



IEEE Standard Specifications for Surge Protectors Used in Low- Voltage Data, Communications, and Signaling Circuits

IEEE Power & Energy Society

Sponsored by the
Surge Protective Devices Committee



IEEE
3 Park Avenue
New York, NY 10016-5997, USA

18 December 2009

IEEE Std C62.64™-2009
(Revision of
IEEE Std C62.64-1997)

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IEEE Standard Specifications for Surge Protectors Used in Low- Voltage Data, Communications, and Signaling Circuits

Sponsor

Surge Protective Devices Committee
of the
IEEE Power & Energy Society

Approved 11 September 2009

IEEE-SA Standards Board

Abstract: Surge protectors for application on multiconductor and coaxial, balanced or unbalanced, data, communications, and signaling circuits with voltages less than or equal to 1000 V rms or 1200 V dc are covered. These surge protectors are multiple-component series or parallel combinations of one or more nonlinear elements and zero or more linear elements. The tables of typical performance values provide a means of comparison among various surge protectors. They also provide a common engineering language beneficial to the user and manufacturer of surge protectors used in low-voltage data, communications, and signaling circuits.

Keywords: low voltage, performance, surge protector

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PDF: ISBN 978-0-7381-6090-0 STD95983
Print: ISBN 978-0-7381-6091-7 STDPD95983

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Introduction

This introduction is not part of IEEE Std C62.64-2009, IEEE Standard Specifications for Surge Protectors Used in Low-Voltage Data, Communications, and Signaling Circuits.

This revision of IEEE Std C62.64-1997 has been developed by the Low-Voltage Data, Communications, and Signaling Circuit Surge Protective Devices Working Group of the Low-Voltage Surge Protective Devices Subcommittee. It provides typical values of the parameters that are used to specify the performance of these surge protectors. The tests that are used to characterize the parameters are in IEEE Std C62.36™-2000, so the two standards are companion documents.^a

This standard is directed toward service providers who wish to provide electrical protection against surges on low-voltage circuits. The typical values promote consistency by helping users in selecting appropriate parameter values and by aiding suppliers in focusing their resources on parameters of interest. Yet, this standard is flexible enough that applications needing values that differ from the typical levels can use whatever is required.

This standard covers a wide range of possible protectors. They may limit voltages, currents, or both. Not all specification values apply to each protector. The user of the standard selects, from among the many possible specifications, the tests and parameter values needed by the application. For instance, a protector for an application that requires only voltage limiting would not specify values from the current-limiting specifications, and would select only the parameters from the voltage-limiting specifications that are required by the application. In that way, a voltage-limiting surge protector may include, for example, a specification value for return loss (see 5.2.3.3), but not for longitudinal balance (see 5.2.3.4). The typical values of this standard also provide standardized values of important parameters for use with international standardization efforts.

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^a Information on references can be found in Clause 2.

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IEEE Standard Specifications for Surge Protectors Used in Low-Voltage Data, Communications, and Signaling Circuits

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1. Overview

This standard is divided into ~~seven~~^{five} clauses, normative annexes (some of which are under study), a glossary, and a bibliography. Clause 1 provides the scope of this standard. Clause 2 lists references to publications that are needed to apply this standard. Clause 3 provides general ~~specifications~~^{definitions} that may be needed for a surge protector regardless of its voltage- or current-limiting function. Clause 4 provides ~~mechanical and environmental specifications that may be needed regardless of a protector's voltage or current limiting function~~ service and test conditions. Clause 5, ~~for protectors that limit surge voltages, is partitioned into two subclauses. The first provides~~ requirements and test ~~specifications that avoid disturbing the circuit when no voltage surges are present; the second covers the voltage limiting performance of the protector when a surge is present.~~ Clause 6, ~~for protectors that limit surge currents, is partitioned into two subclauses. The first provides speci- fications that avoid disturbing the circuit when no current surges are present; the second covers the current limiting performance of the protector when a surge is present.~~ Clause 7 ~~provides specifications that may apply to either type of protector, and are intended to avoid disturbing the circuit when no surges are present.~~

1.1 Scope

This standard applies to surge protectors for application on multi-conductor and coaxial, balanced or unbalanced, data, communications, and signaling circuits with voltages less than or equal to 1000 V rms, or 1200 V dc. These surge protectors are intended to limit voltage surges, current surges, or both.

~~This standard provides performance criteria and tables of preferred values for performance based on characterization tests performed in accordance with IEEE Std C62.36-1994¹. The surge protectors covered are multiple component series or parallel combinations of linear or nonlinear elements, packaged for the purpose of limiting voltage, current, or both. Figure 1 of IEEE Std C62.36-1994, reproduced here for convenience, illustrates as functional block diagrams the surge protectors covered by this standard.~~

~~[†]Information on references can be found in Clause 2.~~

This standard is not intended to cover individual device components. Installation of all surge protectors (SPDs) must be in conformance with the requirements of applicable local and national electrical codes. ~~packaged single gas tube, air gap, varistor, or avalanche junction surge protective devices, which are included in IEEE Std C62.31-1987, IEEE Std C62.32-1981, IEEE Std C62.33-1982, and IEEE Std C62.35-1987, respectively. Safety aspects of performance specifications are not covered; such aspects are covered in the National Electrical Code® (NEC®) (NFPA 70-1996).~~ Specifically excluded from this standard are protectors for low-voltage power circuit applications.

The surge protectors covered by this standard are to be tested by means of the connections or terminations that are used when the surge protector is installed in the field. For surge protectors that are intended to be used with a base or connector, that base or connector shall be part of the tests.

The tables of preferred performance values of this standard provide a means of comparison among various surge protectors. They also provide a common engineering language beneficial to the user and manufacturer of surge protectors used in low-voltage data, communications, and signaling circuits.

~~This standard uses terminology for surge protective devices as defined in IEEE Std 100-1996.~~

1.2 SPD configurations

The surge protectors covered are multiple-component series or parallel combinations of linear or nonlinear elements, packaged for the purpose of limiting voltage, current, or both. Figure 1 is based on Figure 1 of IEEE Std C62.36™-2000 and illustrates functional block diagrams for the surge protectors covered by this standard.¹

1.3 Use of this standard

1.3.1 Application types

Tables of applications in this standard often refer to application types. In such tables, each application type is given an alphanumeric designation that refers to a typical value(s) for that specific application. All of the typical values on the same row as the designator apply to that application type.

A given surge protector has the same designation in all application type tables. For example, a surge protector has application type designation A for the insulation resistance specification, and also application type designation A for the other specifications such as impulse-limiting voltage and impulse reset.

Table 1² describes the application types included in this document. For each application type (e.g., A), a short description is provided on the main characteristics of the surge protector (e.g., where used). Furthermore, each application type has further subcategories that address different designs of surge protectors applied to the same application type. These subcategories are:

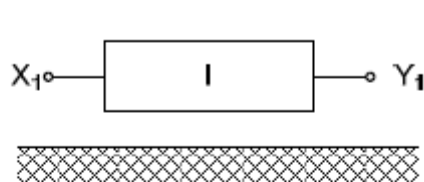
- a) *Main characteristics of the telecommunications circuit.* This subcategory is described in the second column of Table 1 and is designated by the first numeric number after the designation (see Table 1).
- b) *Type of surge protector.* This subcategory is described in the third column of Table 1 and is designated by the second numeric number after the designation (see Table 1). This characteristic addresses the different surge protectors that may contain voltage-limiting devices, or current-limiting devices, or both.

For example, an application type can address primary surge protectors intended for paired conductors in telecommunications circuits (i.e., Public Switching Telephone Network, PSTN); the application type designation is A in Table 1. This application type may be subdivided to surge protectors that are intended for different services such as voice and certain Digital Subscriber Lines (DSLs) technologies; the application types are subdivided to A1, A2, and A3 as described in Table 1. In addition, the surge protectors may have different combinations of voltage and various types of current limiters such as non-resetting and self-resetting intended for the same subcategory (e.g., A1). For this reason, the application types are further subdivided to A11, A12, A14, and A13 as described in Table 1.

¹ Information on references can be found in Clause 2.

² The numbers in brackets correspond to those of the bibliography in Annex I.

TWO – TERMINAL DEVICES

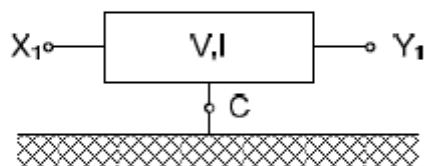


Configuration 2A

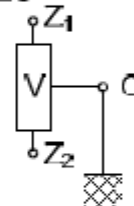


Configuration 2B

THREE – TERMINAL DEVICES

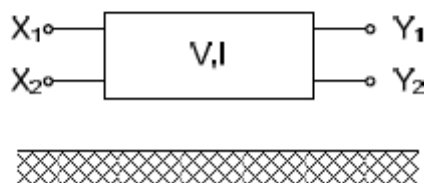


Configuration 3A



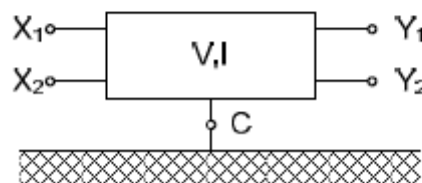
Configuration 3B

FOUR – TERMINAL DEVICE



Configuration 4

FIVE – TERMINAL DEVICE



Configuration 5

I = current-limiting function
V = voltage-limiting function X1,
X2 = signal input terminals Y1,
Y2 = signal output terminals
Z1, Z2 = signal terminals shared by input and output lines
C = common terminal

NOTE 1—The V.I designation in Figure 1 indicates that a surge protector may have a voltage-limiting function, a current-limiting function, or both.²

NOTE 2—Surge protectors intended for coaxial cable circuits shall be tested using Configuration 3A. Outer conductors of the transmission lines are connected to the common terminal of the surge protector during the tests.

NOTE 3—Surge protectors intended for twinaxial cable circuits shall be tested using Configuration 5. Outer conductors of the transmission lines are connected to the common terminal of the surge protector during the tests.

Figure 1—Basic configurations

² Notes in text, tables, and figures of a standard are given for information only and do not contain requirements needed to implement this standard.

Table 1—Application type designations for surge protectors

<u>Application type designation</u>	<u>Main characteristics of telecommunications circuit</u>	<u>Type of surge protector</u>	<u>Example of services provided</u>
<u>A—Primary surge protectors intended to be installed at the end of paired-conductors telecommunications circuits, central offices, and customer premises. See Annex A through Annex G in IEEE Std C62.43™-2005 [B7] and Article 800 in the National Electrical Code® (NEC®) (NFPA 70, 2007 Edition) [B12].</u>			
<u>A10</u>	<u>Up to 1.1 MHz</u>	<u>Only voltage limiter</u>	<u>Voice, ISDN, ADSL, HDSL, SDSL, T1 carrier</u>
<u>A11</u>		<u>Voltage limiter and non-resetting current limiter</u>	
<u>A12</u>		<u>Voltage limiter and self-resetting current limiter</u>	
<u>A13</u>		<u>Voltage limiter and fast resetting current limiter</u>	
<u>A20</u>	<u>Up to 16 MHz</u>	<u>Only voltage limiter</u>	<u>ADSL 2+, VDSL</u>
<u>A21</u>		<u>Voltage limiter and non-resetting current limiter</u>	
<u>A22</u>		<u>Voltage limiter and self-resetting current limiter</u>	
<u>A23</u>		<u>Voltage limiter and fast resetting current limiter</u>	
<u>A30</u>	<u>Up to 30 MHz</u>	<u>Only voltage limiter</u>	<u>VDSL</u>
<u>A31</u>		<u>Voltage limiter and non-resetting current limiter</u>	
<u>A32</u>		<u>Voltage limiter and self-resetting current limiter</u>	
<u>A33</u>		<u>Voltage limiter and fast resetting current limiter</u>	
<u>A40</u>	<u>Up to 1.1 MHz. It requires a protector with low-voltage-limiting capabilities</u>	<u>Voltage limiter and non-resetting current limiter</u>	<u>SESS line cards that require special low-voltage protection.</u>
<u>B—Primary surge protectors applied externally to network-powered broadband communications coaxial cable as described in NEC Article 830.</u>			
<u>B10</u>	<u>Up to 1 GHz</u>	<u>Only voltage limiter</u>	<u>Voice, audio, data, video, and interactive services</u>
<u>C—Surge protectors applied to coaxial cable TV systems (CATV) as described in NEC Article 820.</u>			
<u>C10</u>	<u>60 V and 90 V</u>		<u>CATV</u>

<u>D—Primary surge protectors intended to be installed on coaxial antenna feeder for wireless communication networks. These networks could consist of RF only signals as well as RF, power, and telemetry signals combined on the coaxial cable.</u>			
<u>D10</u>	<u>30 MHz to 3000 MHz</u>	<u>Voltage limiter</u>	<u>Amateur radio, defense communications and radar, federal agency communications, mobile satellite, weather information cellular service, commercial aviation, defense communications, and radar, fixed service, GPS, mobile satellite, multipoint distribution, PCS, unlicensed communications</u>
<u>E—Surge protectors applied to serial data and industrial bus</u>			
<u>E10</u>		<u>Voltage limiter</u>	<u>Serial data communication RS 232, RS 422, or RS 485</u>

Table 1—Application type designations for surge protectors (continued)

<u>Application type designation</u>	<u>Main characteristics of telecommunications circuit</u>	<u>Type of surge protector</u>	<u>Example of services provided</u>
<u>F—Surge protectors applied to alarm circuits</u>			
<u>F10</u>	<u>4 mA to 20 mA current loop, low frequency</u>	<u>Only voltage limiter</u>	<u>Alarm circuits (NEC 760)</u>
<u>G—Surge protectors applied to Ethernet</u>			
<u>G10</u>	<u>Up to 1000 Mb/s data speeds</u>	<u>Voltage-limiting and current-limiting</u>	<u>Ethernet and balanced signal circuit</u>
<u>G20</u>	<u>Up to 1000 Mb/s data speeds</u>	<u>Voltage-limiting and current-limiting</u>	<u>Powered Ethernet</u>

1.3.2 Typical values

The values for the parameters listed in the annexes for the various application types are typical in the sense that their use promotes uniformity. In addition, more than one typical value may be applicable for a parameter for a specific application type. Also, a typical value may be required for a specific application type under certain conditions (e.g., high-exposure customer stations). These typical values are accompanied with a condition statement in the tables.

Other than the typical values of the annexes may be required for specific applications described in this document. This is due to the rapid changes in the telecommunications technologies and deployments. This document does not intend to exclude any new technologies or ideas but to provide guidance as accurate as possible to users on the proper specifications for surge protectors for existing and foreseeable technologies.

1.2 Specification types

Tables of specifications in this standard often refer to *specification types*. In such tables, each specification type is given an alphanumeric designation that refers only to the parameter of that table. All of the parameter values on the same row as the designator apply to that specification type. A given surge protector may have a different specification type designation in other tables. For instance, a surge protector may have specification type designation 1 for the insulation resistance specification, but specification type designation B for the

~~impulse-limiting voltage specification, and specification type designation 3 for impulse reset.~~

1.3 Preferred values

~~The values for the parameters listed in the tables for the various specification types are preferred in the sense that their use promotes uniformity. However, specific applications may require values other than the preferred values of the tables.~~

2. Normative references

The following referenced documents are indispensable for the application of this document (i.e., they must be understood and used, so each referenced document is cited in text and its relationship to this document is explained). For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments or corrigenda) applies.

IEC 60068 series, Environmental Testing.⁴

IEC 60529, Degrees of Protection Provided by Enclosures (IP Code).

IEC 60695-11-5: 2004, Edition 1.0, Fire hazard testing—Test flames—Needle-flame test method—Apparatus, confirmatory test arrangement, and guidance.

IEC 60721 series, Classification of Environmental Conditions.

IEC 60999-1, Connecting devices—Electrical copper conductors—Safety requirements for screw-type and screwless-type clamping units—Part 1: General requirements and particular requirements for clamping units for conductors from 0.2 mm² up to 35 mm² (included).

⁴ IEC publications are available from the Central Office of the International Electrotechnical Commission, 3, rue de Varembe, P.O. Box 131, CH-1211, Geneva 20, Switzerland (<http://www.iec.ch/>). IEC publications are also available in the United States from the Sales Department, American National Standards Institute, 25 West 43rd Street, 4th Floor, New York, NY 10036, USA (<http://www.ansi.org/>).

IEEE Std C62.36™-2000 (Reaff 2006), IEEE Standard Test Methods for Surge Protectors Used in Low-Voltage Data, Communications, and Signaling Circuits.^{5, 6}

Telcordia GR-974-CORE, Generic Requirements for Telecommunications Line Protector Units (TLPUs).⁷

~~References~~

~~This standard shall be used in conjunction with the following publications:~~

~~IEEE Std 100-1996, IEEE Standard Dictionary of Electrical and Electronics Terms.~~²

~~IEEE Std 455-1985 (Reaff 1992), IEEE Standard Test Procedure for Measuring Longitudinal Balance of Telephone Equipment Operating in the Voice Band (ANSI).~~

~~IEEE Std C62.31-1987 (Reaff 1993), IEEE Standard Test Specifications for Gas Tube Surge Protective Devices (ANSI).~~

~~IEEE Std C62.32-1981 (Reaff 1993), IEEE Standard Test Specifications for Low Voltage Air Gap Surge Protective Devices (Excluding Valve and Expulsion Type Devices) (ANSI).~~

~~IEEE Std C62.33-1982 (Reaff 1994), IEEE Standard Test Specifications for Varistor Surge Protective Devices (ANSI).~~

~~IEEE Std C62.35-1987 (Reaff 1993), IEEE Standard Test Specifications for Avalanche Junction Semiconductor Surge Protective Devices.~~

~~IEEE Std C62.36-1994, IEEE Standard Test Methods for Surge Protectors Used in Low Voltage Data, Communications, and Signaling Circuits.~~

~~ITU Recommendation K.17, Tests on Power Fed Repeaters, Geneva, 1988.³~~

~~NEPA 70-1996, National Electrical Code® (NEC®) (ANSI).⁴~~

3. Definitions

This document contains terms defined in IEEE Std C62.36-2000 (see also Annex H). The IEEE Standards Dictionary: Glossary of Terms and Definitions should be referenced for terms not defined in this clause.⁸

3. General specifications

3.1 Marking and documentation

The following information shall be provided by the manufacturer, by means of markings, product information data sheets, technical practice bulletins, or other suitable documentation:

- a) ~~Manufacturer's name or trademark, and model identifier;~~
- b) ~~Intended application;~~

²IEEE publications are available from the Institute of Electrical and Electronics Engineers, 445 Hoes Lane, P.O. Box 1331, Piscataway, NJ 08855-1331, USA.

³ITU-T publications are available from the International Telecommunication Union, Place des Nations, CH 1211, Geneva 20, Switzerland.

⁴The NEC® is available from the NFPA, Publications Sales, National Fire Protection Association, 1 Batterymarch Park, P.O. Box 9101, Quincy, MA 02269-9101, USA. It is also available from the IEEE.

- e) ~~Operating temperature-humidity exposure category (controlled or uncontrolled);~~
- d) ~~Any applicable safety agency approvals;~~
- e) ~~Complete list of specification types, in accordance with the characteristics in this specification, to the extent that the specifications are applicable;~~
- f) ~~Installation instructions;~~
- g) ~~If the surge protector has replaceable components, then the replacement instructions shall be included in the documentation or marking information;~~
- h) ~~If the surge protector is dependent on polarity, or if it could be incorrectly installed, then the terminal identification shall be included in the marking information;~~
- i) ~~If the surge protector has mechanical, optical, or other means to indicate the need to be replaced or reset, an explanation of the meaning of the indicator shall be included in the documentation or marking;~~
- j) ~~If the surge protector contains radioactive material, it shall be marked in accordance with applicable regulations.~~

3.2 Marking

Each surge protector shall be marked in such a manner as to identify the manufacturer and model. Any marking on the surge protector of the information specified in 3.1 shall be indelible and legible.

3.3 Mechanical design

~~The surge protector shall not have sharp edges, corners, etc., that could injure personnel during installation or maintenance. If preloaded springs are employed in the construction, they shall be adequately contained such that they do not cause injury during installation or removal of the surge protector.~~

~~The surge protector shall have sufficient mechanical strength such that it does not explode, thereby creating hazardous projectiles, when subjected to surges within the scope of this standard.~~

3.4 Lead pull-out

~~External leads shall be capable of withstanding a 20 lb (89 N) pull for 1 min.~~

3.5 Mounting arrangements

~~The surge protector shall be capable of being mounted securely in its intended position. Any visual indicators shall be readily accessible and viewable.~~

4. Mechanical and environmental specifications

4.1 Operating temperature and humidity

4. Service and test conditions

4.1 Service conditions

Two categories of operating temperature and humidity for the application of surge protectors are covered in this standard. Each category has an associated range of temperature and relative humidity.

- a) Controlled temperature and humidity

Temperature: 2 °C to 50 °C

Relative humidity: 10% to 80%

- b) Uncontrolled temperature and humidity

Temperature: -40 °C to 65 °C

Relative humidity: 5% to 96%, except that above 50°C the relative humidity may be reduced to 20%.

4.2 Test temperature and humidity

Where only one extreme temperature is specified for a characteristic, or if the specified range is narrower than the full range of 4.1, the extreme temperature or narrow range represents the generally accepted worst-case test condition for a generic protector technology within the application. If it is known beforehand that a particular device technology causes a surge protector to be insensitive to temperature when testing a particular characteristic, a room temperature within the range 20 °C to 25 °C may be used instead for that test.

If a temperature for a particular test is not specified, the specification value may be measured at any temperature within the range of temperatures for the application (see 4.1). Tests related to lightning-caused surges need not be done at temperatures below -20°C .

⁵ IEEE publications are available from the Institute of Electrical and Electronics Engineers, 445 Hoes Lane, Piscataway, NJ 08854, USA (<http://standards.ieee.org/>).

⁶ The IEEE standards or products referred to in Clause 2 are trademarks owned by the Institute of Electrical and Electronics Engineers, Incorporated.

⁷ Telcordia Technologies documents are available from <http://telecom-info.telcordia.com/>.

⁸ The IEEE Standards Dictionary: Glossary of Terms & Definitions is available at <http://shop.ieee.org/>.

4.3 General environmental considerations

After manufacture, SPDs have to be transported, possibly with intervening storage, and installed. The IEC 60721 series, Classification of Environmental Conditions, covers environmental parameters and their severities for the following situations:

- Storage
- Transportation
- Stationary use at weather protected locations
- Stationary use at non-weather protected locations
- Ground vehicle installations
- Ship installations
- Portable and non-stationary use

Part 3 of the IEC 60721 series relates the estimated environmental conditions for the preceding situations to the environmental testing procedures given in the IEC 60068 series, Environmental Testing. This document only covers a limited set of environmental conditions for SPD usage at weather protected locations. The IEC 60721 and IEC 60068 standards should be consulted for details on other environments.

4.3 Temperature and humidity exposure

This characteristic specifies the ability of a surge protector to perform its function after being exposed to temperature and humidity conditions of storage, and while being exposed to the extreme temperatures of its application (see 4.1).

4.3.1 Specification

The duration of exposure to humidity shall be selected from Table 1.

Table 1—Temperature and humidity exposure

Specification type	Duration of exposure (days)
A	10
B	21
C	56

4.3.2 Test method

The surge protector shall be subjected to a sequence of three exposures to humidity and temperature.

During the first exposure, the surge protector is maintained at $40\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$ at a relative humidity between 90% and 96%. The duration of this exposure shall be selected from Table 1. At the end of the exposure, the surge protector shall be subjected to a temperature of $20\text{--}25\text{ }^{\circ}\text{C}$ for not less than 1 h and not more than 2 h. Immediately after this recovery period, the test criteria shall be satisfied.

During the second exposure, the surge protector shall be subjected to the minimum temperature of its exposure category of 4.1 ($2\text{ }^{\circ}\text{C}$ or $-40\text{ }^{\circ}\text{C}$). The duration of this exposure shall be 24 h. At the end of the exposure, but while the surge protector is maintained at the minimum temperature, the test criteria shall be satisfied.

During the third exposure, the surge protector shall be subjected to the maximum temperature of its exposure category of 4.1 ($50\text{ }^{\circ}\text{C}$ or $65\text{ }^{\circ}\text{C}$). The duration of this exposure shall be 24 h. At the end of the exposure, but while the surge protector is maintained at the maximum temperature, the test criteria shall be satisfied.

During the three exposures, the air flow in the test chamber shall be controlled to provide a free-convection heat-transfer environment with the protector shielded from direct flow of forced air. The surge protector is not subjected to bias voltage or current during the three exposures.

Surge protectors that are subjected to the environmental cycling tests of 5.2.6 or 5.2.7 need not be subjected to the first exposure ($40\text{ }^{\circ}\text{C}$; 90–96% relative humidity) portion of this test sequence. They shall be exposed to the low and high temperature portions of the test sequence.

4.3.3 Test criteria

For surge protectors that limit voltage, the impulse limiting voltage shall be less than or equal to the specified value, and the insulation resistance shall be greater than or equal to the specified value. For surge protectors that limit current, the transition current and dc series resistance shall be less than or equal to the specified value.

4.4 Vibration during shipping

This characteristic verifies that a surge protector can withstand the vibration experienced in shipping and handling.

4.4.1 Specification

After being subjected to the vibration conditions in Table 2, the surge protector shall be capable of performing its voltage-limiting and current-limiting functions.

Table 2—Frequency sweep criteria for simulation of transportation vibration

Vibration frequency (Hz)	Acceleration (g)	Sweep rate (oct/min)
5–100	0.5	0.1
100–500	1.5	0.25

4.4.2 Test method

Unpowered surge protectors shall be subjected to the swept frequency vibration conditions of Table 2. The full range of frequencies is swept once at the indicated rate. The vibration and subsequent electrical tests shall be performed at ambient temperature of $20\text{--}25\text{ }^{\circ}\text{C}$. The test criteria are measured after vibration is

~~stopped and the surge protector is at rest.~~

4.4.3 Test criteria

~~For surge protectors that limit voltage, the impulse limiting voltage and dc series resistance shall be less than or equal to the specified value, and the insulation resistance shall be greater than or equal to the specified value. For surge protectors that limit current, the transition current and dc series resistance shall be less than or equal to the specified value.~~

4.5 Drop test

~~This characteristic verifies that a surge protector can withstand the mechanical shock that results if it is dropped during installation.~~

4.5.1 Specification

~~The surge protector shall not crack or become damaged after being subjected to the drop. In addition, the surge protector shall be capable of performing its voltage limiting and current limiting functions.~~

4.5.2 Test method

~~Surge protectors that are intended for the uncontrolled temperature and humidity category (see 4.1) shall be conditioned at -40°C . Surge protectors intended for the controlled temperature and humidity category shall be conditioned at 2°C . Conditioning shall be for a duration of at least 1 h. Installation drop tests shall be done by dropping the surge protector with its shipping package material removed.~~

~~Within 15 s after the conditioning, the surge protector shall be dropped once onto a concrete surface from a height of 1.5 m. The area subjected to the drop shall be that considered most likely to crack or be damaged. If necessary, the protector shall be reassembled after the drop before testing. Any module intended to be replaceable that is damaged during the drop may be replaced.~~

4.5.3 Criteria

~~The surge protector shall not crack or become damaged, except as allowed for replaceable modules. For surge protectors that limit voltage, the impulse limiting voltage and dc series resistance shall be less than or equal to the specified value, and the insulation resistance shall be greater than or equal to the specified value. For surge protectors that limit current, the transition current and dc series resistance shall be less than or equal to the specified value.~~

4.3.1 Environmental parameters for weather protected locations.

The controlled temperature and humidity service condition is similar to the IEC 60721 class 3K3 environment. The uncontrolled temperature and humidity service condition is similar to the IEC 60721 class 3K7 environment that has the possibility of condensation and ice formation. See Table 2.

Table 2—Environmental tests for weather protected locations

<u>Recommended test</u>	<u>Test method</u>	<u>Severity</u>	
		<u>Controlled (3K3)</u>	<u>Uncontrolled (3K7)</u>
<u>Dry heat</u>	<u>IEC 60068-2-2: Bb/Bd</u>	<u>+ 40°C, 16 h</u>	<u>+ 70°C, 16 h</u>
<u>Cold</u>	<u>IEC 60068-2-1: Ab/Ad</u>	<u>+ 5°C, 16 h</u>	<u>40°C, 16 h</u>
<u>Damp heat</u>	<u>IEC 60068-2-56: Cb</u>	<u>+ 30°C, 85% RH, 96 h</u>	<u>+ 40°C, 93% RH, 96 h</u>
<u>Condensation</u>	<u>IEC 60068-2-30: Db variant 2</u>		<u>+ 40°C, 90%–100% RH, 2 cycles</u>
<u>Formation of ice</u>			<u>No IEC 60068-2 test</u>

4.3.2 Other parameters

Table 3 lists some tests that the SPD might require.

Table 3—Miscellaneous tests

<u>Test</u>	<u>Test method</u>
<u>Vibration</u>	<u>IEC 60068-2-6 Fc</u>
<u>Wire and tag solderability</u>	<u>IEC 60068-2-20 Clause 4</u>
<u>Salt spray</u>	<u>IEC 60068-2-52</u>
<u>Bump</u>	<u>IEC 60068-2-29 Eb</u>
<u>Flammability</u>	<u>IEC 60695-2-2</u>
<u>Abrasion of marking</u>	<u>IEC 60068-2-70 Xb</u>
<u>Damp heat, steady state</u>	<u>IEC 60068-2-78 Cab</u>
<u>Change of temperature</u>	<u>IEC 60068-2-14 N</u>
<u>Enclosure protection (IP code)</u>	<u>IEC 60529</u>
<u>Screw- and screwless-type conductor clamps</u>	<u>IEC 60999-1</u>

4.3.3 Specific application parameters

Some industry standards define a complete test suite. As an example Table 4 lists the non-electrical tests for Telcordia GR-974-CORE compliance.

Specification type	Source voltage (V)	Source current (mA)	Impulse waveform (μs)	Max reset time (ms)
1	52.5	260	25 A ^b , 10/1000	30
1	135	200 ^a	25 A ^b , 10/1000	30
2	52.5	260	25 A ^b , 10/1000	150
2	135	200 ^a	25 A ^b , 10/1000	150
3	140	825	25 A ^b , 10/1000	30
4	52	200	100 A ^c	150
4	80	242 ^a	100 A ^c	150
4	135	104 ^a	100 A ^c	150
5	150	200 ^a	500 A, 10/1000	150

^aThe protector may be paralleled by a series combination of a 135–150 Ω resistor and a 0.08–0.1 μF capacitor.

Table 4—GR-974-CORE compliance tests

<u>(a)</u>	<u>(b)</u>	<u>(c)</u>
<u>Mechanical requirements</u>	<u>Environmental requirements</u>	<u>NEBS</u>
<u>Materials</u>	<u>Packaged shock</u>	<u>Transportation and storage environment</u>
<u>Assembly of plug-in type</u>	<u>Transportation vibration environment</u>	<u>Temperature and humidity cycling (controlled environment)</u>
<u>Assembly of nonplug-in or station-type</u>	<u>Drop test</u>	<u>Office vibration environment</u>
<u>Internal clearance</u>	<u>Stress-corrosion cracking</u>	<u>Airborne contaminants (controlled environment)</u>
<u>Fire retardancy</u>	<u>Screw-in type TLPUs</u>	<u>Airborne contaminants (uncontrolled environment)</u>
<u>Personnel safety</u>	<u>Salt fog tests (uncontrolled environment)</u>	
<u>Nominal pin dimensions of the plug-in type</u>	<u>Rain test (uncontrolled environment)</u>	
<u>Screw-in station type color coding</u>	<u>Fungus resistance</u>	
<u>Plug-in type color coding</u>	<u>Resistance to chemicals</u>	
<u>Radioactive content</u>	<u>Aging (uncontrolled environment)</u>	
<u>Hazardous contents</u>	<u>Environmental cycling with impulse surges (uncontrolled environment)</u>	
	<u>Environmental cycling with ac surges (uncontrolled environment)</u>	

4.4 SPD testing

[This standard provides performance criteria of typical values for performance based on characterization tests performed in accordance with IEEE Std C62.36-2000.](#)

4.5 Waveform tolerances

[This subclause defines the waveform tolerances for generators mentioned in IEEE Std C62.36-2000. There are two methods of wave-shape designation: 10% to 90% front time and 30% to 90% front time \(see Figure 2\). Normally current wave shapes use the 10% to 90% front time method and voltage wave shapes use the 30% to 90% front time method to avoid including any ringing at impulse initiation.](#)