SLOVENSKI STANDARD

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Splošni standard za prikaz skladnosti elektronskih in električnih naprav z osnovnimi mejnimi vrednostmi glede izpostavljenosti človeka elektromagnetnim sevanjem (0 Hz – 300 GHz)

Generic standard to demonstrate the compliance of electronic and electrical apparatus with the basic restrictions related to human exposure to electromagnetic fields (0 Hz - 300 GHz)

ICS 13.280

Referenčna številka
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English version

Generic standard to demonstrate the compliance of electronic and electrical apparatus with the basic restrictions related to human exposure to electromagnetic fields (0 Hz - 300 GHz)

Norme de base pour démontrer la conformité des appareils électriques et électroniques, aux restrictions de base pour l'exposition du corps humain aux champs électromagnétiques (0 Hz - 300 GHz)

Fachgrundnorm zur Demonstration der Konformität elektronischer und elektrischer Geräte mit den Basisgrenzwerten für die Exposition von Personen gegenüber elektromagnetischen Feldern (0 Hz - 300 GHz)

This European Standard was approved by CENELEC on 2003-09-23. 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, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Slovakia, Slovenia, 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

This European Standard was prepared by the Technical Committee CENELEC TC 106X, Electromagnetic fields in the human environment.

The text of the draft was submitted to the Unique Acceptance Procedure and was approved by CENELEC as EN 50392 on 2003-09-23.

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) 2004-10-01
- latest date by which the national standards conflicting with the EN have to be withdrawn (dow) 2006-10-01

Contents

1 Scope

The scope of this standard is limited to apparatus which is intended for use by the general public as defined in the Council Recommendation 1999/519/EC of 12 July 1999 on the limitation of exposure of the general public to electromagnetic fields (0 Hz to 300 GHz) (Official Journal L 199 of 30 July 1999).

This generic standard applies to electronic and electrical apparatus for which no dedicated product- or product family standard regarding human exposure to electromagnetic fields applies.

This generic standard does not cover equipment, which fulfils the requirements given in EN 50371 or is medical equipment as defined in the Council Directive 93/42/EEC of 14 June 1993 concerning medical devices.

The frequency range covered is 0 Hz to 300 GHz.

The object of this standard is to demonstrate the compliance of such apparatus with the basic restrictions or reference levels on exposure of the general public related to electric, magnetic, electromagnetic fields and induced and contact current.

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.

EN 50357	Evaluation of human exposure to electromagnetic fields from devices used in Electronic Article Surveillance (EAS), Radio Frequency Identification (RFID) and similar applications
EN 50366	Household and similar electrical appliances – Electromagnetic fields – Methods for evaluation and measurement
EN 50371	Generic standard to demonstrate the compliance of low power electronic and electrical apparatus with the basic restrictions related to human exposure to electromagnetic fields (10 MHz - 300 GHz) - General public
EN 50383	Basic standard for the calculation and measurement of electromagnetic field strength and SAR related to human exposure from radio base stations and fixed terminal stations for wireless telecommunication systems (110 MHz - 40 GHz)
EN ISO/IEC 17025:2000	General requirements for the competence of testing and calibration laboratories (ISO/IEC 17025:1999)

Council Recommendation 1999/519/EC of 12 July 1999 on the limitation of exposure of the general public to electromagnetic fields (0 Hz to 300 GHz) (Official Journal L 199 of 30 July 1999)

International Commission on Non-Ionizing Radiation Protection (1998), Guidelines for limiting exposure in time-varying electric, magnetic, and electromagnetic fields (up to 300 GHz). Health Physics 74, 494-522

3 Terms and definitions

For the purposes of this European Standard the following terms and definitions apply.

3.1
root-mean-square (rms)
effective value or the value associated with joule heating, of a periodic electromagnetic wave. The rms value is obtained by taking the square root of the mean of the squared value of a function

NOTE Although many survey instruments indicate rms, the actual quantity measured is root-sum-square (rss) (equivalent field strength). The value rss is obtained from three individual rms field strength values, measured in three orthogonal directions combined disregarding the phases. The measured rss value is the maximum possible (worse case) and can be quite different from the true root-mean-square (rms) value.

3.2
root-sum-square (rss)
effective value or the value associated with joule heating, of a periodic electromagnetic wave. The rss value is obtained by taking the square root of the sum of the squared value of a function

$$X = \sqrt{\sum_{1}^{n} (X_n)^2}$$

3.3
electric field strength (E)
magnitude of a field vector at a point that represents the force (F) on an infinitely small charge (q) divided by the charge

$$E = \frac{F}{q}$$

3.4
magnetic flux density (B)
magnitude of a field vector that is equal to the magnetic field H multiplied by the permeability (μ) of the medium

$$B = \mu H$$

3.5
magnetic field strength (H)
magnitude of a field vector in a point that results in a force (F) on a charge (q) moving with velocity (v)

$$F = q(v \times \mu H)$$

[or magnetic flux density divided by permeability of the medium, see “magnetic flux density”]

3.6
averaging time (t_{avg})
appropriate time over which exposure is averaged for purposes of determining compliance

3.7
basic restriction
basic restriction is the ceiling level that should not be exceeded under any conditions

3.8
contact current
current flowing into the body resulting from contact with a conductive object in an electromagnetic field. This is the localised current flow into the body (usually the hand, for a light brushing contact)

3.9
current density (J)
current per unit cross-sectional area flowing area inside the human body as a result of direct exposure to electromagnetic fields

3.10
duty factor (or duty cycle)
ratio of pulse duration to the pulse period of a periodic pulse train. Also, maybe 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. A duty factor of 1.0 corresponds to continuous operation

3.11
exposure
exposure occurs whenever and wherever a person is subjected to electric, magnetic or electromagnetic fields or to contact current other than those originating from physiological processes in the body and other natural phenomena

3.12
exposure level
value of the quantity used to assess exposure. This may be an induced current density, SAR, power density, electric or magnetic field strength, a limb current or a contact current

3.13
exposure, direct effect of
result of a direct interaction in the exposed human body from exposure to electromagnetic fields

3.14
exposure, indirect effect of
result of a secondary interaction between the exposed human body and an electromagnetic field, often used to describe a contact current, shock or burn arising from contact with a conductive object

3.15
exposure, partial-body
localised exposure of part of the body, producing a corresponding localised SAR or induced current density, as distinct from a whole-body exposure

3.16
exposure, whole-body
exposure of the whole body (or the torso when induced current density is considered

3.17
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

3.18
induced current
current induced inside the body as a result of direct exposure to electromagnetic fields

3.19
multiple frequency fields
superposition of two or more electromagnetic fields of differing frequency. These may be from different sources within a device e.g. the magnetron and the transformer of a microwave oven, or they may be harmonics in the field of a nominally single frequency source such as a transformer

3.20
power density (S)
power per unit area normal to the direction of electromagnetic wave propagation. For plane waves the power density (S), electric field strength (E) and magnetic field strength (H) are related by the impedance of free space, i.e. 377 Ω.[1)]

$$S = \frac{E^2}{377} = 377\,H^2 = EH$$

In particular where E and H are expressed in units of W/m² and A/m, respectively, and S in the unit of W/m².

It should be noted that the value of 377 Ω is only valid for free space, far field measurement conditions

3.21
power density, average (temporal)
instantaneous power density integrated over a source repetition period. This averaging is not to be confused with the measurement averaging time

3.22
power density, plane-wave equivalent
commonly used term associated with any electromagnetic wave, 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

3.23
reference levels

reference levels are levels of field strength that can be compared with measured exposure field strengths. The reference levels are derived from the basic restrictions using worst-case assumptions about exposure. 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

3.24
specific absorption rate (SAR)
power absorbed by (dissipated in) an incremental mass contained in a volume element of biological tissue when exposure to an electromagnetic field occurs. SAR is expressed in the unit watt per kilogram (W/kg). SAR is used as a measure of whole-body exposure as well as localised exposure

3.25
specific absorption (SA)
energy absorbed per unit mass of biological tissue, (SA) expressed in joule per kilogram (J/kg); specific energy absorption is the time integral of specific energy absorption rate

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1) Although many survey instruments indicate power density units, the actual quantities measured are E or H or the square of those quantities.

3.26
apparatus
see definitions in the relevant EEC Directives

3.27
EUT
equipment under test (EUT)

3.28
exposure limits
exposure limits are the basic restrictions as specified in Annex II of Council Recommendation 1999/519/EC

4 Compliance criteria

The electronic and electrotechnical apparatus shall comply with the basic restriction as specified in Annex II of Council Recommendation 1999/519/EC.

NOTE 1 The time averaging in the EU-Recommendation applies.

The reference levels in the Council Recommendation 1999/519/EC on public exposure to electromagnetic fields are derived from the basic restrictions using worst-case assumptions about exposure. 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. In some situations, it will be necessary to show compliance with the basic restrictions directly, but it may also be possible to derive compliance criteria that allow a simple measurement or calculation to demonstrate compliance with the basic restriction. 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 underlie the reference levels.

NOTE 2 The limit is the basic restriction.

If the technology in the apparatus is not capable of producing an E-field, H-field or contact current, at the normal user position, at levels higher than 1/2 the limit values then the apparatus is deemed to comply with the requirements in this standard in respect of that E-field, H-field or contact current without further assessment.

5 Assessment methods

One or more of the examples of assessment methods in 7.2 may be used.

The assessments should be made according to an existing basic standard. If the assessment method in the basic standard is not fully applicable then deviations are allowed as long as

- a description of the used assessment method is given in the assessment report,
- an evaluation of the total uncertainty is given in the assessment report.

NOTE The information in the annexes is for information and will be replaced by reference to basic standards as soon as they are available.

For transmitters intended for use with external antennas at least one typical combination of transmitter and antenna shall be assessed. The technical specification of this antenna shall be documented in such details that the boundary where the basic restrictions are met can be identified e.g. by documented radiation patterns.

6 Evaluation of compliance to limits

The equipment is deemed to fulfil the requirements of this standard if the measured values are less than or equal to the limit and the assessment uncertainty is less than the measurement uncertainty specified for the applied assessment method(s).

If the assessment uncertainty * is larger than the specified uncertainty value (%) the difference shall be added to the assessment result before comparison with the limit.

NOTE Equation 1 is valid if the measurement uncertainty of the applicable assessment method is 30 % or more.

* The formula for this condition is given below:

$$L_m \leq \left(\frac{1}{0,7 + \frac{U(L_m)}{L_m}} \right) L_{lim} \qquad (1)$$

where

L_m is the measured value;

L_{lim} is the exposure limit;

$U(L_m)$ is the expanded uncertainty.

EXAMPLE

Suppose the relative uncertainty of a certain EMF test is 55 %. Then

$$\frac{U(L_m)}{L_m} = 0,55 .$$

Using equation (1), the condition for the measured value is then:

$$L_m \leq \left(\frac{1}{0,7 + \frac{U(L_m)}{L_m}} \right) L_{lim} = \left(\frac{1}{0,7 + 0,55} \right) L_{lim} = \frac{1}{1,25} L_{lim} = 0,8\, L_{lim}$$

The uncertainty penalty is then:

$$U_{pen} \leq 0,2\, L_{lim}$$

The uncertainty values specified under each assessment method is the maximum allowed uncertainty. If the uncertainty value is not specified then a default value of 30 % shall be used.

7 Applicability of compliance assessment methods

An analysis can be made to investigate what parts emit EMF. A description of the several parts of an apparatus is recommended in order to determine what parts emit EMF. What kind of emission is to be expected under normal conditions.

7.1 Characteristics and parameters of apparatus to be considered

	Further detailed description of the information needed
Frequency	Frequency of emissions
Waveform	Waveform and other information such as duty factor for establishment of peak- and/or average emission
Multiple frequency sources	Does the device produce fields at more than one frequency or fields with a high harmonic content? Are the emissions simultaneous?
Emission of electric fields	Voltage differences and any coupling parts e.g. metallic surfaces charged at a voltage potential
Emission of magnetic fields	Current flow and any coupling parts e.g. coils, transducers or loops
Emission of electromagnetic fields	Generation or transmission of high frequency signals and any radiating parts e.g. antennas, loops, transducers and external cables
Contact currents	Possibility of touching conducting surfaces when either the surface or the person is exposed to electromagnetic fields?
Whole body exposure	Fields produced by device extend over region occupied by the whole body
Partial body exposure	Fields produced by device extend over only part of region occupied by a part of the body, or over region occupied by limbs
Duration/time variation	Duty cycle of emissions, on/off time of power used or emitted by device. Variation of power use or emissions during production process
Homogeneity	Extent to which the strength of the fields varies over the body or region of the body that is exposed. * Shall be measured without the presence of a body
Far – near field	Are exposures in inductive or reactive near field? Propagating near field? Far field?
Pulsed/transient fields	Are the emissions pulse-modulated or true pulses? Are there occasional or periodic transients in the field?
Physical size	Is the device so small that any significant exposure will be to part of the body? In relation to the wavelength (operating frequency) Is it so big that different parts will contribute to exposures “independently”?
Power	What is the emitted power? What is the power consumption? If there is an antenna system, what is the EIRP?
Distance (source ⇒ user)	What is the spatial relationship between the device and the operator or user when it is used normally? The distance used for the assessment shall be specified by the manufacturer and be consistent with the intended usage of the apparatus

Intended usage	How is the device commonly used? Conditions of intended usage producing the highest emission or absorption Operating conditions? How does the intended usage affect the spatial relationship between the device and the user? Can the usage affect the emission characteristics of the device? Can the apparatus be part of a system?
Interaction sources/user	Do the emitted fields change if the device is close to the body? Does the device couple to the body during use?

7.2 List of possible assessment methods

	Applicability area and limitations	**Reference**
Far field calculation	Electromagnetic fields far from source. Very small microwave devices not used close to body, or large lower-frequency transmitters at greater distances. That region of the field of an antenna where the angular field distribution is essentially independent of the distance from the antenna. In this region (also called the free space region), the field has a predominantly plane-wave character, i.e. locally uniform distribution of electric field strength and magnetic field strength in planes transverse to the direction of propagation.	See Annex A
Near field calculation	Electromagnetic fields very close to the source. There can be an interaction between the radiated fields from the source and the user	See Annex A
Simulation with/without a phantom	Evaluation of measurement results inside the phantom representing a body.	See Annex B
Numerical modelling	Calculation only.	See Annex C
Measurement of body current	Measurement only.	See Annex D
SAR	Calculation and measurements; 100 kHz – 10 GHz.	See Annex E
E&H measurement	Near or far field. Direct measurement for comparison with reference levels or as input for more detailed assessment.	See Annex F
Source modelling	Prediction of exposures from calculation of emissions at a specific distance.	See Annex G
Direct measurement of physical properties: Contact current Input power Body current		See Annex D, E or F

NOTE The physical characteristics and intended use of the apparatus may have an impact on the choice of assessment method. E.g. radiators of EMF intended for use in close proximity to the body shall be assessed differently from transmitters intended for fixed installation in buildings.

7.3 Decision tree (Assessment applicability table versus equipment characteristics)

7.3.1 Generic procedure for assessment of apparatus

1) The apparatus should be characterised to determine the nature of EMF emissions (see 7.2) and also the intended usage conditions.

2) If the device fulfils the requirements of EN 50371 (low power, above 10 MHz) it should not be tested against this standard. If it is inherently incapable of producing any exposure greater then 1/2 the limit values then it is deemed to meet the requirements in this standard in respect of that exposure quantity (Clause 3). If an exposure assessment is necessary then:

3) Fields and body currents should be determined at the typical user position under normal operating conditions by measurement or calculation (see 7.2). If these quantities are below the relevant reference levels, taking into account waveform/frequency content (Clause 7), and any allowed time and spatial averaging then the apparatus is deemed to meet the requirements in this standard. If not, then:

4) Measured exposure levels should be compared with any product-specific compliance criteria that can be derived for the apparatus (Clause 3). If the exposure levels are below the product-specific compliance criteria then the apparatus is deemed to meet the requirements in this standard. If no product-specific compliance criteria have been specified for an E-field, H-field or contact current which is to be assessed, or if compliance criteria have been specified but not met, then:

NOTE The technology of some products may allow assumptions about human exposure from the device to be made e.g. always magnetic field, always partial body etc. From these assumptions it may be possible to derive compliance criteria for that product or product type, e.g. "if the magnetic field strength is below." or "if the power is below.

5) Further assessment involving more detailed measurement, calculation and source/exposure modelling should be undertaken (see 7.2) to allow comparison of exposure levels with all relevant basic restrictions on exposure. If the exposures are below the basic restrictions then the apparatus is deemed to meet the requirements in this standard. If not, then the apparatus is deemed not to comply with the requirements in this standard.

This process is summarised in the flowchart below.

The choice of assessment method in stages 3) and 5) above is optional, but it must be suitable for the exposure quantity to be assessed and for the frequency of emission. Where more than one equally valid assessment method exists for a particular exposure quantity, then it is acceptable to use only one assessment method for that particular quantity. Where only one assessment method is chosen this should be clearly stated and the reasons given for the choice.

Examples of alternative compliance criteria related to e.g. output power and magnetic field characteristics can be found in EN 50357 and EN 50371.