SLOVENSKI STANDARD
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Low-voltage surge protective devices - Part 1: Surge protective devices connected to low -voltage power distribution systems - Requirements and tests

Parafoudres basse tension - Partie 1: Parafoudres connectés aux réseaux de distribution basse tension - Exigences et essais

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Partie 1: Prescriptions de fonctionnement et méthodes d'essai

Surge protective devices connected to low-voltage power distribution systems –

Part 1: Performance requirements and testing methods

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SURGE PROTECTIVE DEVICES CONNECTED TO LOW-VOLTAGE POWER DISTRIBUTION SYSTEMS –

Part 1: Performance requirements and testing methods

FOREWORD

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International Standard IEC 61643-1 has been prepared by subcommittee 37A: Low-voltage surge protective devices, of IEC technical committee 37: Surge arresters.

The text of this standard is based on the following documents:

FDIS	Report on voting
37A/63/FDIS	37A/67/RVD

Full information on the voting for the approval of this standard can be found in the report on voting indicated in the above table.

Annexes A and B are for information only.

IEC 61643 consists of the following parts, under the general title: Surge protective devices connected to low-voltage power distribution systems:

– Part 1: Performance requirements and testing methods.

– Part 2: Selection and application principles[1] (in practice situations).

1) To be published.

INTRODUCTION

The present standard addresses performance tests for surge protective devices (SPDs).

There are three classifications of tests.

The class I test is intended to simulate partial conducted lightning current impulses. SPDs subjected to class I test methods are generally recommended for locations at points of high exposure, e.g., line entrances to buildings protected by lightning protection systems.

SPDs tested to class II or III test methods are subjected to impulses of shorter duration. These SPDs are generally recommended for locations with lesser exposure.

All SPDs are tested on a Ablack box≅ basis. Tests are included to assess techniques used by the manufacturers in order to apply the most appropriate test method.

Part 2 addresses the selection and application principles of SPDs in practical situations.

SURGE PROTECTIVE DEVICES CONNECTED TO LOW-VOLTAGE POWER DISTRIBUTION SYSTEMS –

Part 1: Performance requirements and testing methods

1 General

1.1 Scope

This part of IEC 61643 is applicable to devices for surge protection against indirect and direct effects of lightning or other transient overvoltages. These devices are packaged to be connected to 50/60 Hz a.c. and d.c. power circuits, and equipment rated up to 1 000 V r.m.s. or 1 500 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.

1.2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this part of IEC 61643. At the time of publication, the editions indicated were valid. All normative documents are subject to revision, and parties to agreements based on this part of IEC 61643 are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

IEC 60060-1:1989, *High-voltage test techniques – Part 1: General definitions and test requirements*

IEC 60112:1979, *Method for determining the comparative and the proof tracking indices of solid insulating materials under moist conditions*

IEC 60227 (all parts), *Polyvinyl chloride insulated cables of rated voltages up to and including 450/750 V*

IEC 60245 (all parts), *Rubber insulated cables – Rated voltages up to and including 450/750 V*

IEC 60364-4-442:1993, *Electrical installations of buildings – Part 4-442: Protection for safety – Protection against overvoltages – Protection of low-voltage installations against faults between high-voltage systems and earth*

IEC 60529:1989, *Degrees of protection provided by enclosures (IP code)*

IEC 60664-1:1992, *Insulation coordination for equipment within low-voltage systems – Part 1: Principles, requirements and tests*

IEC 60695-2-1/1:1994, *Fire hazard testing – Part 2-1/1: Test methods – Sheet 1: Glow wire end-product test and guidance*

IEC 60884-1:1994, *Plugs and socket outlets for household and similar purposes – Part 1: General requirements*
Amendment 1 (1994)
Amendment 2 (1995)

IEC 60898:1995, *Electrical accessories – Circuit-breakers for overcurrent protection for household and similar installations*

IEC 60947-1:1996, *Low voltage switchgear and controlgear – Part 1: General rules*

IEC 60947-5-1:1990, *Low-voltage switchgear and controlgear – Part 5-1: Control circuit devices and switching elements – Electromechanical control circuit devices*

IEC 60999 (all parts), *Connecting devices – Safety requirements for screw-type and screwless type clamping units for electrical copper conductors*

IEC 61180-1:1992, *High-voltage test techniques for low voltage equipment – Part 1: Definitions, test and procedure requirements*

2 Service conditions

2.1 Normal

2.1.1 Frequency: frequency of the supply mains is between 48 Hz and 62 Hz a.c.

2.1.2 Voltage: the voltage applied continuously between the terminals of the Surge Protective Device (SPD) must not exceed its maximum continuous operating voltage.

2.1.3 Altitude: altitude shall not exceed 2 000 m.

2.1.4 Operating and storage temperatures

- normal range: –5 °C to +40 °C
- extended range: –40 °C to +70 °C

2.1.5 Humidity – relative humidity: under indoor temperature conditions shall be between 30 % and 90 %.

2.2 Abnormal

Exposure of the SPD to abnormal service conditions may require special consideration in the design or application of the SPD, and should be called to the attention of the manufacturer.

For outdoor SPDs exposed to solar or other radiation, additional requirements may be necessary.

3 Definitions

For the purpose of this part of IEC 61643, the following definitions apply.

3.1
Surge Protective Device (SPD)
a device that is intended to limit transient overvoltages and divert surge currents. It contains at least one nonlinear component

3.2
one-port SPD
an SPD connected in shunt with the circuit to be protected. A one port device may have separate input and output terminals without a specific series impedance between these terminals

3.3
two-port SPD
an SPD with two sets of terminals, input and output. A specific series impedance is inserted between these terminals

3.4
voltage switching type SPD
an SPD that has a high impedance when no surge is present, but can have a sudden change in impedance to a low value in response to a voltage surge. Common examples of components used as voltage switching devices are spark gaps, gas tubes, thyristors (silicon-controlled rectifiers) and triacs. These SPDs are sometimes called "crowbar type"

3.5
voltage limiting type SPD
an SPD that has a high impedance when no surge is present, but will reduce it continuously with increased surge current and voltage. Common examples of components used as non-linear devices are varistors and suppressor diodes. These SPDs are sometimes called "clamping type"

3.6
combination type SPD
an SPD that incorporates both voltage switching type components and voltage limiting type components may exhibit voltage switching, voltage limiting or both voltage switching and voltage limiting behaviour depending upon the characteristics of the applied voltage

3.7
modes of protection
an SPDs protective component may be connected line-to-line or line-to-earth or line-to-neutral or neutral-to-earth and combinations thereof. These paths are referred to as modes of protection

3.8
nominal discharge current I_n
the crest value of the current through the SPD having a current waveshape of 8/20. This is used for the classification of the SPD for class II test and also for preconditioning of the SPD for class I and II tests

3.9
impulse current I_{imp}
it is defined by a current peak value I_{peak} and the charge Q. Tested according to the test sequence of the operating duty test. This is used for the classification of the SPD for class I test

3.10
maximum discharge current I_{max} for class II test
crest value of a current through the SPD having an 8/20 waveshape and magnitude according to the test sequence of the class II operating duty test. I_{max} is greater than I_n

3.11
maximum continuous operating voltage U_c
the maximum r.m.s. or d.c. voltage which may be continuously applied to the SPDs mode of protection. This is equal to the rated voltage

3.12
continuous operating current I_c
the current flowing through each mode of protection of the SPD when energized at the maximum continuous operating voltage U_c for each mode

NOTE – I_c corresponds to the sum of currents flowing in the protective component of the SPD and in all internal circuits connected in parallel with the protective components of the SPD.

3.13
follow current I_f
current supplied by the electrical power system and flowing through the SPD after a discharge current impulse. The follow current is significantly different from the continuous operating current I_c

3.14
rated load current
maximum continuous rated r.m.s. or d.c. current that can be supplied to a load connected to the protected output of an SPD

3.15
voltage protection level U_p
a parameter that characterizes the performance of the SPD in limiting the voltage across its terminals, which is selected from a list of preferred values. This value shall be greater than the highest value of the measured limiting voltages.

3.16
measured limiting voltage
the maximum magnitude of voltage that is measured across the terminals of the SPD during the application of impulses of specified waveshape and amplitude

3.17
residual voltage U_{res}
the peak value of voltage that appears between the terminals of an SPD due to the passage of discharge current

3.18
temporary overvoltage U_T
the maximum r.m.s. value or d.c. overvoltage the protective device can withstand and that exceeds the maximum continuous operating voltage U_c for a specified time duration

3.19
load-side surge withstand capability for a two-port SPD
ability of a two-port SPD to withstand surges on the output terminals originated in loads downstream of the SPD

3.20
voltage drop (in per cent)

$$\Delta U = ((U_{IN} - U_{OUT}) / U_{IN}) \times 100\ \%$$

where

U_{IN} is the input voltage and U_{OUT} is the output voltage measured simultaneously with a full rated resistive load connected. This parameter is only used for two-port SPDs.

3.21
insertion loss
at a given frequency, the insertion loss of an SPD connected into a given power system is defined as the ratio of voltages appearing across the mains immediately beyond the point of insertion before and after the insertion of the SPD under test. This result is expressed in decibels

NOTE – Requirements and tests are under consideration.

3.22
1,2/50 voltage impulse
a voltage impulse with a virtual front time (time to rise from 10 % to 90 % of the peak value) of 1,2 µs and a time to half-value of 50 µs

3.23
8/20 current impulse

a current impulse with a virtual front time of 8 µs and a time to half value of 20 µs

3.24
combination wave
the combination wave is delivered by a generator that applies a 1,2/50 voltage impulse across an open circuit and an 8/20 current impulse into a short circuit. The voltage, current amplitude and waveforms that are delivered to the SPD are determined by the generator and the impedance of the SPD to which the surge is applied. The ratio of peak open-circuit voltage to peak short-circuit current is 2 Ω; this is defined as the fictive impedance Z_f. The short-circuit current is symbolized by I_{sc}. The open-circuit voltage is symbolized by U_{oc}

3.25
thermal runaway
an operational condition when the sustained power dissipation of an SPD exceeds the thermal dissipation capability of the housing and connections, leading to a cumulative increase in the temperature of the internal elements culminating in failure

3.26
thermal stability
an SPD is thermally stable if after the operating duty test causing temperature rise, the temperature of the SPD decreases with time when the SPD is energized at specified maximum continuous operating voltage and at specified ambient temperature conditions

3.27
degradation
the change of original performance parameters as a result of exposure of the SPD to surge, service or unfavourable environment

3.28
short-circuit withstand
maximum prospective short-circuit current that the SPD is able to withstand

3.29
SPD disconnector
a device for disconnecting an SPD from the system in the event of SPD failure. It is to prevent a persistent fault on the system and to give visible indication of the SPD failure

3.30
degrees of protection provided by enclosure (IP code)
the extent of protection provided by an enclosure against access to hazardous parts, against ingress of solid foreign objects and/or against ingress of water (see IEC 60529)

3.31
type tests
tests which are made upon the completion of the development of a new SPD design. They are used to establish representative performance and to demonstrate compliance with the relevant standard. Once made, these tests need not be repeated unless the design is changed so as to modify its performance. In such a case, only the relevant tests need be repeated

3.32
routine tests
tests made on each SPD or on parts and materials as required to ensure that the product meets the design specifications

3.33
acceptance tests
tests which are made when it has been agreed between the manufacturer and the purchaser that the SPD or representative samples of an order are to be tested

3.34
decoupling network
a device intended to prevent surge energy from being propagated to the power network during energized testing of SPD. Sometimes called a "back filter"

3.35 Impulse test classification

3.35.1
class I tests
tests carried out with the nominal discharge current I_n defined in 3.8, the 1,2/50 voltage impulse defined in 3.22, and the maximum impulse current I_{imp} for class I test defined in 3.9

3.35.2
class II tests
tests carried out with the nominal discharge current I_n defined in 3.8, the 1,2/50 voltage defined in 3.22, and the maximum discharge current I_{max} for class II test defined in 3.10

3.35.3
class III tests
tests carried out with the combination wave (1,2/50, 8/20) defined in 3.24