SLOVENSKI STANDARD
SIST IEC 61786-2:2017

01-oktober-2017

Merjenje enosmernih in izmeničnih magnetnih polj ter izmeničnih električnih polj od 1 Hz do 100 kHz glede na izpostavljenost ljudi - 2. del: Osnovni standard za meritve

Measurement of DC magnetic, AC magnetic and AC electric fields from 1 Hz to 100 kHz with regard to exposure of human beings - Part 2: Basic standard for measurements

Mesure de champs magnétiques continus et de champs magnétiques et électriques alternatifs dans la plage de fréquences de 1 Hz à 100 kHz dans leur rapport à l'exposition humaine - Partie 2: Norme de base pour les mesures

Ta slovenski standard je istoveten z: **IEC 61786-2**

ICS:

17.220.20	Merjenje električnih in magnetnih veličin	Measurement of electrical and magnetic quantities

SIST IEC 61786-2:2017 **en**

IEC 61786-2

Edition 1.0 2014-12

INTERNATIONAL STANDARD

NORME INTERNATIONALE

colour inside

Measurement of DC magnetic, AC magnetic and AC electric fields from 1 Hz to 100 kHz with regard to exposure of human beings – Part 2: Basic standard for measurements

Mesure de champs magnétiques continus et de champs magnétiques et électriques alternatifs dans la plage de fréquences de 1 Hz a 100 kHz dans leur rapport à l'exposition humaine – Partie 2: Norme de base pour les mesures

INTERNATIONAL ELECTROTECHNICAL COMMISSION

COMMISSION ELECTROTECHNIQUE INTERNATIONALE

PRICE CODE
CODE PRIX W

ICS 17.220.20

ISBN 978-2-8322-1970-6

CONTENTS

INTERNATIONAL ELECTROTECHNICAL COMMISSION

_____

MEASUREMENT OF DC MAGNETIC, AC MAGNETIC AND AC ELECTRIC FIELDS FROM 1 Hz TO 100 kHz WITH REGARD TO EXPOSURE OF HUMAN BEINGS –

Part 2: Basic standard for measurements

FOREWORD

1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
2) The formal decisions or agreements of IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC National Committees.
3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.
4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.
5) IEC itself does not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, access to IEC marks of conformity. IEC is not responsible for any services carried out by independent certification bodies.
6) All users should ensure that they have the latest edition of this publication.
7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.
8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.
9) Attention is drawn to the possibility that some of the elements of this IEC Publication may be the subject of patent rights. IEC shall not be held responsible for identifying any or all such patent rights.

International Standard IEC 61786-2 has been prepared by IEC technical committee 106: Methods for the assessment of electric, magnetic and electromagnetic fields associated with human exposure.

The text of this standard is based on the following documents:

FDIS	Report on voting
106/322/FDIS	106/326/RVD

Full information on the voting for the approval of this standard can be found in the report on voting indicated in the above table.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

The committee has decided that the contents of this publication will remain unchanged until the stability date indicated on the IEC web site under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

IMPORTANT – The 'colour inside' logo on the cover page of this publication indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.

MEASUREMENT OF DC MAGNETIC, AC MAGNETIC AND AC ELECTRIC FIELDS FROM 1 Hz TO 100 kHz WITH REGARD TO EXPOSURE OF HUMAN BEINGS –

Part 2: Basic standard for measurements

1 Scope

This part of IEC 61786 provides requirements for the measurement of quasi-static magnetic and electric fields that have a frequency content in the range 1 Hz to 100 kHz, and DC magnetic fields, to evaluate the exposure levels of the human body to these fields.

Specifically, this standard gives requirements for establishing measurement procedures that achieve defined goals pertaining to human exposure.

NOTE Requirements on field meters and calibration are described in IEC 61786-1

Because of differences in the characteristics of the fields from sources in the various environments, e.g. frequency content, temporal and spatial variations, polarization, and magnitude, and differences in the goals of the measurements, the specific measurement procedures will be different in the various environments.

Sources of fields include devices that operate at power frequencies and produce power frequency and power-frequency harmonic fields, as well as devices that produce fields independent of the power frequency, and DC power transmission, and the geomagnetic field. The magnitude ranges covered by this standard are 0,1 µT to 200 mT for AC (1 µT to 10 T for DC) for magnetic fields, and 1 V/m to 50 kV/m for electric fields.

When measurements outside this range are performed, most of the provisions of this standard will still apply, but special attention should be paid to the specified uncertainty and calibration procedures.

Examples of sources of fields that can be measured with this standard include:

– devices that operate at power frequencies (50/60 Hz) and produce power frequency and power-frequency harmonic fields (examples: power lines, electric appliances…)
– devices that produce fields that are independent of the power frequency. (Examples: electric railway (DC to 20 kHz), commercial aeroplanes (400 Hz), induction heaters (up to 100 kHz), and electric vehicles.)
– devices that produces static magnetic fields: MRI, DC power lines, DC welding, electrolysis, magnets, electric furnaces, etc. DC currents are often generated by converters, which also create AC components (power frequency harmonics), which should be assessed.

When EMF products standards are available, these products standards should be used.

With regard to electric field measurements, this standard considers only the measurement of the unperturbed electric field strength at a point in space (i.e. the electric field prior to the introduction of the field meter and operator) or on conducting surfaces.

Sources of uncertainty during measurements are also identified and guidance is provided on how they should be combined to determine total measurement uncertainty.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 61786-1:2013, *Measurement of DC magnetic, AC magnetic and AC electric fields from 1 Hz to 100 kHz with regard to exposure of human beings – Part 1: Requirements for measuring instruments*

ISO/IEC Guide 99:2007, *International vocabulary of metrology – Basic and general concepts and associated terms (VIM)*

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

3 Terms and definitions

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

NOTE Throughout this standard, the words "magnetic flux density" and "magnetic field" will be considered synonymous.

3.1
average exposure level
spatial average over the entire human body of fields to which the individual is exposed

3.2
correction factor
numerical factor by which the uncorrected result of a measurement is multiplied to compensate for a known error

Note 1 to entry: Since the known error cannot be determined perfectly, the compensation cannot be complete.

3.3
coverage factor
numerical factor used as a multiplier of the combined standard uncertainty in order to obtain an expanded uncertainty

Note 1 to entry: For a quantity z described by a normal distribution with expectation μ_z and standard deviation σ, the interval $\mu_z \pm k\sigma$ encompasses 68,27 %, 95,45 %, and 99,73 % of the distribution for a coverage factor k = 1, 2, and 3, respectively.

3.4
repeatability (of results of measurements)
closeness of agreement between the results of successive measurements of the same measurand, carried out under the same conditions of measurement, i.e.:

– by the same measurement procedure,
– by the same observer,
– with the same measuring instruments, used under the same conditions,
– in the same laboratory,
– at relatively short intervals of time.

[SOURCE: IEC 60050-311:2001, 311-06-06, modified –The note to entry has been deleted.]

3.5
reproducibility (of measurements)
closeness of agreement between the results of measurements of the same value of a quantity, when the individual measurements are made under different conditions of measurement:

- principle of measurement,
- method of measurement,
- observer,
- measuring instruments,
- reference standards,
- laboratory,
- under conditions of use of the instruments, different from those customarily used,
- after intervals of time relatively long compared with the duration of a single measurement

[SOURCE: IEC 60050-311:2001, 311-06-07, modified –The notes to entry have been deleted.]

3.6
standard uncertainty
uncertainty of the result of a measurement expressed as a standard deviation

3.7
uncertainty of measurement
parameter, associated with the result of a measurement, that characterises the dispersion of the values that could reasonably be attributed to the measurand

Note 1 to entry: Uncertainty of measurement generally comprises many components. Some of these components may be estimated on the basis of the statistical distribution of the results of series of measurements, and can be characterised by experimental standard deviations. Estimates of other components can be based on experience or other information.

4 General considerations

4.1 Different goals of measurement

4.1.1 General

Magnetic and electric fields can be characterised according to a number of parameters, i.e. magnitude, frequency, polarization, etc. (see IEC 61786-1:2013, Annex C). Characterisation of one or more of these parameters and how they might relate to human exposure may serve as possible goals of a measurement programme. As an aid for readers interested in developing a field measurement protocol, this subclause provides a list of such possible measurement goals and possible methods for their accomplishment.

Except in the vicinity of high voltage sources, there is no need to measure the power frequency electric field, because the electric field will be, at most, a few tens of volts per metre [3; 22][1].

Annex A gives examples of typical field characteristics in different environments.

The goals of a measurement programme, such as those considered below, shall be clearly defined. A clear definition of goals is required for the determination of instrumentation and calibration requirements, e.g. instrumentation pass-band, magnitude range, frequency calibration points, etc. Once the goals have been identified and appropriate instrumentation has been acquired, a pilot study in the measurement environment of interest may be desirable

[1] Numbers in square brackets refer to the Bibliography.

before decisions are made as to the final measurement methods and associated protocol. The protocol will describe the step-by-step procedure to follow, using the possible methods indicated, to accomplish the measurement goals. The protocol may explicitly indicate such things as instrument requirements (e.g. pass-band, probe size, magnitude range), location of measurements and duration of measurements. It should then be possible, using the same protocol, to compare with confidence measurement results obtained in similar electrical environments.

Possible measurement goals and possible methods for their accomplishment are given in 4.1.2 to 4.1.6.

4.1.2 Characterisation of field levels for compliance with safety standards

Limits on permissible electric or magnetic field levels expressed as resultant values and as a function of frequency have been indicated in a number of documents, such as [17-19; 21] necessitating the determination of field levels with the maximum value or spatial value in specified areas. The choice of measurement location shall be done in consideration of the possible location of people.

Method: Three-axis meters shall be used to make such measurements of the resultant magnetic and electric fields. Standards and guidance exist for such measurements near power lines [4; 9; 15] and electric appliances [10] .

Measurements of magnetic fields near power lines should be correlated with load currents. Load currents for appliances are either constant or, typically, periodic through a fixed range in a relatively short time, enabling the determination of the largest resultant magnetic field with relatively few measurements.

4.1.3 Characterisation of spatial variations

Magnetic and electric fields are not constant around sources. For example, variations of magnetic or electric fields below power lines are typical (Figures 1 and 2) and can be calculated.

In Figure 1, non-uniformity is defined by [4; 9] as the maximum value of

$$\left(\left|B_{\mathrm{h}} - B_{\mathrm{avg}}\right|\right) / B_{\mathrm{avg}} \times 100\ (\%)$$

Where

B_{h} is the magnetic field level at heights of 0,5 m, 1,0 m and 1,5 m above ground;

B_{avg} is the arithmetic mean of the three levels.

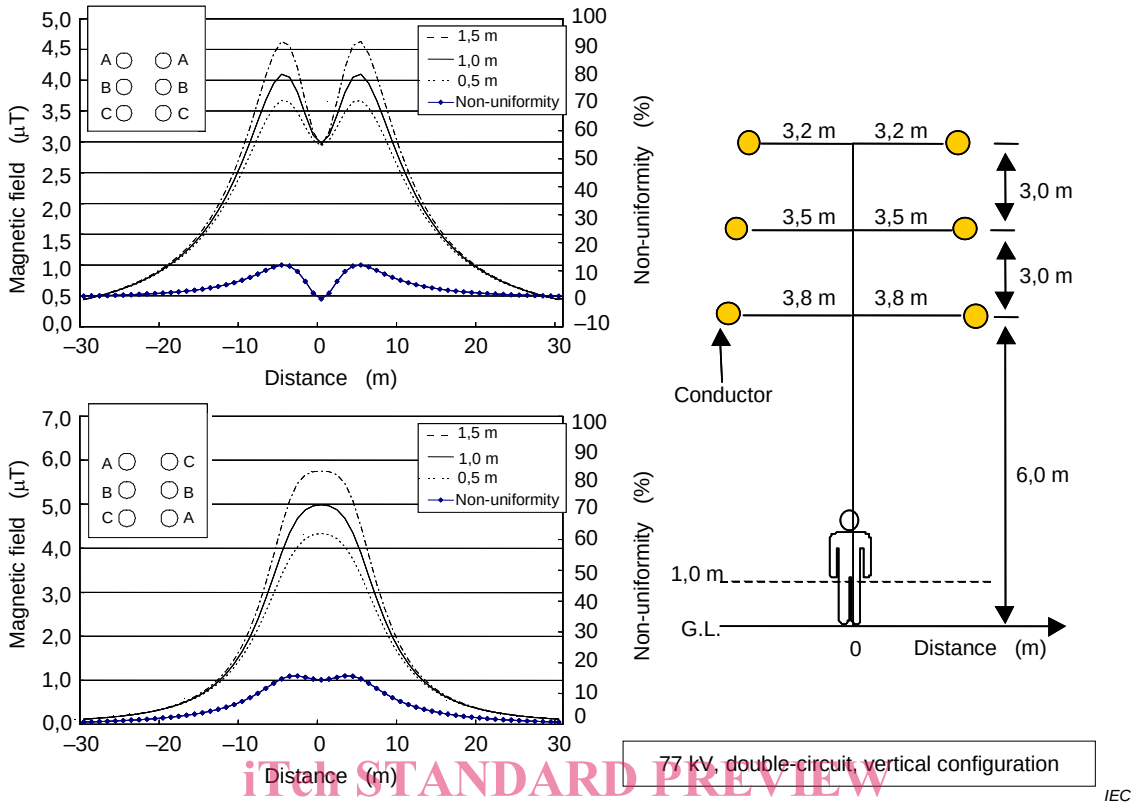

Figure 1 – Magnetic field levels under a 77 kV overhead transmission line (from [9])

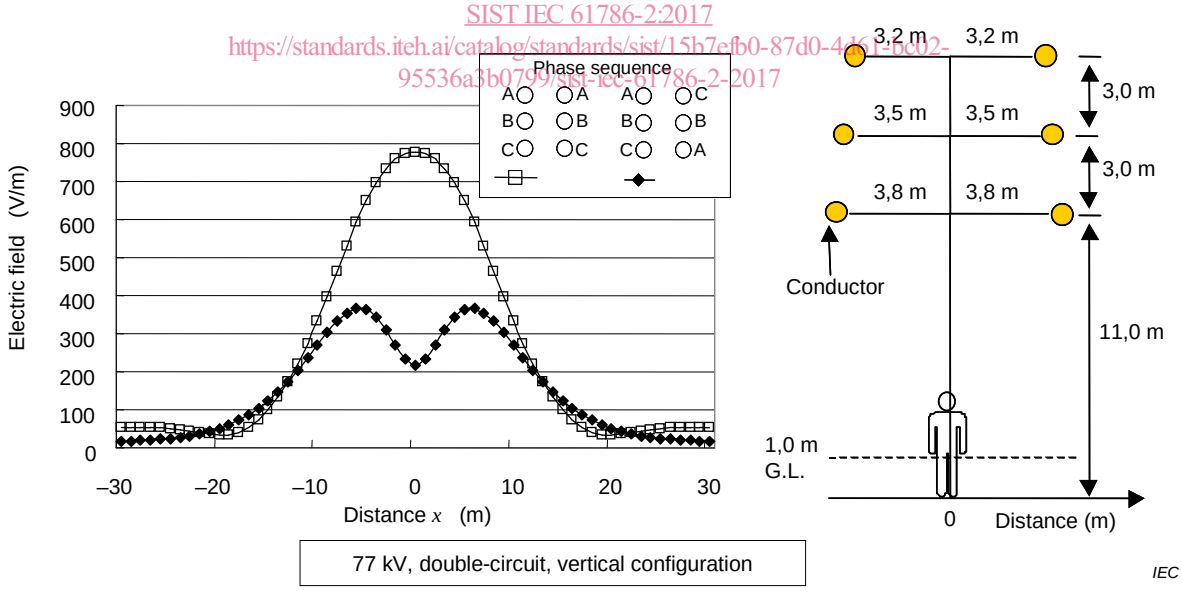

Figure 2 – Electric field levels under an overhead transmission line (from [9])

The spatial distribution of magnetic fields away from power lines or single identifiable sources is typically unknown.

Alternating magnetic fields in most environments will be non-uniform because of the spatial dependence of the fields from the source currents. It is noteworthy that static magnetic fields also show considerable spatial variability in residences [29].

Method: The magnetic field components shall be recorded as a function of coordinate position when characterising spatial variation. Standards exist for carrying out such measurements