



International Electrotechnical Commission

IEC TC106

Standards for the Assessment of
Human Exposure to Electric, Magnetic,
and Electromagnetic Fields,
0 to 300 GHz

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Australia

Austria

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Canada

China

Denmark

Finland

France

Germany

Greece

Ireland

Italy

Japan

Korea (Republic of)

Mexico

Netherlands

Norway

Poland

Russian Federation

South Africa

Spain

Sweden

Switzerland

Turkey

United Kingdom

United States

- CENELEC: (European Committee for Electrotechnical Standardization) TC106X
- ICNIRP: (International Commission on Non-Ionizing Radiation Protection)
- IEC TC 27: Industrial electro-heating equipment
- IEC TC 77: Electromagnetic compatibility
- IEC TC 78: Live [powerline] working
- IEC TC 85: Measuring equipment for electrical and EM quantities
- CISPR/A: Radio interference measurements and statistical techniques
- IEEE ICES: TC34 SC2/P62209 Part 2 (Category D Liaison)
- WHO: EMF Project

Scope of Work

Standardization of measurement and calculation methods to assess human exposure to electric, magnetic and electromagnetic fields. The task includes:

- characterization of the electromagnetic environments with regard to human exposure
- measurement methods; instrumentation and procedures
- calculation methods
- assessment methods for exposure produced by specific sources (in so far as this task is not carried out by specific product committees)
- basic standards for other sources
- assessment of uncertainties

Scope of Work (Continued)

The scope of TC106 covers the frequency range from 0 to 300 GHz; TC106 standards can be used to assess compliance with contemporary safety guidelines and standards such as ICNIRP* and IEEE**.

Excluded are:

- the establishment of exposure limits (**basic restrictions** and **reference levels**)
- mitigation methods (which have to be dealt with by the relevant product committees)

* International Commission on Non-Ionizing Radiation Protection

** Institute of Electrical and Electronics Engineers

Basic restrictions:

Exposure restrictions that are based on established adverse health effects that incorporate appropriate safety factors and are expressed in terms of the **specific absorption rate** (100 kHz to 3 - 10 GHz), or incident power density (3 - 10 GHz to 300 GHz).

Specific absorption rate (SAR)

The time derivative of the incremental energy absorbed by (dissipated in) an incremental mass contained in a volume element of given density. The SI unit of SAR is the watt per kilogram (W/kg).

Specific absorption rate (continued)

The basic restrictions found in most contemporary RF safety standards and guidelines are as follows:

Uniform exposure (e.g., antenna far-field)

0.4 W/kg (exposure in controlled environments-occupational exposure) and 0.08 W/kg (general public) averaged over the mass of the body

Localized exposure (e.g., mobile phone)

2W/kg (exposure in controlled environments-occupational exposure) and 10 W/kg (general public) averaged over any 10 g of tissue in the shape of a cube (IEEE)

Derived limits (maximum permissible exposure values)

The highest rms or peak electric or magnetic field strengths, their squares, or the plane-wave equivalent power densities associated with these fields, or the induced and contact currents to which a person may be exposed without incurring an established adverse health effect and with an acceptable margin of safety.

The MPEs are derived or estimated from the basic restrictions. **If an exposure is proven to be below the basic restrictions, the MPE can be exceeded.**

MPEs are sometimes called *reference levels*, *derived limits* or *investigation levels*.

Working Group 1

Measurement and calculation methods for low frequency (0 to \approx 100 kHz) electric and magnetic fields and induced currents

Projects

62226-1: Methods for calculating induced current density and electric fields in the human body

- Part 1: General (**IEC Standard**)
- Part 2: Magnetic fields-2D models (**IEC Standard**)
- Part 3: Electric Fields (**New Work Item**)

Working Group 2

Characterization of low frequency electric and magnetic fields from specific devices

Projects

- 62233:** Measurement of electric and magnetic fields of domestic appliances with regard to human exposure (**IEC Standard**)
- 62110:** Measurement procedures for electric and Magnetic fields generated by AC power lines with regard to human exposure (**ANW**)

Working Group 3

Measurement and assessment of high frequency (approximately 100 kHz to 300 GHz) electromagnetic fields

Project

62334: Technical report on the measurement and assessment of human exposure to high frequency (9 kHz to 300 GHz) electromagnetic fields. It will cover quantities that can be directly measured, notably electrical and magnetic field strength but includes also the measurement of current and assessment of internal quantities that form the basis for protection guides. (Similar to IEEE C95.3)

Working Group 4

Characterization of high frequency electromagnetic fields and specific absorption rate (SAR) produced by specific sources

Project

62209: Human exposure to radio frequency fields from hand-held and body-mounted wireless communication devices – Human models, instrumentation, and procedures

Working Group 4 (Continued)

Project

62209 (Continued)

- Part 1: Hand-held mobile wireless communication devices (IEC Standard)
- Part 2: Procedure to determine the SAR for two-way radios, wireless palmtop terminals, wireless desktop terminals, and wireless body-mounted devices including accessories and multiple transmitters in the frequency band 30 MHz - 6 GHz (CD1)

Working Group 4 (Continued)

Project

62232: Determination of RF fields in the vicinity of mobile communication base stations for the purpose of evaluating human exposure (Pre CD)

This standard will describe measurement and calculation methods used to evaluate RF fields from mobile communication base stations with the objectives of evaluating compliance of these stations with appropriate international standards and guidelines and national regulations on limiting human exposure to RF fields.

Working Group 4 (Continued)

Project

- P62369:** Assessment of human exposure to electromagnetic fields in the frequency range of 0 -300 GHz
- Part 1: Electronic article surveillance systems, RFID and similar systems (CD1)*
 - Part 2: Alarms, asset tracking, tele-command and control and similar short range low power radio devices (ANW)

*Moved from CENELEC (50357)

Working Group 5

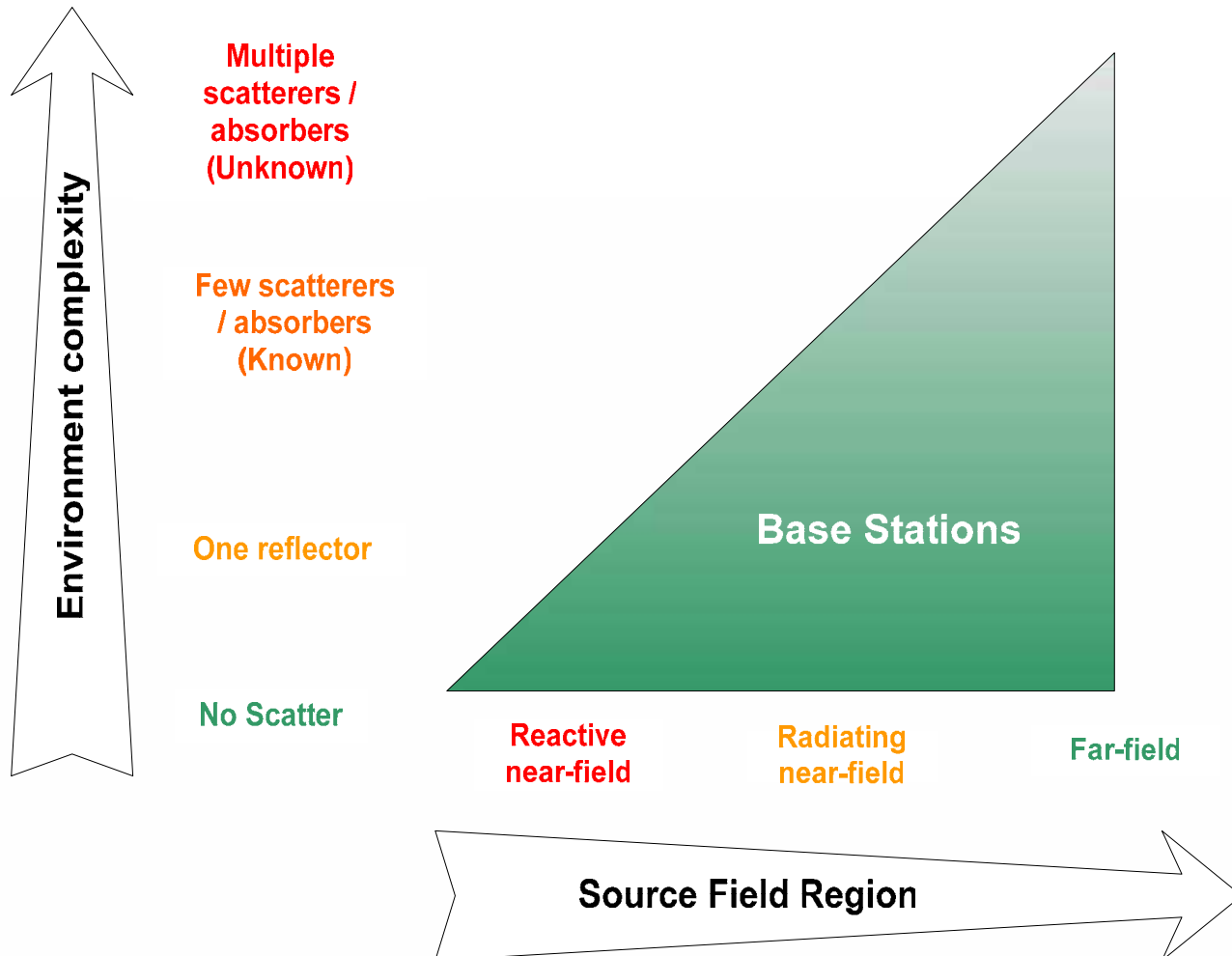
Generic standards: general application and common practices

Projects

P62311: Generic product standard to demonstrate compliance of electrical and electronic apparatus with the basic restrictions related to human exposure to electromagnetic fields (0 Hz-300 GHz)
(NCD)

62232-Wireless Base Stations

62232-Technical Challenge



Scope-Part 1 (Draft)

Measurement methods and analytical techniques to identify levels of RF fields from a single radio base station (RBS) used for wireless telecommunications with one or more antennas.

At present, Part 1 does not include measurement and computation methods for multiple RBS locations nor for other RF transmitters that may be present at the point of observation.

62232-Scope (Continued)

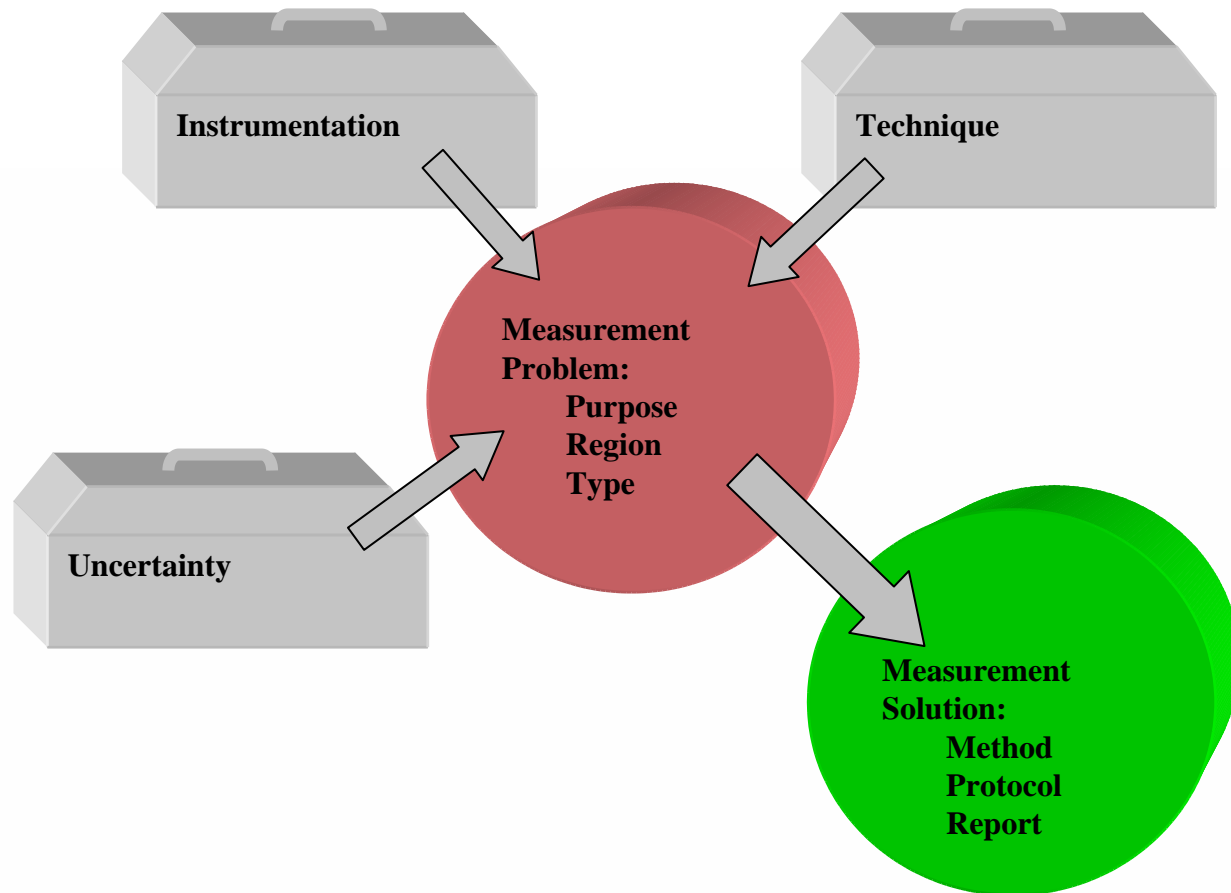
Assessments are based on *in-situ* field measurements or computations at defined locations over a period of time.

The standard will enable assessments based on worse case parameters such as maximum radiated power during the peak of wireless transmission activity and over an extended period of time where such maximum conditions might occur.

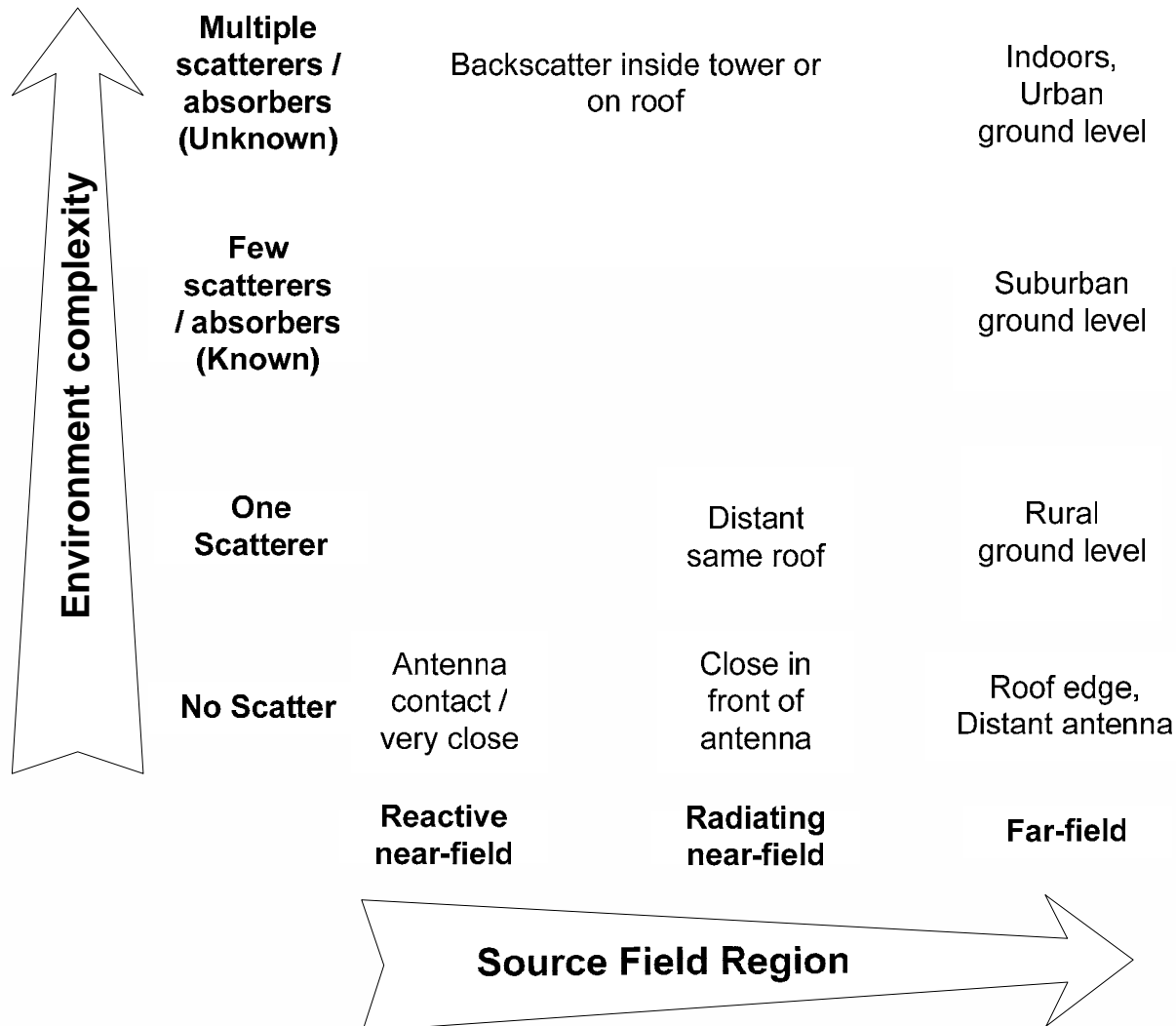
The intent of the standard is to provide:

- Information to communicate to the public to address concerns.
- An evaluation of field strength to facilitate comparison with relevant compliance limits.

62232-Wireless Base Stations



62232-Wireless Base Stations



Source-environment regions

- Near field
- Far field
- Scatters
 - None
 - Single
 - Multiple
 - Well-characterized, non-characterized

62232-General Outline

Selecting the appropriate strategy

- Purpose of survey (e.g., community driven)
- Level of approach
- Accuracy and availability of source data
- Where when to evaluate
- Situations that methods that suggest measurement/calculation

Measurement methods

- Instrumentation (broadband/narrowband)
- Pre-assessment considerations
- Uncertainty

Computational methods

- Ray-tracing (applicability/strength/weaknesses)
- Cylindrical model (applicability/strength/weaknesses)
- Full-wave analysis, e.g., Method of Moments, NEC, (applicability/strength/weaknesses)

SAR evaluation

Data analysis

- Evaluation result
- Uncertainty assessment

62232-General Outline

Report

- Purpose (e.g., community concern, compliance, occupational safety)
- Minimum information required
- Methods for recording data (e.g., manual, analog, digital)

Additional information required

- System parameters (e.g., cable loss, bandwidth, test-antenna gain)

Part 1

The objective of this standard is to specify the measurement method for demonstration of compliance with the specific absorption rate (SAR) limits for such devices.

This International Standard applies to any electromagnetic field (EMF) transmitting device intended to be used with the radiating part of the device in close proximity to the human head and held against the ear, including mobile phones, cordless phones, etc. The frequency range is 300 MHz to 3 GHz.

Part 1 (Continued)

The SAR is determined from measurements of the E-field (E) in an anatomically-correct phantom model (liquid-filled dielectric shell) of the human head using a robotically-scanned miniature E-field probe. The liquid within the shell has electrical properties that simulate human brain tissue. The SAR is determined from the relationship between E and the tissue properties, i.e.,

$$\text{SAR} = \sigma |E^2| / \rho$$

where σ is the liquid conductivity and ρ is the density

Part 1 (Continued)

Measurement system specifications

- General requirements
- Phantom specifications (shell and liquid)
- Specifications of the SAR measurement equipment
- Scanning system specifications
- Device holder specifications
- Measurement of liquid dielectric properties

Part 1 (Continued)

Protocol for SAR assessment

- Measurement preparation
- Tests to be performed
- Measurement procedure
- Post-processing of SAR measurement data

Uncertainty estimation

- General considerations
- Components contributing to uncertainty
- Uncertainty estimation

Part 1 (Continued)

Measurement report

- General
- Items to be recorded in the test report

Annexes

Phantom specifications

Calibration (linearity, isotropy, sensitivity) of the measurement instrument and uncertainty estimation

Post processing techniques and uncertainty estimation

Part 1 (Continued)

SAR measurement system validation

Interlaboratory comparisons

SAR measurement system validation

Inter-laboratory comparisons

**Definition of a phantom coordinate system
and the device under test coordinate system**

Validation dipoles

Flat phantom

62209 – General Outline

Part 1 (Continued)

Recommended recipes for phantom head tissue-equivalent liquids

Measurement of the dielectric properties of liquids and uncertainty estimation

NOTE—Part 1 of IEC 62209 is now being revised – the frequency range will be extended from 3 GHz to 6 GHz

62209 – Part 2 (New Work Item)

Title: Procedure to determine the Specific Absorption Rate (SAR) in the head and body for 30 MHz to 6 GHz Handheld and Body-Mounted Devices used in close proximity to the Body.

This standard will provide a reproducible and conservative measurement methodology for determining compliance with the SAR limits for portable and mobile wireless devices intended to be used with the radiating part of the device closer than 20 cm to the human body. The hand will be modeled for handheld devices only and will not be modeled if the device is intended to be used next to the head or on the body.

62209 – Part 2

The standard applies to devices which are used at a location near the human body, i.e. when held in the hand or in front of the face, or mounted on the body as stand alone devices, transmitting accessories, or embedded in garments. It is applicable for radio frequency exposure in the frequency range 30 MHz to 6 GHz and may be used to assess concurrent exposures from multiple radio sources. The types of devices include but are not limited to mobile telephones, cordless telephones, cordless microphones, auxiliary broadcast devices and radio parts of various sizes of computers.

Expected Completion: 2008

Conclusion

IEC TC-106 develops standards for assessing human exposure to electric, magnetic and electromagnetic fields over the frequency range of 0 Hz to 300 GHz. The standards address products not covered by other IEC standards and generic standards that can be used for conformity assessment with regard to the basic restrictions and derived limits of contemporary RF safety standards, guidelines and regulations. The committee works closely with other international committees to ensure harmonization.

Thank You