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Australian/New Zealand Standard™

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 3.1: Exposure to electric fields — Analytical and 2D numerical models

AS/NZS IEC 62226.3.1:2021

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First published as AS/NZS IEC 62226.3.1:2021.

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 define in detail the coupling factor *K* — introduced by the AS/NZS IEC 62226 series to enable exposure assessment for complex exposure situations, such as non-uniform magnetic field or perturbed electric field — for the case of simple models of the human body, exposed to uniform electric fields. The coupling factor *K* has different physical interpretations depending on whether it relates to electric or magnetic field exposure. It is the so called "shape factor for electric field".

This document applies to the frequency range for which exposure limits are based on the induction of voltages or currents in the human body when exposed to electric fields.

This document can be used when the electric field can be considered to be uniform, for frequencies up to at least 100 kHz.

This situation of exposure to a "uniform" electric field is mostly found in the vicinity of high voltage overhead power systems. For this reason, illustrations given in this part are given for power frequencies (50 Hz and 60 Hz).

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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 3-1: Exposure to electric fields – Analytical and 2D numerical models

FOREWORD

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This Final version does not show where the technical content is modified by amendment 1. A separate Redline version with all changes highlighted is available in this publication.

International Standard IEC 62226-3-1 has been prepared by IEC technical committee 106: Methods for the assessment of electric, magnetic and electromagnetic fields associated with human exposure.

This standard is to be used in conjunction with the first edition of IEC 62226-1:2004, *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.*

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

This International Standard constitutes Part 3-1 of 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.

A list of all parts of the IEC 62226 series, 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*, can be found on the IEC website.

The committee has decided that the contents of the base publication and its amendment 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

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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 the 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 models 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 progressing. 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, specially for product standards where 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.

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 3-1: Exposure to electric fields – Analytical and 2D numerical models

1 Scope

This part of IEC 62226 applies to the frequency range for which exposure limits are based on the induction of voltages or currents in the human body when exposed to electric fields.

This part defines in detail the coupling factor K – introduced by the IEC 62226 series to enable exposure assessment for complex exposure situations, such as non-uniform magnetic field or perturbed electric field – for the case of simple models of the human body, exposed to uniform electric fields. The coupling factor K has different physical interpretations depending on whether it relates to electric or magnetic field exposure. It is the so called “shape factor for electric field”.

This part of IEC 62226 can be used when the electric field can be considered to be uniform, for frequencies up to at least 100 kHz.

This situation of exposure to a “uniform” electric field is mostly found in the vicinity of high voltage overhead power systems. For this reason, illustrations given in this part are given for power frequencies (50 Hz and 60 Hz).

2 Exposure to electric field

Alternating electric fields are generated by energised conductors (i.e. under voltage). In the immediate vicinity of domestic electrical equipment, such as lights, switches, food mixers and irons, local electric-field strengths about 100 V/m may be found. Such fields are non-uniform, but their strengths are far below the levels recommended in safety guidelines, so there is no need of calculation of induced currents in such exposure situations.

Higher electric-field strengths may be found in the vicinity of high voltage equipment such as electric power line. In the frequency range covered by this standard, it is considered that exposure from power lines is the only significant exposure source for public regarding safety guidelines limits.

Guidelines on human exposure to electric fields are generally expressed in terms of induced current density or internal electric field. These quantities cannot be measured directly and the purpose of this document is to give guidance on how to assess these quantities induced in the human body by external (environmental) electric fields E_0.