

INTERNATIONAL STANDARD

NORME INTERNATIONALE



Assessment of electronic and electrical equipment related to human exposure restrictions for electromagnetic fields (0 Hz to 300 GHz)

Évaluation des équipements électroniques et électriques en relation avec les restrictions d'exposition humaine aux champs électromagnétiques (0 Hz à 300 GHz)





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INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

COMMISSION
ELECTROTECHNIQUE
INTERNATIONALE

ICS 97.030

ISBN 978-2-8322-6763-9

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

**ASSESSMENT OF ELECTRONIC AND ELECTRICAL EQUIPMENT
RELATED TO HUMAN EXPOSURE RESTRICTIONS
FOR ELECTROMAGNETIC FIELDS (0 Hz to 300 GHz)**

FOREWORD

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International Standard IEC 62311 has been prepared by IEC technical committee 106: Methods for the assessment of electric, magnetic and electromagnetic fields associated with human exposure.

This second edition cancels and replaces the first edition published in 2007. This edition constitutes a technical revision.

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

- a) a clear distinction between intentional and unintentional radiators has been introduced;
- b) the exposure to non-uniform fields is considered;
- c) the treatment of uncertainty for the assessment procedures has been improved;
- d) various summation regimes are described in Annex A;
- e) the information from meanwhile published basic standards has been used and hence all informative annexes of the previous edition have been removed.

The text of this International Standard is based on the following documents:

FDIS	Report on voting
106/480/FDIS	106/486/RVD

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

This document has been drafted in accordance with the ISO/IEC Directives, Part 2.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under "<http://webstore.iec.ch>" in the data related to the specific document. At this date, the document will be

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ASSESSMENT OF ELECTRONIC AND ELECTRICAL EQUIPMENT RELATED TO HUMAN EXPOSURE RESTRICTIONS FOR ELECTROMAGNETIC FIELDS (0 Hz to 300 GHz)

1 Scope

This document applies to electronic and electrical equipment for which no dedicated product standard or product family standard regarding human exposure to electromagnetic fields applies. It covers equipment with intentional or non-intentional radiators as well as a combination thereof.

This document provides assessment methods and criteria to evaluate equipment against limits on exposure of people related to electric, magnetic and electromagnetic fields. The frequency range covered is from 0 Hz to 300 GHz.

NOTE 1 Further guidance concerning the application of this document and its relationship to other EMF standards is given in Figure 1.

This document does not specify limits expressed by means of basic restrictions and/or reference levels. Such limits are subject to the applied assessment scheme, for example by means of regional limits.

NOTE 2 The assessment methods and criteria to evaluate equipment against basic restrictions or reference levels can be used with regard to either general public or occupational exposure.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 60050-161:1990, *International Electrotechnical Vocabulary – Chapter 161: Electromagnetic compatibility* (available at <http://www.electropedia.org>)

IEC 62232:2017, *Determination of RF field strength, power density and SAR in the vicinity of radiocommunication base stations for the purpose of evaluating human exposure*

3 Terms, definitions and abbreviated terms

3.1 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 60050-161 and the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at <http://www.electropedia.org/>
- ISO Online browsing platform: available at <http://www.iso.org/obp>

3.1.1 averaging time

t_{avg}

<for human exposure to electromagnetic fields> appropriate time interval over which exposure is averaged for purposes of determining compliance

3.1.2 basic restriction

restriction on exposure to time-varying electric, magnetic and electromagnetic fields that is based directly on established health effects

Note 1 to entry: Examples of basic restrictions can be found in Annex II of the Council Recommendation 1999/519/EC [1], ICNIRP Guidelines ([2], [3]), IEEE Std C95.6 [4] and IEEE Std C95.1 [5].

3.1.3 contact current

<for human body> current flowing into the body resulting from contact with a conductive object in an electromagnetic field

Note 1 to entry: This is the localized current flow into the body (usually the hand, for a light brushing contact).

3.1.4 current density

J

current per unit cross-sectional area flowing inside the human body as a result of exposure to electromagnetic fields

3.1.5 duty factor

<for human exposure to electromagnetic fields> ratio of pulse duration to the pulse period of a periodic pulse train

Note 1 to entry: A duty factor can also be considered as a measure of the temporal transmission characteristic of an intermittently transmitting RF source such as a paging antenna by dividing average transmission duration by the average period for transmissions.

Note 2 to entry: A duty factor of 1,0 corresponds to continuous operation.

3.1.6 effective radiated power

ERP

product of the power supplied by a radio transmitter to an antenna and the gain of this antenna relative to a half-wave dipole in a given direction

[SOURCE: IEC 60050-713:1998, 713-09-26]

3.1.7 electric field strength

E

vector field quantity E which exerts on any charged particle at rest a force F equal to the product of E and the electric charge Q of the particle

[SOURCE: IEC 60050-121:1998, 121-11-18]

3.1.8 exposure

situation that occurs wherever a person is subjected to electric, magnetic or electromagnetic fields

Note 1 to entry: The word “exposure” is also commonly used to mean “exposure level” (see 3.1.9).

[SOURCE: IEC 62226-1:2004, 3.1.7]

3.1.9

exposure level

value of the quantity used to assess exposure

Note 1 to entry: This may be an induced current density, *SAR*, power density, electric or magnetic field strength, a limb current or a contact current.

3.1.10

far-field region

region of the field of an antenna where the radial field distribution is essentially dependent inversely on the distance from the antenna

Note 1 to entry: In the far-field region the field has a predominantly plane-wave character, i.e. locally uniform distribution of electric field and magnetic field in planes transverse to the direction of propagation. The vectors of the electric field and the magnetic field are perpendicular to each other and the quotient between the value of the electric field strength *E* and the magnetic field strength *H* is constant and equals the impedance of free space Z_0 .

3.1.11

highest internal frequency

highest fundamental frequency generated or used within the EUT, or the highest frequency at which it operates

3.1.12

induced current

<in a body> current induced inside the body as a result of exposure to electromagnetic fields

3.1.13

inherently compliant

considered to comply with a set of requirements without the need of applying an assessment method (such as measurements or calculations)

Note 1 to entry: A set of requirements can for example be a set of exposure limits for the general public.

Note 2 to entry: Equipment that is inherently compliant with respect to a certain set of requirements (for example exposure limits for workers) is not necessarily inherently compliant with a different set of requirements (for example exposure limits for the general public).

3.1.14

intentional radiator

electrical or electronic equipment in which electric, magnetic or electromagnetic fields are intentionally generated for the purpose of radio communication, radiodetermination, treatment of material or transfer of electromagnetic energy

3.1.15

limb current

current flowing in an arm or a leg, either as a result of a contact current or else induced by an external field

3.1.16

magnetic field strength

H

vector quantity obtained at a given point by subtracting the magnetization *M* from the magnetic flux density *B* divided by the magnetic constant μ_0

[SOURCE: IEC 60050-121:1998, 121-11-56, modified – The notes have been deleted.]

3.1.17 magnetic flux density

B

vector field quantity *B* which exerts on any charged particle having velocity *v* a force *F* equal to the product of the vector product $v \times B$ and the electric charge *Q* of the particle

[SOURCE: IEC 60050-121:1998, 121-11-19, modified – The notes have been deleted.]

3.1.18 near-field region

region generally in proximity to an antenna or other radiating structure, in which the electric and magnetic fields do not have a substantially plane-wave character, but vary considerably from point to point

Note 1 to entry: The near-field region is further subdivided into the reactive near-field region, which is closest to the radiating structure and that contains most or nearly all of the stored energy, and the radiating near-field region where the radiation field predominates over the reactive field, but lacks substantial plane-wave character and is complex in structure.

3.1.19 partial-body exposure

localized exposure of part of the body, producing a corresponding localized *SAR*, power density or induced current density, as distinct from a whole-body exposure

3.1.20 plane-wave equivalent power density

<electromagnetic wave> power density equal in magnitude to the power density of a plane wave having the same electric (*E*) or magnetic (*H*) field strength as the measured field

3.1.21 power density

S

<of electromagnetic wave propagation> power per unit area normal to the direction of electromagnetic wave propagation

Note 1 to entry: For plane waves the power density (*S*), electric field strength (*E*) and magnetic field strength (*H*) are related by the space impedance (Z_0), in the case of plane wave or free space, i.e. 377Ω :

$$S = \frac{E^2}{Z_0} = Z_0 H^2 = EH$$

E and *H* are expressed in units of V/m and A/m, respectively, and *S* in the unit of W/m². The value of 377Ω is only valid for free space, far field measurement conditions.

Note 2 to entry: Although many survey instruments indicate power density units, the actual quantities measured are *E* or *H* or the square of those quantities.

3.1.22 reference level

level of field strength or power density derived from the basic restrictions using conservative assumptions about exposure

Note 1 to entry: If the reference levels are met, then the basic restrictions will be complied with, but if the reference levels are exceeded, that does not necessarily mean that the basic restrictions will not be met.

3.1.23
root-mean-square value
RMS

<of a periodic electromagnetic wave> effective value or the value associated with joule heating, of a periodic electromagnetic wave, obtained by taking the square root of the mean of the squared value of a function

Note 1 to entry: Although many survey instruments in the high frequency range indicate RMS, the actual quantity measured is root-sum-square (RSS) (equivalent field strength).

3.1.24
root-sum-square value
RSS

value obtained from three individual RMS field strength values, measured in three orthogonal directions, combined disregarding the phases

$$X = \sqrt{X_x^2 + X_y^2 + X_z^2}$$

Note 1 to entry: This note applies to the French language only.

3.1.25
transient

pertaining to or designating a phenomenon or a quantity which varies between two consecutive steady states during a time interval short compared with the timescale of interest

[SOURCE: IEC 60050-161:1990, 161-02-01]

3.1.26
whole-body exposure

exposure of the whole body (or the torso when induced current density is considered)

3.2 Abbreviated terms

CISPR	Comité international spécial des perturbations radioélectriques
EIRP	equivalent isotropic radiated power
EMF	electromagnetic fields
EUT	equipment under test
ICNIRP	International Commission on Non-Ionizing Radiation Protection
IEEE	Institute of Electrical and Electronics Engineers
SAR	specific absorption rate

4 Compliance criteria

In general, the basic restrictions shall be used as exposure limits for the assessment of compliance. However, in most cases reference levels are used as limits. Such reference levels for exposure to electric, magnetic and electromagnetic fields are derived from the basic restrictions using realistic worst-case assumptions about exposure. If the reference levels are met, then the basic restrictions will also be met; if the reference levels are exceeded, that does not necessarily mean that the basic restrictions are exceeded. In some situations, it may be possible to show compliance with the basic restrictions directly. It may also be possible to derive compliance criteria that allow a simple measurement or calculation to demonstrate compliance with the basic restrictions. Often these compliance criteria can be derived using realistic assumptions about conditions under which exposures from a device may occur, rather than the conservative assumptions that are the basis for the reference levels.