SLOVENSKI STANDARD
SIST EN 50492:2009

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Osnovni standard za terensko merjenje jakosti elektromagnetnega polja v zvezi z izpostavljenostjo ljudi v okolici baznih postaj

Basic standard for the in-situ measurement of electromagnetic field strength related to human exposure in the vicinity of base stations

Grundnorm für die Messung der elektromagnetischen Feldstärke am Aufstell- und Betriebsort von Basisstationen in Bezug auf die Sicherheit von in ihrer Nähe befindlichen Personen

Norme de base pour la mesure du champ électromagnétique sur site, en relation avec l'exposition du corps humain à proximité des stations de base

Ta slovenski standard je istoveten z: **EN 50492:2008**

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33.070.01	Mobilni servisi na splošno	Mobile services in general

SIST EN 50492:2009 **en,fr,de**

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN 50492

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ICS 17.220.20; 33.070.01

English version

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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.

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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

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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 formal vote and was approved by CENELEC as EN 50492 on 2008-09-01.

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)	2009-09-01
– latest date by which the national standards conflicting with the EN have to be withdrawn	(dow)	2011-09-01

This European Standard has been prepared under Mandate M/305 given to CENELEC by the European Commission and the European Free Trade Association and covers essential requirements of EC Directive RTTED (1999/5/EC).

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1 Scope

This European Standard specifies in the vicinity of base station as defined in 3.2 the measurement methods, the measurement systems and the post processing that shall be used to determine in-situ the electromagnetic field for human exposure assessment in the frequency range 100 kHz to 300 GHz.

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 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 50400, 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

3 Terms and definitions

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

3.1
antenna
device that serves as a transducer between a guided wave (e.g. coaxial cable) and a free space wave, or vice versa. In the present standard, if not mentioned, the term antenna is used only for emitting antenna(s)

3.2
base station (BS)
fixed equipment for radio transmission intended for use in wireless telecommunications networks, such as those used in cellular communication, Wireless Local Area Networks, point-to-point communication and point-to-multipoint communication according to ITU-R Recommendation F.592-3. Point to point and point to multi point communication equipment listed in “The European table of frequency allocations and utilisations covering the frequency range 9 kHz to 275 GHz” (ERC report 25) (see example in Annex A) are considered. For the purpose of this standard, the term “base station” includes the radio station and the antenna

3.3
average (temporal) power (P_{avg})
the time-averaged rate of energy transfer defined by:

$$\bar{P}_{avg} = \frac{1}{t_2 - t_1} \int_{t_1}^{t_2} P(t)dt$$

where t_1 and t_2 are the start and stop time of the measurement. The period t_2 - t_1 is the exposure duration time

3.4
averaging time (t_{avg})
appropriate time over which exposure is averaged for purposes of determining compliance with the limits

3.5
electric field strength (*E*)
magnitude of a field vector at a point that represents the force (*F*) on a small test charge (*q*) divided by the charge

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

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

3.6
intrinsic impedance
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 377 ohm

3.7
hemispherical isotropy
maximum deviation of the field strength when rotating the probe around its major axis with the probe exposed to a reference wave, having varying incidence angles relative to the axis of the probe, incident from the half space in front of the probe

3.8
probe isotropy
degree to which the response of an electric field or magnetic field probe is independent of the polarization and direction of propagation of the incident wave

3.9
axial isotropy
maximum deviation of the field strength when rotating around the major axis of the probe housing while the probe is exposed to a reference wave impinging from a direction along the probe major axis

3.10
linearity
maximum deviation over the measurement range of the measured quantity from the closest linear reference curve defined over a given interval

3.11
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 $\vec{v} \times \vec{B}$ and the electric charge q of the particle:

$$\vec{F} = q\vec{v} \times \vec{B}$$

where

$\vec{F}$	is the vector force acting on the particle in newtons
q	is the charge on the particle in coulombs
$\vec{v}$	is the velocity of the particle in metres per second
$\vec{B}$	is the magnetic flux density in teslas

3.12
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 (permeability) μ:

$$\vec{H} = \frac{\vec{B}}{\mu} - \vec{M}$$

where

$\vec{H}$	is the magnetic field in amperes per metre
$\vec{B}$	is the magnetic flux density in teslas
μ	is the magnetic constant (permeability) of the vacuum in henries per metre
$\vec{M}$	is the magnetization in amperes per metre

NOTE For the purposes of this standard, $\vec{M}$ = 0 at all points.

3.13
multi-band
multi-band equipment is operating in more than one frequency band, e.g., GSM 900 and GSM 1 800

3.14
permeability (*μ*)
magnetic permeability of a material is defined by the magnetic flux density *B* divided by the magnetic field strength *H*:

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

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

3.15
permittivity (*ε*)
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*

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

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

3.16
root-mean-square (r.m.s.)
effective value or r.m.s. value obtained by taking the square root of the average of the square of the value of the periodic function taken throughout one period

3.17
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)

3.18
transmitter
device to generate radio frequency electrical power to be connected to an antenna for communication purpose

4 Physical quantities, units and constants

4.1 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
Frequency	f	hertz	Hz
Magnetic field strength	H	ampere per metre	A/m
Magnetic flux density	B	tesla (Vs/m²)	T
Permeability	μ	henry per metre	H/m
Permittivity	ε	farad per metre	F/m
Wavelength	λ	metre	m

4.2 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	377 ohm (approx 120π Ω)

5 General process

This clause describes the process that shall be followed to determine the methods, the measurement systems and the post processing that shall be used to estimate in-situ the electromagnetic field for human exposure assessment [1].

Depending on the objectives (see Clause 6), the in-situ measurement shall be performed in compliance with the following flowchart:

1) This European Standard takes into account the CEPT-ECC Recommendation (02)04.

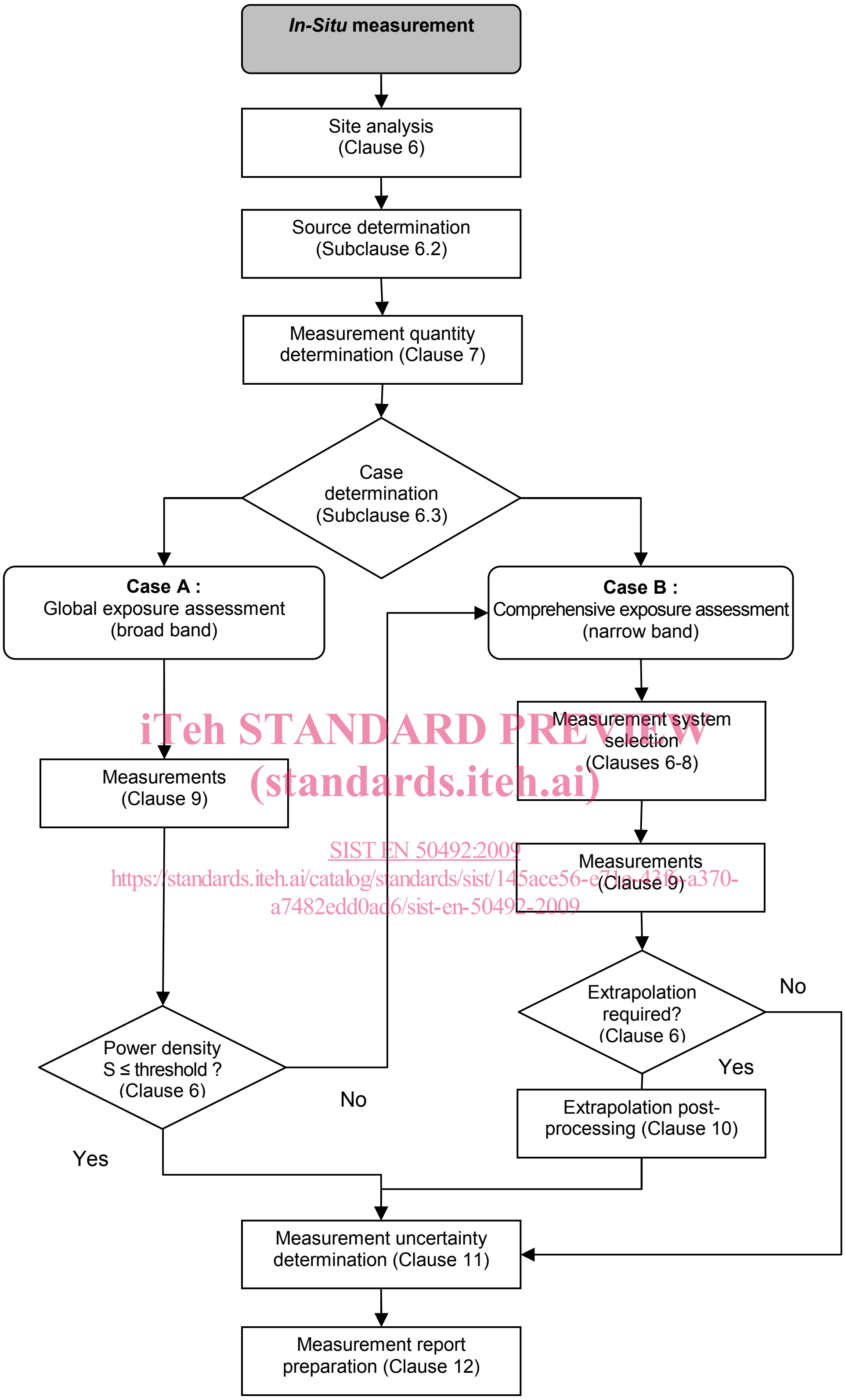

Figure 1 – Alternative routes to determine in-situ the electromagnetic field for human exposure assessment

6 Site analysis and case determination

6.1 Introduction

This clause describes how to analyse the site and determine which type of measurement shall be performed depending on the objective.

6.2 RF sources to be considered

Reasonable endeavours shall be applied to identify all RF emissions between 100 kHz and 300 GHz.

Such sources can be identified e.g. through visual inspection, consulting databases as defined in EN 50400 and using frequency selective measurements. If sources are identified, then measurements shall be performed according to applicable standards. If the location to be evaluated is not in the main beam of antennas operating at frequencies above 6 GHz, then the fields produced by such sources can be generally ignored since in most cases they are not significant for human exposure assessment.

All fixed permanently installed identified RF sources operating between 100 kHz and 6 GHz shall be considered.

6.3 Case determination

6.3.1 Overview

The first decision is to choose between evaluation approaches (Cases A and B). Case A provides a single result covering all sources and frequencies. Case B provides a set of field values for sources, frequencies or frequency sub-bands.

If the objective of the in-situ measurement is a comprehensive exposure assessment, i.e. investigating every contribution from RF sources using a frequency selective analysis, then Case B is applicable.

If the objective of the in-situ measurement is a global exposure assessment, i.e. combining the contributions of all RF sources then the assessment shall be done either using Case B through a combination of all the measured contribution (i.e. Total Exposure Ratio defined in EN 50400) or Case A.

6.3.2 Case A

Case A corresponds to the situation where one wants to perform global exposure assessment using broadband equipment in compliance with Clause 8.

Broadband measurement may be used to indicate if it is necessary to perform a comprehensive exposure assessment (Case B). Evaluation of power density levels above a threshold of 10 mW/m² shall be completed according to Case B. However, if there are pre-existing national requirements, a different threshold between 5 mW/m² and 100 mW/m² may be used.

Broadband measurement may be used to give real-time environmental field-strength information "as observed".

Broadband measurement shall not be used for extrapolation (Clause 10). Without the ability to discriminate frequency, such extrapolation will result in a large overestimation of the maximum exposure.

6.3.3 Case B

Case B corresponds to the situation where one wants to perform a comprehensive exposure assessment including if needed an extrapolation to estimate the field at maximum traffic.

To perform this comprehensive exposure assessment the operator shall use frequency selective measurement equipment in compliance with Clause 8.

7 Determination of field quantity to measure in relation to the distance to source antennas

The objective of this clause is to determine, from site analysis and contributors, the quantities that have to be measured according to the distance from the source antennas (only electric and magnetic fields are covered conforming to the scope of this standard).

For each contributor (or group of contributors) and according to the site analysis, we have to measure either *E* or *H*, or both according to the Table 1.

Electromagnetic fields are composed of an electric field *E* (measured in V/m) and a magnetic field *H* (measured in A/m). Far from the sources (region III) the *E*-field and the *H*-field are mathematically interdependent, but closer to the sources (regions I and II) they might need to be measured separately.

Table 1 – Quantities to measure at different distances from radio-stations

<table>
<tr><th>Region</th><th>Region I</th><th>Region II</th><th>Region III</th></tr>
<tr><td>Region edges, measured from antenna
where
λ wavelength
D largest dimension of the antenna</td><td>$0 \cdots \max\begin{pmatrix}\lambda \\ D \\ \frac{D^2}{4\lambda}\end{pmatrix}$</td><td>$\max\begin{pmatrix}\lambda \\ D \\ \frac{D^2}{4\lambda}\end{pmatrix} \cdots \max\begin{pmatrix}5\lambda \\ 5D \\ \frac{0{,}6D^2}{\lambda}\end{pmatrix}$</td><td>$\max\begin{pmatrix}5\lambda \\ 5D \\ \frac{0{,}6D^2}{\lambda}\end{pmatrix} \cdots \infty$</td></tr>
<tr><td>$E \perp H$</td><td>No</td><td>Effectively yes</td><td>Yes</td></tr>
<tr><td>$\eta = E / H$</td><td>$\neq \eta_0$</td><td>$\approx \eta_0$</td><td>$= \eta_0$</td></tr>
<tr><td>Component to be measured</td><td>E & H</td><td>E or H</td><td>E or H</td></tr>
<tr><td rowspan="2">Comment</td><td rowspan="2">In region I, reactive power components are not negligible. The power density oscillates and depending on the measurement location, lower values might be obtained closer to the antenna in contrast to higher values further away. In this region both E and H have to be measured.</td><td>Antenna pattern according the specifications of the manufacturer not yet valid.</td><td>Far field conditions</td></tr>
<tr><td colspan="2">In regions II and III, it is acceptable to measure one field component E or H only.</td></tr>
</table>

NOTE 1 These distance limits of the regions are applicable generally. Therefore, antennas might exist for which these limits are conservative, e.g. for region *I*, λ might be sufficient even if *D* or $D^2/(4\lambda)$ are larger. However, if resorting to these cases, they must be supported by sustainable proof.

NOTE 2 Nevertheless, the distance limits of the regions in Table 1 are already smaller than those proposed in textbooks covering exact descriptions of antennas. For exposure assessment, the original distance limits were reduced resulting in the values of Table 1, whose precision is still better than the uncertainty of the exposure assessment. FCC OET Bulletin 65 proposes these small distance limits and they have been confirmed by recent measurements and calculations.

8 Requirements of measurement systems

8.1 General

This clause describes the basic requirements applicable to measurement equipment that can be used to perform the measurement in this standard.