SLOVENSKI STANDARD

SIST EN 50400:2006

december 2006

Osnovni standard za prikaz skladnosti stacionarne opreme za radijski prenos (110 MHz–40 GHz), namenjene za uporabo v brezžičnih telekomunikacijskih omrežjih z osnovnimi ali izvedenimi mejnimi vrednostmi v povezavi z izpostavljenostjo prebivalstva elektromagnetnim sevanjem

Basic standard to demonstrate the compliance of fixed equipment for radio transmission (110 MHz - 40 GHz) intended for use in wireless telecommunication networks with the basic restrictions or the reference levels related to general public exposure to radio frequency electromagnetic fields, when put into service

ICS 17.220.20; 33.070.01

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EUROPEAN STANDARD

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English version

Basic standard to demonstrate the compliance of fixed equipment for radio transmission (110 MHz - 40 GHz) intended for use in wireless telecommunication networks with the basic restrictions or the reference levels related to general public exposure to radio frequency electromagnetic fields, when put into service

Norme de base pour démontrer la conformité des équipements fixes de transmission radio (110 MHz - 40 GHz), destinés à une utilisation dans les réseaux de communication sans fil, aux restrictions de base ou aux niveaux de référence relatives à l'exposition des personnes aux champs électromagnétiques de fréquence radio, lors de leur mise en service

Grundnorm zum Nachweis der Übereinstimmung von stationären Einrichtungen für Funkübertragungen (110 MHz bis 40 GHz), die zur Verwendung in schnurlosen Telekommunikationsnetzen vorgesehen sind, bei ihrer Inbetriebnahme mit den Basisgrenzwerten oder den Referenzwerten bezüglich der Exposition der Allgemeinbevölkerung gegenüber hochfrequenten elektromagnetischen Feldern

This European Standard was approved by CENELEC on 2005-12-06. 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, Cyprus, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland and the United Kingdom.

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

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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 50400 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

This European Standard has been prepared under a mandate given to CENELEC by the European Commission and the European Free Trade Association.

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1 Scope

This basic standard applies to Base Stations as defined in Clause 4, operating in the frequency range 110 MHz to 40 GHz.

The objective of this basic standard is to specify, for such equipment and when it is put into service in its operational environment, the methods to assess the value of the Total Exposure Ratio or to establish whether the Total Exposure Ratio is less than or equal to one in relevent areas where the general public has access.

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 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)

ISO “Guide to the expression of uncertainty in measurement”: Ed.1.1995

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 Physical quantities, units and constants

3.1 Quantities

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

Quantity	Symbol	Unit	Dimensions
Electric field strength	E	volt per meter	V/m
Electric flux density	D	coulomb per square meter	C/m^2
Frequency	f	hertz	Hz
Magnetic field strength	H	ampere per meter	A/m
Magnetic flux density	B	tesla (Vs/m^2)	T
Mass density	ρ	kilogram per cubic meter	kg/m^3
Permeability	μ	Henry per meter	H/m
Permittivity	ε	farad per meter	F/m
Specific absorption rate	SAR	watt per kilogram	W/kg
Wavelength	λ	meter	m

3.2 Constants

Physical constant	Symbol	Magnitude
Speed of light in a vacuum	c	2,997 x 10^{8} m/s
Permittivity of free space	ε_0	8,854 x 10^{-12} F/m
Permeability of free space	μ_0	4 π x 10^{-7} H/m
Impedance of free space	η_0	120 π Ω (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. It can be used either to emit or to receive a radio signal. In the present standard, if not mentioned, the term antenna is used only for emitting antenna(s)

4.2
average emitted power
the average emitted power is the time-averaged rate of energy transfer defined by

$$P_{aep} = \frac{1}{t_2 - t_1}\int_{t_1}^{t_2} P(t)dt$$

where

$t_2 - t_1$ is the averaging time, t_{avg} defined as a function of frequency in the Council Recommendation 1999/519/EC of 12 July 1999;

$P(t)$ is the power radiated by the antenna at the maximum duty cycle of the equipment

4.3
average equivalent isotropic radiated power (average EIRP)
the product of the power supplied to the antenna and the maximum antenna gain relative to an isotropic antenna

$$P_{aEIRP} = P_{aep} * G$$

where

P_{aep} is the average emitted power;

G is the maximum gain of the antenna relative to an isotropic antenna

4.4
base station (BS)
fixed equipment for radio transmission used in cellular communication and/or wireless local area networks. Point-to-point communication and point-to-multipoint communication equipment integral to the above networks are also included. For the purpose of this standard, the term base station includes the radio transmitter(s) and the associated antenna(s)

4.5
basic restriction
restrictions on exposure to time - varying electric, magnetic, and electromagnetic fields that are based directly on established health effects. Depending upon the frequency of the field, the physical quantities used to specify these restrictions are current density (J), specific absorption rate (SAR) and power density (S)

4.6
compliance boundary (CB)
the compliance boundary is defined according to EN 50383

4.7
domain of investigation (DI)
sub-domain of relevant domain where the general public may have access when the base station is put into service

4.8
electric field strength (*E*)
the magnitude of a field vector at a point that represents the force (*F*) on a small test charge (*q*) divided by the charge

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

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

4.9
equipment under test (EUT)

base station that is the subject of the specific test investigation being described

4.10
equivalent free space conditions (EFSC)
conditions allowing re-use of free space methods defined in EN 50383

4.11
equivalent plane wave power density
the power per unit area normal to the direction of propagation of a plane wave in free space is related to the electric and magnetic fields by the expression

$$S = \frac{E^2}{120\pi} = 120\pi * H^2$$

4.12
exposure ratio (ER)
the assessed exposure parameter at a specified location for each operating frequency of a radio source, expressed as the fraction of the related limit

For assessment against the basic restrictions

Between 100 kHz and 10 GHz:

$$ER = MAX\left[\frac{SARwb}{SARWBL}, \frac{SARpb}{SARPBL}\right]$$

Between 10 GHz and 40 GHz:

$$ER = \left(\frac{S}{SL}\right)$$

For assessments against reference levels:

Between 100 kHz and 40 GHz:

$$ER = MAX\left[\left(\frac{E}{EL}\right)^2, \left(\frac{H}{HL}\right)^2\right]$$

or between 10 MHz and 40 GHz:

$$ER = \left(\frac{S}{SL}\right)$$

where

ER is the exposure ratio at each operating frequency for the source;

EL is the investigation E-field limit at frequency f;

HL is the investigation H-field limit at frequency f;

SARWBL is the SAR whole body limit at frequency f;

SARPBL is the SAR partial body limit at frequency f;

SL is the equivalent plane wave power density limit at frequency f;

E is the assessed E-field at frequency f for the source;

H is the assessed H-field at frequency f for the source;

SARwb is the assessed whole body SAR at frequency f for the source (EN 50383);

SARpb is the assessed partial body SAR at frequency f for the source (EN 50383);

S is the assessed equivalent plane wave power density at frequency f for the source;

f is each operating frequency of the source.

ER is applicable to limits based on ICNIRP principles

4.13

intrinsic impedance (of free space η_0) η

the 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 (120 π) is approximately 377 Ω

4.14

isotropy

physical property that is invariant of direction. 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 polarization with regard to the axis of the probe in the half space in front of the probe

4.15

linearity

the maximum deviation over the measurement range of the measured quantity value from the closest linear reference curve defined over a given interval

4.16
magnetic field strength (H)
the magnitude of a field vector in a point that results in a force (F) on a charge q moving with the velocity v

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

The magnetic field strength is expressed in units of amperes per meter (A/m)

4.17
magnetic flux density (B)
the magnitude of a field vector that is equal to the magnetic field strength H multiplied by the permeability (μ) of the medium

$$B = \mu\ H$$

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

4.18
permeability (μ)
the magnetic permeability of a material is defined by the magnetic flux density B divided by the magnetic field strength H:

$$\mu = \frac{B}{H}$$

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

4.19
permittivity (ε)
the property of a dielectric material (e.g., biological tissue). In case of an isotropic material, it is defined by the electrical flux density D divided by the electrical field strength E

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

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

4.20
point of investigation (PI)
the location within the domain of investigation at which the value of E-field, H-field or power density is evaluated. This location is defined in cartesian, cylindrical or spherical co-ordinates relative to the reference point on the Equipment Under Test as defined in EN 50383

4.21
power density (S)
the 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/m^2)

4.22
PDMF
power density multiplication factor

4.23
reference levels
reference levels are provided for the purpose of comparison with exposure quantities in air. Respect of the reference levels will ensure respect of the basic restriction. In the frequency range 110 MHz to 40 GHz the reference levels are expressed as electric field strength, magnetic field strength and power density values

4.24
reference point
the antenna is referenced by the centre of the rear reflector, in case of panel antennas, and by the centre of the antenna in case of omni-directional antennas. For other configurations, appropriate references must be defined

4.25
relevant domain (RD)
domain surrounding the antenna where the equipment under test may be considered as a relevant source

4.26
relevant source (RS)
a radio source, in the frequency range 100 kHz to 40 GHz, which at a given point of investigation has an exposure ratio larger than 0,05

4.27
specific absorption rate (SAR)
the time derivative of the incremental energy (dW) absorbed by (dissipated in) an incremental mass (dm) contained in a volume element (dV) of given mass density (ρ)

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

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

NOTE SAR can be calculated by

$$SAR = \frac{\sigma E_i^{\,2}}{\rho}$$

where

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

σ is conductivity of body tissue in S/m;

ρ is density of body tissue in kg/m^3

4.28
scatter domain (SD)
domain surrounding the antenna where a structure may cause reflected or diffracted fields, interfering with the incident fields and resulting in significant modifications of the compliance boundary estimated in free space according to EN 50383. Structures to be considered are extensive surfaces like walls, not railings, ladders, etc.

4.29
total exposure ratio (TER)
the total exposure ratio is the maximum value of the sum of exposure ratios of the Equipment Under Test and all relevant sources over the frequency range 100 kHz to 40 GHz

$$TER = ER_{EUT} + ER_{RS}$$

where

ER_{EUT} is the assessed Exposure Ratio from the Equipment Under Test;

ER_{RS} is the assessed Exposure Ratio of all the Relevant Sources

4.30
transmitter
device to generate radio frequency electrical power to be connected to an antenna for communication purpose