SIST

SLOVENSKI STANDARD
SIST EN 50383:2010

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Nadomešča:

SIST EN 50383:2003

Osnovni standard za izračunavanje in merjenje moči elektromagnetnega polja in SAR v povezavi z izpostavljenostjo ljudi sevanjem zaradi radijskih baznih postaj in fiksnih terminalskih postaj za brezžične telekomunikacijske sisteme (110 MHz - 40 GHz)

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)

Grundnorm für die Berechnung und Messung der elektromagnetischen Feldstärke und SAR in Bezug auf die Sicherheit von Personen in elektromagnetischen Feldern von Mobilfunk-Basisstationen und stationären Teilnehmergeräten von schnurlosen Telekommunikationsanlagen (110 MHz bis 40 GHz)

Norme de base pour le calcul et la mesure des champs électromagnétiques et SAR associés à l'exposition des personnes provenant des stations de base radio et des stations terminales fixes pour les systèmes de radiotélécommunications (110 MHz - 40 GHz)

Ta slovenski standard je istoveten z: **EN 50383:2010**

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EUROPEAN STANDARD

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EN 50383

June 2010

ICS 17.220.20; 33.070.01

Supersedes EN 50383:2002

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

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Foreword

This European Standard was prepared by the Technical Committee CENELEC TC 106X, Electromagnetic fields in the human environment. It was submitted to the Unique Acceptance Procedure as a draft amendment and approved by CENELEC as a new edition on 2010-06-01.

This European Standard supersedes EN 50383:2002.

The main changes compared to EN 50383:2002 are as follows (minor changes are not listed):

– the frequency range has been extended to cover 300 MHz to 6 GHz now, was 300 MHz to 3 GHz before

– the references to EN 50361 have been updated with referring to EN 62209-2:2010 now and paragraphs have been removed, that are covered by EN 62210-2

– the former Annex A "Boundaries between field regions" has been replaced by an Annex "Considerations for using far-field method"

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN and CENELEC shall not be held responsible for identifying any or all such patent rights.

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)	2011-06-01
– latest date by which the national standards conflicting with the EN have to be withdrawn	(dow)	2013-06-01

1 Scope

This basic standard applies to radio base stations and fixed terminal stations for wireless telecommunication systems as defined in Clause 4, operating in the frequency range 110 MHz to 40 GHz.

The objective of the standard is to specify, for such equipment, 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.

EN 62209-2:2010, *Human exposure to radio frequency fields from hand-held and body-mounted wireless communication devices – Human models, instrumentation, and procedures – Part 2: Procedure to determine the specific absorption rate (SAR) for mobile wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz*

ISO/IEC 17025:1999, General requirements for the competence of testing and calibration laboratories

ISO/IEC Guide 98-3:2008, *Uncertainty of measurement – Part 3: Guide to the expression of uncertainty in measurement* (GUM:1995)

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 197 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 Physical quantities, units and constants

3.1.1 Quantities

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

Quantity	Symbol	Unit	Dimensions
Current density	J	ampere per square metre	A/m^2
Electric field strength	E	volt per metre	V/m
Electric flux density	D	coulomb per square metre	C/m^2
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/m^2)	T
Mass density	ρ	kilo per cubic metre	kg/m^3
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

3.1.2 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

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
average (temporal) absorbed power
***P*avg**
the time-averaged rate of energy transfer defined by:

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

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

4.3
averaging time
***t*avg**
the appropriate time over which exposure is averaged for purposes of determining compliance with the limits

4.4
base station
BS
in this standard, the term “Base Station” (BS) covers radio base stations as well as fixed terminal stations intended for use in wireless telecommunications networks

4.5
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 110 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

4.6
compliance boundary
volume outside which any point of investigation is deemed to be compliant. Outside the compliance boundary, the exposure levels do not exceed the basic restrictions irrespective of the time of exposure

4.7
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)

4.8
continuous exposure
exposure for a duration exceeding the averaging time

4.9
duty factor (duty cycle)
ratio of the pulse duration to the pulse period of a periodic pulse train. A duty factor of unity corresponds to continuous-wave operation

4.10
electric field strength
E
the magnitude of a field vector at a point that represents the force (F) on a positive small charge (q) divided by the charge:

$$E = \frac{F}{q} \tag{2}$$

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

4.11
electric flux density
D
the magnitude of a field vector that is equal to the electric field strength (E) multiplied by the permittivity (ε):

$$\boldsymbol{D} = \varepsilon \boldsymbol{E} \tag{3}$$

Electric flux density is expressed in units of coulomb per square metre (C/m^2)

4.12
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

4.13
fixed terminal station
a fixed terminal station, usually associated with the user, comprises the hardware, including transceivers, necessary to transmit and receive radio signals. Fixed terminal stations with integrated antennas, fixed terminal stations with connectors for external antennas and fixed terminal stations intended for use with external antennas not supplied by the same manufacturer are covered.

In this standard, the fixed terminal stations are covered by the term "base station"

4.14
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 is 120 π (approximately 377) ohm

4.15
isotropy
deviation of the measured value with regard to various angles of incidence of the measured signal. 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 with regard to the axis of the probe in the half space in front of the probe

4.16
linearity
maximum deviation over the measurement range of the measured quantity from the closest linear reference curve defined over a given interval

4.17
loss tangent
the loss tangent tan(δ) is the ratio of the imaginary part of the complex dielectric constant of a material to its real part

4.18
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:

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

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

4.19
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:

$$F = q\,(v \times \mu H) \tag{5}$$

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

4.20
multi-band
a multi-band equipment is operating in more than one frequency band, e.g. GSM 900 and GSM 1800

4.21
multi-mode
a multi-mode equipment is operating with various radio communication systems, e.g. GSM and DECT

4.22
permeability
μ
the magnetic permeability of a material is defined by the magnetic flux density B divided by the magnetic field strength H:

$$\mu = \frac{B}{H} \tag{6}$$

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

4.23
permittivity
ε
the property of a dielectric material (e.g. biological tissue) defined by the electrical flux density D divided by the electrical field strength E:

$$\varepsilon = \frac{D}{E} \tag{7}$$

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

4.24
phantom
in this context, a phantom is a simplified representation or a model similar in appearance to the human anatomy and composed of materials with electrical properties similar to the corresponding tissues

4.25
point of investigation
POI
the 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

4.26
power flux density
S
power per unit area normal to the direction of electromagnetic wave propagation

4.27
radio base station
a radio base station, usually associated with the network, comprises the hardware, including transceivers, necessary to transmit and receive radio signals. Radio base stations with integrated antennas, radio base stations with connectors for external antennas and radio base stations intended for use with external antennas not supplied by the same manufacturer are covered.

In this standard, the radio base stations are covered by the term “base station”

4.28
radio frequency
RF
for purposes of these safety considerations, the frequency range of interest is 110 MHz to 40 GHz

4.29
relative permittivity
ε_r
the ratio of the permittivity of a dielectric material to the permittivity of free space i.e.

$$\varepsilon_r = \frac{\varepsilon}{\varepsilon_0} \tag{8}$$

4.30
root-mean-square
rms
value obtained by taking the square root of the average of the square of the value of the periodic function taken throughout one period

4.31
root-sum-square
rss
the rss value or the Hermitian magnitude of a vector v is obtained by the square root of the sum of the squared rms values of all three orthogonal components of vector v. The rss value is proportional to the joule heating and can be quite different from the rms amplitude of vector v

4.32
scanning system
the scanning system is the positioning system capable of placing the measurement probe at the specified positions

4.33
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)

$$SAR = \frac{d}{dt}\left(\frac{dW}{dm}\right) = \frac{d}{dt}\left(\frac{dW}{\rho dV}\right) \tag{9}$$

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

NOTE SAR can be calculated by:

$$SAR = \frac{\sigma E_i^{\,2}}{\rho} \tag{10}$$

$$SAR = c_i \frac{dT}{dt}\bigg|_{(\text{time} = 0)} \tag{11}$$ [1]

where

E_i	rms value of the electric field strength in the tissue in V/m
σ	conductivity of body tissue in S/m
ρ	density of body tissue in kg/m^3
c_i	heat capacity of body tissue in J/kg K
$\frac{dT}{dt}$	time derivative of temperature in body tissue in K/s

4.34
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

5.1.1 Introduction

Guidelines and recommended limits on human exposure to radio waves give basic restrictions in terms of SAR or power flux density and also reference levels in terms of field strengths in the absence of the body.

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 EUT. The compliance boundary is determined via a procedure where sufficient points of investigation are assessed.

It is technically possible to determine the compliance boundary 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. However, the choice of the most appropriate assessment method depends on a variety of other considerations.

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, however this approach may not be conservative over localised SAR, which shall be assessed separately.

5.2 Assessment procedure

5.2.1 Reference and alternative methodologies

This standard describes measurement and calculation methodologies that may be used to establish the compliance boundary. The current best evaluation techniques are assigned as the "reference" methodologies to be applied in the case of dispute.

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[1] This equation does not address thermal regulation in a live person.

However, simpler-to-apply alternative methodologies may provide more restrictive results than the reference methods and are therefore also acceptable. Compliance at a point of investigation may therefore be established via any of the described methods.

Table 1 establishes the reference and alternative methodologies as described in this specification.

Table 1 – Reference and alternative methodologies

	Applicable methodologies for each antenna region (see 8.2) [a,b]		
	Reactive near-field	**Radiating near-field**	**Far-field**
Reference	SAR evaluation Clause 7 [c,d]	SAR evaluation Clause 7 [c,d]	E-field or H-field calculation Clause 8 [f]
First alternative	E-field and H-field measurement Clause 6 [e]	E-field or H-field measurement Clause 6 [e]	E-field or H-field measurement Clause 6
Second alternative	E-field and H-field calculation Clause D.1 [f]	E-field or H-field calculation Clause 8 [e]	None

[a] The reference methodology may be more complex to implement than the alternatives.

[b] The alternative methodologies give valid conservative compliance assessments.

[c] Methodology is not currently specified for whole body SAR evaluation above restricted power limits (see 7.1.2).

[d] Localised SAR evaluation currently limited to

- 110 MHz ≤ frequency < 6 000 MHz,
- for investigation distances ≤ 400 mm.

[e] Spatial averaging (Clause 9) provides a more accurate whole body evaluation of EM compliance than peak values, provided localised SAR compliance is assessed.

[f] See general investigation methods for E & H calculations in Clause D.1.

5.2.2 Alternative routes to determine compliance distances

Any of the alternative routes described in Figure 1 shall be used in accordance with Table 1 to establish if a point of investigation is compliant or not. Any completed route can be demonstrated to assure compliance to the "basic restriction" either directly or indirectly via compliance with the "reference level".

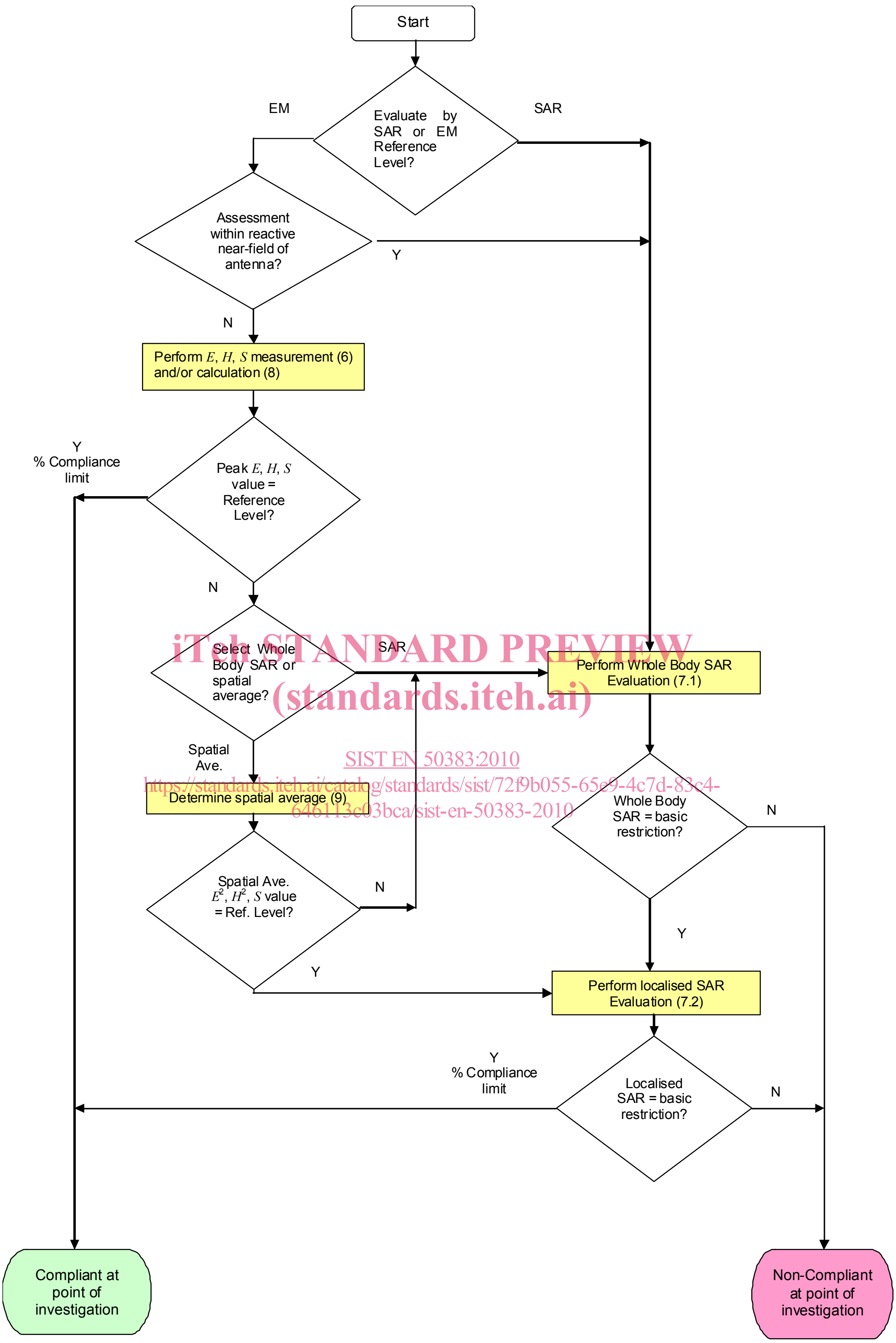

Figure 1 - Alternative routes to establish compliance at a point of investigation

5.2.3 Multiple Frequency bands

Where the EUT can be simultaneously operated on multiple frequency bands, the fractions of the exposure limit shall be established on each band. The sum of all these fractions must be less than one for overall compliance at the point of investigation to be established as described in normative references (Clause 2). When this principle is applied to multi-band data, it will provide a clear algorithm specific for the case under investigation that may provide a number of compliant solutions with different power applied to each band for any given compliance boundary.

5.2.4 General requirements

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.

Compliance boundary shall be established at least for the centre, the low-end and high-end frequencies of each frequency band.

5.2.5 Compliance boundary

The compliance boundary may have a simple (e.g. parallelepiped, sphere or cylinder) or a more complex shape. In any case, the points of investigation outside the compliance boundary shall be in compliance with the limits. Moreover, the shape of the compliance boundary shall be accurately described in the assessment report (Clause 10).

6 Electromagnetic field measurement

6.1 Introduction

This section describes the measurement procedures that may be used to assess, at points of investigation, the electromagnetic field components (E and H and therefore the power density) radiated by antennas.

The field measurements can be obtained either by surface or volume scanning.

The methods used are to measure directly or indirectly the E-field or H-field strength, deduce the field distribution for a given input power and frequency.

6.2 Surface scanning method

6.2.1 Introduction

Methods to perform surface scanning could be, but are not limited to, far-field, compact range, and planar, cylindrical or spherical near-field as long as the methodology is accurately defined and the uncertainty criteria (Annexes B and E) are fulfilled.

6.2.2 Spherical scanning method

6.2.2.1 General

Measurements of electric field amplitude, phase and polarisation are made at sufficient points on the surface of a sphere surrounding the EUT to establish the parameters to model a set of isotropic sources on that surface that will produce at the point of investigation the same field as the EUT. To make this valid, the scanned spherical surface shall contain all the relevant energy that is radiated from the EUT. The parameters of this set of isotropic-radiators are then used to calculate the field at the points of investigation required in order to establish the compliance boundary.

The principle steps are summarised in Figure 2.

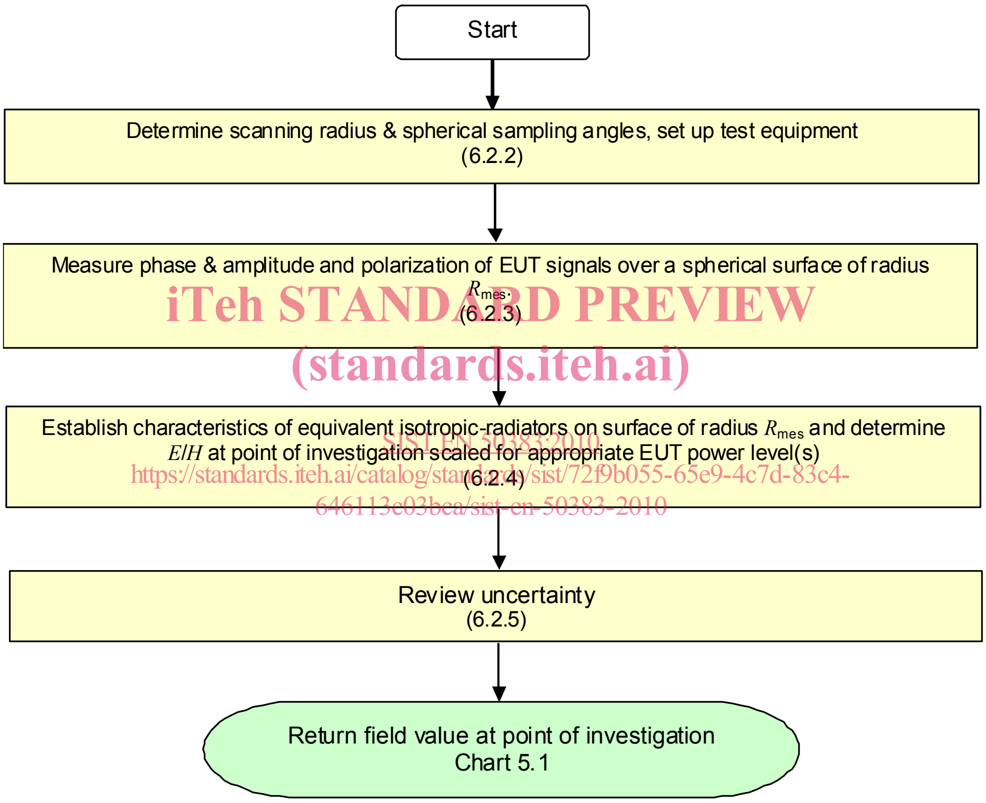

Figure 2 – Outline of the surface scanning methodology

6.2.3 Measurement equipment

6.2.3.1.1 General description

The surface scanning consists of an Equipment Under Test (EUT) mounted on an azimuthal positioner and the probe(s) mounted on a support structure at distance R_{mes} from the EUT. This method requires the ability to measure the phase of the signal. Detection shall consist of either one probe moved mechanically along the structure or one probe array switched electronically in order to perform an angular elevation scan of the electromagnetic fields.

Alternatively, the EUT can be moved to different elevation angles by means of an additional elevation positioner.

The near-field antenna measurement system shall be configured according to Figure 3.