SLOVENSKI STANDARD
SIST EN 50420:2006

01-december-2006

Osnovni standard za ocenjevanje izpostavljenosti ljudi elektromagnetnim sevanjem samostojnih oddajnikov (30 MHz–40 GHz)

Basic standard for the evaluation of human exposure to electromagnetic fields from a stand alone broadcast transmitter (30 MHz - 40 GHz)

Grundnorm für die Berechnung und Messung der Exposition von Personen gegenüber elektromagnetischen Feldern von einzelnen Rundfunksendern (30 MHz bis 40 GHz)

Norme pour le calcul et la mesure de l'exposition des personnes aux champs électromagnétiques provenant des émetteurs de radiodiffusion isolés (30 MHz - 40 GHz)

Ta slovenski standard je istoveten z: **EN 50420:2006**

ICS:

13.280	Varstvo pred sevanjem	Radiation protection
17.240	Merjenje sevanja	Radiation measurements

SIST EN 50420:2006 **en**

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN 50420

June 2006

ICS 13.280

English version

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CENELEC

European Committee for Electrotechnical Standardization

Comité Européen de Normalisation Electrotechnique

Europäisches Komitee für Elektrotechnische Normung

Central Secretariat: rue de Stassart 35, B - 1050 Brussels

Ref. No. EN 50420:2006 E

Foreword

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

The text of the draft was submitted to the formal vote and was approved by CENELEC as EN 50420 on 2005-12-06.

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)	2007-01-01
– latest date by which the national standards conflicting with the EN have to be withdrawn	(dow)	2009-01-01

Contents

1 Scope

This standard applies to a broadcast transmitter operating in the frequency range 30 MHz to 40 GHz when put on the market.

The objective of the standard is to specify, for such equipment operating in typical conditions, the method for assessment of compliance distances according to the basic restrictions (directly or indirectly via compliance with reference levels) related to human exposure to radio frequency electromagnetic fields.

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.

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)

EN 50413[1)], *Basic standard on measurement and calculation procedures for human exposure to electric, magnetic and electromagnetic fields (0 Hz - 300 GHz)*

EN 50421, *Product standard to demonstrate the compliance of stand alone broadcast transmitters with the reference levels or the basic restrictions related to public human exposure to radio frequency electromagnetic fields (30 MHz - 40 GHz)*

EN 55016-4-2, *Specification for radio disturbance and immunity measuring apparatus and methods – Part 4-2: Uncertainties, statistics and limit modelling – Uncertainty in EMC measurements* (CISPR 16-4-2)

EN ISO/IEC 17025:2000, *General requirements for the competence of testing and calibration laboratories* (ISO/IEC 17025:1999)

European Commission Enterprise Directorate General Standardisation Mandate addressed to CEN, CENELEC, and ETSI in the field of electro-technology, information technology and telecommunications M/305 Brussels

IEEE Std C95.1:1999, *IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz*

International Commission on Non-Ionizing Radiation Protection, Guidelines for Limiting Exposure to Time-Varying Electric, Magnetic, and Electromagnetic Fields (up to 300 GHz), Health Physics Vol. 74, No 4, pp 494-522, 1998

ISO *Guide to the expression of uncertainty in measurement,* 1995

[1)] At draft stage.

3 Physical quantities, units and constants

3.1 Quantities

The internationally accepted SI-units are used throughout the standard.

Quantity	Symbol	Unit	Dimensions
Current density	*J*	ampere per square metre	A/m²
Electric field strength	*E*	volt per metre	V/m
Electric flux density	*D*	coulomb per square metre	C/m²
Electric conductivity	σ	siemens per metre	S/m
Frequency	*f*	hertz	Hz
Magnetic field strength	*H*	ampere per metre	A/m
Magnetic flux density	*B*	tesla (Vs/m²)	T
Mass density	ρ	kilo per cubic metre	kg/m³
Permeability	μ	henry per metre	H/m
Permittivity	ε	farad per metre	F/m
Specific absorption rate	*SAR*	watt per kilogram	W/kg
Wavelength	λ	metre	m
Temperature	*T*	kelvin	K

3.2 Constants

Physical constant		Magnitude
Speed of light in a vacuum	c	$2{,}997 \times 10^{8}$ m/s
Permittivity of free space	ε_0	$8{,}854 \times 10^{-12}$ F/m
Permeability of free space	μ_0	$4\pi \times 10^{-7}$ H/m
Impedance of free space	η_0	120π (approx. 377) Ω

4 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

4.1
antenna
device that serves as a transducer between a guided wave (e.g. coaxial cable) and a free space wave, or vice versa

4.2
basic restriction
restrictions on exposure to time-varying electric, magnetic, and electromagnetic fields that are based directly on established health effects. In the frequency range from 30 MHz to 10 GHz, the physical quantity used is the specific absorption rate. Between 10 GHz and 40 GHz, the physical quantity is the power density

4.3
broadcasting service
radiocommunication service in which the transmissions are intended for direct reception by the general public. This service may include sound transmissions, television transmissions or other types of transmission

4.4
compliance distance
minimum distance from the antenna where a point of investigation is deemed to be compliant. The set of compliance distances therefore defines the boundary outside which the exposure levels do not exceed the basic restrictions irrespective of the time of exposure. The distances are measured related to the nearest point of the antenna in each investigation direction

4.5
conductivity (σ)
ratio of the conduction-current density in a medium to the electric field strength. Conductivity is expressed in units of siemens per metre (S/m)

4.6
contact current
current produced in the body involved by human contact with metallic objects in the field. Shocks and burns can be the adverse indirect effects . Contact current relates to an instantaneous effect and so can't be time-averaged

4.7
electric field strength (*E*)
magnitude of a field vector at a point that represents the force (*F*) on a positive small charge (*q*) divided by the charge

$$E = \frac{F}{q} \quad (1)$$

Electric field strength is expressed in units of volt per metre (V/m)

4.8
electric flux density (*D*)
magnitude of a field vector that is equal to the electric field strength (E) multiplied by the permittivity (ε)

$$\boldsymbol{D} = \varepsilon \boldsymbol{E} \quad (2)$$

Electric flux density is expressed in units of coulomb per square metre (C/m²)

4.9
equipment under test (EUT)
device (such as transmitter, base station or antenna as appropriate) that is the subject of the specific test investigation being described

4.10
induced current
currents circulating inside a human body resulting directly from an exposure to an electromagnetic field

4.11
intrinsic impedance (of free space η_0**)** η
ratio of the electric field strength to the magnetic field strength of a propagating electromagnetic wave. The intrinsic impedance of a plane wave in free space is 120 π (approximately 377) Ω

4.12
isotropy
e.g., of a hypothetical receiving or transmitting antenna is, having equal intensities in all directions. Deviations of isotropy have to be considered at all measured values of EMF with regard to various angles of incidence and polarization of the measured field In this document it is defined for incidences covering a hemisphere centred at the tip of the probe, with an equatorial plane normal to the probe and expanding outside the probe. The axial isotropy is defined by the maximum deviation of the measured quantity when rotating the probe along its main axis with the probe exposed to a reference wave with normal incidence with regard to the axis of the probe. The hemispherical isotropy is defined by the maximum deviation of the measured quantity when rotating the probe along its main axis with the probe exposed to a reference wave with varying angles of incidences and polarisation with regard to the axis of the probe in the half space in front of the probe

4.13
linearity
e.g. of an antenna or any other technical device is showed, when all relationships between a reference quantity and the deviations of this quantity lie along a straight line. The maximum deviation over the measurement range of the measured quantity value from the closest linear reference curve defined over a given interval has to be taken into account in measurement procedures

4.14
magnetic field strength (*H*)
magnitude of a field vector in a point that results in a force (F) on a charge q moving with the velocity v

$$F = q\,(v \times \mu H) \tag{3}$$

The magnetic field strength is expressed in units of ampere per metre (A/m)

4.15
magnetic flux density (*B*)
magnitude of a field vector that is equal to the magnetic field strength *H* multiplied by the permeability (μ) of the medium

$$B = \mu\ H \tag{4}$$

Magnetic flux density is expressed in units of tesla (T)

4.16
modulation
process, or the result of the process, where some characteristic of the wave (amplitude, frequency or phase) is varied in accordance with another wave or signal. It must also be taken into consideration when carrying out measurements and calculations to determine whether or not the limits are being exceeded

4.17
permeability (μ)
magnetic permeability of a material defined by the magnetic flux density *B* divided by the magnetic field strength *H*:

$$\mu = \frac{B}{H}, \tag{5}$$

where

μ is the permeability of the medium expressed in henry per metre (H/m)

4.18
permittivity (ε)
property of a dielectric material (e.g., biological tissue) defined by the electrical flux density *D* divided by the electrical field strength *E*

$$\varepsilon = \frac{D}{E} \tag{6}$$

The permittivity is expressed in units of farad per metre (F/m)

4.19
point of investigation (PI)
location in space at which the value of *E*-field, *H*-field, Power flux density or *SAR* is evaluated. This location is defined in cartesian, cylindrical or spherical co-ordinates relative to the reference point on the EUT

4.20
power density (*S*)
radiant power incident perpendicular to a surface, divided by the area of the surface. The power density is expressed in units of watt per square metre (W/m²)

4.21
reference levels
reference levels of exposure are provided for comparison with measured values of physical quantities; compliance with all reference levels given in these guidelines will ensure compliance with basic restrictions. If measured values are higher than reference levels, it does not necessarily follow that the basic restrictions have been exceeded, but a more detailed analysis is necessary to assess compliance with the basic restrictions.

In the frequency range 30 MHz to 40 GHz the reference levels are expressed as electric field strength, magnetic field strength, power density values and contact currents

4.22
relative permittivity (ε_r)
ratio of the permittivity of a dielectric material to the permittivity of free space i.e.:

$$\varepsilon_r = \frac{\varepsilon}{\varepsilon_0} \tag{7}$$

4.23
root-mean-square (r.m.s.)
the r.m.s. value is obtained by taking the square root of the average of the square of the value of the periodic function taken throughout one period

4.24
specific absorption rate (*SAR*)
time derivative of the incremental energy *(*d*W)* absorbed by (dissipated in) an incremental mass *(*d*m)* contained in a volume element *(*d*V)* of given mass density (ρ)

$$SAR = \frac{d}{dt}\left(\frac{dW}{dm}\right) = \frac{d}{dt}\left(\frac{dW}{\rho dV}\right) \tag{8}$$

SAR is expressed in units of watt per kilogram (W/kg)

NOTE *SAR* can be calculated by:

$$SAR = \frac{\sigma E_i^{\,2}}{\rho} \qquad (9)$$

$$SAR = c_i \frac{dT}{dt}\bigg|_{(t=0)} \qquad (10)$$

where

E_i is the r.m.s. value of the electric field strength in the tissue in V/m;

σ is the conductivity of body tissue in S/m;

ρ is the density of body tissue in kg/m³;

c_i is the heat capacity of body tissue in J/kg K;

$\frac{dT}{dt}$ is the time derivative of temperature in body tissue in K/s.

4.25
transmitter
device to generate radio frequency power for the purpose of communication but on its own is not intended to radiate it

5 Applicability of compliance assessment methods

5.1 Introduction

Guidelines and recommended limits on human exposure to radio waves give basic restrictions in terms of *SAR* (below 10 GHz) or power flux density (above 10 GHz) and also reference levels in terms of contact current (between 30 MHz and 110 MHz) and field strengths or power density.

The compliance boundary defines the volume outside which the exposure levels do not exceed the basic restrictions irrespective of the time of exposure for the specific operating conditions of the broadcast transmitter. The compliance boundary is determined via a procedure where sufficient points of investigation are assessed.

It is technically possible to determine the compliance distance through measurements or calculations of *SAR* or electromagnetic fields relating to basic restrictions or reference levels, since compliance to the reference levels guarantees compliance to the basic restrictions.

Where the assessment is made through *SAR*, it should be noted that both localised and whole-body basic restrictions must be considered. Spatial averaging may be used with field strength assessments in order to assess whole-body *SAR*.

5.2 Assessment procedure

5.2.1 Methods

This standard describes measurement and calculation methods that may be used to establish the compliance distances.