

Electromagnetic compatibility —

Part 5-7: Installation and mitigation guidelines — Degrees of protection by enclosures against electromagnetic disturbances (EM code)

The European Standard EN 61000-5-7:2001 has the status of a
British Standard

ICS 23.100.20

National foreword

This British Standard is the official English language version of EN 61000-5-7:2001. It is identical with IEC 61000-5-7:2001.

The UK participation in its preparation was entrusted by Technical Committee GEL/210, EMC - Policy, to Subcommittee GEL/210/12, EMC Basic and Generic Standards, which has the responsibility to:

- aid enquirers to understand the text;
- present to the responsible European committee any enquiries on the interpretation, or proposals for change, and keep the UK interests informed;
- monitor related international and European developments and promulgate them in the UK.

A list of organizations represented on this Subcommittee can be obtained on request to its secretary.

From 1 January 1997, all IEC publications have the number 60000 added to the old number. For instance, IEC 27-1 has been renumbered as IEC 60027-1. For a period of time during the change over from one numbering system to the other, publications may contain identifiers from both systems.

Cross-references

The British Standards which implement international or European publications referred to in this document may be found in the BSI Standards Catalogue under the section entitled “International Standards Correspondence Index”, or by using the “Find” facility of the BSI Standards Electronic Catalogue.

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This British Standard, having been prepared under the direction of the Electrotechnical Sector Committee, was published under the authority of the Standards Committee and comes into effect on 15 August 2001

Summary of pages

This document comprises a front cover, an inside front cover, the EN title page, pages 2 to 27 and a back cover.

The BSI copyright date displayed in this document indicates when the document was last issued.

Amendments issued since publication

Amd. No.	Date	Comments

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ISBN 0 580 38031 9

**Electromagnetic compatibility (EMC)
Part 5-7: Installation and mitigation guidelines -
Degrees of protection by enclosures
against electromagnetic disturbances (EM code)
(IEC 61000-5-7:2001)**

Compatibilité électromagnétique (CEM)
Partie 5-7: Guide d'installation et
d'atténuation -
Degrés de protection procurés par les
enveloppes contre les perturbations
électromagnétiques (Code EM)
(CEI 61000-5-7:2001)

Elektromagnetische Verträglichkeit (EMV)
Teil 5-7: Installationsrichtlinien und
Abhilfemaßnahmen -
Schutzarten durch Gehäuse gegen
elektromagnetische Störgrößen
(EM-Code)
(IEC 61000-5-7:2001)

This European Standard was approved by CENELEC on 2001-01-01. 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, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and United Kingdom.

CENELEC

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

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Foreword

The text of document 77C/96/FDIS, future edition 1 of IEC 61000-5-7, prepared by SC 77C, High power transient phenomena, of IEC TC 77, Electromagnetic compatibility, was submitted to the IEC-CENELEC parallel vote and was approved by CENELEC as EN 61000-5-7 on 2001-01-01.

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) 2001-11-01
- latest date by which the national standards conflicting
with the EN have to be withdrawn (dow) 2004-01-01

Annexes designated "normative" are part of the body of the standard.
Annexes designated "informative" are given for information only.
In this standard, annex ZA is normative and annexes A to D are informative.
Annex ZA has been added by CENELEC.

Endorsement notice

The text of the International Standard IEC 61000-5-7:2001 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:

IEC 60297-1	NOTE: Harmonized as HD 493.1 S1:1988 (not modified).
IEC 60297-2	NOTE: Harmonized as HD 493.2 S1:1988 (not modified).
IEC 60297-3	NOTE: Harmonized as HD 493.3 S1:1988 (not modified).
IEC 60297-4	NOTE: Harmonized as EN 60297-4:1995 (not modified).
IEC 60917-1	NOTE: Harmonized as EN 60917-1:1998 (not modified).

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INTRODUCTION

IEC 61000 is published in separate parts according to the following structure:

Part 1: General

- General consideration (introduction, fundamental principles)
- Definitions, terminology

Part 2: Environment

- Description of the environment
- Classification of the environment
- Compatibility levels

Part 3: Limits

- Emission limits
- Immunity limits (in so far as they do not fall under responsibility of the product committees)

Part 4: Testing and measurement techniques

- Measurement techniques
- Testing techniques

Part 5: Installation and mitigation guidelines

- Installation guidelines
- Mitigation methods and devices

Part 6: Generic standards

Part 9: Miscellaneous

Each part is further subdivided into several parts, published either as International Standards, technical specifications or technical reports, some of which have already been published as sections. Others will be published with the part number followed by a dash and completed by a second number identifying the subdivision (example: 61000-6-1).

This part of IEC 61000 gives electromagnetic shielding performance markings, and test requirements and procedures related to the electromagnetic shielding performance of empty electrical and electronics equipment enclosures.

ELECTROMAGNETIC COMPATIBILITY (EMC) –

Part 5-7: Installation and mitigation guidelines – Degrees of protection provided by enclosures against electromagnetic disturbances (EM code)

1 Scope

This part of IEC 61000 describes performance requirements, test methods and classification procedures for degrees of protection provided by empty enclosures against electromagnetic disturbances for frequencies between 10 kHz and 40 GHz. The shielding performance is to be measured prior to the installation of internal electrical and/or electronic equipment and components. This shielding protection is measured for the purpose of demonstrating that the enclosure provides adequate shielding of electromagnetic energy to support acceptable performance of the complete assembled units when tested to applicable IEC standards. However, it should be noted that satisfactory performance of an empty enclosure does not necessarily ensure that the completed units will pass all EMC performance test standards for the operating equipment (see discussion in annex A).

The purpose of this standard is to provide a repeatable means for evaluating the electromagnetic shielding performance of empty mechanical enclosures, including cabinets and subracks, and to specify a marking code to allow a manufacturer to select an enclosure with a known capability for attenuating electromagnetic fields. The requirements for immunity to various types of electromagnetic disturbances, including lightning and high-altitude electromagnetic pulse (HEMP) will need to be considered by manufacturers when determining the need for application of this standard for specific equipment and applications, and for the specific enclosure shielding requirements which are necessary as a function of frequency.

The adoption of the classification system in this standard will, whenever possible, promote uniformity in methods of describing the protection against electromagnetic stresses provided by the enclosure. This includes protection of equipment inside the enclosure from external electromagnetic stresses, as well as protection of external equipment from internally generated electromagnetic stresses.

Technical Committees responsible for enclosures may decide on the extent and manner in which the classification defined in this standard is used in their standards and to define “enclosure” as it applies to their equipment. However, the tests and performance categories must not differ from those specified in this standard. An informative guide for the details to be specified in relevant enclosure product standards is given in annex B.

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this part of IEC 61000. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this part of IEC 61000 are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of ISO and IEC maintain registers of currently valid International Standards.

IEC 60050(161): *International Electrotechnical Vocabulary (IEV) – Chapter 161: Electro-magnetic compatibility*

IEC 60050(826): *International Electrotechnical Vocabulary (IEV) – Chapter 826: Electrical installations of buildings*

IEC 60068-1: *Environmental testing – Part 1: General and guidance*

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

IEC 61000-4-3: *Electromagnetic compatibility (EMC) – Part 4: Testing and measurement techniques – Section 3: Radiated, radio-frequency, electromagnetic field immunity test*

IEC 61000-4-23: *Electromagnetic compatibility (EMC) – Part 4-23: Testing and measurement techniques – Test methods for protective devices for HEMP and other radiated disturbances*

3 General

Other standards in the IEC series define requirements for construction and immunity testing of electrical and electronic equipment which shall withstand the stresses produced by electromagnetic disturbances, including fast electrical transients and electrostatic discharge (ESD). In addition, there are similar requirements for testing to verify immunity to high-altitude electromagnetic pulses (HEMP). There are also existing standards for these enclosures for other effects, primarily IEC 60529.

However, manufacturers of this electrical and electronic equipment need to either construct or procure enclosures for this equipment prior to the electromagnetic disturbance immunity testing noted in the previous paragraph. With experience the manufacturers will be able to determine the particular levels of electromagnetic shielding effectiveness which are sufficient to permit their finished product to pass the required EMC immunity and emissions tests.

Shielding Effectiveness (SE) is a broad term describing the ability of an EM shield to reduce or attenuate external (or internally produced) electromagnetic fields and external (or internal) surface currents before they reach the interior (exterior) of the shield. Typically, the shield encloses sensitive electronic equipment that must be protected from exterior electromagnetic disturbances. However, shields are also used to reduce electromagnetic fields produced by interior equipment from reaching the exterior of the shield. EM protection is provided by a complete topology, consisting not only of a metallic shell surrounding the shielded volume, but also including proper treatments of required electrical (power, communication, antenna, signal,

alarms, etc.) and mechanical penetrations (doors, vents, pipes, etc.). Testing of non-linear terminal protection devices for electrical penetrations is beyond the scope of this standard and is addressed in other IEC standards. Equipment manufacturers should coordinate the protection provided by electromagnetic shields and line penetration protection devices such as filters and non-linear elements to afford comparable levels of protection against both radiating electromagnetic fields and conducted transients.

Enclosure shielding effectiveness is defined as the ratio of received power with and without an intervening shield system inserted between a receiving and a transmitting antenna. The shielding effectiveness at a given point thus requires a calibration sweep (no barrier) and a measurement sweep (with barrier), and is obtained as the power ratio (difference in dB) between these two separate results. Assuming that sensor antenna voltage is detected, then,

$$SE = \frac{V_c}{V_m} \quad (1a)$$

$$SE \text{ (dB)} = 20 \log_{10} \frac{V_c}{V_m} = 10 \log_{10} \frac{P_c}{P_m} \quad (1b)$$

where

V_m is the measured signal with the barrier present;

V_c is the calibration signal at the same power, frequency, antenna polarisation and separation without the barrier;

P_c and P_m are the powers corresponding to V_c and V_m at the 50 Ω inputs of the network analyser.

In addition, for each shielding effectiveness result, a measurement range (MR) must be given which quantifies the noise floor for the measurements. The measurement range defines the maximum shielding effectiveness that can be accurately measured. For empty equipment enclosures, the measurement range is obtained in the same manner as the shielding effectiveness from the same calibration sweep and an additional noise sweep, which is a measurement with the external energy radiated by the shielding effectiveness diagnostic equipment but with the cable to the receive antenna terminated in 50 Ω (at the same location as the antenna), and all other conditions remaining constant. Barrier shielding effectiveness results are obtained by combining the data in a manner described in clause 7.

There is evidence that for many cases an enclosure will exhibit a higher shielding effectiveness after installation of components and modules than does the empty enclosure. In other cases an enclosure will exhibit a low shielding effectiveness after installing additional penetrations. Manufacturers should consider these potential impacts for each particular application.

4 Definitions

For the purpose of this part of IEC 61000, the following definitions apply:

4.1

decibel (dB)

one tenth of a bel, the number of decibels denoting the ratio of two amounts of power being 10 times the logarithm to the base 10 of this ratio. With P_1 and P_2 designating two amounts of power and n the number of decibels denoting their ratio,