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INTERNATIONAL STANDARD

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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





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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**

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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

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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

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iTeh STANDARD PREVIEW (standards.iteh.ai)

<u>IEC 62822-3:2017</u> https://standards.iteh.ai/catalog/standards/sist/030e2fff-3c7e-4e24-8810-45500c68ab27/iec-62822-3-2017

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

Part 3: Resistance welding equipment

Scope 1

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.

https://standards.iteh.ai/catalog/standards/sist/030e2fff-3c7e-4e24-8810-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.

Normative references 2

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

 $CC_{\mathsf{B}}, CC_{\mathsf{J}}, CC_{\mathsf{E}}$

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)

 $\frac{\text{IEC } 62822-3:2017}{\text{https://standards.iteh.ai/<math>J(i; \emptyset)/\overline{stag}(j; \emptyset)/\overline{stag}(j$

3.1.3 exposure index El

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".]

318

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 (standards.iteh.ai)

3.1.13

standardized configuration

IEC 62822-3:2017 configuration reflecting the normal operator positions //030e2fff-3c7e-4e24-8810-

45500c68ab27/iec-62822-3-2017

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 | Ι | Ampere | A |
| Electric current density | J | Ampere per square metre | A m ⁻² |
| Electric field strength | Ε | Volt per metre | V m ⁻¹ |
| Frequency | f | Hertz | Hz |
| Magnetic flux density | В | 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 Glause 7D PREVIEW

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 https://standards.iten.arcatalogistandards/sist/030e2fff-3c7e-4e24-8810-

45500c68ab27/iec-62822-3-2017

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.



- 11 -

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. STANDARD PREVIEW

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.

https://standards.iteh.ai/catalog/standards/sist/030e2fff-3c7e-4e24-8810-

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.

| Head | 300 mm |
|-------|--------|
| Trunk | 200 mm |
| Limbs | 100 mm |

Table 1 – Standardized distances

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.

- 12 -

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).

$$CC_{\mathsf{B}}(R,d) = \frac{B_{\mathsf{max}}}{I}$$
(2)

$$CC_{\mathsf{J}}(R,d) = \frac{J_{\mathsf{max}}(f)}{I \cdot f}$$
(3)

$$CC_{\mathsf{E}}(R,d) = \frac{E_{\mathsf{max}}(f)}{I \cdot f}$$
(4)

where

- is the welding current; Ι
- is the frequency of the welding current ARD PREVIEW f
- R is the disk radius;

is the distance to the field source; (standards.iteh.ai) d

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

https://standards.iteh.ai/catalog/standards/sist/030e2fff-3c7e-4e24 45500c68ab27/iec-62822-3-2017

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 | Truck | Limbs | |
|----------------------|--------|--------|-------|--------|
| | | TTUTK | Hand | Thigh |
| Disk radius <i>R</i> | 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.



NOTE The frequency range can be limited when determining the coupling coefficients as appropriate. https://standards.iteh.ai/catalog/standards/sist/030e2fff-3c7e-4e24-8810-

The uncertainty for these values shall be taken sas 302% rsince 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