SLOVENSKI STANDARD

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Nizkonapetostne naprave za zaščito pred prenapetostnimi udari - 12. del: Naprave za zaščito pred prenapetostnimi udari za nizkonapetostne napajalne sisteme – Izbira in načela za uporabo (IEC 61643-12:2002, spremenjen)

(istoveten CLC/TS 61643-12:2006)

Low-voltage surge protective devices - Part 12: Surge protective devices connected to low-voltage power systems - Selection and application principles (IEC 61643-12:2002, modified)

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English version

Low-voltage surge protective devices Part 12: Surge protective devices connected to low-voltage power systems – Selection and application principles

(IEC 61643-12:2002, modified)

Parafoudres basse tension
Partie 12: Parafoudres connectés aux réseaux de distribution basse tension –
Principes de choix et d'application
(CEI 61643-12:2002, modifiée)

Überspannungsschutzgeräte für Niederspannung
Teil 12: Überspannungsschutzgeräte für den Einsatz in Niederspannungsanlagen –
Auswahl und Anwendungsgrundsätze
(IEC 61643-12:2002, modifiziert)

This Technical Specification was approved by CENELEC on 2006-04-15.

CENELEC members are required to announce the existence of this TS in the same way as for an EN and to make the TS available promptly at national level in an appropriate form. It is permissible to keep conflicting national standards in force.

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CENELEC

European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

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Foreword

The text of the International Standard IEC 61643-12:2002, prepared by SC 37A, Low-voltage surge protective devices, of IEC TC 37, Surge arresters, together with the common modifications prepared by CLC 37A was submitted to the formal vote. The combined text was approved by CENELEC as CLC/TS 61643-12 on 2006-04-15.

The following date was fixed:

– latest date by which the existence of the CLC/TS has to be announced at national level	(doa)	2006-07-01

Annex ZA has been added by CENELEC.

CONTENTS

Introduction

This TS is to be used with the European standard EN 61643-11:2001, *Low-voltage surge protective devices – Part 11: Surge protective devices connected to low voltage power systems – Requirements and tests.*

Surge protective devices (SPDs) are used to protect, under specified conditions, electrical systems and equipment against various overvoltages and impulse currents, such as lightning and switching surges.

SPDs shall be selected in accordance with their environmental conditions and the acceptable failure rate of the equipment and the SPDs.

This TS provides information :

- to the user about characteristics useful for the selection of an SPD.
- to evaluate the need for using SPDs in low-voltage systems.
- on selection and co-ordination of SPDs, while taking into account the entire environment in which they are applied. Some examples are: equipment to be protected and system characteristics, insulation levels, overvoltages, method of installation, location of SPDs, co-ordination of SPDs, failure mode of SPDs and equipment failure consequences.
- and provides guidance to perform a risk analysis.

The HD 384 series of harmonised documents provides direct information for contractors on the installation of SPDs.

For the purpose of having a usable and complete working document, parts from existing documents have been duplicated where necessary. Such parts are explicitly mentioned in the text and attention is drawn to the reader that these parts may change in future.

Keys to understanding the structure of this standard

The list below summarizes the structure of this standard and provides a summary of the information covered in each clause and annex. The main clauses provide basic information on the factors used for SPD selection. Readers who wish to obtain more detail on the information provided in Clauses 4 to 7 should refer to the relevant annexes.

Clause 1 describes the scope of this standard.

Clause 2 lists the normative references where additional information may be found.

Clause 3 provides definitions useful for the comprehension of this standard.

Clause 4 addresses the parameters of systems and equipment relevant to SPDs. In addition to the stresses created by lightning, those created by the network itself as temporary overvoltages and switching surges are described.

Clause 5 lists the electrical parameters used in the selection of an SPD and gives some explanation regarding these parameters. These are related to the data given in EN 61643-11.

Clause 6 is the core of this standard. It relates the stresses coming from the network (as discussed in Clause 4) to the characteristics of the SPD (as discussed in Clause 5). It outlines how the protection given by SPDs may be affected by its installation. The different steps for the selection of an SPD are presented including the problems of co-ordination when more than one SPD is used in an installation (details about co-ordination may be found in Annex F).

Clause 7 is an introduction to the risk analysis (considerations of when the use of SPDs is beneficial).

Clause 8 deals with co-ordination between signalling and power lines (under consideration).

Annex A gives examples of various SPD technologies

Annex B deals with explanations of testing procedures used in EN 1643-11

Annex C deals with the calculation of the sharing of lightning current between different earthing systems.

Annex D provides specific examples on the use of this TS.

Annex E provides specific examples of the use of the risk analysis.

Annex F deals with consideration when Type ! SPDs are to be applied

Annex G discusses differences between immunity level and insulation withstand of equipments

Annex H provides practical examples of SPD installation as used in some countries

List of variables and abbreviations used in this standard

List of variables	
EMAX	Maximum energy withstand
I_c	Continuous operating current
I_f	Follow current
I_{fi}	Follow current interrupting rating
Iimp	Impulse current for class I test
I_L	Rated load current
Imax	Maximum discharge current for class II test
I_n	Nominal discharge current
I_p	Prospective short circuit current of the power supply
Ipeak	Current peak value of impulse current
I_{PE}	Residual current
I_{sc}	Short-circuit current of the CWG
N_g	Ground flash density
N_k	Keraunic level
U_c	Maximum continuous operating voltage
U_{cs}	Maximum continuous operating voltage of the power system
Udyn	Dynamic sparkover voltage of a gap
U_m	Measured limiting voltage
U_n	Nominal voltage of the system phase to earth
U_0	Line-to-neutral voltage of the system
U_{oc}	Open-circuit voltage for class III test
U_p	Voltage protection level
Uref	Reference voltage of a varistor
Ures	Residual voltage
U_T	Temporary overvoltage
UTOV	Temporary overvoltage of the power system
UTOV,HV	Temporary overvoltage of the network inside the high-voltage system
UTOV,LV	Temporary overvoltage of the network inside the low-voltage system
U_W	Voltage withstand

List of abbreviations	
CWG	Combination wave generator
EMC	Electromagnetic compatibility
GDT	Gas discharge tubes
HV	High voltage
IP	Degrees of protection provided by the enclosure
L	Inductance
LPS	Lightning protection system
LPZ	Lightning protection zone
LV	Low voltage
MEB	Main equipotential bonding
MOV	Metal oxide varistor
HVA	High voltage A (medium voltage, <50 kV), called sometimes improperly MV
PE	Protective Earth
Q	Charge of impulse current
RCD	Residual current device
TOV	Temporary overvoltage
SPD	Surge protective device
ZnO	Zinc oxide

LOW-VOLTAGE SURGE PROTECTIVE DEVICES –

Part 12: Surge protective devices connected to low-voltage power distribution systems – Selection and application principles

1 Scope

This part of IEC 61643 describes the principles for selection, operation, location and co-ordination of SPDs to be connected to 50 Hz to 60 Hz a.c. power circuits and equipment rated up to 1 000 V r.m.s..

NOTE 1 This technical specification deals only with SPDs and not with SPDs components integrated inside equipment.

2 Normative references

See Annex ZA.

3 Definitions

For the purposes of this Technical Specification the following definitions apply.

NOTE These definitions are for the most part reproduced from EN 61643-11 (the definition number being indicated within square brackets). Where necessary a note has been added for better understanding regarding application of SPDs.

3.1
surge protective device
SPD
device that is intended to limit transient overvoltages and divert surge currents. It contains at least one non-linear component

[definition 3.1 of EN 61643-11]

3.2
continuous operating current
I_c
current flowing through each mode of protection of the SPD when energized at the maximum continuous operating voltage (U_c) for each mode

3.3
maximum continuous operating voltage
U_c
maximum r.m.s. voltage which may be continuously applied to the SPD's mode of protection. This is equal to the rated voltage

[definition 3.11 of EN 61643-11]

3.4
voltage protection level
U_p
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 is greater than the highest value of the measured limiting voltages

[definition 3.15 of EN 61643-11]

3.5
measured limiting voltage
maximum magnitude of voltage that is measured across the terminals of the SPD during the application of impulses of specified waveshape and amplitude

[definition 3.16 of EN 61643-11]

3.6
residual voltage
U_{res}
peak value of voltage that appears between the terminals of an SPD due to the passage of discharge current

[definition 3.17 of EN 61643-11]

3.7
temporary overvoltage test value
U_T
test voltage applied for a specific duration, to the SPD to simulate the stress under TOV conditions

NOTE 1 Adapted from 3.18 of EN 61643-11 by adding the following note.

NOTE 2 It is a characteristic declared by the manufacturer that gives information about the behaviour of the SPD when stressed with voltages U_T above Uc for a given specific duration t_T (this behaviour may either be no change in the performance after application of the temporary overvoltage or a defined failure without hazard for either personnel, equipment or facility)

3.8
temporary overvoltage of the network
U_{TOV}
power frequency overvoltage occurring on the network at a given location, of relatively long duration. TOVs may be caused by faults inside the LV system ($U_{TOV,LV}$) or inside the HV system ($U_{TOV,HV}$)

NOTE Temporary overvoltages, typically lasting up to several seconds, usually originate from switching operations or faults (for example, sudden load rejection, single-phase faults, etc.) and/or from non-linearity (ferroresonance effects, harmonics, etc.)

3.9
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

[definition 3.8 of EN 61643-11]

3.10
impulse current
I_{imp}
it is defined by three parameters, a current peak value *I*peak, a charge Q and a specific energy W/R. Tested in accordance with the test sequence of the operating duty test. This is used for the classification of the SPD for class I test

[definition 3.9 of EN 61643-11]

3.11
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

[definition 3.25 of EN 61643-11]

3.12
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

[definition 3.26 of EN 61643-11]

3.13
SPD disconnector
device (internal and/or external) required for disconnecting an SPD from the power system

NOTE This disconnecting device is not required to have isolating capability. It is to prevent a persistent fault on the system and is used to give indication of the SPD failure.

There may be more than one disconnector function for example, an overcurrent protection function and a thermal protection function. These functions may be integrated into one unit or performed in separate units.

[definition 3.29 of EN 61643-11]

3.14
short-circuit withstand
maximum prospective short-circuit current that the SPD is able to withstand

[definition 3.28 of EN 61643-11]

3.15
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 specified series impedance between these terminals

NOTE 1 Adapted from 3.2 of EN 61643-11 by adding the following note.

NOTE 2 Annex A shows some typical one-port SPDs and the generic drawing for a one-port SPD. A one-port SPD may be connected in shunt, Figure A.1 a), or in line with the power supply. In the first case the load current is not flowing through the SPD. In the second case, the load current is flowing through the SPD and the temperature rise under load current and the associated maximum admissible load current may be determined as for a two-port SPD. Figure A.3 shows the response of various types of one-port SPD to an 8/20 impulse applied via a combination wave generator.

3.16
two-port SPD
SPD with two sets of terminals, input and output. A specific series impedance is inserted between these terminals

NOTE 1 Adapted from 3.3 of EN 61643-11 by adding the following note.

NOTE 2 The measured limiting voltage may be higher at the input terminals than at the output terminals. Therefore, equipment to be protected shall be connected to the output terminals. Figure A.2 shows typical two-port SPDs. Figure A.3 shows the response of a two-port SPD to an 8/20 impulse applied via a combination wave generator.

3.17
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 discharge tubes (GDT), thyristors (silicon-controlled rectifiers) and triacs. These SPDs are sometimes called "crowbar type"

NOTE 1 Adapted from 3.4 of EN 61643-11 by adding the following note.

NOTE 2 A voltage-switching device has a discontinuous U versus I characteristic. Figure 3c shows the response of a typical voltage switching SPD to an impulse applied via a combination wave generator.

3.18
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"

NOTE 1 Adapted from 3.5 of EN 61643-11 by adding the following note.

NOTE 2 A voltage-limiting device has a continuous U versus I characteristic. Figure 3b shows the response of a typical voltage-limiting SPD to an impulse applied via a combination wave generator.

3.19
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

NOTE 1 Adapted from 3.6 of EN 61643-11 by adding the following note.

NOTE 2 Figure A.3 shows the response of various typical combination type SPDs to a combination wave impulse.

3.20
modes of protection
SPD protective components may be connected line to line or line to earth or line to neutral or neutral to earth and combination thereof. These paths are referred to as modes of protection

[definition 3.7 of EN 61643-11]

3.21
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)

[definition 3.13 of EN 61643-11]

3.22
maximum discharge current for class II test
(I_{max})
crest value of a current through the SPD having an 8/20 waveshape and magnitude in accordance with the test sequence of the class II operating duty test. I_{max} is greater than I_n

[definition 3.10 of EN 61643-11]

3.23
degradation
change of original performance parameters as a result of exposure of the SPD to surge, service or unfavourable environment

NOTE 1 Adapted from 3.27 of EN 61643-11 by adding the following note.

NOTE 2 Degradation is a measure of the ability of an SPD to withstand the conditions for which it is designed throughout its service life. Two type tests are applied to provide confidence with respect to degradation. The first one is the operating duty test and the second is the ageing test. However, these two tests may be combined.

The operating duty test is conducted by applying a specified number of defined current waveshapes to the SPD. Permitted changes in the SPD characteristics are given in EN 61643-11.

The ageing test is carried out at a specified temperature with a voltage of specified magnitude and duration applied to the SPD. Permitted changes in the SPD characteristics are given in this standard (this test is under consideration).

This can be used to determine the SPD prospective installed life which should also consider the following:

– replacement policy;
– location and accessibility;
– acceptable failure rate;
– operating practices.