall be designed to have a maximum impulse breakdown or clamping voltage not exceeding 100 volts for an impulse with a 10 kV/ μ s risetime.

- e. Secondary surge protector shall be capable of discharging a 2,000 volt, 1,000 amperes standard 1.2/50 μ s - 8/20 μ s combination waveform as defined in ANSI/IEEE Standard C62.41.
- f. When secondary surge protectors are tested as described in C-4-e, the secondary surge protector under breakdown test conditions shall have a let-through voltage of no more than 4 times maximum system voltage into any load.

D. Mechanical, Environmental and Structural

1. Secondary surge protector devices shall meet the environmental requirements as noted in 11.5.1 based on the installation classification.
2. Secondary surge protectors intended for application in vital signal circuits should be designed for standard AAR terminal spacing of either 1-inch with terminal posts spaced on or 2-3/8-in. centers. Binding posts, nuts, and washers, if provided, shall conform to Manual Part 14.1.11 Recommended Design Criteria for Binding Posts, Nuts and Washers.
3. Secondary signal surge protector assembly, covers, and accessories shall not ignite or melt, nor cause ignition of adjacent surfaces, when surge protector is used within rated operating and surge conditions.
4. Exposed metal parts of secondary signal surge protectors shall be suitably protected against corrosion to maintain design electrical and leakage parameters.
5. Secondary signal surge protectors shall be designed and constructed to ensure no degradation of performance or change in operating values throughout the useful life of the secondary surge protector when used within the manufacturer's ratings.

E. Secondary Signal Surge Protector Documentation

Manufacturer—The manufacturer should provide the following information in published documentation for each secondary surge protector:

- a. Breakdown voltage range (dc or 60 Hz peak).
- b. Maximum output terminal impulse breakdown or clamping voltage.
- c. Maximum output terminal single impulse discharge current.
- d. Energy handling capability and the test parameters used.

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