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Exposure to electric or magnetic fields in the low and intermediate frequency range — Methods for calculating the current density and internal electric field induced in the human body

Part 1: General

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Australian Centre for Radiofrequency Bioeffects Research
Australian Industry Group
Australian Mobile Telecommunications Association
Australian Radiation Protection and Nuclear Safety Agency
Commercial Radio Australia
Communications, Electrical and Plumbing Union —Electrical Division
Department of Defence (Australian Government)
Electrical Engineers Association of NZ
Engineers Australia
Ministry of Health (NZ)
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Preface

This Standard was prepared by the Joint Standards Australia/Standards New Zealand Committee TE-007, Human Exposure to Electromagnetic Fields.

The objective of this document is to provide means for demonstrating compliance with the basic restrictions on human exposure to low and intermediate frequency electric and magnetic fields specified in exposure standards or guidelines such as those produced by IEEE and ICNIRP.

The object of this series of Standards is—

(a) to propose a more realistic approach to the modelling of the human exposure to low frequency electric and magnetic fields, using a set of models of growing complexity for the field emission source, or the human body or both; and

(b) to propose standardised values for the electrical parameters of organs in the human body: electrical conductivity and permittivity and their variation with the frequency.

This document does not aim at replacing the definitions and procedures specified in exposure standards or guidelines, such as those produced by IEEE or ICNIRP, but aims at providing additional procedures with a view to allowing compliance assessment with these documents.

This document provides means for demonstrating compliance with the basic restrictions without having to go to the sophisticated models. Nevertheless, when the exposure conditions are well characterized (such as in product standards, for example) and when results from such models are available, they can be used for demonstrating compliance with EMF standards or guidelines.

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

EXPOSURE TO ELECTRIC OR MAGNETIC FIELDS IN THE LOW AND INTERMEDIATE FREQUENCY RANGE – METHODS FOR CALCULATING THE CURRENT DENSITY AND INTERNAL ELECTRIC FIELD INDUCED IN THE HUMAN BODY –

Part 1: General

FOREWORD

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International Standard IEC 62226 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
106/78/FDIS	106/82/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.

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

This International Standard constitutes Part 1 of the IEC 62226 series, which will regroup several international standards and technical reports within the framework of the calculation of induced current densities and internal electric fields, and will be published under the general title *Exposure to electric or magnetic fields in the low and intermediate frequency range - Methods for calculating the current density and internal electric field induced in the human body.*

This series is planned to be published according to the following structure:

Part 1: General

Part 2: Exposure to magnetic fields

Part 2-1 : 2D models

Part 2-2 : 3D models

Part 2-3 : Guidelines for practical use of coupling factors

Part 3: Exposure to electric fields

Part 3-1: Analytical and 2D numerical models

Part 3-2: 3D numerical models

Part 4: Electrical parameters of human living tissues (Technical Report)

The committee has decided that the contents of this publication will remain unchanged until the maintenance result 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.

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INTRODUCTION

Public interest concerning human exposure to electric and magnetic fields has led international and national organisations to propose limits based on recognised adverse effects.

This standard applies to the frequency range for which the exposure limits are based on the induction of voltages or currents in human body, when exposed to electric and magnetic fields. This frequency range covers the low and intermediate frequencies, up to 100 kHz. Some methods described in this standard can be used at higher frequencies under specific conditions.

The exposure limits based on biological and medical experimentation about these fundamental induction phenomena are usually called “basic restrictions”. They include safety factors.

The induced electrical quantities are not directly measurable, so simplified derived limits are also proposed. These limits, called “reference levels”, are given in terms of external electric and magnetic fields. They are based on very simple models of coupling between external fields and the body. These derived limits are conservative.

Sophisticated models for calculating induced currents in the body have been used and are the subject of a number of scientific publications. These use numerical 3D electromagnetic field computation codes and detailed models of the internal structure with specific electrical characteristics of each tissue within the body. However such models are still developing; the electrical conductivity data available at present has considerable shortcomings; and the spatial resolution of models is still advancing. Such models are therefore still considered to be in the field of scientific research and at present it is not considered that the results obtained from such models should be fixed indefinitely within standards. However it is recognised that such models can and do make a useful contribution to the standardisation process, especially for product standards in which particular cases of exposure are considered. When results from such models are used in standards, the results should be reviewed from time to time to ensure they continue to reflect the current status of the science.

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EXPOSURE TO ELECTRIC OR MAGNETIC FIELDS IN THE LOW AND INTERMEDIATE FREQUENCY RANGE – METHODS FOR CALCULATING THE CURRENT DENSITY AND INTERNAL ELECTRIC FIELD INDUCED IN THE HUMAN BODY –

Part 1: General

1 Scope

This part of IEC 62226 provides means for demonstrating compliance with the basic restrictions on human exposure to low and intermediate frequency electric and magnetic fields specified in exposure standards or guidelines such as those produced by IEEE and ICNIRP.

The object of IEC 62226 is

– to propose a more realistic approach to the modelling of the human exposure to low frequency electric and magnetic fields, using a set of models of growing complexity for the field emission source, or the human body or both;

– to propose standardised values for the electrical parameters of organs in human body: electrical conductivity and permittivity and their variation with the frequency.

The present basic standard does not aim at replacing the definitions and procedures specified in exposure standards or guidelines, such as those produced by IEEE or ICNIRP, but aims at providing additional procedures with a view to allowing compliance assessment with these documents.

The present basic standard provides means for demonstrating compliance with the basic restrictions without having to go to the sophisticated models. Nevertheless, when the exposure conditions are well characterized (such as in product standards, for example) and when results from such models are available, they can be used for demonstrating compliance with EMF standards or guidelines.

NOTE 1 Examples of use of such sophisticated models can be found in the IEC Trend Technology Assessment [2][1].

NOTE 2 References to the scientific literature are given in the bibliography.

2 General data on electromagnetic fields and human exposure

2.1 General

The total field emitted by any electrical device when operating is composed of the electric field and the magnetic field and is called the **electromagnetic field**. It is characterised by its frequency f or its wavelength λ, which is the ratio of the velocity of light in vacuum (c), divided by its frequency: $\lambda = c/f$.

[1] Figures in square brackets refer to the Bibliography

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