



BSI Standards Publication

Safety in installations for electroheating and electromagnetic processing

Part 1: General requirements

National foreword

This British Standard is the UK implementation of EN IEC 60519-1:2020. It is identical to IEC 60519-1:2020. It supersedes BS EN 60519-1:2015, which is withdrawn.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 secretary.

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© The British Standards Institution 2020
Published by BSI Standards Limited 2020

ISBN 978 0 580 52160 7

ICS 25.180.10

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This British Standard was published under the authority of the Standards Policy and Strategy Committee on 30 June 2020.

Amendments/corrigenda issued since publication

Date	Text affected
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English Version

**Safety in installations for electroheating and electromagnetic
processing - Part 1: General requirements
(IEC 60519-1:2020)**

Sécurité dans les installations destinées au traitement
électrothermique et électromagnétique - Partie 1: Exigences
générales
(IEC 60519-1:2020)

Sicherheit in Elektroerwärmungsanlagen und Anlagen für
elektromagnetische Bearbeitungsprozesse - Teil 1:
Allgemeine Anforderungen
(IEC 60519-1:2020)

This European Standard was approved by CENELEC on 2020-04-15. 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 27/1121/FDIS, future edition 6 of IEC 60519-1, 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 60519-1:2020.

The following dates are fixed:

- latest date by which the document has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 2021-01-15
- latest date by which the national standards conflicting with the document have to be withdrawn (dow) 2023-04-15

This document supersedes EN 60519-1:2015 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 mandate given to CENELEC by the European Commission and the European Free Trade Association, and supports essential requirements of EU Directive(s).

For the relationship with EU Directive(s) see informative Annex ZZ, which is an integral part of this document.

Endorsement notice

The text of the International Standard IEC 60519-1:2020 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 standards indicated:

IEC 60079 series NOTE Harmonized as EN 60079 series
IEC 60335 series NOTE Harmonized as EN 60335 series
IEC 60519 series NOTE Harmonized as EN 60519 series
IEC 60601 series NOTE Harmonized as EN 60601 series
IEC 60974 series NOTE Harmonized as EN 60974 series
IEC 61010 series NOTE Harmonized as EN 61010 series
IEC 61140:2016 NOTE Harmonized as EN 61140:2016 (not modified)
IEC 62226 series NOTE Harmonized as EN 62226 series
IEC 62311 NOTE Harmonized as EN IEC 62311

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.cenelec.eu.

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
IEC 60071-1	2006	Insulation co-ordination - Part 1: Definitions, principles and rules	EN 60071-1	2006
+A1	2010		+A1	2010
IEC 60204-1	2016	Safety of machinery - Electrical equipment of machines - Part 1: General requirements	EN 60204-1	2018
IEC 60204-11	2018	Safety of machinery - Electrical equipment of machines - Part 11: Requirements for equipment for voltages above 1 000 V AC or 1 500 V DC and not exceeding 36 kV	EN IEC 60204-11	2019
-	-		+corrigendum Feb.	2010
IEC 60228	2004	Conductors of insulated cables	EN 60228	2005
+ A1	2013		-	-
+ A2	2016		-	-
IEC 60335-1 (mod)	2010	Household and similar electrical appliances - Safety - Part 1: General requirements	EN 60335-1	2012
-	-		+A11	2014
			+A13	2017
			+A14	2019
+A1	2013		+A1	2019
+A2	2016		+A2	2019
IEC 60335-2-24	-	Household and similar electrical appliances - Safety - Part 2-24: Particular requirements for refrigerating appliances, ice-cream appliances and ice makers	EN 60335-2-24	2010
IEC 60335-2-89	-	Household and similar electrical appliances - Safety - Part 2-89: Particular requirements for commercial refrigerating appliances with an incorporated or remote refrigerant condensing unit or compressor	EN 60335-2-89	2010
-	-		+A1	2016
			+A2	2017
IEC 60364-1 (mod)	2005	Low-voltage electrical installations - Part 1: Fundamental principles, assessment of general characteristics, definitions	HD 60364-1	2008
-	-		+A11	2017
IEC 60364-4-41 (mod)	2005	Low-voltage electrical installations - Part 4-41: Protection for safety - Protection against electric shock	HD 60364-4-41	2017

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-	-		+A11	2017
			+A12	2019
+A1	2017			
IEC 60364-4-42	2010	Low-voltage electrical installations - Part 4-42: Protection for safety - Protection against thermal effects	HD 60364-4-42	2011
+A1	2014		+A1	2015
IEC 60364-4-44 (mod)	2007	Low-voltage electrical installations - Part 4-44: Protection for safety - Protection against voltage disturbances and electromagnetic disturbances	HD 60364-4-44	2012
+A1 (mod)	2015		HD 60364-4-443	2016
+A2	2018			
IEC 60364-5-53	2001	Electrical installations of buildings - Part 5-53: Selection and erection of electrical equipment - Isolation, switching and control		-
+ A1 (mod)	2002		HD 60364-5-534	2016
+ A2 (mod)	2015			
IEC 60364-5-54	2011	Low-voltage electrical installations - Part 5-54: Selection and erection of electrical equipment - Earthing arrangements and protective conductors	HD 60364-5-54	2011
-	-		+A11	2017
IEC 60398	2015	Installations for electroheating and electromagnetic processing - General performance test methods	IEC 60398	2015
IEC 60417	-	Graphical symbols for use on equipment -		-
IEC 60445	2017	Basic and safety principles for man-machine interface, marking and identification - Identification of equipment terminals, conductor terminations and conductors	EN 60445	2017
IEC 60529	1989	Degrees of protection provided by enclosures (IP Code)	EN 60529	1991
+ A1	1999		+A1	2000
+A2	2013		+A2	2013
IEC 60664-1	2007	Insulation coordination for equipment within low-voltage systems - Part 1: Principles, requirements and tests	EN 60664-1	2007
IEC 60825-1	2014	Safety of laser products - Part 1: Equipment classification and requirements	EN 60825-1	2014
IEC 60865-1	2011	Short-circuit currents - Calculation of effects - Part 1: Definitions and calculation methods	EN 60865-1	2012
IEC 60909-0	2016	Short-circuit currents in three-phase a.c. systems - Part 0: Calculation of currents	EN 60909-0	2016
IEC 60990	2016	Methods of measurement of touch current and protective conductor current	EN 60990	2016
IEC 61000-6-2	2016	Electromagnetic compatibility (EMC) - Part 6-2: Generic standards - Immunity standard for industrial environments	EN IEC 61000-6-2	2019
IEC 61000-6-7	2014	Electromagnetic compatibility (EMC) - Part 6-7: Generic standards - Immunity requirements for equipment intended to perform functions in a safety-related system (functional safety) in industrial locations	EN 61000-6-7	2015

IEC 61010-1	2010	Safety requirements for electrical equipment for measurement, control and laboratory use - Part 1: General requirements	EN 61010-1	2010
+ A1	2016		+A1	2019
IEC 61082-1	2014	Preparation of documents used in electrotechnology - Part 1: Rules	EN 61082-1	2015
IEC 61310-1	2007	Safety of machinery - Indication, marking and actuation -- Part 1: Requirements for visual, acoustic and tactile signals	EN 61310-1	2008
IEC 61310-2	2007	Safety of machinery - Indication, marking and actuation -- Part 2: Requirements for marking	EN 61310-2	2008
IEC 61310-3	2007	Safety of machinery - Indication, marking and actuation -- Part 3: Requirements for the location and operation of actuators	EN 61310-3	2008
IEC 61439	series	Low-voltage switchgear and control gear assemblies	EN 61439	series
IEC 61508-1	2010	Functional safety of electrical/electronic/programmable electronic safety-related systems -- Part 1: General requirements	EN 61508-1	2010
IEC 61786-1	2013	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	EN 61786-1	2014
IEC 61786-2	2014 ¹⁾	Measurement of low-frequency magnetic and electric fields with regard to exposure of human beings - Part 2: Guidance for measurements		-
IEC 61936-1 (mod)	2010	Power installations exceeding 1 kV a.c. - Part 1: Common rules	EN 61936-1	2010
+ A1	2014		+ A1	2014
IEC 62061	2005	Safety of machinery - Functional safety of safety-related electrical, electronic and programmable electronic control systems	EN 62061	2005
+ A1	2012		+ A1	2013
+ A2	2015		+ A2	2015
IEC 62271	series	High-voltage switchgear and controlgear	EN 62271	series
IEC 62471 (mod)	2006	Photobiological safety of lamps and lamp systems	EN 62471	2008
IEC 82079-1	2012	Preparation of instructions for use - Structuring, content and presentation - Part 1: General principles and detailed requirements	EN 82079-1	2012
CISPR 11 (mod)	2015	Industrial, scientific and medical equipment - Radio-frequency disturbance characteristics - Limits and methods of measurement	EN 55011	2016
+ A1	2016		+ A1	2017
+ A2	2019			
IEEE C95.1	2005	IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz		-

¹⁾ Dated as no equivalent European Standard exist.

EN IEC 60519-1:2020 (E)

IEEE C95.6	2002	IEEE Standard for Safety Levels with- Respect to Human Exposure to Electromagnetic Fields, 0–3 kHz	-
ISO 3864-1	2011	Graphical symbols - Safety colours and- safety signs - Part-1: Design principles for safety signs and safety markings	-
ISO 6385	2016	Ergonomics principles in the design ofEN ISO 6385 work systems (ISO 6385:2016)	2016
ISO 7000	2019 ¹⁾	Graphical symbols for use on equipment -- Registered symbols	-
ISO 7010	-	Graphical symbols - Safety colours andEN ISO 7010 safety signs - Registered safety signs	2020
ISO 12100	2010	Safety of machinery - General principlesEN ISO 12100 for design - Risk assessment and risk reduction	2010
ISO 13577-1	2016	Industrial furnaces and associated- processing equipment - Safety - Part 1: General requirements	-
ISO 13577-2	2014	Industrial furnaces and associated- processing equipment - Safety - Part 2: Combustion and fuel handling systems	-
ISO 13577-3	2016	Industrial furnaces and associated processing equipment - Safety - Part 3: Generation and use of protective and reactive atmosphere gases	-
ISO 13732-1	2006	Ergonomics of the thermal environment -EN ISO 13732-1 Methods for the assessment of human responses to contact with surfaces - Part 1: Hot surfaces	2008
ISO 13849-1	2015	Safety of machinery - Safety-related partsEN ISO 13849-1 of control systems	2015
ISO 13850	2015	Safety of machinery - Emergency stop -EN ISO 13850 Principles for design	2015
ISO 13855	2010	Safety of machinery - Positioning ofEN ISO 13855 safeguards with respect to the approach speeds of parts of the human body	2010
ISO 13857	2008	Safety of machinery - Safety distances toEN ISO 13857 prevent hazard zones being reached by upper and lower limbs	2008
ISO 14119	2013	Safety of machinery - Interlocking devicesEN ISO 14119 associated with guards - Principles for design and selection	2013
ISO 14120	2015	Safety of machinery – Guards - GeneralEN ISO 14120 requirements for the design and construction of fixed and movable guards	2015
ISO 14159	2002	Safety of machinery - HygieneEN ISO 14159 requirements for the design of machinery	2008
ISO 19353	2019	Safety of machinery - Fire prevention andEN ISO 19353 fire protection	2019

Annex ZZ

(informative)

Relationship between this European standard and the safety objectives of Directive 2014/35/EU [2014 OJ L96] aimed to be covered

This European Standard has been prepared under a Commission's standardization request relating to harmonized standards in the field of the Low Voltage Directive, M/511, to provide one voluntary means of conforming to safety objectives of Directive 2014/35/EU of the European Parliament and of the Council of 26 February 2014 on the harmonization of the laws of the Member States relating to the making available on the market of electrical equipment designed for use within certain voltage limits [2014 OJ L96].

Once this standard is cited in the Official Journal of the European Union under that Directive, compliance with the normative clauses of this standard given in Table ZZ.1 confers, within the limits of the scope of this standard, a presumption of conformity with the corresponding safety objectives of that Directive, and associated EFTA regulations.

Table ZZ.1 – Correspondence between this European standard and Annex I of Directive 2014/35/EU [2014 OJ L96]

Safety objectives of Directive 2014/35/EU	Clause(s) / sub-clause(s) of this EN	Remarks / Notes
1 (a)	clauses 1, 4, 6, 7.3, 7.9, 8.5, 9.3, 13.3, 13.10, 14.5, 18.5 Annexes G and F	this standard addresses products for industrial use only
1 (b)	clauses 4 through 17, 18 and 19	
1 (c), intended use	clauses 1, 3, 4, 6, 13 Annexes B, C, D	refer to entries in 2(a) to 2(d) and 3(a) to 3(c) in this table.
1 (c), maintenance	clauses 7, 9, 10, 13, 14	refer to entries in 2(a) to 2(d) and 3(a) to 3(c) in this table.
2 (a)	clauses 4, 7, 13, 18 Annexes B, D, E, F	the general public and animals are outside the scope of this standard
2 (b)	clauses 4, 7, 8, 9, 10, 11, 13 and 18 Annexes C, D, E, F	
2 (c)	clauses 4, 9 through 17 and 18	the general public and animals are outside the scope of this standard
2 (d)	clauses 4, 7, 13 and 18	specific to electroheating is high temperature affecting insulations
3 (a)	clauses 4, 6, 10.4, 10.5, 12.3, 13.6, 13.9, 13.10, 13.13, 14, 15, 16.3 and 18	the general public and animals are outside the scope of this standard
3 (b)	clauses 4, 6, 9, 10, 11, 12, 13.7, 13.9, 13.13, 13.14, 14, 16.3 and 18	the general public and animals are outside the scope of this standard
3 (c)	clauses 6.5, 7, 10, 11, 12, 13, 14, 18	the general public and animals are outside the scope of this standard

WARNING 1: Presumption of conformity stays valid only as long as a reference to this European standard is maintained in the list published in the Official Journal of the European Union. Users of this standard should consult frequently the latest list published in the Official Journal of the European Union.

WARNING 2: Other Union legislation may be applicable to the product(s) falling within the scope of this standard.

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

**SAFETY IN INSTALLATIONS FOR ELECTROHEATING
AND ELECTROMAGNETIC PROCESSING –****Part 1: General requirements**

FOREWORD

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International Standard IEC 60519-1 has been prepared by IEC technical committee 27: Industrial electroheating and electromagnetic processing.

This sixth edition cancels and replaces the fifth edition published in 2015. This edition constitutes a technical revision.

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

- a) removal of noise from the scope;
- b) clarification of EMC requirements;
- c) risk classification of hazards based on emission for all processing frequencies;
- d) clarification of boundaries between IEC 60519 (all parts) and ISO 13577 (all parts).

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

FDIS	Report on voting
27/1121/FDIS	27/1123/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.

In this document, the following print types are used:

- requirements and definitions: in roman type;
- NOTES: in smaller roman type;
- **terms** used throughout this standard which have been defined in Clause 3: **in bold type**.

A list of all parts in the IEC 605019 series, published under the general title *Safety in installations for electroheating and electromagnetic processing*, 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.

INTRODUCTION

These general requirements apply to all industrial **EH** and **EPM equipment**, unless an exception is given in the Particular requirements dealing with specific equipment in other parts of the IEC 60519 series. The provisions of other parts of the IEC 60519 series that directly apply to specific types of equipment take precedence over the provisions of this document.

Annex I and Annex J provide orientation with respect to the application of ISO 13577-1 in combination with this document.

This document presumes that the installation or equipment is operated and maintained only by personnel consisting of **skilled** or **instructed persons**.

This document is intended for verifying whether the **EH** or **EPM installation** or **equipment** meets the safety requirements of this document through design, site acceptance tests, routine tests or inspection.

Annex H provides a guide on the use of this document and a list of typical industrial **EH** and **EPM** processes.

SAFETY IN INSTALLATIONS FOR ELECTROHEATING AND ELECTROMAGNETIC PROCESSING –

Part 1: General requirements

1 Scope

This part of IEC 60519 specifies the general safety requirements for industrial installations or equipment intended for **electroheating (EH)** and **electroheating** based treatment technologies as well as for **electromagnetic processing of materials (EPM)**. This document deals with the significant hazards, hazardous situations or hazardous events relevant to industrial **EH** and **EPM equipment**, as listed in Annex A, for **normal operation** and for **single fault condition** as well as under conditions of reasonably foreseeable misuse.

This document specifies the requirements intended to be met by the **manufacturer** to ensure the safety of persons and property during the complete life cycle of the equipment from design through commissioning, operation, maintenance, inspection, to decommissioning, as well as in the event of foreseeable **single fault condition** that can occur in the equipment.

The rated voltage of **EH** and **EPM equipment** can be in the range of low voltage; details are given in 4.2.

This document does not apply to equipment and appliances within the scope of

- IEC 60079 (all parts) – i.e. equipment intended for use in potentially explosive atmospheres;
- IEC 60335 (all parts) – i.e. household, commercial and similar electrical appliances, including room heating;
- IEC 60601 (all parts) – i.e. medical electrical equipment;
- IEC 60974 (all parts) – i.e. arc welding equipment;
- IEC 61010 (all parts) – i.e. equipment for laboratory use.

This document does not provide requirements for type testing.

NOTE Industrial equipment covered by this document is typically produced as a single unit or a very small number of units; such unit usually has a very high value and can cause severe harm at disintegration.

This document does not address data security and hazards arising from neglect of security.

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 60071-1:2006 ¹, *Insulation co-ordination – Part 1: Definitions, principles and rules*
IEC 60071-1:2006/AMD1:2010

¹ A consolidated version of this publication exists, comprising IEC 60071-1:2006 and IEC 60071-1:2006/AMD1:2010.

IEC 60204-1:2016, *Safety of machinery – Electrical equipment of machines – Part 1: General requirements*

IEC 60204-11:2018, *Safety of machinery – Electrical equipment of machines – Part 11: Requirements for equipment for voltages above 1 000 V AC or 1 500 V DC and not exceeding 36 kV*

IEC 60228:2004, *Conductors of insulated cables*

IEC 60335-1:2010², *Household and similar electrical appliances – Safety – Part 1: General requirements*

IEC 60335-1:2010/AMD1:2013

IEC 60335-1:2010/AMD2:2016

IEC 60335-2-24, *Household and similar electrical appliances – Safety – Part 2-24: Particular requirements for refrigerating appliances, ice-cream appliances and ice makers*

IEC 60335-2-89, *Household and similar electrical appliances – Safety – Part 2-89: Particular requirements for commercial refrigerating appliances with an incorporated or remote refrigerant unit or compressor*

IEC 60364-1:2005, *Low-voltage electrical installations – Part 1: Fundamental principles, assessment of general characteristics, definitions*

IEC 60364-4-41:2005³, *Low-voltage electrical installations – Part 4-41: Protection for safety – Protection against electric shock*

IEC 60364-4-41:2005/AMD1:2017

IEC 60364-4-42:2010⁴, *Low-voltage electrical installations – Part 4-42: Protection for safety – Protection against thermal effects*

IEC 60364-4-42:2010/AMD1:2014

IEC 60364-4-44:2007⁵, *Low-voltage electrical installations – Part 4-44: Protection for safety – Protection against voltage disturbances and electromagnetic disturbances*

IEC 60364-4-44:2007/AMD1:2015

IEC 60364-4-44:2007/AMD2:2018

IEC 60364-5-53:2001⁶, *Electrical installations of buildings – Part 5-53: Selection and erection of electrical equipment – Isolation, switching and control*

IEC 60364-5-53:2001/AMD1:2002

IEC 60364-5-53:2001/AMD2:2015

IEC 60364-5-54:2011, *Low-voltage electrical installations – Part 5-54: Selection and erection of electrical equipment – Earthing arrangements and protective conductors*

² A consolidated version of this publication exists, comprising IEC 60335-1:2010, IEC 60335-1:2010/AMD1:2013 and IEC 60335-1:2010/AMD2:2016.

³ A consolidated version of this publication exists, comprising IEC 60364-4-41:2005 and IEC 60364-4-41:2005/AMD1:2017.

⁴ A consolidated version of this publication exists, comprising IEC 60364-4-42:2010 and IEC 60364-4-42:2010/AMD1:2014.

⁵ A consolidated version of this publication exists, comprising IEC 60364-4-44:2007, IEC 60364-4-44:2007/AMD1:2015 and IEC 60364-4-44:2007/AMD2:2018.

⁶ A consolidated version of this publication exists, comprising IEC 60364-5-53:2001, IEC 60364-5-53:2001/AMD1:2002 and IEC 60364-5-53:2001/AMD2:2015.

IEC 60398:2015, *Installations for electroheating and electromagnetic processing – General performance test methods*

IEC 60417, *Graphical symbols for use on equipment* (available at <http://www.graphical-symbols.info/equipment>)

IEC 60445:2017, *Basic and safety principles for man-machine interface, marking and identification – Identification of equipment terminals, conductor terminations and conductors*

IEC 60529:1989, *Degrees of protection provided by enclosures (IP Code)*

IEC 60664-1:2007, *Insulation coordination for equipment within low-voltage systems – Part 1: Principles, requirements and tests*

IEC 60825-1:2014, *Safety of laser products – Part 1: Equipment classification and requirements*

IEC 60865-1:2011, *Short-circuit currents – Calculation of effects – Part 1: Definitions and calculation methods*

IEC 60909-0:2016, *Short-circuit currents in three-phase a.c. systems – Part 0: Calculation of currents*

IEC 60990:2016, *Methods of measurement of touch current and protective conductor current*

IEC 61000-6-2:2016, *Electromagnetic compatibility (EMC) – Part 6-2: Generic standards – Immunity standard for industrial environments*

IEC 61000-6-7:2014, *Electromagnetic compatibility (EMC) – Part 6-7: Generic standards – Immunity requirements for equipment intended to perform functions in a safety-related system (functional safety) in industrial locations*

IEC 61010-1:2010, *Safety requirements for electrical equipment for measurement, control, and laboratory use – Part 1: General requirements*

IEC 61082-1:2014, *Preparation of documents used in electrotechnology – Part 1: Rules*

IEC 61310-1:2007, *Safety of machinery – Indication, marking and actuation – Part 1: Requirements for visual, acoustic and tactile signals*

IEC 61310-2:2007, *Safety of machinery – Indication, marking and actuation – Part 2: Requirements for marking*

IEC 61310-3:2007, *Safety of machinery – Indication, marking and actuation – Part 3: Requirements for the location and operation of actuators*

IEC 61439 (all parts), *Low-voltage switchgear and controlgear assemblies*

IEC 61508-1:2010, *Functional safety of electrical/electronic/programmable electronic safety-related systems – Part 1: General requirements*

IEC 61786-1:2013, *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 61786-2:2014, *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 61936-1:2010 ⁷, *Power installations exceeding 1 kV a.c. – Part 1: Common rules*
IEC 61936-1:2010/AMD1:2014

IEC 62061:2005 ⁸, *Safety of machinery – Functional safety of safety-related electrical, electronic and programmable electronic control systems*
IEC 62061:2005/AMD1:2012
IEC 62061:2005/AMD2:2015

IEC 62271 (all parts), *High-voltage switchgear and controlgear*

IEC 62471:2006, *Photobiological safety of lamps and lamp systems*

IEC 82079-1:2012, *Preparation of instructions for use – Structuring, content and presentation – Part 1: General principles and detailed requirements*

CISPR 11:2015⁹, *Industrial, scientific and medical equipment – Radio-frequency disturbance characteristics – Limits and methods of measurement*
CISPR 11:2015/AMD1:2016
CISPR 11:2015/AMD2:2019

IEEE C95.1:2005, *IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz*

IEEE C95.6:2002, *IEEE Standard for Safety Levels with Respect to Human Exposure to Electromagnetic Fields, 0–3 kHz*

ISO 3864-1:2011, *Graphical symbols – Safety colours and safety signs – Part 1: Design principles for safety signs and safety markings*

ISO 6385:2016, *Ergonomics principles in the design of work systems*

ISO 7000, *Graphical symbols for use on equipment* (available at <http://www.graphical-symbols.info/equipment>)

ISO 7010, *Graphical symbols – Safety colours and safety signs – Safety signs used in workplaces and public areas*

ISO 12100:2010, *Safety of machinery – General principles for design – Risk assessment and risk reduction*

ISO 13577-1:2016, *Industrial furnaces and associated processing equipment – Safety – Part 1: General requirements*

ISO 13577-2:2014, *Industrial furnaces and associated processing equipment – Safety – Part 2: Combustion and fuel handling systems*

⁷ A consolidated version of this publication exists, comprising IEC 61936-1:2010 and IEC 61936-1:2010/AMD1:2014.

⁸ A consolidated version of this publication exists, comprising IEC 62061:2005, IEC 62061:2005/AMD1:2012 and IEC 62061:2005/AMD2:2015.

⁹ A consolidated version of this publication exists, comprising CISPR 11:2015, CISPR 11:2015/AMD1:2016 and CISPR 11:2015/AMD2:2019.

ISO 13577-3:2016, *Industrial furnaces and associated processing equipment – Safety – Part 3: Generation and use of protective and reactive atmosphere gases*

ISO 13732-1:2006, *Ergonomics of the thermal environment – Methods for the assessment of human responses to contact with surfaces – Part 1: Hot surfaces*

ISO 13849-1:2015, *Safety of machinery – Safety-related parts of control systems – Part 1: General principles for design*

ISO 13850:2015, *Safety of machinery – Emergency stop function – Principles for design*

ISO 13855:2010, *Safety of machinery – Positioning of safeguards with respect to the approach speeds of parts of the human body*

ISO 13857:2008, *Safety of machinery – Safety distances to prevent hazard zones being reached by upper and lower limbs*

ISO 14119:2013, *Safety of machinery – Interlocking devices associated with guards – Principles for design and selection*

ISO 14120:2015, *Safety of machinery – Guards – General requirements for the design and construction of fixed and movable guards*

ISO 14159:2002, *Safety of machinery – Hygiene requirements for the design of machinery*

ISO 19353:2019, *Safety of machinery – Fire prevention and fire protection*

3 Terms, definitions and abbreviated terms

For the purposes of this document, the following terms and definitions 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 General concepts

3.1.1

electroheating

EH

DEPRECATED: electroheat

conversion of electric energy into heat for useful purposes

Note 1 to entry: This note applies to the French language only.

3.1.2

electromagnetic processing of materials

EPM

interaction between electromagnetic energy or forces and materials for useful purposes

Note 1 to entry: **EPM** can include but is not limited to heating.

Note 2 to entry: This note applies to the French language only.

3.1.3**electromagnetic field****EMF**

electric or magnetic field or a combination of electric and magnetic time varying field

Note 1 to entry: This note applies to the French language only.

3.1.4**electromagnetic radiation**

propagating **electromagnetic field** transporting energy

EXAMPLE Microwave radiation or optical radiation (infrared, visible and ultraviolet).

3.1.5**near-field region**

<of an electromagnetic field> region near an antenna where non-propagating **electromagnetic field** effects dominate

Note 1 to entry: The **near-field region** is further subdivided into the reactive **near-field region**, which is closest to the radiating structure and that contains most or nearly all of the stored energy, and the radiating **near-field region** where the radiation field predominates over the reactive field, but lacks substantial plane-wave character and is complex in structure.

Note 2 to entry: The non-radiating part of the **electromagnetic fields** dominates significantly in a region up to about a distance of 0,5 wavelengths from the antenna.

3.1.6**manufacturer**

producer of the **EH** or **EPM equipment** or **installation** responsible for compliance with this document

Note 1 to entry: The **manufacturer** in the sense of this document can also be a supplier, distributor, importer or authorised representative.

3.1.7**user**

party responsible for the operation and maintenance of the **EH** or **EPM equipment** or **installation**, from putting into service to de-commissioning

3.1.8**skilled person****trained person**

person with suitable education, knowledge and experience to perceive risks and to avoid hazards which can be relevant for the type of installation or equipment, including supervision of the **instructed persons**

Note 1 to entry: The term **trained person** is used in ISO 13577 (all parts).

3.1.9**instructed person**

person advised or supervised by **skilled persons**, able to perceive risks and to avoid hazards which an installation or equipment can create

3.1.10**operator**

skilled person or **instructed person** performing one or more tasks during operation, adjustment, maintenance, repair or disassembly of an installation or equipment

3.1.11**ordinary person**

person not trained or skilled to perceive risks and avoid hazards, who can be harmed by **exposure** to lower limits than **operators**

EXAMPLE A member of the general public including pregnant, elderly or disabled persons, but not children.

3.1.12

vacuum

pressure lower than 30 000 Pa

Note 1 to entry: Defined as a pressure lower than any environmental pressure on the land surface of earth.

Note 2 to entry: **Vacuum** is divided into the following pressure ranges:

- rough **vacuum** from 100 Pa to 10 000 Pa;
- fine **vacuum** from 0,1 Pa to 100 Pa;
- high **vacuum** from 10^{-5} Pa to 0,1 Pa;
- ultra high **vacuum** below 10^{-5} Pa.

3.2 Equipment and state of equipment

3.2.1

electrical equipment

set of items used to generate, convert, transmit, distribute or utilize electric energy, such as converters, transformers, capacitors, switchgear and control gear, measuring instruments, **protective devices** and wiring systems

3.2.2

electroheating equipment

EH equipment

DEPRECATED: electroheat equipment

equipment in which electric work is converted into heat for useful purposes

Note 1 to entry: This note applies to the French language only.

3.2.3

equipment for electromagnetic processing of materials

EPM equipment

equipment in which electromagnetic energy or electromagnetic force is provided for the **electromagnetic processing of materials**

Note 1 to entry: This note applies to the French language only.

3.2.4

electroheating installation

EH installation

DEPRECATED: electroheat installation

installation composed of **EH equipment**, **electrical equipment** and mechanical equipment needed for its operation and use

Note 1 to entry: This note applies to the French language only.

3.2.5

installation for electromagnetic processing of materials

EPM installation

installation composed of **EPM equipment**, **electrical equipment** and mechanical equipment needed for its operation and use

Note 1 to entry: This note applies to the French language only.

3.2.6

normal operation

operation of the installation or equipment as specified by the **manufacturer** and agreed with the **user**

3.2.7

workload

object or material being processed

Note 1 to entry: The term "load" has a different meaning. Load is used and defined accordingly in the Particular requirements of IEC 60519 (all parts), if available.

3.2.8

single fault condition

condition in which there is a fault of a single protection (but not a reinforced protection) or of a single component or a device

Note 1 to entry: If a **single fault condition** results in one or more other fault conditions, all are considered as one single fault condition.

Note 2 to entry: A **single fault condition** may or may not affect the process or the intended operation of the **EH** or **EPM installation** or **equipment**.

Note 3 to entry: An incident that stops the **normal operation**, that directly causes hazards or that leads to direct disintegration of the **EH** or **EPM installation** or **equipment** or parts of it is not a **single fault condition** in the understanding of this definition, it is then a major damage, an average, an accident.

[SOURCE: IEC Guide 104:2019, 3.8, modified – Notes 2 and 3 have been added.]

3.2.9

electric single fault condition

condition in which one means for protection against electric shock is defective or one fault is present which could cause a hazard

Note 1 to entry: **Electric single fault condition** is identical to **single fault condition** as defined in IEC 61140:2016.

[SOURCE: IEC 61140:2016, 3.1.4, modified – The original term "single fault condition" has been changed to "**electric single fault condition**" and the note has been replaced by a new one.]

3.2.10

processing frequency

DEPRECATED: output frequency

operating frequency of the **EH** or **EPM equipment** or **installation** at which the current or field is applied to the **workload**

Note 1 to entry: Specific ranges of **processing frequencies** are defined in Table 1.

3.3 Parts and accessories

3.3.1

enclosure

housing affording the type and degree of protection suitable for the intended application

[SOURCE: IEC 60050-195:1998, 195-02-35]

3.3.2

window

part of an **enclosure** that allows passage of some kind of radiation

3.3.3

barrier

physical object limiting access to equipment or the **enclosure** of that equipment, which can only be removed with the use of a tool or is interlocked

Note 1 to entry: A **barrier** can be physically separated from the equipment, but is a part of the installation.

Note 2 to entry: **Barriers** are usually transparent to the processing electric, magnetic field or radiation.

3.3.4

guard

barrier that is a part of the equipment

3.3.5

obstacle

item impeding access, which is secured to prevent unintentional removal but is removable without a tool or key

3.3.6

protective device

<electrical>

electrical device that reduces a risk

EXAMPLE Two-hand control, pressure sensitive mat or edge, trip bar and wire, light curtain, laser scanner.

3.3.7

screen

device intended to reduce the penetration of an electric, magnetic or **electromagnetic field** into a given region

[SOURCE: IEC 60050-151:2001, 151-13-09, modified – The second term "shield" has been omitted.]

3.3.8

interlock

mechanical or electrical **protective device** or system that prevents an action which can create a hazard

3.3.9

thermal cut-out

temperature protector

device switching off the equipment when the pre-determined temperature is exceeded

Note 1 to entry: **Thermal cut-outs** are not resettable and are replaced each time they have operated; **temperature protectors** are resettable.

3.3.10

handheld applicator

easily movable device providing an electric or magnetic field or **electromagnetic radiation** to a **workload**

EXAMPLE Contacting applicators being in direct contact with the **workload** to be treated; insertion applicators, to be inserted into the **workload**; coil applicators, like hand held induction coils; lamp and luminaire units, irradiating a **workload**.

Note 1 to entry: "Easily movable" implies lightweight.

3.3.11

means of access

all features of the **EH** or **EPM installation** or **equipment** which can be opened or removed and enable access to a hazard or hazard zone

Note 1 to entry: **Means of access** can be part of the **enclosure**, **obstacles** or **doors**.

Note 2 to entry: **Means of access** can be secured by an **interlock**.

3.4 Safety related concepts

3.4.1

functional test

way to test specified functions of a system without regard to its internal structure

[SOURCE: IEC TR 62059-11:2002, 3.6, modified – The note has been removed.]

3.4.2

live part

conductor or conductive part intended to be energized in **normal operation**, including a neutral conductor, but by convention not a PEN conductor or PEM conductor or PEL conductor

Note 1 to entry: This concept does not necessarily imply a risk of electric shock.

[SOURCE: IEC 60050-195:1998, 195-02-19]

3.4.3

hazardous-live-part

live part which, under certain conditions, can give a harmful electric shock

[SOURCE: IEC 60050-195:1998, 195-06-05]

3.4.4

high-voltage hazard zone

zone limited by the minimum clearance around **hazardous-live-parts** of high voltage equipment without complete protection against direct contact

Note 1 to entry: Entering the **high-voltage hazard zone** is considered the same as touching **hazardous-live parts**.

3.4.5

touch voltage

voltage between conductive parts when touched simultaneously by a person or an animal

Note 1 to entry: The value of the effective **touch voltage** may be appreciably influenced by the impedance of the person or the animal in electric contact with these conductive parts.

[SOURCE: IEC 60050-195:1998, 195-05-11, modified – The other term "(effective) touch voltage" is not used in this document.]

3.4.6

touch current

electric current flowing through the body of a person or an animal when a **touch voltage** is present and a conductive path available

3.4.7

leakage current

electric current in an unwanted conductive path under normal operating conditions

3.4.8

induced electric shock

physiological effect caused by an induced electric field inside the human body

Note 1 to entry: Effect usually observed in the **near-field region** of an **electromagnetic field**; it does not necessitate contact to a conductor. The effects are essentially the same as those of electric shock caused through contact to a conductor, for example burn or nerve reaction.

3.4.9

insulation

insulating materials ensuring proper operation of the equipment and protection against electric shock

Note 1 to entry: **Insulation** also refers to the action of insulating.

Note 2 to entry: Under certain circumstances, thermal insulating material can equally perform the function of the electrical **insulation**.

3.4.10

basic insulation

insulation of hazardous-live-parts which provides basic protection

Note 1 to entry: This concept does not apply to **insulation** used exclusively for functional purposes.

[SOURCE: IEC 60050-195:1998, 195-06-06]

3.4.11

galvanic separation

prevention of electric conduction between two electric circuits intended to exchange power and/or signals

Note 1 to entry: **Galvanic separation** can be provided for example by an isolating transformer or an opto-coupler.

[SOURCE: IEC 60050-151:2001, 151-12-26]

3.4.12

emission

<as a concept> energy sent out from a source in the form of a field, particles, a chemical agent, pressure or other physical agent

3.4.13

emission

<for assessment> detectable energy emitted from and detectable outside the boundary of an **EH** or **EPM installation** or equipment in the absence of a human or animal disturbing the field or flow of energy

3.4.14

exposure

receiving or absorbing emitted energy by a person or an animal

Note 1 to entry: The determination of absorbed energy may necessitate the presence of the exposed person or animal in the **emission**.

3.4.15

accessible emission

level of radiation or field determined at a certain distance from the **EH** or **EPM installation** or equipment and being accessible in **normal operation** or **single fault condition**

3.4.16

emission limit

maximum **accessible emission** permitted for a particular risk class

3.5 Abbreviated terms

EH **electroheating**

ELV extra low voltage (below 50 V at mains frequency)

EMC electromagnetic compatibility

EPM **electromagnetic processing of materials**

HV	high voltage (above 1 000 V at mains frequency)
IR	infrared radiation
LED	light-emitting diode
LV	low voltage (the range between 50 V and 1 000 V at mains frequency)
MW	microwave
PE	protective earthing conductor
PEL	protective earthing conductor being a line conductor as well
PEM	protective earthing conductor being a mid-point conductor as well
PEN	protective earthing conductor being a neutral conductor as well
SAR	specific absorption rate of energy
UV	ultraviolet radiation
VIS	visible radiation

4 Classification and subdivision of equipment and installations

4.1 Classification by processing frequency

EH and **EPM installation** and **equipment** is classified by its **processing frequency**. Table 1 lists the equipment types and their **processing frequency** ranges as well as safety relevant frequency limits. An **EH** or **EPM installation** may include more than one type of **EH** or **EPM equipment**.

Table 1 – Equipment, processing frequency and safety-relevant frequency limits

Equipment type	Frequency range ^a defining equipment type	Frequency range ^b used for safety limits	Hazards associated with the frequency range
Direct current ^c or stationary field	0 Hz	0 Hz or no change in polarity	Electric shock, neural stimulus, dizziness
Low frequency	> 0 Hz to < 60 Hz		Electric shock, burn, not let-go, neural stimulus
Mains frequency	50 Hz or 60 Hz		
Medium frequency	> 60 Hz to 100 kHz	> 60 Hz to 100 kHz	
High frequency	> 100 kHz to 0,3 GHz	> 100 kHz to 6 MHz	Burn, bodypart heating
		> 6 MHz to 0,3 GHz	Bodypart heating
Microwave	> 0,3 GHz to 300 GHz		
Infrared	780 nm to 1 mm	IR-C 3 000 nm to 1 mm	Burn of skin and cornea
		IR-B 1 400 nm to 3 000 nm	
		IR-A 780 nm to 1 400 nm	Burn of skin and cornea, burn of retina
Visible	400 nm to 780 nm		
Ultraviolet ^d	10 nm to 400 nm	UV-A 315 nm to 400 nm	Burn of skin and cornea, skin cancer
		UV-B 280 nm to 315 nm	
		UV-C 100 nm to 280 nm	
		EUV 10 nm to 100 nm	
Laser	10 nm to 1 mm (> 300 GHz to 30 PHz)		Burn of skin, cornea and retina
^a Rated processing frequency .			
^b Values of the corresponding free space wavelengths are also given in case of optical radiation.			
^c Direct current type – equipment with no intended change of polarity, but including switch-on and switch-off.			
^d The definition of UV follows IEC 62471:2006; radiation between 380 nm and 400 nm is usually sensed.			

4.2 Classification by voltage

The supply voltage of an installation or equipment is classified as

- extra low voltage (ELV) below 50 V (RMS) at mains frequency or 120 V direct current,
- low voltage (LV) between 50 V (RMS) at mains frequency or 120 V direct current and 1 000 V (RMS) at mains frequency or 1 500 V direct current, and
- high voltage (HV) above 1 000 V (RMS) at mains frequency or 1 500 V direct current.

NOTE The definitions of ELV and voltage band 1, LV and voltage band 2 and HV and voltage band 3 are identical. Voltages below 25 V mains frequency or 60 V direct current are seen as without risk for any **ordinary person** in most circumstances (exception is possible in wet conditions).

This distinction shall be made for the installation and for parts as defined in 4.3.1 and

- depending on the supply and the output voltage, whichever is the higher value (internal voltages inside the **electrical equipment** may be higher), but
- not depending on the process voltage or internal voltage of the installation or equipment.

Different parts of one installation may be classified as ELV, LV or HV.

4.3 Subdivision of installation and equipment

4.3.1 Subdivision into parts

An **EH** or **EPM installation** consists of diverse and specific parts. Figure 1 presents a block diagram of a typical installation for reference. It determines the boundary of installations and equipment. Not all parts are found in every kind of an **EH** or **EPM installation**.

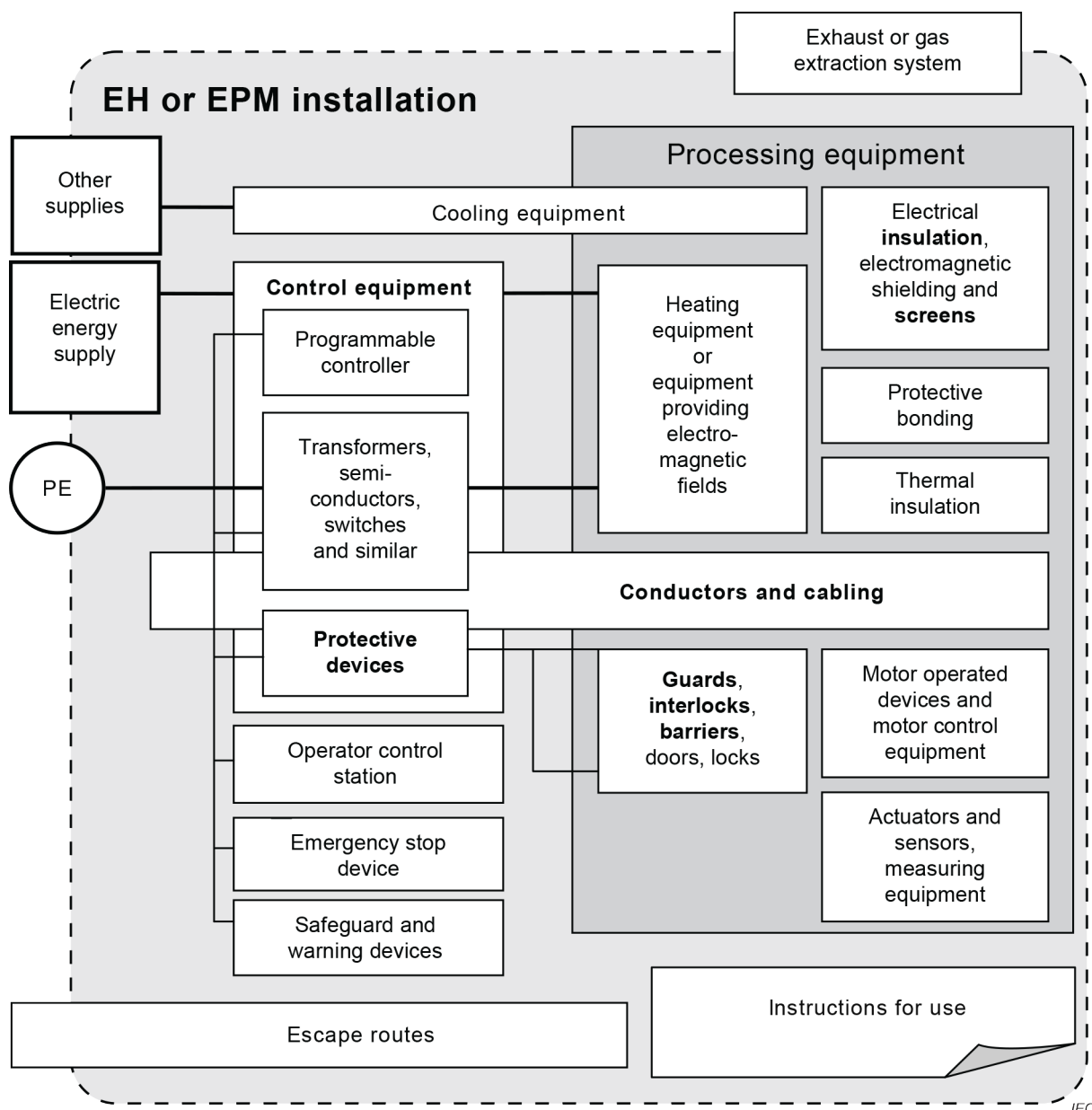


Figure 1 – Block diagram of a typical EH or EPM installation

Table 2 provides references to clauses of this document or to other standards relevant to the parts identified in Figure 1. The requirements for equipment outside the processing equipment are covered by IEC or ISO standards specified in Table 2. The basic sources of safety provisions for **electrical equipment** of **EH** or **EPM installations** and **equipment** are IEC 60204-1 for LV and IEC 60204-11 for HV.

The safety requirements for the processing equipment itself are specific because of its extraordinary environment and of conditions inside or near, where

- extreme temperatures can interact with the equipment,

- b) strong electric, magnetic or **electromagnetic fields** can interact with the equipment, and
c) thermal energy or electromagnetic forces can endanger the structural integrity of the equipment or of **insulation** and of protective means.

Table 2 – Typical EH or EPM installation – Listing of parts and references

Part of installation or equipment – See Figure 1		Condition for which the reference is valid	Reference/source of provisions
Part	Component/item		
Electric energy supply		LV, ≤ 200 Hz	IEC 60364-4-41, IEC 60364-4-42, IEC 60364-4-44, IEC 60364-5-53, IEC 60364-5-54, IEC 60445, IEC 60664-1
Protective earth, PE			
Protective bonding			
Electric energy supply		HV, ≤ 200 Hz	IEC 61936-1, IEC 60071-1
Protective earth, PE			
Protective bonding			
Electric energy supply		all other, ≤ 36 kV	Clause 7
Protective earth, PE			
Protective bonding			
Conductors and cabling at standard environmental conditions		< 40 °C	IEC 60228
Conductors and cabling exposed to non-standard environmental conditions		> 40 °C	6.4.2 and 13.2
Control equipment	Switchgear and controlgear	LV, ≤ 200 Hz	IEC 60204-1
		HV, ≤ 36 kV, ≤ 200 Hz	IEC 60204-11
		> 36 kV, ≤ 200 Hz	Particular requirements
		> 200 Hz	Clause 7
	Programmable controller	all	IEC 61508-1, IEC 62061, ISO 13849-1
	Protective device		
Operator control station (same as switchgear and controlgear)		< 1 000 V, ≤ 200 Hz	IEC 60204-1
		> 1 000 V, ≤ 200 Hz	IEC 60204-11
		all other	Clauses 7 and 8
Emergency stop device (same as switchgear and controlgear)		< 1 000 V, ≤ 200 Hz	IEC 60204-1
		> 1 000 V, ≤ 200 Hz	IEC 60204-11
		all other	ISO 13850
Safeguard and warning devices (same as switchgear and controlgear)		< 1 000 V, ≤ 200 Hz	IEC 60204-1
		> 1 000 V, ≤ 200 Hz	IEC 60204-11
		all other	ISO 13850
Other supplies –for example fluids, compressed air		all	Clause 12; ISO 13577-3
Gaseous or liquid fuels		all	ISO 13577-2
Fluid extraction system		all	Clause 12; ISO 13577-1
Exhaust		all	ISO 13577-1
Escape routes		all	IEC 60364-4-42