

AS/NZS 61786.2:2021



Australian/New Zealand Standard™

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 (IEC 61786-2:2014 (ED. 1.0) MOD)



currently in preview, click for full version

AS/NZS 61786.2:2021

This Joint Australian/New Zealand Standard™ was prepared by Joint Technical Committee TE-007, Human Exposure to Electromagnetic Fields. It was approved on behalf of the Council of Standards Australia on 16 April 2021 and by the New Zealand Standards Approval Board on 4 May 2021.

This Standard was published on 21 May 2021.

The following are represented on Committee TE-007:

- 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)
- National Measurement Institute
- National Radiation Laboratory New Zealand
- Victoria University of Wellington NZ

This Standard was issued in draft form for comment as DR AS/NZS 61786.2:2021.

Keeping Standards up-to-date

Ensure you have the latest versions of our publications and keep up-to-date about Amendments, Rulings, Withdrawals, and new projects by visiting:

www.standards.org.au

www.standards.govt.nz

ISBN 978 1 76113 322 0

Australian/New Zealand Standard™

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 (IEC 61786-2:2014 (ED. 1.0) MOD)

First published as AS/NZS 61786.2:2021.



© IEC Geneva Switzerland 2021 — All rights reserved

© Standards Australia Limited/the Crown in right of New Zealand, administered by the New Zealand Standards Executive 2021

All rights are reserved. No part of this work may be reproduced or copied in any form or by any means, electronic or mechanical, including photocopying, without the written permission of either the IEC or the publisher, unless otherwise permitted under the Copyright Act 1968 (Cth) or the Copyright Act 1994 (New Zealand). If you have any questions about IEC copyright or have an enquiry about obtaining additional rights to this publication, please see the contact details on the back cover or the contact us page of the website for further information.

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 specify 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.

This document specifies requirements for establishing measurement procedures that achieve defined goals pertaining to human exposure.

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 document 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 document 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 document include:

- (a) devices that operate at power frequencies (50/60 Hz) and produce power frequency and power-frequency harmonic fields (e.g. power lines, electric appliances);
- (b) devices that produce fields that are independent of the power frequency (e.g. electric railway (DC to 20 kHz), commercial aeroplanes (400 Hz), induction heaters (up to 100 kHz), and electric vehicles);
- (c) devices that produce 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.

Regarding electric field measurements, this document 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.

This document is an adoption with national modifications, and has been reproduced from, IEC 61786-2:2014 (ED. 1.0), *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*. The modifications are additional requirements and are set out in [Appendix ZZ](#), which has been added at the end of the source text.

[Appendix ZZ](#) lists the variations to IEC 61786-2:2014 (ED. 1.0) for the application of this document in Australia and New Zealand.

As this document has been reproduced from an International Standard the following applies:

- (a) In the source text “this part of 61786” should read “this document”.
- (b) A full point substitutes for a comma when referring to a decimal marker.

Australian or Australian/New Zealand Standards that are identical adoptions of international normative references may be used interchangeably. Refer to the online catalogue for information on specific Standards.

The terms “normative” and “informative” are used in Standards to define the application of the appendices or annexes to which they apply. A “normative” appendix or annex is an integral part of a Standard, whereas an “informative” appendix or annex is only for information and guidance.

Currently in preview, click buy full version

CONTENTS

FOREWORD.....	4
1 Scope.....	6
2 Normative references	7
3 Terms and definitions	7
4 General considerations.....	8
4.1 Different goals of measurement	8
4.1.1 General.....	8
4.1.2 Characterisation of field levels for compliance with safety standards.....	9
4.1.3 Characterisation of spatial variations.....	9
4.1.4 Characterisation of temporal variation.....	11
4.1.5 Characterisation of frequency content in magnetic field or electric field.....	12
4.1.6 Characterisation of population exposure to magnetic field and definition of metric.....	13
4.2 Sources with multiple frequencies	14
4.2.1 General.....	14
4.2.2 Sum of weighted magnitudes	14
4.2.3 Weighted peak value.....	15
4.2.4 Impulse separation.....	15
4.2.5 Weighted RMS value.....	15
4.2.6 Highest weighted spectral line.....	16
4.2.7 Conclusion and recommendation.....	16
4.3 Considerations before measurements	16
5 Measurement procedures and precaution	17
5.1 AC magnetic field.....	17
5.2 DC magnetic field	18
5.3 AC electric field	19
6 Measurement uncertainty	21
7 Measurement report	22
Annex A (informative) Examples of fields characteristics in typical environments	24
Annex B (informative) Examples of measurement distances	27
B.1 IEC 62110:2009 [9].....	27
B.2 IEC 62233:2005 [10].....	27
B.3 IEC 62371:2007 [11].....	27
B.4 IEC 62369-1:2008 [12].....	27
B.5 IEC/TS 62597:2011 [14].....	27
B.6 IEC 62493:2009 [13].....	28
Annex C (normative) Measurement uncertainty.....	29
C.1 Overview.....	29
C.2 Assessment of type A uncertainty	29
C.3 Assessment of type B uncertainty	29
C.3.1 Non-uniform field.....	29
C.3.2 Pass-band limitations	30
C.3.3 Temperature.....	30
C.3.4 Humidity	30
C.3.5 Location of measurement.....	30

C.3.6	Long-term drift.....	31
C.3.7	Instrument time constant	31
C.3.8	Proximity effect of observer (for electric field)	31
C.3.9	Correction factor.....	31
C.3.10	Hysteresis between scales	31
Annex D (informative)	Example of measurement uncertainty.....	32
Bibliography.....		33
Figure 1	– Magnetic field levels under a 77 kV overhead transmission line (from [9])	10
Figure 2	– Electric field levels under an overhead transmission line (from [9]).....	10
Figure 3	– Example of load variation of 735kV line due to the human activities (daily) and outdoor temperature (seasonal)	11
Figure 4	– 50 Hz magnetic field in a high speed train in France	12
Figure 5	– Waveform (a) and frequency spectrum (b) of magnetic field generated by a 66,04 cm (26 inches) flat-screen LCD television	13
Figure 6	– Example of DC magnetic field profile above DC underground cable (calculated at a height of 1 m).....	19
Figure 7	– Observer proximity effects during electric field measurement in vertical electric field	20
Figure A.1	– Magnetic field exposure of typical worker (electrician) in North American power plant (based on 3 days recording)	25
Figure B.1	– Lighting equipment and measurement distances (from [13]).....	28
Table A.1	– Example of field characteristics inside (workers environment) and outside (public environment) electric substations in a North American utility	24
Table A.2	– Field characteristics (μT) in different mass transportation system in US: average and (maximum)	26
Table D.1	– Example of measurement uncertainty	32

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 the 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 measurement, 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 μ T to 200 mT for AC (1 μ T 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 produce 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.