

INTERNATIONAL STANDARD

NORME INTERNATIONALE



Electric welding equipment – Assessment of restrictions related to human exposure to electromagnetic fields (0 Hz to 300 GHz) – Part 3: Resistance welding equipment

Matériels de soudage électrique – Évaluation des restrictions relatives à l'exposition humaine aux champs électromagnétiques (0 Hz à 300 GHz) – Partie 3: Matériels de soudage par résistance



THIS PUBLICATION IS COPYRIGHT PROTECTED

Copyright © 2017 IEC, Geneva, Switzerland

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from either IEC or IEC's member National Committee in the country of the requester. If you have any questions about IEC copyright or have an enquiry about obtaining additional rights to this publication, please contact the address below or your local IEC member National Committee for further information.

Droits de reproduction réservés. Sauf indication contraire, aucune partie de cette publication ne peut être reproduite ni utilisée sous quelque forme que ce soit et par aucun procédé, électronique ou mécanique, y compris la photocopie et les microfilms, sans l'accord écrit de l'IEC ou du Comité national de l'IEC du pays du demandeur. Si vous avez des questions sur le copyright de l'IEC ou si vous désirez obtenir des droits supplémentaires sur cette publication, utilisez les coordonnées ci-après ou contactez le Comité national de l'IEC de votre pays de résidence.

IEC Central Office
3, rue de Varembe
CH-1211 Geneva 20
Switzerland

Tel.: +41 22 919 02 11
Fax: +41 22 919 03 00
info@iec.ch
www.iec.ch

About the IEC

The International Electrotechnical Commission (IEC) is the leading global organization that prepares and publishes International Standards for all electrical, electronic and related technologies.

About IEC publications

The technical content of IEC publications is kept under constant review by the IEC. Please make sure that you have the latest edition, a corrigenda or an amendment might have been published.

IEC Catalogue - webstore.iec.ch/catalogue

The stand-alone application for consulting the entire bibliographical information on IEC International Standards, Technical Specifications, Technical Reports and other documents. Available for PC, Mac OS, Android Tablets and iPad.

IEC publications search - www.iec.ch/searchpub

The advanced search enables to find IEC publications by a variety of criteria (reference number, text, technical committee,...). It also gives information on projects, replaced and withdrawn publications.

IEC Just Published - webstore.iec.ch/justpublished

Stay up to date on all new IEC publications. Just Published details all new publications released. Available online and also once a month by email.

Electropedia - www.electropedia.org

The world's leading online dictionary of electronic and electrical terms containing 20 000 terms and definitions in English and French, with equivalent terms in 16 additional languages. Also known as the International Electrotechnical Vocabulary (IEV) online.

IEC Glossary - std.iec.ch/glossary

65 000 electrotechnical terminology entries in English and French extracted from the Terms and Definitions clause of IEC publications issued since 2002. Some entries have been collected from earlier publications of IEC TC 37, 77, 86 and CISPR.

IEC Customer Service Centre - webstore.iec.ch/csc

If you wish to give us your feedback on this publication or need further assistance, please contact the Customer Service Centre: csc@iec.ch.

A propos de l'IEC

La Commission Electrotechnique Internationale (IEC) est la première organisation mondiale qui élabore et publie des Normes internationales pour tout ce qui a trait à l'électricité, à l'électronique et aux technologies apparentées.

A propos des publications IEC

Le contenu technique des publications IEC est constamment revu. Veuillez vous assurer que vous possédez l'édition la plus récente, un corrigendum ou amendement peut avoir été publié.

Catalogue IEC - webstore.iec.ch/catalogue

Application autonome pour consulter tous les renseignements bibliographiques sur les Normes internationales, Spécifications techniques, Rapports techniques et autres documents de l'IEC. Disponible pour PC, Mac OS, tablettes Android et iPad.

Recherche de publications IEC - www.iec.ch/searchpub

La recherche avancée permet de trouver des publications IEC en utilisant différents critères (numéro de référence, texte, comité d'études,...). Elle donne aussi des informations sur les projets et les publications remplacées ou retirées.

IEC Just Published - webstore.iec.ch/justpublished

Restez informé sur les nouvelles publications IEC. Just Published détaille les nouvelles publications parues. Disponible en ligne et aussi une fois par mois par email.

Electropedia - www.electropedia.org

Le premier dictionnaire en ligne de termes électroniques et électriques. Il contient 20 000 termes et définitions en anglais et en français, ainsi que les termes équivalents dans 16 langues additionnelles. Egalement appelé Vocabulaire Electrotechnique International (IEV) en ligne.

Glossaire IEC - std.iec.ch/glossary

65 000 entrées terminologiques électrotechniques, en anglais et en français, extraites des articles Termes et Définitions des publications IEC parues depuis 2002. Plus certaines entrées antérieures extraites des publications des CE 37, 77, 86 et CISPR de l'IEC.

Service Clients - webstore.iec.ch/csc

Si vous désirez nous donner des commentaires sur cette publication ou si vous avez des questions contactez-nous: csc@iec.ch.

INTERNATIONAL STANDARD

NORME INTERNATIONALE



Electric welding equipment – Assessment of restrictions related to human exposure to electromagnetic fields (0 Hz to 300 GHz) – Part 3: Resistance welding equipment

Matériels de soudage électrique – Évaluation des restrictions relatives à l'exposition humaine aux champs électromagnétiques (0 Hz à 300 GHz) – Partie 3: Matériels de soudage par résistance

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

COMMISSION
ELECTROTECHNIQUE
INTERNATIONALE

ICS 25.160.30

ISBN 978-2-8322-4814-0

**Warning! Make sure that you obtained this publication from an authorized distributor.
Attention! Veuillez vous assurer que vous avez obtenu cette publication via un distributeur agréé.**

CONTENTS

FOREWORD.....	5
1 Scope.....	7
2 Normative references	7
3 Terms, definitions, quantities, units and constants.....	8
3.1 Terms and definitions.....	8
3.2 Quantities and units	9
3.3 Constants	10
4 Requirements	10
5 Coupling coefficients	10
5.1 General.....	10
5.2 Conductive disks.....	12
5.3 Anatomical body models for numerical calculations.....	14
6 Source model	14
6.1 General.....	14
6.2 Single cable	15
6.3 Parallel cables	15
6.4 Rectangular loop.....	16
7 Assessment methods.....	18
7.1 General.....	18
7.2 General considerations	18
7.2.1 Time averaging.....	18
7.2.2 Spatial averaging.....	18
7.2.3 Frequency range limitations.....	18
7.2.4 Measurement instruments.....	19
7.2.5 Uncertainty of assessment.....	19
7.3 Equipment with sinusoidal welding current.....	19
7.4 Equipment with pulsed or non-sinusoidal welding current.....	20
7.4.1 General	20
7.4.2 Derivation of the weighting function from limits for field quantities	20
7.4.3 Application of the weighted peak method in the frequency domain.....	22
7.4.4 Application of the weighted peak method in the time domain	23
7.5 Method based on measuring of external field levels	23
7.5.1 General.....	23
7.5.2 Measurement equipment	23
7.5.3 Spatial averaging.....	24
7.5.4 Exposure of the head.....	24
7.5.5 Exposure of the trunk	25
7.5.6 Exposure of the limbs	25
7.6 Assessment procedure.....	26
7.6.1 General	26
7.6.2 Power-source	27
7.6.3 Electrode-assembly	27
7.6.4 Welding-system	27
8 EMF data sheet and assessment report.....	28
8.1 General.....	28
8.2 EMF datasheet of components.....	28

8.2.1	Power sources.....	28
8.2.2	Electrode assemblies.....	29
8.2.3	Other components	29
Annex A (informative) Example of the weighted peak method in the time domain.....		30
A.1	General.....	30
A.2	Power source.....	30
A.2.1	General	30
A.2.2	Applied limits	30
A.2.3	Assessment of the electrode-assembly	32
A.2.4	Datasheets	33
Annex B (informative) Example of the weighted peak method in the frequency domain.....		37
B.1	General.....	37
B.2	Power source.....	37
B.2.1	General	37
B.2.2	Applied limits	38
B.2.3	Assessment of the electrode-assembly	40
B.2.4	Datasheets	41
Annex C (informative) IEC 62822-3 for users of IEC 62822-2.....		45
Annex D (informative) Coupling coefficients for common arrangements		47
D.1	Single wire.....	47
D.2	Example of standardized loop configurations.....	48
D.2.1	0,5 m x 0,5 m	48
D.2.2	1,0 m x 1,0 m	50
D.2.3	1,0 m x 1,5 m	52
Annex E (informative) Conservative approximation of coupling coefficients for rectangular loops		54
E.1	General.....	54
E.2	XY-plane.....	54
E.3	Z-direction	55
E.4	Correlation factors	56
Annex F (informative) Example EMF datasheets		57
F.1	Example datasheet – Welding system	57
F.2	Example datasheet – Power source	59
F.3	Example datasheet – Electrode assembly	60
Bibliography.....		61
Figure 1 – Example of a reference system		11
Figure 2 – Conducting disk in a uniform, time variant magnetic flux density		12
Figure 3 – Electrical conductivity for homogeneous body models		13
Figure 4 – Example of the placement of the conductive disks.....		13
Figure 5 – Source model – Single cable.....		15
Figure 6 – Assessment configuration – Single cable		15
Figure 7 – Source model – Parallel cables		15
Figure 8 – Assessment Configuration – Parallel Cables		16
Figure 9 – Rectangular loop configuration.....		16
Figure 10 – Assessment distances for the loop configuration		17
Figure 11 – Piecewise linear and approximated limit amplitudes		21

Figure 12 – Piecewise linear and approximated summation function phase angles	22
Figure 13 – Field measurement at head position	24
Figure 14 – Field measurement at trunk position	25
Figure 15 – Field measurement at limb positions, hand and thigh	26
Figure 16 – Assessment of a complete welding system	27
Figure 17 – Typical component based assessment	27
Figure A.1 – Current waveform	30
Figure A.2 – Combined ELVs for the head [1]	31
Figure A.3 – Unity-coupling waveform	31
Figure A.4 – Geometry of the electrode assembly	32
Figure A.5 – Datasheet of the power source	33
Figure A.6 – Datasheet of the electrode assembly	34
Figure A.7 – Datasheet of the welding system	35
Figure A.8 – Datasheet of the welding system	36
Figure B.1 – Current waveform	37
Figure B.2 – Spectrum of the current waveform	38
Figure B.3 – Combined ELVs for the head [1]	39
Figure B.4 – Unity-coupling waveform	39
Figure B.5 – Geometry of the electrode assembly	40
Figure B.6 – Datasheet of the power source	41
Figure B.7 – Datasheet of the electrode assembly	42
Figure B.8 – Datasheet of the welding system	43
Figure B.9 – Datasheet of the welding system	44
Figure E.1 – Geometry of the electrode assembly – XY-plane	54
Figure E.2 – Geometry of the electrode assembly – Z-direction	55
Figure F.1 – Example datasheet – Welding system	57
Figure F.2 – Example datasheet – Power source	59
Figure F.3 – Example data sheet – Power source	60
Table 1 – Standardised distances	11
Table 2 – Radii for the 3D disk model	13
Table D.1 – Coupling coefficients – Single wire	47
Table D.2 – Coupling coefficients XY-plane – Loop 0,5 m × 0,5 m	48
Table D.3 – Coupling coefficients XY-plane – Loop 0,5 m × 0,5 m	49
Table D.4 – Coupling coefficients XY-plane – Loop 1,0 m × 1,0 m	50
Table D.5 – Coupling coefficients Z-plane – Loop 1,0 m × 1,0 m	51
Table D.6 – Coupling coefficients XY-plane – Loop 1,0 m × 1,5 m	52
Table D.7 – Coupling coefficients Z-plane – Loop 1,0 m × 1,5 m	53
Table E.1 – Correlation factors – XY	56
Table E.2 – Correlation factors – Z	56

INTERNATIONAL ELECTROTECHNICAL COMMISSION

**ELECTRIC WELDING EQUIPMENT –
ASSESSMENT OF RESTRICTIONS RELATED TO HUMAN
EXPOSURE TO ELECTROMAGNETIC FIELDS (0 Hz TO 300 GHz) –**

Part 3: Resistance welding equipment

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, issue 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 62822-3 has been prepared by IEC technical committee 26: Electric welding.

The text of this International Standard is based on the following documents:

FDIS	Report on voting
26/626A/FDIS	26/630/RVD

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

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

A list of all parts in the IEC 62822 series, published under the general title *Electric welding equipment – Assessment of restrictions related to human exposure to electromagnetic fields (0 Hz to 300 GHz)*, can be found on the IEC website.

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

ELECTRIC WELDING EQUIPMENT – ASSESSMENT OF RESTRICTIONS RELATED TO HUMAN EXPOSURE TO ELECTROMAGNETIC FIELDS (0 Hz TO 300 GHz) –

Part 3: Resistance welding equipment

1 Scope

This part of IEC 62822 applies to equipment for resistance welding and allied processes designed for occupational use by professionals and for use by laymen.

NOTE 1 Typical allied processes are resistance hard and soft soldering or resistance heating achieved by means comparable to resistance welding equipment.

This document specifies procedures for the assessment of human exposure to magnetic fields produced by resistance welding equipment. It covers non-thermal biological effects in the frequency range from 0 Hz to 10 MHz and defines standardized test scenarios.

NOTE 2 The general term "field" is used throughout this document for "magnetic field".

NOTE 3 For the assessment of exposure to electric fields and thermal effects, the methods specified in the Generic Standard IEC 62311 or relevant basic standards apply.

This document does not define methods for workplace assessment regarding the risks arising from electromagnetic fields (EMF). However, the EMF data that results from the application of this Basic Standard can be used to assist in workplace assessment.

Other standards can apply to products covered by this document. In particular this document cannot be used to demonstrate electromagnetic compatibility with other equipment. It does not specify any product safety requirements other than those specifically related to human exposure to electromagnetic fields.

This document focuses on the use of coupling coefficients to assess the exposure to EMF.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 61796-1, *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*

IEC 61786-2, *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 62226-2-1, *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 2-1: Exposure to magnetic fields – 2D models*

IEC 62822-1, *Electric welding equipment – Assessment of restrictions related to human exposure to electromagnetic fields (0 Hz to 300 GHz) – Part 1: Product family standard*