IEC 62305-4

Edition 2.0 2010-12

INTERNATIONAL STANDARD

NORME INTERNATIONALE

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

Protection contre la foudre –
Partie 4: Réseaux de puissance et de communication dans les structures

IEC 62305-4:2010

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PROTECTION AGAINST LIGHTNING –

Part 4: Electrical and electronic systems within structures

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 liaising 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 62305-4 has been prepared by IEC technical committee 81: Lightning protection.

This second edition cancels and replaces the first edition, published in 2006, and constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

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5) Annex C dealing with SPD coordination is withdrawn and referred back to SC 37A.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.

This bilingual version (2012-06) corresponds to the monolingual English version, published in 2010-12.

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

FDIS	Report on voting
81/373/FDIS	81/383/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.

The French version of this standard has not been voted upon.

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

A list of all the parts in the IEC 62305 series, under the general title *Protection against lightning*, can be found on the IEC website.

The committee has decided that the contents of this publication will remain unchanged until the stability 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

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).

PROTECTION AGAINST LIGHTNING –

Part 4: Electrical and electronic systems within structures

1 Scope

This part of IEC 62305 provides information for the design, installation, inspection, maintenance and testing of electrical and electronic system protection (SPM) to reduce the risk of permanent failures due to lightning electromagnetic impulse (LEMP) within a structure.

This standard does not cover protection against electromagnetic interference due to lightning, which may cause malfunctioning of internal systems. However, the information reported in Annex A can also be used to evaluate such disturbances. Protection measures against electromagnetic interference are covered in IEC 60364-4-44 [1] [1] and in the IEC 61000 series [2].

This standard provides guidelines for cooperation between the designer of the electrical and electronic system, and the designer of the protection measures, in an attempt to achieve optimum protection effectiveness.

This standard does not deal with detailed design of the electrical and electronic systems themselves.

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 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*

IEC 61000-4-5:2005, *Electromagnetic compatibility (EMC) – Part 4-5: Testing and measurement techniques – Surge immunity test*

IEC 61000-4-9:1993, *Electromagnetic compatibility (EMC) – Part 4-9: Testing and measurement techniques – Pulse magnetic field immunity test – Basic EMC Publication*

IEC 61000-4-10:1993, *Electromagnetic compatibility (EMC) – Part 4-10: Testing and measurement techniques – Damped oscillatory magnetic field immunity test – Basic EMC Publication*

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 61643-12:2008, *Low-voltage surge protective devices – Part 12: Surge protective devices connected to low-voltage power distribution systems – Selection and application principles*

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1 Figures in square brackets refer to the bibliography.

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 61643-22, *Low voltage surge protective devices – Part 22: Surge protective devices connected to telecommunications and signalling networks – Selection and application principles*

IEC 62305-1:2010, *Protection against lightning – Part 1: General principles*

IEC 62305-2:2010, *Protection against lightning – Part 2: Risk management*

IEC 62305-3:2010, *Protection against lightning – Part 3: Physical damage to structures and life hazard*

3 Terms and definitions

For the purposes of this document, the following terms and definitions, as well as those given in other parts of IEC 62305, apply.

3.1
electrical system
system incorporating low voltage power supply components

3.2
electronic system
system incorporating sensitive electronic components such as telecommunication equipment, computer, control and instrumentation systems, radio systems, power electronic installations

3.3
internal systems
electrical and electronic systems within a structure

3.4
lightning protection
LP
complete system for the protection of structures and/or electrical and electronic systems in those structures from the effects of lightning, consisting of an LPS and SPM

3.5
lightning protection system
LPS
complete system used to reduce physical damage due to lightning flashes to a structure

NOTE It consists of both external and internal lightning protection systems.

3.6
lightning electromagnetic impulse
LEMP
all electromagnetic effects of lightning current via resistive, inductive and capacitive coupling which create surges and electromagnetic fields

3.7
surge
transient created by LEMP that appears as an overvoltage and/or overcurrent

3.8
rated impulse withstand voltage level
U_W
impulse withstand voltage assigned by the manufacturer to the equipment or to a part of it, characterizing the specified withstand capability of its insulation against overvoltages

NOTE For the purposes of this part of IEC 62305, only withstand voltage between live conductors and earth is considered.

3.9
lightning protection level
LPL
number related to a set of lightning current parameters relevant to the probability that the associated maximum and minimum design values will not be exceeded in naturally occurring lightning

NOTE Lightning protection level is used to design protection measures according to the relevant set of lightning current parameters.

3.10
lightning protection zone
LPZ
zone where the lightning electromagnetic environment is defined

NOTE The zone boundaries of an LPZ are not necessarily physical boundaries (e.g. walls, floor and ceiling).

3.11
LEMP protection measures
SPM
measures taken to protect internal systems against the effects of LEMP

NOTE This is part of overall lightning protection.

3.12
grid-like spatial shield
magnetic shield characterized by openings

NOTE For a building or a room, it is preferably built by interconnected natural metal components of the structure (e.g. rods of reinforcement in concrete, metal frames and metal supports).

3.13
earth-termination system
part of an external LPS which is intended to conduct and disperse lightning current into the earth

3.14
bonding network
interconnecting network of all conductive parts of the structure and of internal systems (live conductors excluded) to the earth-termination system

3.15
earthing system
complete system combining the earth-termination system and the bonding network

3.16
surge protective device
SPD
device intended to limit transient overvoltages and divert surge currents; contains at least one non-linear component

3.17

SPD tested with I_{imp}
SPDs which withstand the partial lightning current with a typical waveform 10/350 μs and require a corresponding impulse test current I_{imp}

NOTE For power lines, a suitable test current I_{imp} is defined in the Class I test procedure of IEC 61643-1:2005.

3.18
SPD tested with I_n
SPDs which withstand induced surge currents with a typical waveform 8/20 μs and require a corresponding impulse test current I_n

NOTE For power lines a suitable test current I_n is defined in the Class II test procedure of IEC 61643-1:2005.

3.19
SPD tested with a combination wave
SPDs that withstand induced surge currents with a typical waveform 8/20 μs and require a corresponding impulse test current I_{SC}

NOTE For power lines a suitable combination wave test is defined in the Class III test procedure of IEC 61643-1:2005 defining the open circuit voltage U_{OC} 1,2/50 μs and the short-circuit current I_{SC} 8/20 μs of a 2 Ω combination wave generator.

3.20
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

NOTE 1 Common examples of components used as voltage switching devices include spark gaps, gas discharge tubes (GDT), thyristors (silicon controlled rectifiers) and triacs. These SPDs are sometimes called "crowbar type".

NOTE 2 A voltage-switching device has a discontinuous voltage/current characteristic.

3.21
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

NOTE 1 Common examples of components used as non-linear devices are varistors and suppressor diodes. These SPDs are sometimes called "clamping type".

NOTE 2 A voltage-limiting device has a continuous voltage/current characteristic.

3.22
combination type SPD
SPD that incorporates both voltage-switching and voltage-limiting type components and that may exhibit voltage-switching, voltage-limiting or both voltage-switching and voltage-limiting behaviour, depending upon the characteristics of the applied voltage

3.23
coordinated SPD system
SPDs properly selected, coordinated and installed to form a system intended to reduce failures of electrical and electronic systems

3.24
isolating interfaces
devices which are capable of reducing conducted surges on lines entering the LPZ

NOTE 1 These include isolation transformers with earthed screen between windings, metal-free fibre optic cables and opto-isolators.

NOTE 2 Insulation withstand characteristics of these devices are suitable for this application intrinsically or via SPD.

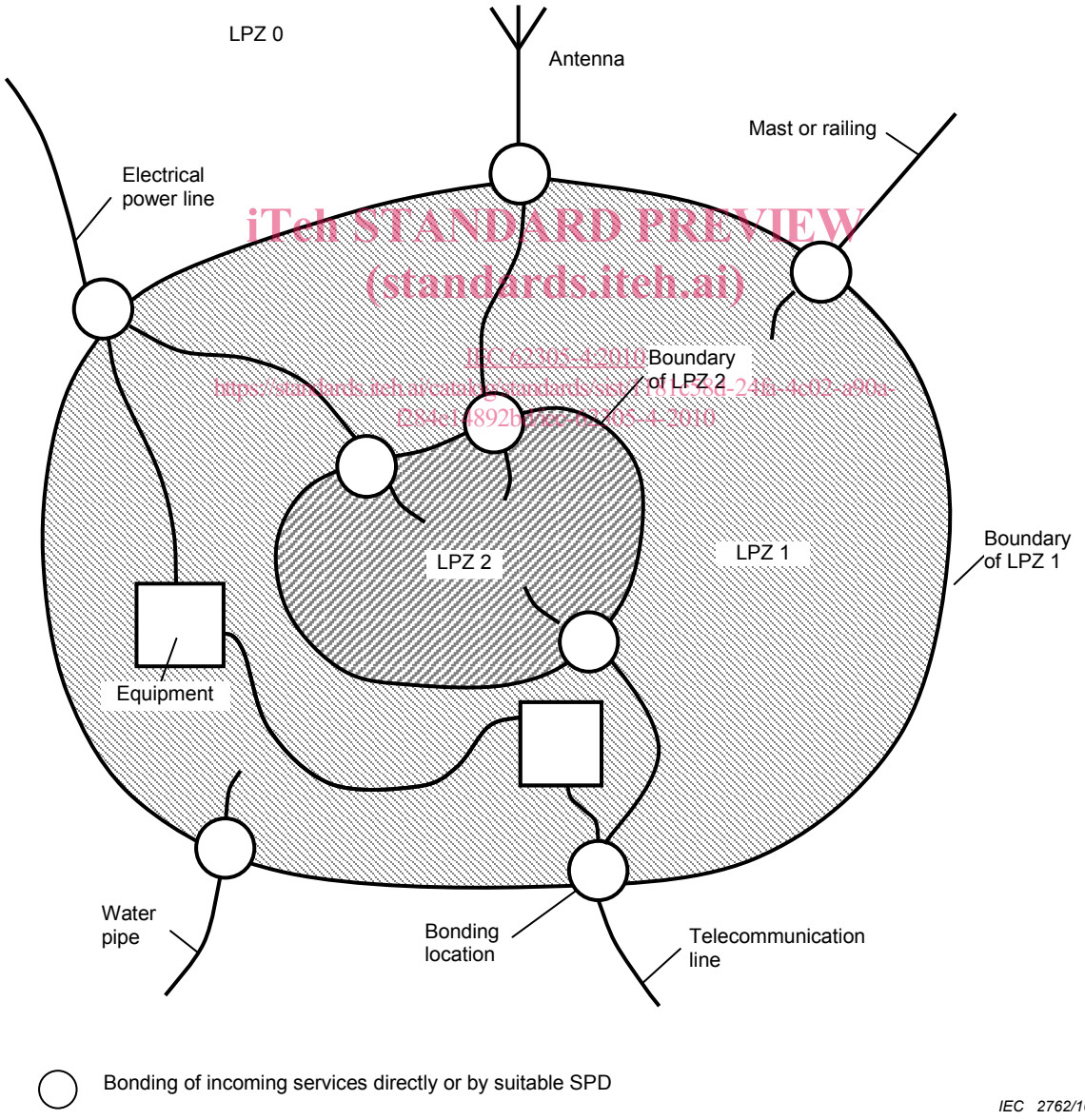
4 Design and installation of SPM

4.1 General

Electrical and electronic systems are subject to damage from a lightning electromagnetic impulse (LEMP). Therefore SPM need to be provided to avoid failure of internal systems.

The design of SPM should be carried out by experts in lightning and surge protection who possess a broad knowledge of EMC and installation practices.

Protection against LEMP is based on the lightning protection zone (LPZ) concept: the zone containing systems to be protected shall be divided into LPZs. These zones are theoretically assigned part of space (or of an internal system) where the LEMP severity is compatible with the withstand level of the internal systems enclosed (see Figure 1). Successive zones are characterized by significant changes in the LEMP severity. The boundary of an LPZ is defined by the protection measures employed (see Figure 2).



NOTE This figure shows an example of dividing a structure into inner LPZs. All metal services entering the structure are bonded via bonding bars at the boundary of LPZ 1. In addition, the conductive services entering LPZ 2 (e.g. computer room) are bonded via bonding bars at the boundary of LPZ 2.

Figure 1 – General principle for the division into different LPZ