SLOVENSKI STANDARD
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Protection against lightning electromagnetic impulse (LEMP) - Part 4: Protection of equipment in existing structures

Protection against lightning electromagnetic impulse - Part 4: Protection of equipment in existing structures

Protection contre l'impulsion électromagnétique générée par la foudre - Partie 4: Protection des équipments dans les structures existantes

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Partie 4: Protection des équipements dans les structures existantes

Protection against lightning electromagnetic impulse –

Part 4: Protection of equipment in existing structures

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PROTECTION AGAINST LIGHTNING ELECTROMAGNETIC IMPULSE –

Part 4: Protection of equipment in existing structures

FOREWORD

1) The IEC (International Electrotechnical Commission) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of the 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, the IEC publishes International Standards. 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. The 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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3) The documents produced have the form of recommendations for international use and are published in the form of standards, technical reports or guides and they are accepted by the National Committees in that sense.

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The main task of IEC technical Committees is to prepare International Standards. In exceptional circumstances, a technical committee may propose the publication of a technical report of one of the following types:

- type 1, when the required support cannot be obtained for the publication of an International Standard, despite repeated efforts;
- type 2, when the subject is still under technical development or where for any other reason there is the future but no immediate possibility of an agreement on an International Standard;
- type 3, when a technical committee has collected data of a different kind from that which is normally published as an International Standard, for example "state of the art".

Technical reports of types 1 and 2 are subject to review within three years of publication to decide whether they can be transformed into International Standards. Technical reports of type 3 do not necessarily have to be reviewed until the data they provide are considered to be no longer valid or useful.

IEC 61312-4, which is a technical report of type 2, has been prepared by IEC technical committee 81: Lightning protection.

The text of this technical report is based on the following documents:

Committee draft	Report on voting
81/106/CDV	81/115/RVC

Full information on the voting for the approval of this technical report can be found in the report on voting indicated in the above table.

IEC 61312-4 forms part of a series of publications under the general title: Protection against lightning electromagnetic impulse.

This part 4 supplements part 1, which sets out general principles.

This document is being issued in the Technical Report (type 2) series of publications (according to subclause G.3.2.2 of part 1 of the *ISO/IEC Directives*) as a "prospective standard for provisional application" in the field of protection against lightning electromagnetic impulse because there is an urgent need for guidance on how standards in this field should be used to meet an identified need.

This document is not to be regarded as an "International Standard". It is proposed for provisional application so that information and experience of its use in practice may be gathered. Comments on the content of this document should be sent to the IEC Central Office.

A review of this Technical Report (type 2) will be carried out not later than three years after its publication, with the options of either extension for another three years; conversion into an International Standard; or withdrawal.

INTRODUCTION

General principles of the protection against Lightning electromagnetic impulse (LEMP) are given in IEC 61312-1. However, the increasing use of complex electronic equipment in existing structures demands special care for protection against lightning and other electromagnetic disturbances. It should be borne in mind that in existing structures suitable counter-measures against lightning effects need to take into account the conditions of the structure, such as the construction elements, the existing power distribution and the existing information technology equipment (ITE).

The checklist in clause 2 helps to address specific points and to select the most economical measures for the hardening of equipment against LEMP. The checklist facilitates risk analysis and selection of the most suitable counter-measures.

For existing structures in particular, it is strongly recommended to set up a systematic layout governed by the zoning concept, set out in IEC 61312-1. This is respected when the measurements of figure 1 are applied.

PROTECTION AGAINST LIGHTNING ELECTROMAGNETIC IMPULSE –

Part 4: Protection of equipment in existing structures

1 General

1.1 Scope

This technical report gives guidelines for protection of information technology equipment (ITE) against LEMP effects in existing structures and includes methods suitable for new structures.

1.2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this technical report. At the time of publication, the editions indicated were valid. All normative documents are subject to revision, and parties to agreements based on this technical report are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

IEC 61024-1:1990, *Protection of structures against lightning – Part 1: General principles*

IEC, 61024-1-2:1998, *Protection of structures against lightning – Part 1-2: General principles – Guide B – Design, installation, maintenance and inspection of lightning protection systems*

IEC 61312-1:1995, *Protection against lightning electromagnetic impulse – Part 1: General principles*

IEC 61662/TR:1995, *Assessment of the risk of damage due to lightning*
Amendment 1 (1996)

IEC 60364-4-444:1996, *Electrical installations of buildings – Part 4: Protection for safety – Section 444: Protection against electromagnetic interference (EMI) in installations of buildings*

IEC 61000-4-5:1995, *Electromagnetic compatibility (EMC) – Part 4: Testing and measurement techniques – Section 5: Surge immunity test*

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

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

IEC 61000-5-2/TR:1997, *Electromagnetic compatibility (EMC) – Part 5: Installation and mitigation guidelines – Section 2: Earthing and cabling*

ITU-T Recommendation K.21:1996, *Resistibility of subscriber's terminal to overvoltages and overcurrents*

2 Checklist

The following checklist should be used in conjunction with IEC 61662 and its amendment 1 (especially elaborated for structures containing electronic systems), to determine whether protective measures for the electronic system are needed and, if so, to identify the most cost-effective protection measures for that equipment.

Additional information, not directly related to IEC 61662, but useful for the implementation of the protective measures for EMC or other reasons, is noted in table 4.

Table 1 – Structural characteristics and surroundings

Item	Questions	IEC 61662 Clause	IEC 61662 Amendment 1 Clause
2.1.1	Masonry, bricks, wood, reinforced concrete, steel frame structures?	2.3.3, table 6	C.3, table C.1
2.1.2	One single integrated structure or interconnected blocks with expansion joints?	2.2.3, table 6	C.3, table C.1
2.1.3	Flat and low or high-rise structures? (Dimensions of the structure)	2.2.1	C.2, see also limitation of scope of IEC 61024-1
2.1.4	Are reinforcing bars electrically connected throughout the structure?	–	C.3, table C.1
2.1.5	Metal facades electrically bonded or not?	–	C.3, table C.1
2.1.6	Window sizes?	–	C.3, table C.1
2.1.7	Structure equipped with an external LPS?	–	C.3, table C.1
2.1.8	Type and quality of this LPS?	–	C.3, table C.1
2.1.9	Nature of ground (rock, soil)?	2.2.2.1	C.2
2.1.10	Adjacent structures (height, distance) earth termination?	2.2.2.2	C.2

Table 2 – Installation characteristics

Item	Questions	IEC 61662 Clause	IEC 61662 Amendment 1 Clause
2.2.1	Incoming services (underground or overhead)?	2.2.2.2, tables 1 and 2	C.2
2.2.2	Aerials (antennas or other external devices)?	2.2.2.2	C.2
2.2.3	Type of electric power supply (high voltage, low voltage, overhead or underground)?	2.2.2.2, table 1	C.2, table C.3
2.2.4	Cable routing (numbers and locations of risers, ducts)?	–	C.3, table C.2
2.2.5	Use of metal cable trays?	–	C.3, table C.2
2.2.6	Are the electronics self-contained within the structure?	–	C.2, note
2.2.7	Metallic conductors to other structures?	2.2.2.2	C.2

Table 3 – Equipment characteristics

Item	Questions	IEC 61662 Clause	IEC 61662 Amendment 1 Clause	Other documents
2.3.1	Type of information technology equipment links (screened or unscreened multicore cables, coax cable, analog and/or digital, symmetrical and/or asymmetrical, fibre optic data lines)?	–	C.3, table C.2	–
2.3.2	Are the immunity levels against damage of the equipment specified?	1.2	–	ITU-T Recommendation K.21 IEC 61000-4-5 IEC 61000-4-9 IEC 61000-4-10

Table 4 – Other questions which need to be considered for the determination of a protection concept

Item	Questions	IEC 61662	Other documents
2.4.1	Frames of the windows electrically bonded or not?	–	–
2.4.2	Roof material metallic or not?	–	–
2.4.3	Configuration TN, TT or IT?	–	–
2.4.4	Location of the electronics?	–	IEC 61312-1, 1.3.8
2.4.5	Where are interconnections of functional earthing conductors of the electronics with the common bonding network (CBN)?	–	–

3 Protection measures influenced by the external LPS of the structure

Bearing in mind the risk analyses (IEC 61662) and depending on the result of the checklist, it can be decided whether an external LPS is required or not. In general, an external LPS is useful when it is designed according to IEC 61024-1-2 with special attention to clause 3. Concerning reinforced concrete structures, annex A of IEC 61024-1-2 should be considered.

The main task of the lightning protection expert is to find the trade-off between an upgraded external LPS and the remaining installation measures.

An upgrading of the external LPS. can be achieved by:

a) integrating existing metal facades and roofs into the LPS according to IEC 61024-1, 2.2.5 d);

b) using the reinforcing bars if the reinforcement is electrically interconnected from the topmost reinforced concrete roof down through the walls to the earth termination of the structure;

c) reducing the spacing of the downconductors, and reducing the mesh size of the air termination system (see IEC 61312-2, clause 3, and IEC 61662, amendment 1). Reasonable values are: distances between downconductors and mesh size 1 m to 5 m;

d) installation of bonding straps (flexible flat bonding conductors) across the expansion joints between adjacent but structurally separated blocks (see IEC 61024-1-2, figure A.12) The distance between the straps should be half the distance between the downconductors;

e) across expansion joints between a structure and a long corridor a cable route linking it to another block of the structure bonding should be provided. Typically, a bond should be provided at each corner of the corridor, and the bond straps should be as short as possible;

f) metallic roof fixtures which need protection against direct strikes (LPZ 0_B) should be provided e.g. with a local air termination which is bonded to the LPS (see IEC 61024-1-2, figure 48). Between such an air termination and the fixtures the safety distance *d* needs to be respected. (see IEC 61024-1, 3.2).

4 Protection measures influenced by the cable installation

Suitable cable routing and screening are effective measures to reduce overvoltages.

These measures become all the more important the smaller the shielding effect of an external LPS. Table B.1 of IEC 61024-1-2 shows this relationship. Examples of good cable routing and screening techniques are given in diagrams 3 and 4, respectively of that table.

Further details are shown in figures 26 and 27, as well as figures B.2, B.3 and B.4 of IEC 61024-1-2.

When special circumstances do not allow the installation of an external LPS (IEC 61024-1, 3.1.1), the techniques of fundamental principles shown in figure 1 provide very high protection against the effects of LEMP [1] [1].

Suitable separation between existing and new installations can be achieved by using double-insulated transformers or class II equipment which should be installed in order to avoid mainly 50/60 Hz interferences in TN-C installations of existing buildings (see explanations (1.2) and (1.3) in figure 1).

The installation concepts shown in figure 1 provide systematic layout recommendations for earthing, bonding and cable routing which comply with IEC 61312-1, 3.4. Figures 1a to 1d show each an example of possible zoning, depending of number, type and sensitivity of ITE:

- Figure 1a gives an example for the application of only LPZ 1 within the building. The measures (1.2) and (1.3) are still useful even within LPZ 1 in order to avoid low-frequency interference.
- Figure 1b shows a LPZ 2 area created to shelter all new installations. This requires upgraded SPDs at the boundary of LPZ 0 to LPZ 2.

Figures 1c and 1d show possible variations of LPZ 2 designed according to IEC 61312-1, figure 4. Each LPZ 2 represents the volume within the ITE is less exposed to the effects of lightning and low frequency interference currents and fields. Shielded cables or interconnected cable traces may link two different LPZ 2 in order to reduce the number of SPDs.

There are two types of interfaces between LPZ 1 and LPZ 2:

a) Interface to the right hand side:

Direct bonding of the functional earthing conductor shall be established where the additional screening between the floors provides a low impedance path for all kinds of interference currents and a very low interference coupling into signal and power cables. In this case, the screen itself becomes the boundary between LPZ 1 and LPZ 2.

1) Figures in square brackets refer to the bibliography.