

Piksekaitse. Osa 4: Ehitiste elektri- ja elektroonikasüsteemid

Protection against lightning - Part 4: Electrical and electronic systems within structures

EVS

EESTI STANDARDI EESSÕNA

NATIONAL FOREWORD

Käesolev Eesti standard EVS-EN 62305-4:2011 sisaldab Euroopa standardi EN 62305-4:2011 ja selle paranduse AC:2016 ingliskeelset teksti.

Standard on kinnitatud Eesti Standardikeskuse 31.03.2011 käskkirjaga ja jõustub sellekohase teate avaldamisel EVS Teatajas.

Euroopa standardimisorganisatsioonide poolt rahvuslikele liikmetele Euroopa standardi teksti kättesaadavaks tegemise kuupäev on 25.02.2011, parandusele AC 04.11.2016.

Standard on kättesaadav Eesti standardiorganisatsioonist

This Estonian standard EVS-EN 62305-4:2011 consists of the English text of the European standard EN 62305-4:2011 and its corrigendum AC:2016.

This standard is ratified with the order of Estonian Centre for Standardisation dated 31.03.2011 and is endorsed with the notification published in the official bulletin of the Estonian national standardisation organisation.

Date of Availability of the European standard text is 25.02.2011, for corrigendum AC 04.11.2016.

The standard is available from Estonian standardisation organisation.

ICS 29.020, 91.120.40

ehitis, elektroonikasüsteemid, valgukaitse, välk

Standardite reprodutseerimis- ja levitamiseõigus kuulub Eesti Standardikeskusele

Andmete paljundamine, taastekitamine, kopeerimine, salvestamine elektroonilisse süsteemi või edastamine ükskõik millises vormis või millisel teel on keelatud ilma Eesti Standardikeskuse poolt antud kirjaliku loata.

Kui Teil on küsimusi standardite autorikaitse kohta, palun võtke ühendust Eesti Standardikeskusega:
www.evs.ee; Telefon: 605 5050; E-post: info@evs.ee

Right to reproduce and distribute belongs to the Estonian Centre for Standardisation

No part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying, without permission in writing from Estonian Centre for Standardisation.

If you have any questions about standards copyright, please contact Estonian Centre for Standardisation:
Estonia; www.evs.ee; Phone: 605 5050; E-mail: info@evs.ee

English version

**Protection against lightning -
Part 4: Electrical and electronic systems within structures
(IEC 62305-4:2010, modified)**

Protection contre la foudre -
Partie 4: Réseaux de puissance et de
communication dans les structures
(CEI 62305-4:2010, modifiée)

Blitzschutz - Teil 4: Elektrische und
elektronische Systeme in baulichen
Anlagen
(IEC 62305-4:2010, modifiziert)

This European Standard was approved by CENELEC on 2011-01-13. CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CENELEC member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CENELEC member into its own language and notified to the Central Secretariat has the same status as the official versions.

CENELEC members are the national electrotechnical committees of Austria, Belgium, Bulgaria, Croatia, Cyprus, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland and the United Kingdom.

CENELEC

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

Management Centre: Avenue Marnix 17, B - 1000 Brussels

Foreword

The text of document 81/373/FDIS, future edition 2 of IEC 62305-4, prepared by IEC TC 81, Lightning protection, was submitted to the IEC-CENELEC parallel vote and was approved by CENELEC as EN 62305-4 on 2011-01-13.

This European Standard supersedes EN 62305-4:2006 + corr. Nov.2006.

This EN 62305-4:2011 includes the following significant technical changes with respect to EN 62305-4:2006 + corr. Nov.2006:

- 1) Isolating interfaces capable of reducing conducted surges on lines entering the structure are introduced.
- 2) Minimum cross-sections for bonding components are slightly modified.
- 3) First negative impulse current is introduced for calculation purposes as electromagnetic source of harm to the internal systems.
- 4) Selection of SPD with regard to voltage protection level is improved to take into account oscillation and induction phenomena in the circuit downstream of SPD.
- 5) Annex C dealing with SPD coordination is withdrawn and referred back to SC 37A.
- 6) A new informative Annex D is introduced giving information on factors to be considered in the selection of SPDs.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN and CENELEC shall not be held responsible for identifying any or all such patent rights.

The following dates were fixed:

- | | | |
|--|-------|------------|
| – latest date by which the EN has to be implemented at national level by publication of an identical national standard or by endorsement | (dop) | 2011-10-13 |
| – latest date by which the national standards conflicting with the EN have to be withdrawn | (dow) | 2014-01-13 |

Annex ZA has been added by CENELEC.

Endorsement notice

The text of the International Standard IEC 62305-4:2010 was approved by CENELEC as a European Standard without any modification.

In the official version, for Bibliography, the following notes have to be added for the standards indicated:

- | | | |
|----------------------|------|---|
| [2] IEC 61000 series | NOTE | Harmonized in EN 61000 series (partially modified). |
| [8] IEC 61643-11 | NOTE | Harmonized as EN 61643-11. |
-

EVS

Annex ZA (normative)

Normative references to international publications with their corresponding European publications

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.

NOTE When an international publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
IEC 60364-5-53	2001	Electrical installations of buildings - Part 5-53: Selection and erection of electrical equipment - Isolation, switching and control	-	-
IEC 60664-1	2007	Insulation coordination for equipment within low-voltage systems - Part 1: Principles, requirements and tests	EN 60664-1	2007
IEC 61000-4-5	2005	Electromagnetic compatibility (EMC) - Part 4-5: Testing and measurement techniques - Surge immunity test	EN 61000-4-5	2006
IEC 61000-4-9	1993	Electromagnetic compatibility (EMC) - Part 4-9: Testing and measurement techniques - Pulse magnetic field immunity test	EN 61000-4-9	1993
IEC 61000-4-10	1993	Electromagnetic compatibility (EMC) - Part 4-10: Testing and measurement techniques - Damped oscillatory magnetic field immunity test	EN 61000-4-10	1993
IEC 61643-1	2005	Low-voltage surge protective devices - Part 1: Surge protective devices connected to low-voltage power distribution systems - Requirements and tests	-	-
IEC 61643-12 (mod)	2008	Low-voltage surge protective devices - Part 12: Surge protective devices connected to low-voltage power distribution systems - Selection and application principles	CLC/TS 61643-12	2009
IEC 61643-21	-	Low voltage surge protective devices - Part 21: Surge protective devices connected to telecommunications and signalling networks - Performance requirements and testing methods	EN 61643-21	-
IEC 61643-22 (mod)	-	Low-voltage surge protective devices - Part 22: Surge protective devices connected to telecommunications and signalling networks - Selection and application principles	CLC/TS 61643-22	-
IEC 62305-1	2010	Protection against lightning - Part 1: General principles	EN 62305-1	2011
IEC 62305-2	2010	Protection against lightning - Part 2: Risk management	EN 62305-2	2011

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
IEC 62305-3	2010	Protection against lightning - Part 3: Physical damage to structures and life hazard	EN 62305-3	2011

EVS

CONTENTS

FOREWORD.....	5
INTRODUCTION	7
1 Scope.....	9
2 Normative references.....	9
3 Terms and definitions.....	10
4 Design and installation of SPM.....	13
4.1 General.....	13
4.2 Design of SPM.....	16
4.3 Lightning protection zones (LPZ)	17
4.4 Basic SPM	20
5 Earthing and bonding.....	21
5.1 General.....	21
5.2 Earth-termination system	22
5.3 Bonding network	24
5.4 Bonding bars	28
5.5 Bonding at the boundary of an LPZ	29
5.6 Material and dimensions of bonding components.....	29
6 Magnetic shielding and line routing.....	30
6.1 Spatial shielding	30
6.2 Shielding of internal lines.....	30
6.3 Routing of internal lines	30
6.4 Shielding of external lines	31
6.5 Material and dimensions of magnetic shields	31
7 Coordinated SPD system.....	31
8 Isolating interfaces	32
9 SPM management	32
9.1 General.....	32
9.2 SPM management plan.....	32
9.3 Inspection of SPM.....	33
9.3.1 Inspection procedure	34
9.3.2 Inspection documentation	34
9.4 Maintenance.....	35
Annex A (informative) Basis of electromagnetic environment evaluation in an LPZ	36
Annex B (informative) Implementation of SPM for an existing structure	60
Annex C (informative) Selection and installation of a coordinated SPD system.....	76
Annex D (informative) Factors to be considered in the selection of SPDs	82
Bibliography.....	87
Figure 1 – General principle for the division into different LPZ.....	13
Figure 2 – Examples of possible SPM (LEMP protection measures).....	15
Figure 3 – Examples for interconnected LPZ	19
Figure 4 – Examples for extended lightning protection zones	20
Figure 5 – Example of a three-dimensional earthing system consisting of the bonding network interconnected with the earth-termination system	22
Figure 6 – Meshed earth-termination system of a plant.....	23

Figure 7 – Utilization of reinforcing rods of a structure for equipotential bonding	25
Figure 8 – Equipotential bonding in a structure with steel reinforcement.....	26
Figure 9 – Integration of conductive parts of internal systems into the bonding network	27
Figure 10 – Combinations of integration methods of conductive parts of internal systems into the bonding network	28
Figure A.1 – LEMP situation due to lightning strike	37
Figure A.2 – Simulation of the rise of magnetic field by damped oscillations	40
Figure A.3 – Large volume shield built by metal reinforcement and metal frames	41
Figure A.4 – Volume for electrical and electronic systems inside an inner LPZ n	42
Figure A.5 – Reducing induction effects by line routing and shielding measures.....	43
Figure A.6 – Example of SPM for an office building.....	45
Figure A.7 – Evaluation of the magnetic field values in case of a direct lightning strike	46
Figure A.8 – Evaluation of the magnetic field values in case of a nearby lightning strike	48
Figure A.9 – Distance s_a depending on rolling sphere radius and structure dimensions	50
Figure A.10 – Types of grid-like large volume shields.....	52
Figure A.11 – Magnetic field strength $H_{1/MAX}$ inside a grid-like shield type 1.....	53
Figure A.12 – Magnetic field strength $H_{1/MAX}$ inside a grid-like shield type 1 according to mesh width.....	53
Figure A.13 – Low-level test to evaluate the magnetic field inside a shielded structure	55
Figure A.14 – Voltages and currents induced into a loop formed by lines.....	56
Figure B.1 – SPM design steps for an existing structure	63
Figure B.2 – Possibilities to establish LPZs in existing structures	67
Figure B.3 – Reduction of loop area using shielded cables close to a metal plate.....	69
Figure B.4 – Example of a metal plate for additional shielding.....	70
Figure B.5 – Protection of aerials and other external equipment.....	71
Figure B.6 – Inherent shielding provided by bonded ladders and pipes.....	72
Figure B.7 – Ideal positions for lines on a mast (cross-section of steel lattice mast)	72
Figure B.8 – Upgrading of the SPM in existing structures.....	74
Figure C.1 – Surge voltage between live conductor and bonding bar.....	79
Figure D.1 – Installation example of test Class I, Class II and Class III SPDs	83
Figure D.2 – Basic example for different sources of damage to a structure and lightning current distribution within a system.....	84
Figure D.3 – Basic example of balanced current distribution	85
Table 1 – Minimum cross-sections for bonding components	30
Table 2 – SPM management plan for new buildings and for extensive changes in construction or use of buildings.....	33
Table A.1 – Parameters relevant to source of harm and equipment.....	38
Table A.2 – Examples for $I_{0/MAX} = 100$ kA and $w_m = 2$ m	48
Table A.3 – Magnetic attenuation of grid-like spatial shields for a plane wave.....	49
Table A.4 – Rolling sphere radius corresponding to maximum lightning current.....	51
Table A.5 – Examples for $I_{0/MAX} = 100$ kA and $w_m = 2$ m corresponding to $SF = 12,6$ dB	51
Table B.1 – Structural characteristics and surroundings	60
Table B.2 – Installation characteristics.....	61
Table B.3 – Equipment characteristics	61

Table B.4 – Other questions to be considered for the protection concept.....	61
Table D.1 – Preferred values of I_{imp}	82

INTRODUCTION

Lightning as a source of harm is a very high energy phenomenon. Lightning flashes release many hundreds of mega-joules of energy. When compared with the milli-joules of energy that may be sufficient to cause damage to sensitive electronic equipment in electrical and electronic systems within a structure, it is clear that additional protection measures will be necessary to protect some of this equipment.

The need for this International Standard has arisen due to the increasing cost of failures of electrical and electronic systems, caused by electromagnetic effects of lightning. Of particular importance are electronic systems used in data processing and storage as well as process control and safety for plants of considerable capital cost, size and complexity (for which plant outages are very undesirable for cost and safety reasons).

Lightning can cause different types of damage in a structure, as defined in IEC 62305-1:

- D1 injury to living beings by electric shock;
- D2 physical damage (fire, explosion, mechanical destruction, chemical release) due to lightning current effects, including sparking;
- D3 failure of internal systems due to LEMP.

IEC 62305-3 deals with the protection measures to reduce the risk of physical damage and life hazard, but does not cover the protection of electrical and electronic systems.

This Part 4 of IEC 62305 therefore provides information on protection measures to reduce the risk of permanent failures of electrical and electronic systems within structures.

Permanent failure of electrical and electronic systems can be caused by the lightning electromagnetic impulse (LEMP) via:

- a) conducted and induced surges transmitted to equipment via connecting wiring;
- b) the effects of radiated electromagnetic fields directly into equipment itself.

Surges to the structure can originate from sources external to the structure or from within the structure itself:

- surges which originate externally from the structure are created by lightning flashes striking incoming lines or the nearby ground, and are transmitted to electrical and electronic systems within the structure via these lines;
- surges which originate internally within the structure are created by lightning flashes striking the structure itself or the nearby ground.

NOTE 1 Surges can also originate internally within the structure, from switching effects, e.g. switching of inductive loads.

The coupling can arise from different mechanisms:

- resistive coupling (e.g. the earth impedance of the earth-termination system or the cable shield resistance);
- magnetic field coupling (e.g. caused by wiring loops in the electrical and electronic system or by inductance of bonding conductors);
- electric field coupling (e.g. caused by rod antenna reception).

NOTE 2 The effects of electric field coupling are generally very small when compared to the magnetic field coupling and can be disregarded.

Radiated electromagnetic fields can be generated via

- the direct lightning current flowing in the lightning channel,
- the partial lightning current flowing in conductors (e.g. in the down-conductors of an external LPS in accordance with IEC 62305-3 or in an external spatial shield in accordance with this standard).