SLOVENSKI STANDARD
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Nizkonapetostne naprave za zaģ ito pred prenapetostnimi udari - 1. del: Naprave za zaģ ito pred prenapetostnimi udari za nizkonapetostne razdelilne sisteme - Zahteve in preskusi

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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29.120.50	Varovalke in druga medtokovna zaģ ita	Fuses and other overcurrent protection devices
29.240.10	Transformatorske postaje. Prenapetostni odvodniki	Substations. Surge arresters

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Parafoudres basse tension –

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

Low-voltage surge protective devices –

Part 1: Surge protective devices connected to low-voltage power distribution systems – Requirements and tests

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

LOW-VOLTAGE SURGE PROTECTIVE DEVICES –

Part 1: Surge protective devices connected to low-voltage power distribution systems – Requirements and tests

FOREWORD

1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liasing with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.

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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.

This second edition of IEC 61643-1 cancels and replaces the first edition of IEC 61643-1, published 1998, Amendment 1 (2001) and corrigendum 1 (2003). This edition incorporates Amendment 2 which was not published separately due to the number of changes and pages

The document 37A/169/FDIS, circulated to the National Committees as amendment 2, led to the publication of this standard.

The text of this standard is based on the first edition of IEC 61643-1, its Amendment 1, its corrigendum 1 and on the following documents:

FDIS	Report of voting
37A/169/FDIS	37A/172/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.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

The IEC TC 37, SC 37A and SC 37B have adopted a new numbering scheme for all IEC publications developed within these committees.

In this scheme, the IEC 61643 series of publications covers all the publications from SC 37A and SC 37B according to the table below with the common general title *Low-voltage surge protective devices*.

Publication No	**Title**	**Present document**
IEC 61643	Low-voltage surge protective devices	–
IEC 61643-11	Low-voltage surge protective devices – Part 11: Surge protective devices connected to low-voltage power distribution systems – Performance requirements and testing methods	IEC 61643-1
IEC 61643-12	Low-voltage surge protective devices – Part 12: Surge protective devices connected to low-voltage power distribution systems – Selection and application principles	IEC 61643-12
IEC 61643-21	Low-voltage surge protective devices – Part 21: Surge protective devices connected to telecommunications and signalling networks – Performance requirements and testing methods	IEC 61643-21
IEC 61643-22	Low-voltage surge protective devices – Part 22: Surge protective devices connected to telecommunications and signalling networks – Selection and application principles	
IEC 61643-301	Low-voltage surge protective devices – Components for surge protective devices – Part 301: General test specifications	
IEC 61643-302	Low-voltage surge protective devices – Components for surge protective devices – Part 302: General performance specifications	
IEC 61643-303	Low-voltage surge protective devices – Components for surge protective devices – Part 303: General selection and application principles	
IEC 61643-311	Low-voltage surge protective devices – Components for surge protective devices – Part 311: Test specification for gas discharge tubes (GDTs)	IEC 61643-311
IEC 61643-312	Low-voltage surge protective devices – Components for surge protective devices – Part 312: Performance specification for gas discharge tubes (GDTs)	
IEC 61643-313	Low-voltage surge protective devices – Components for surge protective devices – Part 313: Selection and applications principles for gas discharge tubes (GDTs)	
IEC 61643-321	Low-voltage surge protective devices – Components for surge protective devices – Part 321: Test specification for avalanche breakdown diodes (ABDs)	IEC 61643-321

IEC 61643-322	Low-voltage surge protective devices – Components for surge protective devices – Part 322: Performance specification for avalanche breakdown diodes (ABDs)	
IEC 61643-323	Low-voltage surge protective devices – Components for surge protective devices – Part 323: Selection and applications principles for avalanche breakdown diodes (ABDs)	
IEC 61643-331	Low-voltage surge protective devices – Components for surge protective devices – Part 331: Test specification for metal oxide varistors (MOVs)	IEC 61643-331
IEC 61643-332	Low-voltage surge protective devices – Components for surge protective devices – Part 332: Performance specification for metal oxide varistors (MOVs)	
IEC 61643-333	Low-voltage surge protective devices – Components for surge protective devices – Part 333: Selection and application principles for metal oxide varistors (MOVs)	
IEC 61643-341	Low-voltage surge protective devices – Components for surge protective devices – Part 341: Test specification for thyristor surge suppressors (TSSs)	IEC 61643-341
IEC 61643-342	Low-voltage surge protective devices – Components for surge protective devices – Part 342: Performance specification for thyristor surge suppressors (TSSs)	
IEC 61643-343	Low-voltage surge protective devices – Components for surge protective devices – Part 343: Selection and application principles for thyristor surge suppressors (TSSs)	

The committee has decided that the contents of this publication will remain unchanged until the maintenance result date indicated on the IEC web site under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

- reconfirmed;
- withdrawn;
- replaced by a revised edition, or
- amended.

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 "black box" basis. Tests are included to assess techniques used by the manufacturers in order to apply the most appropriate test method.

Part 12 addresses the selection and application principles of SPDs in practical situations.

LOW-VOLTAGE SURGE PROTECTIVE DEVICES –

Part 1: Surge protective devices connected to low-voltage power distribution systems – Requirements and tests

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 referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

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

IEC 60112:2003, *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 60364-5-53:2001, *Electrical installations of buildings – Part 5-53: Selection and erection of electrical equipment – Isolation, switching and control*

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 60884-1:2002, *Plugs and socket outlets for household and similar purposes – Part 1: General requirements*

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

IEC 60947-5-1:2003, *Low-voltage switchgear and controlgear – Part 5-1: Control circuit devices and switching elements – Electromechanical control circuit devices*

IEC 60999 (all parts), *Connecting devices – for electrical copper conductors – Safety requirements for screw-type and screwless type clamping units* IEC 61180-1:1992, *High-voltage test techniques for low voltage equipment – Part 1: Definitions, test and procedure requirements*

IEC 61643-12:2002, Low-voltage *surge protective devices – Part 12: Surge protective devices connected to low-voltage power distribution systems –Selection and application principles*

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
device that is intended to limit transient overvoltages and divert surge currents. It contains at least one nonlinear component

3.2
one-port SPD
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
SPD with two sets of terminals, input and output. A specific series impedance is inserted between these terminals

3.4
voltage switching type SPD
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
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
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
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
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}
defined by three parameters, a current peak value I_{peak}, a charge Q and a specific energy W/R.

Note: This is used for the classification of the SPD for test class I

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
maximum r.m.s. or d.c. voltage, which may be continuously applied to the SPD´s mode of protection

3.12
standby power consumption
P_c
power consumed by the SPD when energized at the maximum continuous operating voltage (U_c) with balanced voltages and phase angles and no load. The SPD is connected in accordance with the manufacturer's instructions

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
I_L
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 test value
U_T
test voltage applied, for a specific duration, to the SPD to simulate the stress under TOV conditions

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
voltage impulse with a virtual front time of 1,2 µs and a time to half-value of 50 µs

Note 1 the front time is defined according to IEC 60060-1 to be 1,67 x ($t_{90} - t_{30}$), where t_{90} and t_{30} are the 90 % and 30 % points on the leading edge of the waveform;

Note 2 the time to half-value is defined as the time between the virtual origin and the 50 % point on the tail. The virtual origin is the point where a straight line, drawn through the 30 % and 90 % points on the leading edge of the waveform, intersects the U = 0 line.

3.23
8/20 current impulse
current impulse with a virtual front time of 8 µs and a time to half-value of 20 µs

Note 1 the front time is defined according to IEC 60060-1 to be 1,25 x ($t_{90} - t_{10}$), where t_{90} and t_{10} are the 90 % and 10 % points on the leading edge of the waveform;

Note 2 the time to half-value is defined as the time between the virtual origin and the 50 % point on the tail. The virtual origin is the point where a straight line, drawn through the 10 % and 90 % points on the leading edge of the waveform, intersects the I = 0 line.

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