IEC 62822-3

Edition 1.0 2017-09

INTERNATIONAL STANDARD

NORME INTERNATIONALE

colour inside

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

IEC 62822-3:2017-09(en-fr)

IEC Central Office
3, rue de Varembé
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 It also gives information on projects, replaced and withdrawn publications.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.

IEC 62822-3

Edition 1.0 2017-09

INTERNATIONAL STANDARD

NORME INTERNATIONALE

colour inside

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

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 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 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 61786-1, *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*

3 Terms, definitions, quantities, units and constants

3.1 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 60050-851, IEC 60974-1, IEC 60974-6, and the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at http://www.electropedia.org/
- ISO Online browsing platform: available at http://www.iso.org/obp

3.1.1
basic restrictions
exposure limit value
restrictions on exposure to electric, magnetic and electromagnetic fields that are based directly on established health effects and biological considerations

3.1.2
coupling coefficient
CC_B, CC_J, CC_E
coupling-coefficient that map the electric current in a field source to the maximum of the external magnetic flux density (CC_B), the maximum intracorporeal induced electric current density (CC_J) or the maximum intracorporeal electric field strength (CC_E) respectively

Note 1 to entry: Keeping in mind that the electric conductivity can be frequency dependent, a conversion between CC_J and CC_E is possible with the relation given in Formula (1)

$$J(j\omega) = \sigma(j\omega) \cdot E(j\omega) \quad (1)$$

3.1.3
exposure index
EI
result of the evaluation of exposure to (both sinusoidal and non-sinusoidal) EMF, expressed as a fraction or percentage of the permissible values

Note 1 to entry: Fractions higher than 1 (100 %) exceed the permissible values.

3.1.4
general public
individuals of all ages and of varying health conditions

3.1.5
health effect
adverse effect, such as thermal heating or stimulation of nerve and muscle tissue as a result of human exposure to EMF

3.1.6
intracorporeal
situated or occurring within the body

3.1.7
layman
operator who does not weld in the performance of his profession and may have little or no formal instruction in welding

[SOURCE: IEC 60050-851, 851-11-14, modified – "Arc welding" was replaced by "welding".]

3.1.8
non-thermal effect
stimulation of muscles, nerves or sensory organs as a result of human exposure to EMF

3.1.9
occupational exposure
exposure of workers to EMF at their workplaces, generally under known conditions, and as a result of performing their regular or assigned job activities

Note 1 to entry: A worker is any person employed by an employer, including trainees and apprentices

3.1.10
reference level
directly measurable quantity, derived from basic restrictions, provided for practical exposure assessment purposes

Note 1 to entry: Respect of the reference levels will ensure respect of the relevant basic restriction. If the reference levels are exceeded, it does not necessarily follow that the basic restriction will be exceeded.

3.1.11
resistance welding system
combination of power source, transformer, cabling and welding circuit

3.1.12
sensory effect
transient disturbed sensory perceptions and minor change in brain functions as a result of human exposure to EMF

3.1.13
standardized configuration
configuration reflecting the normal operator positions

3.1.14
standardized distance
distance from the axis of a part of the welding circuit to the closest surface of the body in standardized configurations

3.1.15
welding circuit
conductive material through which the welding current is intended to flow

Note 1 to entry: In resistance welding, the workpieces are not part of the welding circuit for the purposes of this document.

[SOURCE: IEC 60050-851, 851-14-10, modified – The two notes to entry have been deleted, and a new note to entry has been added.]

3.2 Quantities and units

The internationally accepted SI units are used throughout this document.

Symbols set in bold type are vector quantities.

Physical quantity	Symbol	Unit	Dimension
Electric conductivity	σ	Siemens per metre	S m^{-1}
Electric current	I	Ampere	A
Electric current density	J	Ampere per square metre	A m^{-2}
Electric field strength	E	Volt per metre	V m^{-1}
Frequency	f	Hertz	Hz
Magnetic flux density	B	Tesla	V s m^{-2}
Magnetic permeability	μ	Henry per metre	H m^{-1}

3.3 Constants

Physical constant	Symbol	Magnitude	Dimension
Permeability of free space	μ_0	$4 \cdot \pi \cdot 10^{-7}$	H m^{-1}

4 Requirements

Equipment shall be assessed as defined in Clause 8.

Assessments shall follow the provision in Clause 7.

If the assessment is conducted using calculated external field levels, 7.5 shall be applied in conjunction with Clause 5.

The results shall be reported as specified in Clause 8.

5 Coupling coefficients

5.1 General

A reference system shall be defined to measure the distances between the field source and the part of the human body to be assessed.

For occupational exposure, Figure 1 shows an example where two directions of approach are sufficient to be taken into account for setting a reference system.

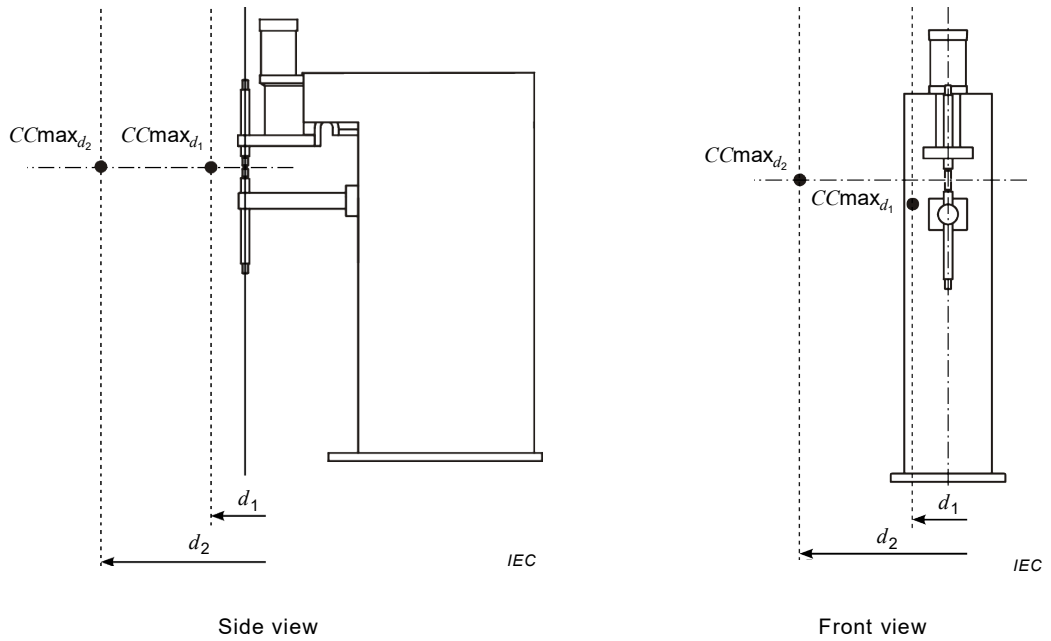

Figure 1 – Example of a reference system

NOTE 1 For other systems, other directions of approach can be considered because of its usage. More examples are shown in Annex A and Annex B.

NOTE 2 In Figure 1, the actual position of the highest *CC* in respect to the separation distance is only given for further illustration purposes.

NOTE 3 The front-view in Figure 1 illustrates a situation where the position of the highest *CC* changes in respect to the separation distance and symmetry-axis of the loop.

The coupling coefficients shall map a given welding current to the highest field quantity found at a specific separation distance within this reference system keeping in mind the degrees of freedom provided by the reference system.

NOTE 4 Annex C contains theoretical background information.

Separation distances are given in Table 1 and represent the standardized configurations.

If applicable national and international requirements exclude specific configurations (e.g. the assessment of the exposure of limbs is not required), coupling coefficients for these configurations may be omitted.

If applicable national and international requirements specifically call for the application of exposure configurations covered by this document, suitable assessment configurations following the underlying principles in Clauses 5, 6 and 7 shall be derived.

NOTE 5 For different field quantities (B, J, E) different sets of coupling factors can be used.

Clause 6 shall be applied for the modelling of the field source when deriving coupling coefficients for different field quantities.

Table 1 – Standardized distances

Head	300 mm
Trunk	200 mm
Limbs	100 mm

The coupling coefficients CC_J, and CC_E shall be obtained by the methods given in 5.2 and 5.3 as found appropriate by the manufacturer.

CC_B shall be either obtained using calculated (Clause 6) or measured (7.5) values of the magnetic flux density B.

The coupling coefficients CC for the different field quantities shall be calculated with Formulas (2), (3) and (4).

$$CC_B(R,d) = \frac{B_{max}}{I} \tag{2}$$

$$CC_J(R,d) = \frac{J_{max}(f)}{I \cdot f} \tag{3}$$

$$CC_E(R,d) = \frac{E_{max}(f)}{I \cdot f} \tag{4}$$

where

I is the welding current;

f is the frequency of the welding current;

R is the disk radius;

d is the distance to the field source;

B_{max}, J_{max}, E_{max} are the maxima of the field quantities B, J and E respectively.

5.2 Conductive disks

The simplest analytical model used in EMF health guidelines is based on the hypothesis of coupling between a uniform, external magnetic field at a single frequency, and a homogeneous disk of given conductivity, used to represent the part of the body under consideration. This is illustrated in Figure 2.

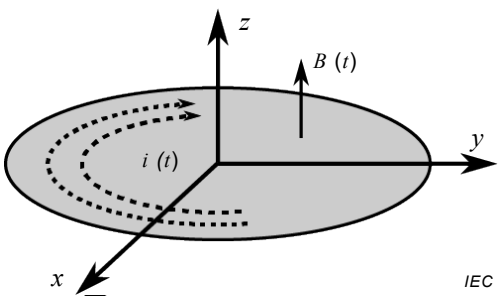

Figure 2 – Conducting disk in a uniform, time variant magnetic flux density

The radii of the disks which shall be used for calculations with regard to head, trunk and limbs of the welder's body are given in Table 2.

Table 2 – Radii for the 2D disk model

	Head	Trunk	Limbs	
			Hand	Thigh
Disk radius *R*	100 mm	200 mm	50 mm	100 mm

The electrical parameters used for modelling the human body are very critical. Average values of the electrical conductivity σ are given in Figure 3. These average values shall only be used for assessment procedures using simplified body models with homogeneous electrical conductivity.

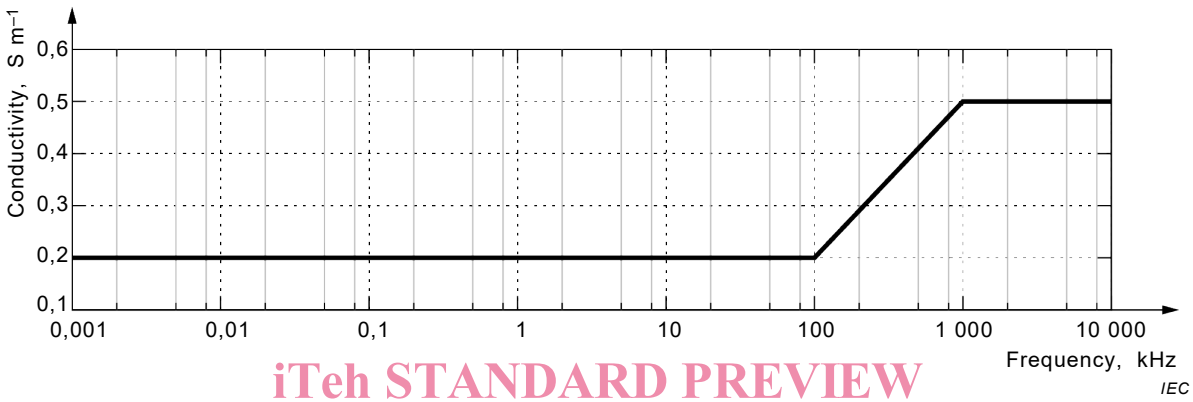

Figure 3 – Electrical conductivity for homogeneous body models

NOTE The frequency range can be limited when determining the coupling coefficients as appropriate.

The uncertainty for these values shall be taken as 0 % since the average values of the electrical conductivity, combined with the application of homogeneous body models, provide a conservative approach to the assessment of exposure.

IEC 62226-2-1 describes in detail the procedure to find E_{max} and J_{max} within the disk area.

To minimize numerical errors, appropriate averaging methods shall be applied to the induced field quantities.

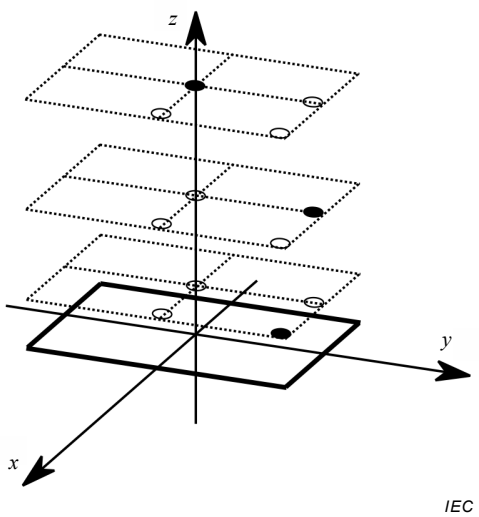

Figure 4 – Example of the placement of the conductive disks