



BSI Standards Publication

Safety in installations for electroheating and electromagnetic processing

Part 6: Particular requirements for high frequency dielectric
and microwave heating and processing equipment

National foreword

This British Standard is the UK implementation of EN IEC 60519-6:2024. It is identical to IEC 60519-6:2022. It supersedes BS EN 60519-6:2011, which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee PEL/27, Electroheating.

A list of organizations represented on this committee can be obtained on request to its committee manager.

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Date	Text affected
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English Version

Safety in installations for electroheating and electromagnetic processing - Part 6: Particular requirements for high frequency dielectric and microwave heating and processing equipment
(IEC 60519-6:2022)

Sécurité dans les installations destinées au traitement électrothermique et électromagnétique - Partie 6: Exigences particulières pour les équipements de chauffage et de traitement diélectriques à hautes fréquences et à hyperfréquences
(IEC 60519-6:2022)

Sicherheit in Elektrowärmeanlagen und Anlagen für elektromagnetische Bearbeitungsprozesse - Teil 6: Besondere Anforderungen für kapazitive Hochfrequenz- und Mikrowellen-Erwärmungs- und Bearbeitungseinrichtungen
(IEC 60519-6:2022)

This European Standard was approved by CENELEC on 2024-04-03. CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

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European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

CEN-CENELEC Management Centre: Rue de la Science 23, B-1040 Brussels

European foreword

The text of document 27/1142/FDIS, future edition 4 of IEC 60519-6, prepared by IEC/TC 27 "Industrial electroheating and electromagnetic processing" was submitted to the IEC-CENELEC parallel vote and approved by CENELEC as EN IEC 60519-6:2024.

The following dates are fixed:

- latest date by which the document has to be implemented at national (dop) 2025-01-03 level by publication of an identical national standard or by endorsement
- latest date by which the national standards conflicting with the (dow) 2027-04-03 document have to be withdrawn

This document supersedes EN 60519-6:2011 and all of its amendments and corrigenda (if any).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CENELEC shall not be held responsible for identifying any or all such patent rights.

This document has been prepared under a standardization request addressed to CENELEC by the European Commission. The Standing Committee of the EFTA States subsequently approves these requests for its Member States.

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Endorsement notice

The text of the International Standard IEC 60519-6:2022 was approved by CENELEC as a European Standard without any modification.

In the official version, for Bibliography, the following notes have to be added for the standard indicated:

IEC 62311:2019	NOTE	Approved as EN IEC 62311:2020 (not modified)
IEC 60335-2-25:2020	NOTE	Approved as EN IEC 60335-2-25:2021 (not modified) + A11:2021
IEC 60335-2-90:2015	NOTE	Approved as EN IEC 60335-2-90:2021 (not modified)
IEC 60335-2-90:2015/A1:2019	NOTE	Approved as EN IEC 60335-2-90:2021/A1:2021 (not modified)
IEC 60335-2-110:2013	NOTE	Approved as EN IEC 60335-2-110:2021 (not modified)
IEC 60335-2-110:2013/A1:2019	NOTE	Approved as EN IEC 60335-2-110:2021/A1:2023 (not modified)
IEC 60519-3	NOTE	Approved as EN 60519-3
IEC 60601-2-2:2017	NOTE	Approved as EN IEC 60601-2-2:2018 (not modified)
IEC 61010-2-010:2019	NOTE	Approved as EN IEC 61010-2-010:2020 (not modified)
IEC 61307:2011	NOTE	Approved as EN 61307:2011 (not modified)
IEC 61308:2005	NOTE	Approved as EN 61308:2006 (not modified)

Annex ZA (normative)

Normative references to international publications with their corresponding European publications

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.

NOTE 1 Where an International Publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

NOTE 2 Up-to-date information on the latest versions of the European Standards listed in this annex is available here: www.cencenelec.eu.

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
IEEE/ANSI C95.1	2019	IEEE standard for safety levels with respect to human exposure to electric, magnetic, and electromagnetic fields, 0 Hz to 300 GHz	-	-

CONTENTS

FOREWORD.....	4
INTRODUCTION.....	7
1 Scope.....	8
2 Normative references	9
3 Terms and definitions	9
3.1 General concepts.....	9
3.2 Equipment and state of equipment.....	11
3.3 Parts and accessories.....	13
4 Classification and subdivision of equipment and installations.....	13
4.1 Classification by processing frequency.....	13
5 Risk assessment	14
6 General provisions.....	14
7 Protection against hazards from electric shock	15
8 Protection against hazards from electric or magnetic fields.....	17
9 Protection against hazards from radiation.....	20
10 Protection against hazards from thermal influences	21
11 Protection against hazards from fire	21
12 Protection against hazards from fluids	22
13 Specific requirements for components and subassemblies	22
14 Control of the installation or equipment.....	22
15 Protection against mechanical hazards.....	23
16 Protection against hazards resulting from use	23
17 EMC	23
18 Verification and testing	23
19 Information for use	23
Annex A (normative) List of significant hazards.....	24
Annex B (normative) Limits to touch currents	25
Annex C (normative) Non coherent optical radiation – Limits and risk classes.....	26
Annex D (normative) Electric and magnetic fields	27
Annex E (normative) Surface temperature limits	28
Annex F (normative) EH, EPM and fire.....	29
Annex G (normative) Marking and warning.....	30
Annex H (informative) Guidelines on using this document.....	31
Annex I (informative) Connection with ISO 13577 (all parts).....	32
Annex J (informative) Requirements specific to the EU and associated countries.....	33
Annex AA (normative) Information for use.....	34
AA.1 General.....	34
AA.2 Labelling	34
Annex BB (normative) Measurements and evaluations of the high frequency emission and contact current	37
BB.1 General.....	37
BB.2 Conditions of equipment operation for measurements	37
BB.3 Evaluation of the HF field characteristics	

BB.4	Electric, magnetic fields, and contact currents.....	38
BB.5	Limiting values, continuous energising of the processing frequency source.....	39
BB.6	Limiting values, intermittent energising of the processing frequency source	39
BB.7	Relaxation for processing frequencies up to 41 MHz	39
BB.8	Risk classes.....	40
BB.9	Instrumentation	40
Annex CC	(normative) Measurements and evaluations of the microwave emission	44
CC.1	Conditions for measurement	44
CC.2	Measurement details.....	44
CC.3	Risk classes.....	44
CC.4	Instrumentation	45
Annex DD	(informative) Rationales for the high frequency emission limits and measurements	49
DD.1	The biological effects of HF emissions from 3 MHz to 300 MHz.....	49
DD.2	Today's agreed limits for operator safety	49
DD.3	Differences between the concepts in the cited standards and this document.....	50
DD.4	Field behaviour	51
DD.5	Conclusions	60
Annex EE	(informative) Rationales for the microwave barrier and associated microwave leakage tests.....	62
EE.1	Standard measurement of microwave emission.....	62
EE.2	Microwave hazards – SAR basic restriction.....	63
EE.3	Microwave hazard evaluation – free space exposure method	63
EE.4	Microwave hazards from openings in cavities, and from exit and entrance ports	64
EE.5	Time averaging	65
EE.6	Conclusions and modifications of the standards for ovens with a cavity door	66
Bibliography		67
Figure AA.1	– Examples of warning sign and labels	35
Figure AA.2	– Labels at open HF applicators and handheld or open MW applicators.....	35
Figure BB.1	– Large HF barrier for a conveyorised heating equipment scenario.....	42
Figure BB.2	– Conditions for a HF plastic welding equipment.....	43
Figure CC.1	– Large barrier for conveyorised microwave heating equipment.....	46
Figure CC.2	– Small microwave access barrier for conveyorised microwave heating equipment.....	47
Figure CC.3	– Vertical-only MW barriers for conveyorised microwave heating equipment.....	48
Figure DD.1	– The overall complete scenario (left) with details	53
Figure DD.2	– Field maxima with linear scaling (six top images) and decibel scaling (six bottom images)	55
Figure DD.3	– Quiver plots of momentary total fields at the same time phase	56
Figure DD.4	– Power density patterns in the body-parts receiving the highest exposure values	57
Figure DD.5	– E field comparisons 30/100 MHz, and 100 MHz field polarisation	58
Figure DD.6	– SAR maxima at 100 MHz in the scenario with only the body present	59
Table 101	– Dimensional requirements for HF/MW barriers.....	21
Table DD.1	– Maximum power densities in circularly cylindrical muscle objects irradiated by 100 MHz plane waves with the E field parallel to the axis	60

INTERNATIONAL ELECTROTECHNICAL COMMISSION

**SAFETY IN INSTALLATIONS FOR ELECTROHEATING
AND ELECTROMAGNETIC PROCESSING –****Part 6: Particular requirements for high frequency dielectric
and microwave heating and processing equipment**

FOREWORD

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IEC 60519-6 has been prepared by IEC technical committee 27: Industrial electroheating and electromagnetic processing. It is an International Standard.

This fourth edition cancels and replaces the third edition published in 2011.

This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

- a) the structure has been redrafted according to the IEC 60519-1:2020;
- b) the scope and object have been redrafted;
- c) the terms/definitions, normative references and bibliography have been updated and completed;

- d) all requirements and content from IEC 60519-6:2011 which are included in IEC 60519-1:2020 were removed to avoid any duplication;
- e) inclusion of high frequency equipment which was previously covered by IEC 60519-9:2005 (withdrawn). This edition constitutes an extension to high frequency equipment.

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

Draft	Report on voting
27/1142/FDIS	27/1144/RVD

Full information on the voting for its approval can be found in the report on voting indicated in the above table.

The language used for the development of this International Standard is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/standardsdev/publications.

A list of all parts in the IEC 60519 series, published under the general title *Safety in installations for electroheating and electromagnetic processing*, can be found on the IEC website.

The clauses of this part 6 of the IEC 60519 series (called Particular Requirements) supplement or modify the corresponding clauses of IEC 60519-1:2020 (*General Requirements*), hereinafter called Part 1.

In this standard, the following print types are used:

- requirements and definitions: in roman type;
- NOTES: in smaller roman type;
- terms defined in Clause 3 in this document and in Part 1 are in **bold type**, from Clause 1.

This part of IEC 60519 is to be read in conjunction with Part 1. It supplements or modifies the corresponding clauses of Part 1. Where the text indicates a “modification” of, “addition” to or a “replacement” of the relevant provision of Part 1, these changes shall be made to the relevant text of Part 1. Where no change is necessary, the words “This clause of Part 1 is applicable” are used. When a particular subclause of Part 1 is not mentioned in this part, that subclause applies as far as is reasonable. When a particular subclause of Part 1 is not applicable, the word “void” is used.

Additional specific provisions to those in Part 1, given as individual clauses or subclauses, are numbered starting from 101.

NOTE The following numbering system is used:

- subclauses, tables and figures that are numbered starting from 101 are additional to those in Part 1;
- unless notes are in a new subclause or involve notes in Part 1, they are numbered starting from 101, including those in a replaced clause or subclause;
- additional annexes are lettered AA, BB, etc.

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.

INTRODUCTION

Some types of **electroheating equipment**, including the **workload**, can emit hazardous levels of infrared radiation. It has been agreed in the IEC Technical Committee 27 that IEC 60519-12 addresses these infrared radiation aspects for this document.

This document presumes that the **manufacturer** possesses sufficient knowledge in equipment design, manufacturing and documentation in accordance with good engineering practise, and that the installation or equipment is operated and maintained only by personnel consisting of **skilled or instructed persons**.

This document is intended to verify whether the installation or equipment meets the requirements of safety, by design, and numerical verification if carefully carried out, site acceptance tests, routine tests or inspection.

SAFETY IN INSTALLATIONS FOR ELECTROHEATING AND ELECTROMAGNETIC PROCESSING –

Part 6: Particular requirements for high frequency dielectric and microwave heating and processing equipment

1 Scope

This clause of Part 1 is modified by the following regarding the areas of application.

Modification:

This part of IEC 60519 is applicable to equipment using high frequency or microwave energy alone or in combination with other kinds of energy for industrial heating and processing of materials. It is also applicable to **HF** and **MW generators** made available to **users** as separate units.

This part is applicable to equipment operating in the frequency range 3 MHz to 300 GHz, with the following limitations.

- This document applies to only high frequency **dielectric heating** and **processing** as defined in 3.1.103. It does not apply to induction heating, which it is possible to carry out in the lower part of the specified frequency band and is covered by IEC 60519-3, with magnetic field safety aspects addressed in IEC TS 62997:2017, the latter to be replaced by a technical report (TR) or by a revised technical specification (TS).
- The ISM centre frequencies for **dielectric heating** and **processing** of industrial interest are narrow bands about 6,78 MHz, 13,56 MHz, 27,12 MHz and 40,68 MHz. Different field **emission** measurement procedures and limiting values are applicable, depending on the **processing frequency** in the high frequency range 3 to 300 MHz. Specifications are in Annex BB.
- This document specifies limits for microwave **emission** only for the ISM frequencies between 800 MHz and 6 MHz, as specified in Annex CC. For other microwave frequencies the **basic restriction** and IEC 62311 apply.
- The foundations for compliance with **emission** values are the **basic restrictions**, referred to in the IEEE/ANSI C95.1:2019 and Directive 2013/35/EU. However, maximum **HF processing frequency** electric and magnetic field values are taken from the IEEE/ANSI C95.1:2019 standard, as indicated in Annex BB.
- This document is not applicable to:
 - appliances for household and similar use (covered by e.g. IEC 60335-2-25);
 - commercial use (covered by IEC 60335-2-90 and IEC 60335-2-110);
 - laboratory use (covered by IEC 61010-2-010);
 - medical high frequency equipment and accessories (covered by IEC 60601-2-2).

NOTE 101 Since high frequency and microwave tunnel ovens and also some other types of microwave and high frequency equipment are sometimes intended either for commercial, laboratory or industrial use, the following criteria are suitable for determination of the classification as industrial equipment:

- commercial equipment is typically designed and planned for series production of many identical units, whereas industrial equipment is typically produced in small series or even as single units. The processed goods are consumed or ready for final use at the end of the heating process.
- laboratory heating equipment is for preparing material in a laboratory environment, and the processed material is immediately available for investigations or further processing. Regular production of large quantities of material is not foreseen.

- with industrial equipment, the processed goods are not immediately accessible to the end user, and the goods are sometimes not in a final state from the perspective of the end user.

2 Normative references

This clause of Part 1 is applicable with the following addition.

Addition:

IEEE/ANSI C95.1:2019, *IEEE standard for safety levels with respect to human exposure to electric, magnetic, and electromagnetic fields, 0 Hz to 300 GHz*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 60519-1 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>

Additions:

3.1 General concepts

3.1.101

basic restrictions

BR

restrictions on *in situ* (i.e. internal) electric fields or specific absorption rates (SAR) or power densities with time and spatial averaging or integration, resulting from a part of or the whole body being subjected to an external alternating electric (E) field, magnetic (B) flux or electromagnetic field, and that are intended to be based directly on resulting established pathophysiological effects

Note 1 to entry: The term exposure is defined in 3.4.14 in Part 1. Other definitions are provided in Annex DD.2.1. There are no exposure requirements in this document since its definition does not consider any specific characteristics of the source and **accessible emission**, as in this document. See Note 3 to entry.

Note 2 to entry: **Basic restrictions** have a safety margin to harm.

Note 3 to entry: Sources of scientific and medical information on numerical values of limits for workers are e.g. IEEE, ICNIRP and EU; see the Bibliography. Another term for the **basic restrictions** is exposure limit values (ELV).

Note 4 to entry: Time factors of **specific absorption rates (SAR)** or power densities, i.e. energy absorption versus time and over which tissue volumes are necessary for establishing criteria.

[SOURCE: IEC TS 62997:2017, 3.1.2, modified, to be replaced by a technical report (TR) or by a revised technical specification (TS)]

3.1.102

contact current

induced current

current flowing into the body resulting from contact with a conductive object in an electric, magnetic or electromagnetic field

Note 1 to entry: The scientific definition of induced current in IEC 60050-121:1998, 121-11-29 is replaced here, but the definitions are consistent.

Note 2 to entry: A **touch current** flows through the body or body-parts between two defined contact areas as defined in e.g. Entry 3.4.6 in Part 1.

[SOURCE: IEC TR 63167:2018, 3.1]

3.1.103

dielectric heating and processing

electric treatment process in which the heat is generated in lossy dielectric or semiconducting **HF loads** in the frequency range 1 MHz to 300 MHz

Note 1 to entry: The addition of "lossy" is used in this context since the power absorption mechanism can be by dipolar relaxation and ionic or other conductivity phenomena.

Note 2 to entry: **Dielectric heating** and **processing** does not apply to metallic **HF loads**.

[SOURCE: IEC 60050-841:2004, 841-28-01, modified – The entry has been extended by adding "processing", the definition has been completed by adding "lossy" and two notes have been added.]

3.1.104

electric nearfield

accessible emission of an electric field at a distance, characterised by fulfilling the criterion of **dielectric heating and processing**

Note 1 to entry: The practical consequence of the definition is that the **accessible emission** of the electric nearfield energy (proportional to $\epsilon_0|E|^2$) is approximately equal to or higher than the magnetic nearfield energy (proportional to $\mu_0|H|^2$) in the same locations, where ϵ_0 is the electric constant and μ_0 the magnetic constant. Due to the relative phase of these fields, their coupling to body-parts is very different than from a propagating electromagnetic field.

3.1.105

electromagnetic emission

phenomenon by which electric, magnetic or electromagnetic energy is available near a source

Note 1 to entry: The **emission** characteristics and equipment-related precautionary measures are used instead of operator exposure limits in this document, and are intended to result in a tolerable risk as defined in ISO/IEC Guide 51.

Note 2 to entry: The source data used in this document is typically based on field properties of the **accessible emission**, but high frequency fields are also characterised/limited by the particular conditions for **dielectric heating and processing**.

Note 3 to entry: The energy is basically reactive where body-parts are present, i.e. non-radiating (evanescent).

[SOURCE: IEC 60050-161:1990, 161-01-08, modified – The definition has been modified by replacing the words "electromagnetic energy emanates from a source" by "electric, magnetic or electromagnetic energy is available near a source" and notes to entry have been added.]

3.1.106

HF/MW transparency

property of a material having negligible absorption and reflection of high frequency or microwave fields

Note 1 to entry: The relative permittivity of a microwave transparent material is usually less than 7 and the loss factor is usually less than 0,015.

[SOURCE: IEC 60050-841:2004, 841-29-14, modified – In the definition, the word "microwaves" has been replaced by "high frequency or microwave fields".]

3.1.107**prospective primary capacitive current area**

part of the body in its most onerous position facing the live source

[SOURCE: IEC TS 62996:2017, 3.7, to be replaced by a technical report (TR) or by a revised technical specification (TS)]

3.1.108**secondary contact area**

live part or ground, with or without protective insulation, through which the current flows when the primary contact area is being contacted or touched, or through the **prospective primary capacitive current area**

[SOURCE: IEC TS 62996:2017, 3.10, to be replaced by a technical report (TR) or by a revised technical specification (TS)]

3.1.109**spark discharge**

transfer of current across an air gap prior to making contact with another conductive object at a different potential

[SOURCE: IEC TR 63167:2018, 3.6]

3.1.110**reference surface**

fictitious surface in the vicinity of mainly the **entrance and exit ports**, located as a consequence of **HF/MW leakage** measurements of **accessible emission**

Note 1 to entry: See 9.1.1.103 for the practical specifications.

3.1.111**scenario**

in numerical modelling, all relevant geometrical parts/components/body-parts, locations and dimensions, all complex permittivities, boundary conditions, source characteristics, excitation and operating frequency or frequency interval

3.2 Equipment and state of equipment**3.2.101****accessible <HF/MW> emission****HF/MW leakage**

electromagnetic, electric or magnetic field existing near the equipment where practically relevant measurement results related to **induced electric shock** or body-part SAR are considered possible

Note 1 to entry: Measurements of the field characteristics very close to a **processing frequency** source or a mechanically accessible part of the equipment are considered unreliable with regard to the possible specific absorption rate (SAR) in a body-part located there. As a consequence, minimum distances between the field measurement probe and mechanically accessible parts are to be defined, as is done in 9.1.1.103.

[SOURCE: IEC 60519-1:2020, 3.4.15, modified by addition of the necessity of the emission to be measurable]

3.2.102**cover**

structural feature of any part of the **HF/MW equipment** which can be opened or removed by the use of a tool to provide access for routine maintenance, service, replacement of expendable parts, etc.

3.2.103

entrance port

exit port

openings in the **HF/MW enclosure** through which the **HF/MW load** moves

3.2.104

HF applicator

device comprising the heating capacitive device or work electrodes with their fixing and positioning systems, impedance matching circuits (if not situated in the generator assembly) and, where necessary, protective and screening devices, means for transport, supply and ventilation

3.2.105

HF enclosure

MW enclosure

enclosure intended to confine the electromagnetic, electric or magnetic energy to a defined region

Note 1 to entry: Examples are a **microwave cavity**, door seals and waveguides.

Note 2 to entry: **HF/MW barriers** mounted outside the **HF/MW enclosure** are not considered to be a part of it.

[SOURCE: IEC 60050-841:2004, 841-29-20, modified by extension to lower-frequency fields]

3.2.106

high frequency generator

HF generator

source used to produce electromagnetic energy in the **processing frequency** range from 3 MHz to 300 MHz

3.2.107

HF/MW interlock

interlock that prevents unacceptably high **HF/MW emission**

3.2.108

HF/MW load

objects in the treatment region of the **HF/MW applicator**

Note 1 to entry: This includes the **workload** as well as an intermediate electromagnetic ionised gas (plasma), and any containers, as well as **test loads** for determination of **HF/MW generator** characteristics.

[SOURCE: IEC 60050-841:2004, 841-29-12, modified by extension to lower-frequency fields]

3.2.109

MW applicator

structure which applies the electromagnetic energy to the **MW load**

EXAMPLE A **microwave cavity**, a plasma source, or a **handheld applicator**

[SOURCE: IEC 60050-841:2004, 841-29-11, modified by addition of examples]

3.2.110

microwave cavity

space enclosed by inner metal walls and a door or an access opening and in which the **micro-wave load** is placed

[SOURCE: IEC 60050-841:2004, 841-29-19, modified by use of the term microwave load]

3.2.111**microwave generator****MW generator**

source used to produce electromagnetic energy in the **processing frequency** range from 300 MHz to 300 GHz

3.3 Parts and accessories**3.3.101****HF/MW barrier**

barrier which is **HF/MW transparent** and does not influence the HF/MW field

Note 1 to entry: **HF/MW barriers** may be fixed to the equipment or not; in either case they are considered to be a part of the installation.

Note 2 to entry: Devices such as an array of metal chains or hinged metal plates at **entrance and exit ports** intended to reduce **HF/MW leakage** are not considered **HF/MW barriers**.

Note 3 to entry: The **transparency** also applies to **guards**.

3.3.102**HF screen**

screen that, when removed, significantly increases the **HF emission** in the region which it is intended to protect

Note 1 to entry: **HF screens** are reflective or absorptive, or both.

Note 2 to entry: **HF screens** may be fixed to the equipment or not; in either case they are considered to be a part of the installation.

Note 3 to entry: Devices such as hinged metal plates at **entrance and exit ports** intended to reduce **HF emission** are considered to be **HF screens**.

Note 4 to entry: The non-**transparency** also applies to **obstacles**.

3.3.103**maintenance door**

all structural features of any part of the MW/HF equipment which can be opened or removed without the use of a tool to provide access to locations other than the **HF/MW applicator** or **microwave cavity**

3.3.104**test load**

artificial power-absorbing device used for testing **HF/MW generators** with similar equivalent impedance to the actual **HF/MW load** for which the equipment is designed, to allow the output power to be applied under **normal operation** in the absence of the actual load

4 Classification and subdivision of equipment and installations

This clause of Part 1 is applicable with the following.

4.1 Classification by processing frequency

Modifications:

4.1.101 High frequency in this document means rated **processing frequencies** between 3 MHz and 300 MHz, and microwave means **processing frequencies** which are higher than 300 MHz.

NOTE **Dielectric heating and processing** frequencies less than 3 MHz are not considered industrially feasible.

4.1.102 For **HF dielectric heating and processing frequencies** up to 300 MHz, field measurement principles, methods and **emission** limits are specified in Annex BB. Magnetic fields shall also be measured for **HF processing frequencies** 100 MHz and higher, and both the maximum electric and magnetic emission levels shall then be complied with. For **HF processing frequencies** less than 100 MHz, **contact currents** are measured as an alternative to magnetic field measurements.

NOTE There are relaxations of the electric field emission levels as specified in Clause BB.6 for equipment with processing frequencies less than 41 MHz, determined to fulfil the criteria in BB.3.2 for **dielectric heating and processing**.

4.1.103 For microwave **processing frequencies** from 800 MHz to 6 GHz, probes sensing the electric field only are accepted. Measurement principles, methods and **electromagnetic emission** limits are specified in Annex CC. IEC 62311 applies for lower and higher microwave **processing frequencies**.

5 Risk assessment

This clause of Part 1 is applicable.

6 General provisions

This clause of Part 1 is applicable except as follows:

6.4 Physical environment and operating conditions for electrical equipment caused by operation of the processing equipment

Additions to 6.4.2:

6.4.2.101 Unintended conveyor stops during HF/MW operation and operation under conditions which are not **normal operation** are defined as a single fault condition. Requirements for these kinds of abnormal operation regarding excessive heating of the **HF/MW load** are in 11.101; requirements for HF and microwave leakage are in 9.1.103, and for interlock functions in 14.4.101 to 14.4.103.

6.4.2.102 The following applies to HF equipment: Operation without a load or interruption of the flow of **HF loads** is a case of **normal operation** for some types of equipment and shall not result in a non-compliant **HF emission**. Compliance with this requirement can be checked by detection of the **HF emission** or by the equipment operation being stopped by other means. Defeating the safety circuit is considered to be a single fault condition. The requirements on **HF emission** levels for this condition are those for **normal operation** in 9.1.1.103.

6.4.2.103 The following applies to MW equipment: no-load operation of MW equipment and interruption of the flow of **MW load(s)** shall be protected against. Compliance with this requirement can be checked by detecting the **MW emission** by an active leakage monitor which switches off the **MW generator** in order for the requirements of Annex CC to be fulfilled. Defeating the safety sensor circuit is considered a single fault condition. Requirements on **MW emission** levels for this condition are in 9.1.1.102.

6.4.2.104 Any single electrical or mechanical fault in the HF/MW equipment under **normal operation** shall not result in energising the **HF/MW generator**.

NOTE 1 A mechanical fault in an array of metal chains or hinged metal plates at entrance and exit ports intended to reduce MW or HF field leakage is a single fault condition.

NOTE 2 Compliance with this requirement can be checked by inspection of the circuit diagrams and/or with the measurements as specified in Annex BB or Annex CC.

For the purpose of testing, all **maintenance doors**, **means of access** and **HF/MW barriers** and **HF screens** are removed or opened, except those which incorporate **HF/MW interlocks** which prohibit generation of HF/MW power when removed or open. Attempts to start **normal operation** shall be made and shall not result in **HF emission or MW leakage** exceeding the limits in 9.1.1.103 and Annex BB or Annex CC.

6.4.2.105 The following applies to HF equipment: If no-load operation is likely to damage the equipment, suitable interlock(s) shall be provided to ensure that this cannot occur.

6.4.2.106 If a reduction occurs of the liquid flow of any microwave-absorbing means which require flow of a liquid, its flow shall operate at least one interlock, if the said reduction results in microwave emission in excess of the limit specified in Annex CC.

NOTE Measurements according to Annex CC are limited to the microwave frequencies 800 MHz to 6 GHz. Clause 1 applies for other frequencies.

6.4.2.107 In MW equipment with means for absorbing microwave energy without any dedicated cooling, the absorbing function shall not be impaired by excessive temperature rises in the absorber. This is tested under **normal operation**, and also under conditions of abnormal operation as specified in 9.1.1.102. The absorbing means shall remain securely in place and not be degraded.

6.6 Access

Addition to 6.6.1:

6.6.1.101 MW/HF equipment shall be designed, constructed and operated as to provide adequate protection against hazards due to electric, magnetic and electromagnetic emissions.

The HF/MW equipment shall be provided with a device giving adequate indication of when the **processing frequency** power is switched on and which is clearly visible to anyone entering the general area of the installation.

Where the **processing frequency** power can be or is varied by a user control, an indicator shall show the operator the level of applied power.

Addition to 6.6.2:

6.6.2.101 The following applies for fixed equipment and installations: There shall be a key switch, code panel, card reader or similar device on the control panel requiring the insertion of a key, input of a code or card or similar before **processing frequency** power can be generated.

7 Protection against hazards from electric shock

This clause of Part 1 is applicable except as follows:

7.3 General provisions

Addition to 7.3.4:

7.3.4.101 Maintenance doors allowing access to high voltage parts of the **HF/MW generator** assembly shall be provided with key locks or interlocks as appropriate according to the voltage band of the supply. If **HF/MW emission** is possible, 14.101 also applies.

7.4 Basic protection

NOTE The particular requirements on **HF/MW barriers** and **screens** are given in 8.5.5.

Addition to 7.4.6

7.4.6.101 The potential grading impedance of the **HF processing frequency** earth circuit is important, in particular that of earthed electrodes and that which is due to the small energy penetration depth of metals at these frequencies (see Formula (1) in 8.5.4 in Part 1).

7.6 Protective equipotential bonding

Addition to 7.6.2:

7.6.2.101 Earthing of the **HF processing frequency** circuit is allowed, to the mains earth at single suitable point directly in galvanic contact with the **enclosure**. Current loops shall be avoided, since they may cause HF emission and also interference with radio frequency communication.

Replacement of 7.6.3:

7.6.2.102 Earthing of one of the high voltage poles of the **HF/MW generator** power supply (or supplies) is allowed. If the power supply and the microwave generator are not in the same metal housing and thus have a common chassis, an additional high voltage cable, in addition to normal means for earthing, and having the same class of insulation as for the high voltage cables, shall be mounted between the chassis of the high voltage power supply and the **HF/MW generator** chassis, and marked so that no confusion is possible. The mounting point shall not be used for any other purpose and be marked with a label containing the equivalent of "HIGH VOLTAGE RETURN – DO NOT DISCONNECT" in at least 3 mm lettering. The warning text shall be in the necessary language(s).

7.7 Additional provisions for fault protection for frequencies above 200 Hz

Replacement of 7.7.4:

7.7.4.101 Earthing of the **HF processing frequency** circuit is allowed.

NOTE This relaxation is also addressed in 7.6.2.101 and 7.6.2.102.

7.9 Touch current and touch voltage

Addition:

7.9.101 HF processing frequency touch voltages, and by that also such **touch currents** shall be protected against.

Typically with dielectric heating and processing equipment, the processing frequency voltages are high and touch currents would be harmful and shall therefore be protected against, eliminated, or reduced to insignificant levels by design.

NOTE 1 See the additions in this document to Clause 6 and in 8.5.5.104.

NOTE 2 Contact currents are dealt with in 8.1.2.101.

MW processing frequency touch voltages and **touch currents** are irrelevant and are replaced by the specifications in Annex CC.

8 Protection against hazards from electric or magnetic fields

This clause of Part 1 is applicable except as follows:

8.1 General

Addition to 8.1.1:

8.1.1.101 Additional provisions for **HF emission** are given in Annex BB, and for **MW emission** in Annex CC.

Addition to 8.1.2:

8.1.2.101 Induced currents at the HF **processing frequency**, in principle between the feet of a standing earthed operator and the floor or similar are the most onerous and typically maximum in the ankles. They shall be measured in cases where direct conductive contact between the feet and floor is possible. The measurements are specified in Annex BB for this case, and the case where the operator is sitting on a fully earthed chair.

If required in the manufacturer's specifications, special insulating and protecting footwear are allowed. The capacitance and risk of arcing of the special footwear shall be controllable and shall not deteriorate with time, or it should be regularly replaced. Such information shall be included in the **manufacturer's** instructions to the **user** and information signs about maintenance, cleanliness, etc, shall be posted near the operator position.

Alternatively, if an insulated standing area is used instead, this should be designed and have such a large area that the operator using the equipment is not able to use the equipment when standing outside the area and at arm's reach, 850 mm, away from the normal operating position. Furthermore, it shall not be possible for the operator to touch any objects in the installation other than those intended by the manufacturer to be accessible.

The measurements of the induced current are made with one or two naked feet of the operator with or without the protective footwear standing on a slightly raised and insulated flat metal plate with a surface just covering the contact area and the floor as earthed or with the insulated stand. The current measurement is made with special low HF impedance instrumentation connected between the flat metal plate and ground. The operation of the equipment shall be started after the operator is standing in the test position. The other procedures in BB.4.3 shall be adhered to.

As an alternative, an HF current clamp meter around the ankle is used for the current measurements, as described in BB.4.3.

The operator should move the body, arms and hands into various positions during the test, for obtaining the most onerous reading.

Addition to 8.1.3

8.1.3.101 Limits for **HF emission** are given in Clauses BB.5 and BB.6, and for **MW emission** in 9.1.1.102 and Annex CC. Any national regulations on HF and MW **emission** based on the reference surface concept should be adhered to; also see Note 101 in Annex J.

8.5 Requirements related to barriers and screens

Additions to 8.5.5:

8.5.5.101 The equipment including **HF/MW barriers** or **HF screens** installed in order to limit access of personnel to a distance from the **HF/MW enclosure** are either enclosing the **entrance or exit port** and mounted on the equipment, or not a part of it but of the installation and are then essentially only vertical, unless their mechanical strength and that of the supports are sufficient to allow them to be leant upon. All types shall comply with the following:

- **HF/MW barriers** shall not be constructed of metal or a **processing frequency** power absorbing material in such a way that they can guide or absorb such power;
HF/MW screens shall be so designed that no significant heating of them occurs under **normal operation** and single fault condition;
- dimensions of any accessible opening in the **HF/MW barrier or HF screen** as such shall not be larger than the openings of the **HF/MW enclosure** which they protect, with a maximum of 65 mm × 65 mm; the requirement of maximum dimensions 65 mm × 65 mm is not applicable for any openings in **HF/MW barriers** or **HF screens** through which the **HF/MW loads** move;
- **HF windows** in the **HF enclosure** shall have maximum openings 65 mm × 65 mm or maximum diameter 75 mm.
- **MW windows** in the **microwave enclosure** shall have metal tube lengths and maximum openings which create an efficient cut-off of any propagation; see Table 101.
- the **HF/MW barriers** and **HF screens** shall either be removable only with the aid of a tool, or their removal shall operate at least one interlock, and shall have a warning label to advise of its function;
- **HF/MW barriers** and **HF screens** that are only vertical and located along the **MW/HF load** transport direction shall start at maximum 75 mm and end at least 1 800 mm above the floor. This height is applicable if **HF/MW** emission at levels comparable to the maximum allowed emission levels or risk of **touch currents** exist just inside the **barrier/screen**; lower vertical barrier/screen heights which only require persons to stand at a certain minimum distance from the equipment are allowed if the arm's reach criterion of 850 mm to regions with maximum allowed emission levels is fulfilled.

NOTE 1 The ≤75 mm limit in the last dashed item above is intended to prohibit access by arm's length while simplifying cleaning of the floor. It can be modified by national sanitation requirements for food processing or similar justifiable reasons. The ≥1 800 mm (or modified) **HF/MW barrier** height requirement, with the appropriate warning sign as specified in Annex AA and shown there and in Annex G is intended to make it obvious that access is not allowed.

NOTE 2 **HF/MW barriers** and **screens** that are only vertical can be supported by metal poles or similar, provided that these poles do not increase the emissions or otherwise detract from the purpose of the **HF/MW barrier** or **screen**.

NOTE 3 For **HF/MW barriers** and **HF screens** which are not fixed to the **HF/MW** equipment and are instead a part of the installation, Annex BB or Annex CC also applies.

NOTE 4 The ≤65 mm × ≤65 mm requirement for accessible opening dimensions in **HF/MW barriers** and **HF screens** and **windows** are to prevent insertion of the human hand, as is the <Ø 75 mm requirement for **MW barriers** in Table 101; this is also applicable to **HF windows**.

8.5.5.102 The dimensional and location requirements for **HF barriers, screens, guards and obstacles** are set in relation to the type of protection and the field decay properties in the **reference surface** region, and are given in Table 101. Instructions and warning signs or labels should be provided to warn against insertion of e.g. metal objects through openings in the **barriers** or **screens**.

For **HF barriers**, the geometry is calculated from the **reference surface**, which is at the probe positions obtained in 9.1.1.103. In order for this to be determined, **HF barriers** are removed and their associated interlocks are defeated.

NOTE 1 Electric and magnetic field measurements closer than the specified 150 mm from any metallic surface of the **HF enclosure** are not realistic, due to the nearfield characteristics.