

# INTERNATIONAL STANDARD

## NORME INTERNATIONALE

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

**Parafoudres basse tension –  
Partie 12: Parafoudres connectés aux réseaux de distribution basse tension –  
Principes de choix et d'application**



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INTERNATIONAL  
ELECTROTECHNICAL  
COMMISSION

COMMISSION  
ELECTROTECHNIQUE  
INTERNATIONALE

PRICE CODE  
CODE PRIX

ICS 29.240; 29.240.10

ISBN 2-8318-1014-9

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# INTERNATIONAL ELECTROTECHNICAL COMMISSION

## LOW-VOLTAGE SURGE PROTECTIVE DEVICES –

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

#### FOREWORD

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International Standard IEC 61643-12 has been prepared by subcommittee 37A: Low-voltage surge protective devices, of IEC technical committee 37: Surge arresters.

This second edition of IEC 61643-12 cancels and replaces the first edition published in 2002. It constitutes a technical revision. Specific change with respect to the previous edition is the incorporation of Amendment 1, which was not published separately due to the number of changes and pages.

This standard shall be used in conjunction with IEC 61643-1:2005, *Low-voltage surge protective devices – Part 1: Surge protective devices connected to low-voltage power distribution systems – Requirements and tests*.

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

FDIS	Report on voting
37A/209/FDIS	37A/212/RVD

This publication has been drafted in accordance with the ISO/IEC Directives, Part 3.

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Publication	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 61643-22
IEC 61643-301	Low-voltage surge protective devices – Part 301: Components for surge protective devices – General test specifications	
IEC 61643-302	Low-voltage surge protective devices – Part 302: Components for surge protective devices – General performance specifications	
IEC 61643-303	Low-voltage surge protective devices – Part 303: Components for surge protective devices – General selection and application principles	
IEC 61643-311	Low-voltage surge protective devices – Part 311: Components for surge protective devices – Test specification for gas discharge tubes (GDTs)	IEC 61643-311
IEC 61643-312	Low-voltage surge protective devices – Part 312: Components for surge protective devices – Performance specification for gas discharge tubes (GDTs)	
IEC 61643-313	Low-voltage surge protective devices – Part 313: Components for surge protective devices – Selection and applications principles for gas discharge tubes (GDTs)	
IEC 61643-321	Low-voltage surge protective devices – Part 321: Components for surge protective devices – Test specification for avalanche breakdown diodes (ABDs)	IEC 61643-321
IEC 61643-322	Low-voltage surge protective devices – Part 322: Components for surge protective devices – Performance specification for avalanche breakdown diodes (ABDs)	
IEC 61643-323	Low-voltage surge protective devices – Part 323: Components for surge protective devices – Selection and applications principles for avalanche breakdown diodes (ABDs)	
IEC 61643-331	Low-voltage surge protective devices – Part 331: Components for surge protective devices – Test specification for metal oxide varistors (MOVs)	IEC 61643-331
IEC 61643-332	Low-voltage surge protective devices – Part 332: Components for surge protective devices – Performance specification for metal oxide varistors (MOVs)	
IEC 61643-333	Low-voltage surge protective devices – Part 333: Components for surge protective devices – Selection and application principles for metal oxide varistors (MOVs)	
IEC 61643-341	Low-voltage surge protective devices – Part 341: Components for surge protective devices – Test specification for thyristor surge suppressors (TSSs)	IEC 61643-341

IEC 61643-342	Low-voltage surge protective devices – Part 342: Components for surge protective devices – Performance specification for thyristor surge suppressors (TSSs)	
IEC 61643-343	Low-voltage surge protective devices – Part 343: Components for surge protective devices – Selection and application principles for thyristor surge suppressors (TSSs)	

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## 0 Introduction

### 0.1 General

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 according to their environmental conditions and the acceptable failure rate of the equipment and the SPDs.

This standard provides information to the user about characteristics useful for the selection of an SPD.

This standard provides information to evaluate, with reference to IEC 62305, Parts 1 to 4 and IEC 60364 series, the need for using SPDs in low-voltage systems. It provides information on selection and co-ordination of SPDs, while taking into account the entire environment in which they are applied. Examples include: equipment to be protected and system characteristics, insulation levels, overvoltages, method of installation, location of SPDs, coordination of SPDs, failure mode of SPDs and equipment failure consequences.

It also provides guidance for performing a risk analysis.

Guidance on requirements for product insulation coordination is provided by IEC 60664 series. Requirements for safety (fire, overcurrent and electric shock) and installation are provided by IEC 60364 series.

The IEC 60364 series of standards provide direct information for contractors on the installation of SPDs. IEC/TR 62066 gives more information on the scientific background of surge protection.

### 0.2 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, namely 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 IEC 61643-1.

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 coordination when more than one SPD is used in an installation (details about coordination 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 coordination between signalling and power lines (under consideration).

Annex A deals with information needed for tenders and explains testing procedures used in IEC 61643-1.

Annex B provides examples of the relationship between two important parameters of SPDs,  $U_c$  and  $U_p$ , in the specific case of ZnO varistors and also examples of the relationship between  $U_c$  and the nominal voltage of the network.

Annex C supplements the information given in Clause 4 on surge voltages in low-voltage systems.

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

Annex E deals with calculation of temporary overvoltages due to faults in the high-voltage system.

Annex F supplements the information given in Clause 6 on coordination rules when more than one SPD is used in a system.

Annex G provides specific examples on the use of this standard.

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

Annex I supplements the information given in Clause 4 about system stresses.

Annex J supplements the information given in Clause 5 on criteria for selection of SPDs.

Annex K supplements the information given in Clause 6 on the application of SPDs in various low-voltage systems.

Annex L supplements the information given in Clause 7 on the parameters used in risk analysis.

Annex M discusses differences between immunity level and insulation withstand of electrical equipment

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

Annex O discusses problems of coordination with equipment having both signalling and power terminals

Annex P provides information on withstand of fuses in surge conditions

## 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 coordination of SPDs to be connected to 50 Hz to 60 Hz a.c. and to d.c. power circuits and equipment rated up to 1 000 V r.m.s. or 1 500 V d.c.

NOTE 1 Additional requirements may be necessary for special applications such as electrical traction, etc.

NOTE 2 It should be remembered that IEC 60364 series and IEC 62305-4 are also applicable.

NOTE 3 This standard deals only with SPDs and not with SPDs components integrated inside equipment.

#### 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, *Lamp caps and holders together with gauges for the control of interchangeability and safety – Part 1: Lamp cap*

IEC 60364 (all parts), *Low-voltage electrical installations*

IEC 60364-4-41, *Low-voltage electrical installations – Part 4-41: Protection for safety – Protection against electric shock*

IEC 60364-4-44, *Low voltage electrical installations – Part 4-44: Protection for safety – Protection against voltage disturbances and electromagnetic disturbances*

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

IEC 60529, *Degrees of protection provided by enclosures (IP Code)*

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

IEC 61000-4-5, *Electromagnetic compatibility (EMC) – Part 4-5: Testing and measurement techniques – Surge immunity test*

IEC 61008-1, *Residual current operated circuit-breakers without integral overcurrent protection for household and similar uses (RCCBs) – Part 1: General rules*

IEC 61009-1, *Residual current operated circuit-breakers with integral overcurrent protection for household and similar uses (RCBOs) – Part 1: General rules*

IEC 62305-1, *Protection against lightning – Part 1: General principles*

IEC 62305-2, *Protection against lightning – Part 2: Risk management*

IEC 62305-3, *Protection against lightning – Part 3: Physical damages to structures and life hazard*

IEC 62305-4, *Protection against lightning – Part 4: Electrical and electronic systems within structures*

IEC 61643-1 *Low-voltage surge protective devices – Part 1: Surge protective devices connected to low-voltage power distribution systems – Requirements and tests*

### 3 Terms, definitions and abbreviated terms

#### 3.1 Terms and definitions

For the purposes of this document, the following terms, definitions and abbreviated terms apply.

NOTE These terms and definitions are for the most part reproduced from IEC 61643-1 (the definition number being indicated within square brackets). Where necessary a note has been added for better understanding regarding application of SPDs.

##### 3.1.1

##### **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 IEC 61643-1]

##### 3.1.2

##### **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

##### 3.1.3

##### **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. This is equal to the rated voltage

[definition 3.11 of IEC 61643-1]

##### 3.1.4

##### **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 IEC 61643-1]

##### 3.1.5

##### **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 IEC 61643-1]