SLOVENSKI STANDARD
SIST IEC/TR 61000-2-7:1999

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Electromagnetic compatibilty (EMC) – Part 2: Environment – Section 7: Low frequency magnetic fields in various environments

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Compatibilité électromagntique (CEM) - Partie 2: Environnement - Section 7: Champs magnétiques basse fréquence en environnements divers

Ta slovenski standard je istoveten z: **IEC/TR 61000-2-7**

ICS:

33.100.99	Drugi vidiki v zvezi z EMC	Other aspects related to EMC

SIST IEC/TR 61000-2-7:1999 **en**

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Electromagnetic compatibility (EMC) –

Part 2: Environment – Section 7: Low frequency magnetic fields in various environments

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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ELECTROMAGNETIC COMPATIBILITY (EMC) –

Part 2: Environment – Section 7: Low frequency magnetic fields in various environments

FOREWORD

1) The IEC (International Electrotechnical Commission) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of the 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, the IEC publishes International Standards. 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. The 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 the 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 National Committees.

3) The documents produced have the form of recommendations for international use and are published in the form of standards, technical reports or guides and they are accepted by the National Committees in that sense.

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6) Attention is drawn to the possibility that some of the elements of this International Standard may be the subject of patent rights. The IEC shall not be held responsible for identifying any or all such patent rights.

The main task of IEC technical committees is to prepare International Standards. In exceptional circumstances, a technical committee may propose the publication of a technical report of one of the following types:

- type 1, when the required support cannot be obtained for the publication of an International Standard, despite repeated efforts;
- type 2, when the subject is still under technical development or where for any other reason there is the future but no immediate possibility of an agreement on an International Standard;
- type 3, when a technical committee has collected data of a different kind from that which is normally published as an International Standard, for example "state of the art".

Technical reports of types 1 and 2 are subject to review within three years of publication to decide whether they can be transformed into International Standards. Technical reports of type 3 do not necessarily have to be reviewed until the data they provide are considered to be no longer valid or useful.

IEC 61000-2-7, which is a technical report of type 3, has been prepared by subcommittee 77A: Low frequency phenomena, of IEC technical committee 77: Electromagnetic Compatibility.

The text of this technical report is based on the following documents:

Committee draft	Report on voting
77A/134/CDV	77A/151A/RVC

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

This document is issued in the type 3 technical report series of publications (according to G.3.2.3 of part 1 of the IEC/ISO Directives) as a purely informative document.

This document is not to be regarded as an International Standard.

INTRODUCTION

IEC 61000 is published in separate parts according to the following structure:

Part 1: General
- General considerations (introduction, fundamental principles)
- Definitions, terminology

Part 2: Environment
- Description of the environment
- Classification of the environment
- Compatibility levels

Part 3: Limits
- Emission limits
- Immunity limits (in so far as they do not fall under responsibility of product committees)

Part 4: Testing and measurement techniques
- Measurement techniques
- Testing techniques

Part 5: Installation and mitigation guidelines
- Installation guidelines
- Mitigation methods and devices

Part 6: Generic standards

Part 9: Miscellaneous

Each part is further subdivided into sections which are to be published either as International Standards or as technical reports.

These standards and reports will be published in chronological order and numbered accordingly.

This section is a technical report of type 3.

ELECTROMAGNETIC COMPATIBILITY (EMC) –

Part 2: Environment – Section 7: Low frequency magnetic fields in various environments

1 Scope

Interest in magnetic fields has been stimulated in recent years by concern over the physiological effects they may have on humans and animals and the deleterious effects they have on the performance of some electrical equipment, particularly video display units. Investigations have yielded results which are presented in this report as reference values.

Note 1 – The European Union EMC Directive has prompted magnetic field measurements, particularly in respect of the commercial office environments associated with supply authority substations and electrical distribution systems within buildings. Supply authorities have sponsored most of the work and the results are generally within the frequency range of 50 Hz to 2 kHz, and presented as r.m.s. values. There is, however, a need to have some knowledge about d.c. fields and the fields up to 150 kHz as they may interfere with some types of equipment.

Note 2 – Most of the magnetic field data in this report is associated with sinusoidal current sources and r.m.s. values may be assumed unless otherwise stated.

Power supply systems operating at voltages less than or equal to 1 000 V are designated low-voltage, those above 1 000 V and up to 35 kV are designated medium-voltage, and those in excess of 35 kV are designated high-voltage.

2 Normative reference

The following normative document contains provisions which, through reference in this text, constitute provisions of this technical report. At the time of publication, the edition indicated was valid. All normative documents are subject to revision, and parties to agreements based on this technical report are encouraged to investigate the possibility of applying the most recent edition of the normative document indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

IEC 60050(161):1990, *International Electrotechnical Vocabulary (IEV) – Chapter 161: Electromagnetic compatibility.*

3 Units

Magnetic field values in this report are either expressed in field strengths of amperes per metre, A/m, or in flux densities of microtesla, μT. Where the older flux density unit of milligauss, mG, has appeared in reference documents it has been converted to μT by the following relationship:

$$1\ \mu T = 10\ mG \approx 0{,}796\ A/m$$

The following units are applied in the present report:

Magnetic field strength: H in A/m

Magnetic flux density: $B = \mu \times H$ in T (Tesla)

whereby the permeability $\mu = \mu_r \times \mu_0$ and $\mu_0 = 1{,}256 \cdot 10^{-6}$ (Wb/Am)

in air the relative permeability $\mu_r = 1$ and B (μT) = 1,256 H (A/m)

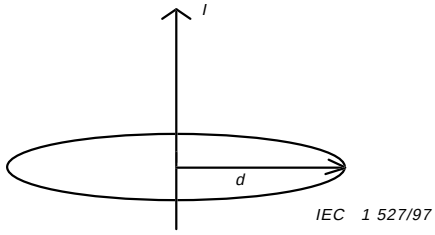
NOTE – 1 T = 1 Wb/m^2 = 10^4 G and $B = 1{,}256 \cdot 10^{-9}$ G (in air)

Example: Magnetic field of a single conductor

The relationship between the magnetic field strength and magnetic induction at a distance *d* from a single conductor carrying a current *I* is given by the following expressions:

$$H = \frac{I}{2\pi d} \text{ (A/m)}$$

$$B = 1{,}256\frac{I}{2\pi d} \text{ (μT)}$$



An alternating current produces an alternating magnetic field, and in the case of a multi-phase cable or overhead line, the alternating magnetic field rotates as it results from the vector sum of the fields produced by individual phase currents.

An alternating magnetic field will induce an electromotive force in any electrical conductor to which it is exposed. This effect is utilised by meters which have search coils. Such meters are in common use.

Other types of meter used for low frequency measurements utilise the Hall effect. These meters are not so good for measuring the fields from environmental sources, but they are very useful when measuring points in space and static magnetic fields.

4 Natural phenomena

Three kinds of natural magnetic fields have to be considered:

– the earth's magnetic field (a static field);

– magnetic fields produced by thunderstorms and solar activity (time-varying with very low frequencies);

– magnetic fields caused by lightning strokes (pulses).

The first measurements and use of magnetic fields related to navigation and intense study of the earth's magnetic fields has resulted in the production of field maps, an example of which is given in figure 1 [1]*. All unscreened conductors moving in the earth's magnetic field will generate a voltage across their ends of a magnitude related to the speed and direction of movement. Such voltage may disturb sensitive electronic devices in associated circuits. Static electrical equipment is not normally affected by the earth's field.

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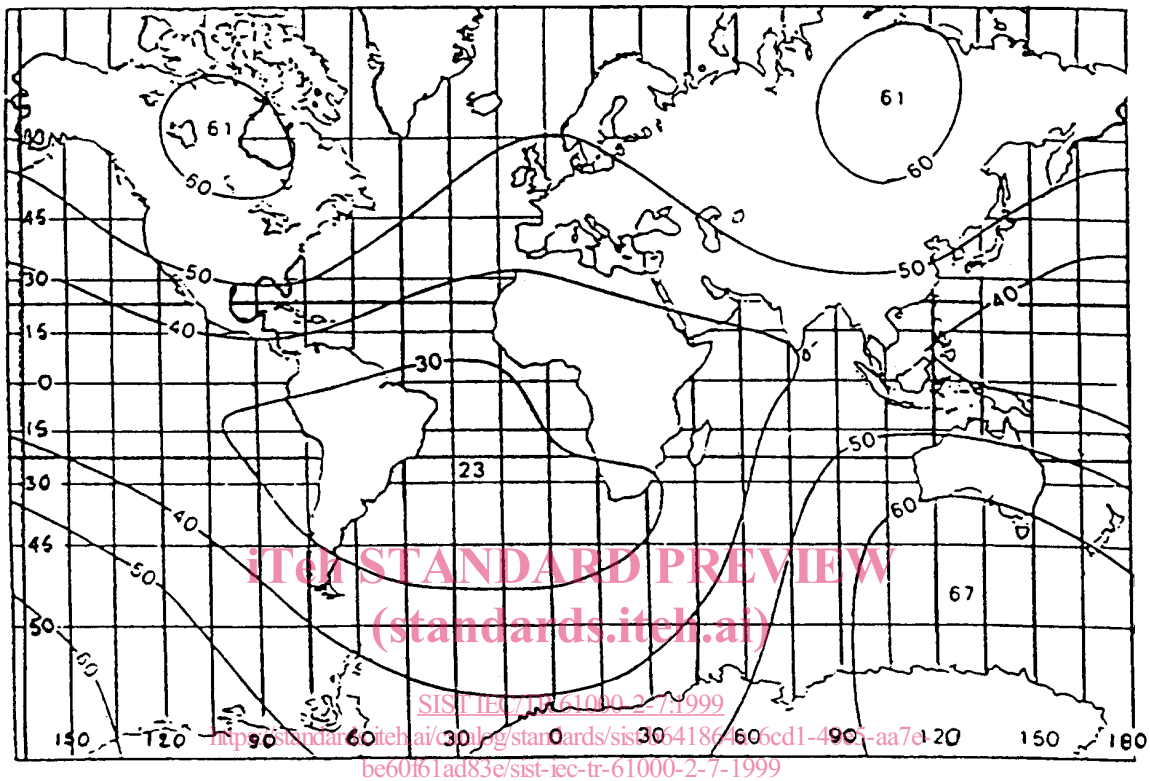
* Figures in square brackets refer to the bibliography.

The earth's static magnetic field is nearly always present as a steady state background reading at 0 Hz to site measurements. Near the poles flux densities are as high as 60 µT whilst at the equator they are only 30 µT.

A normal value assumed for the purpose of calculations is 50 µT [1]. See figure 1.

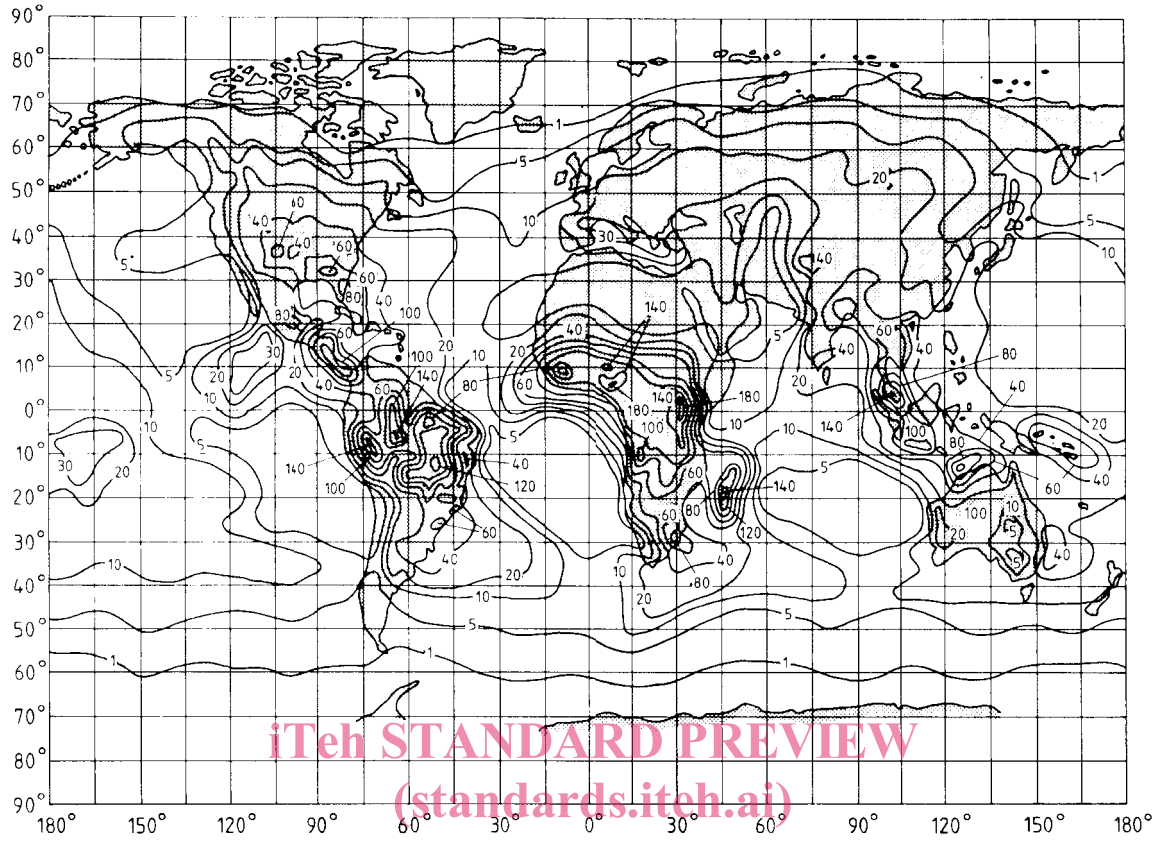


IEC 1 528/97

Figure 1 – The earth's total magnetic field at the surface in µT

Natural phenomena, such as thunderstorms and solar activity, produce time-varying magnetic fields in the extra-low-frequency range. Such fields are generally of low strength, up to 0,01 µT (8 mA/m), although during intense magnetic storms, they can reach intensities of about 0,5 µT (0,4 A/m).

Very little data is available regarding the number of lightning strokes that a particular location may receive in a year. However the ceraunic map in figure 2 [2] does indicate the level of activity and the probability of the highest fields being achieved.



IEC 1 529/97

Figure 2 – Map showing thunderstorm days per year throughout the world

NOTE – This map is based on information of the World Meteorological Organization for 1955.

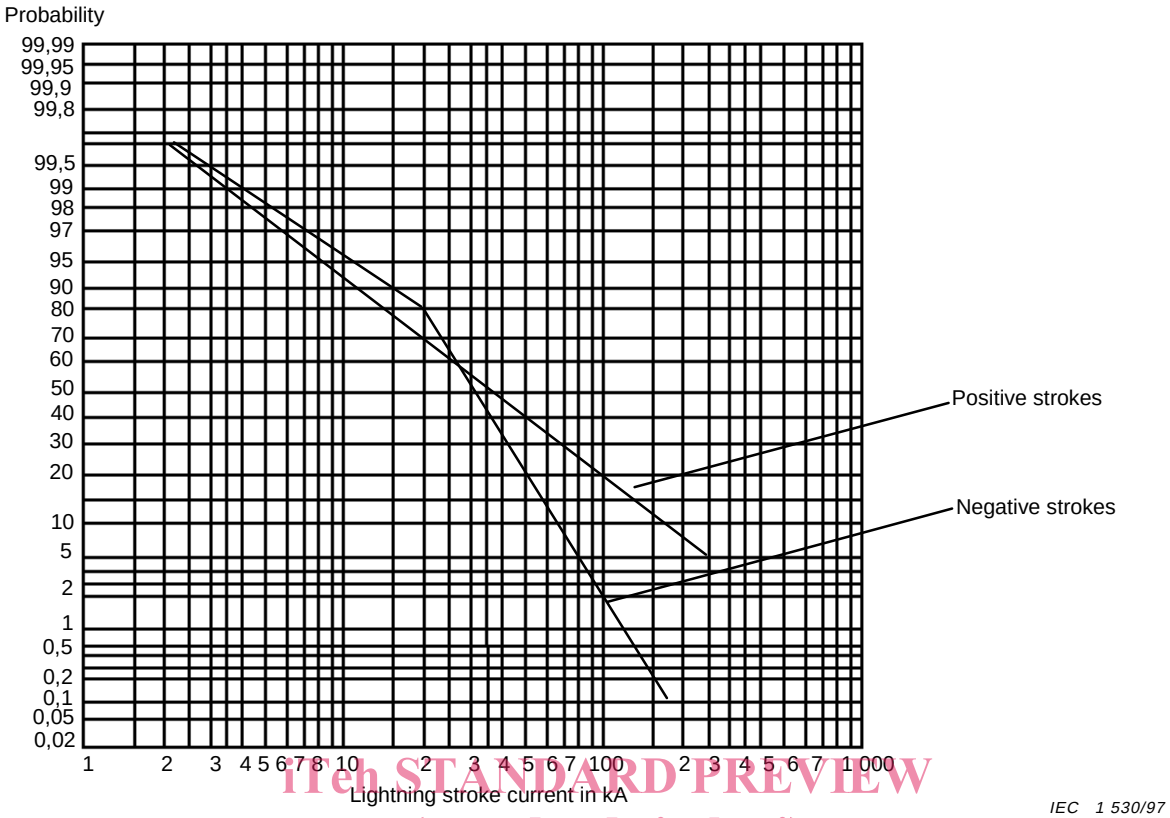


Figure 3 – Cumulative frequency of lightning current from IEC 61024-1-1

The following reference values for the cumulative frequency of lightning current (see figure 3):

	Negative stroke	Positive stroke
5 %	80 kA	250 kA
50 %	33 kA	35 kA
95 %	7 kA	5 kA

The lightning stroke creates magnetic field pulses with a rise time of about 1 µs and a mid-magnetic duration of about 100 µs.

The resulting magnetic field can be calculated according to the relationship:

$H_{peak} = \frac{I}{2\pi d}$ e.g. with I = 200 kA and d = 1 km: H = 32 A/m and B = 40 µT