



DPC: 22/30454090 DC

BSI Group Headquarters

389 Chiswick High Road London W4 4AL

Tel: +44 (0)20 8996 9000

Fax: +44 (0)20 8996 7400

www.bsigroup.com

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Title: Draft BS EN 50156-1 Electrical equipment for furnaces and ancillary equipment. Part 1: Requirements for application design and installation.

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Introduction

This draft standard is based on national and international discussions. Your comments on this draft are invited and will assist in the preparation of the consequent standard.

For international standards, comments will be reviewed by the relevant UK national committee before sending the consensus UK vote and comments to the international committee, which will then decide appropriate action. If the international standard is approved, it is usual for the text to be published as a British Standard.

For national standards, comments will be reviewed by the relevant UK national committee and the resulting standards published as a British Standard.

UK Vote

Please indicate whether you consider the UK should submit a negative (with supporting technical reasons) or positive vote on this draft. Please indicate if you are aware of any reason why this draft standard should not be published as a British Standard.

Submission of Comments

- **Annotated drafts are not acceptable and will be rejected.**
- All comments should be submitted online at <https://standardsdevelopment.bsigroup.com/>. You will need to register in order to comment.

Template for comments and secretariat observations

Date: xx/xx/20xx	Document: ISO/DIS xxxx
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1	2	(3)	4	5	(6)	7
MB	Clause No./ Subclause No./Annex (e.g. 3.1)	Paragraph/ Figure/Table/Note	Type of comment	Comment (justification for change) by the MB	Proposed change by the MB	Secretariat observations on each comment submitted
	3.1	Definition 1	ed	Definition is ambiguous and needs clarifying.	Amend to read '...so that the mains connector to which no connection...'	
	6.4	Paragraph 2	te	The use of the UV photometer as an alternative cannot be supported as serious problems have been encountered in its use in the UK.	Delete reference to UV photometer.	

October 2022

ICS 27.060.01

Will supersede EN 50156-1:2015

English Version

Electrical equipment for furnaces and ancillary equipment - Part 1: Requirements for application design and installation

Equipements électriques d'installation de chaudière - Partie
1: Exigences pour la conception, pour l'application et
l'installation

Elektrische Ausrüstung von Feuerungsanlagen und
zugehörige Einrichtungen - Teil 1: Bestimmungen für die
Anwendungsplanung und Errichtung

This draft European Standard is submitted to CENELEC members for enquiry.
Deadline for CENELEC: 2023-01-06.

It has been drawn up by CLC/BTTF 132-2.

If this draft becomes a European Standard, 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.

This draft European Standard was established by CENELEC in three official versions (English, French, German).
A version in any other language made by translation under the responsibility of a CENELEC member into its own language and notified to the CEN-CENELEC Management Centre has the same status as the official versions.

CENELEC members are the national electrotechnical committees of Austria, Belgium, Bulgaria, Croatia, Cyprus, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Norway, Poland, Portugal, Republic of North Macedonia, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Türkiye and the United Kingdom.

Recipients of this draft are invited to submit, with their comments, notification of any relevant patent rights of which they are aware and to provide supporting documentation.

Warning : This document is not a European Standard. It is distributed for review and comments. It is subject to change without notice and shall not be referred to as a European Standard.



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

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European foreword

This document (prEN 50156-1:2022) has been prepared by CLC/BTTF 132-2 "Revision of EN 50156 'Electrical equipment for furnaces and ancillary equipment'".

This document is currently submitted to the Enquiry.

The following dates are proposed:

- | | | |
|---|-------|--|
| • latest date by which the existence of this document has to be announced at national level | (doa) | dor + 6 months |
| • latest date by which this document has to be implemented at national level by publication of an identical national standard or by endorsement | (dop) | dor + 12 months |
| • latest date by which the national standards conflicting with this document have to be withdrawn | (dow) | dor + 36 months
(to be confirmed or modified when voting) |

This document will supersede EN 50156-1:2015 and all of its amendments and corrigenda (if any).

prEN 50156-1:2022 includes the following significant technical changes with respect to EN 50156-1:2015:

- harmonization of the definitions to the new version of EN 61508;
- check and updating of the normative references;
- creation of the Annex ZZ for the harmonization to the new Low Voltage Directive;
- significant changes in Clause 4.1 and 10;
- EN 50156-3 will not be created.

This document has been prepared under a Standardization Request given to CENELEC by the European Commission and the European Free Trade Association, and supports essential requirements of EU Directive(s) / Regulation(s).

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

This document covers the Principle Elements of the Safety Objectives for Electrical Equipment Designed for Use within Certain Voltage Limits 2014/35/EU [2014 OJ L96].

This document is the first part of a series of European standards which specify the requirements for equipment of safety functions for furnaces, especially safety related system to protect personnel, the furnace with its ancillary equipment against hazards related to heat generation, the heated system and to operate reliably during normal conditions, and abnormal conditions which can be foreseen.

This document has been prepared by the German National Committee with the participation of experts of other National Committees. It is currently divided into 2 parts under the generic title "Electrical equipment for furnaces and ancillary equipment":

- Part 1: Requirements for application design and installation;
- Part 2: Requirements for design, development and type approval of safety devices and subsystems;

This document is based on EN 61508:2010 “Functional safety of electrical/electronic/ programmable electronic safety-related systems”, Parts 1 to 7, as a basic safety standard.

Introduction

This Part of EN 50156 specifies the requirements and recommendations for the application design and installation of electrical and control equipment for furnaces and ancillary equipment and for the systems heated by the thermal energy released in the furnace to ensure:

- safety of personnel, property and the environment;
- consistency of proper function.

The operating conditions of the furnace, the hazards of combustion and the safety of heated systems are considered.

A safety-related system consisting of safety devices for:

- monitoring of flames and other safety conditions of the firing;
- interrupting the flow of fuel to the furnace;
- ventilating the body of the furnace and the flue gas ducts;
- monitoring of the safety condition of the heated systems (e.g. water level limiter in steam boilers);

may be necessary to ensure proper ignition and combustion of fuel and to avoid the development, existence and/or ignition of an explosive mixture of fuel and air, and also to avoid damage to the heated systems (see 3.23).

The rating of necessary safety integrity levels is based on EN 61508-1:2010.

Figure 1 is provided as an aid to understanding the relationship between the various elements of furnaces and their ancillary equipment, the heated systems, the control system and the safety-related systems.

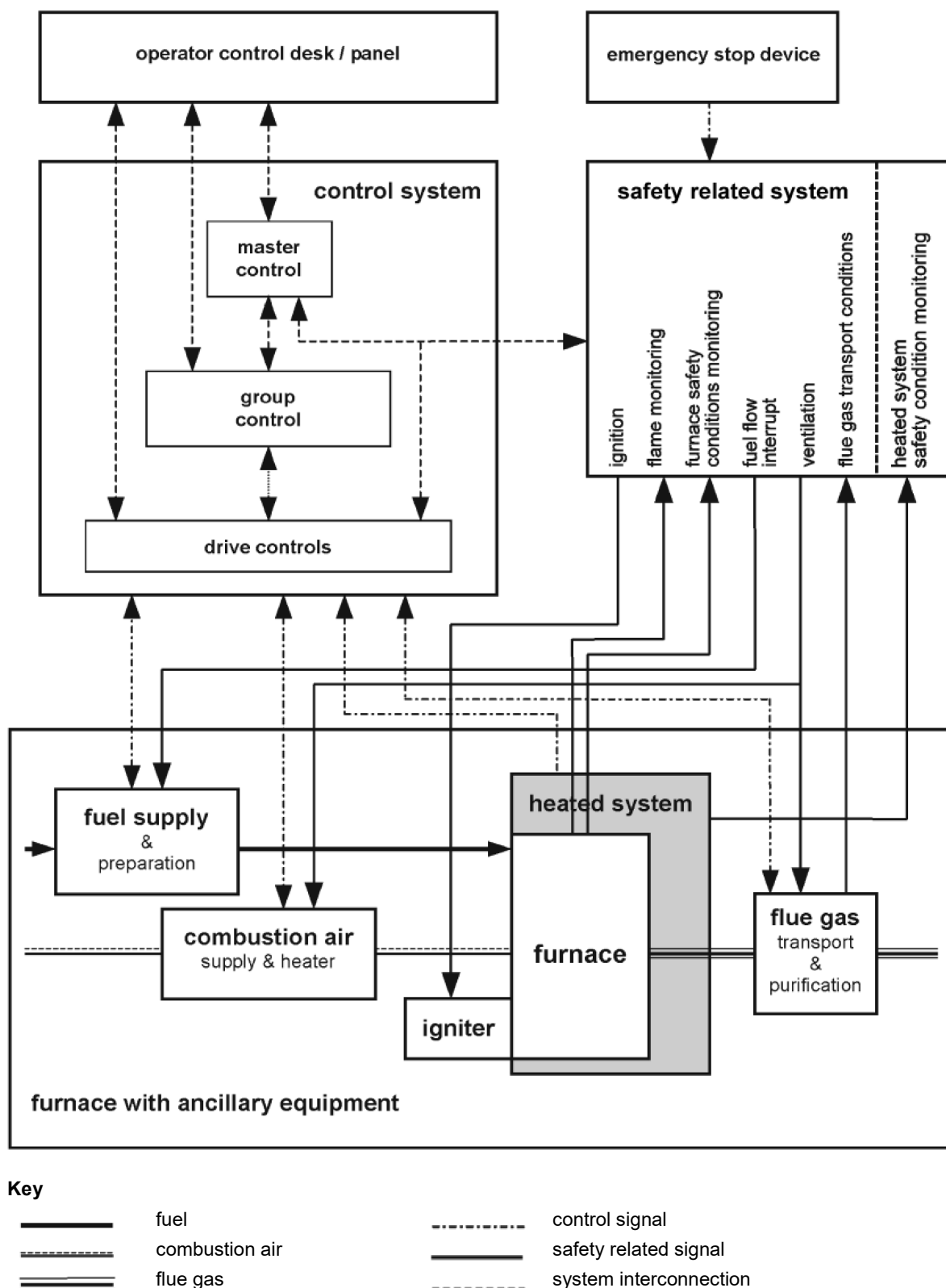


Figure 1 — Example of the functionality of a furnace with its ancillary equipment, heated systems and relationship to control system and safety related system

1 Scope

This document applies to the application design and installation of electrical equipment, control circuits and safety-related systems for furnaces which are operated with solid, liquid or gaseous fuels and their ancillary equipment. It specifies requirements to meet the operating conditions of furnaces, to reduce the hazards of combustion and to protect the heated systems from damage e.g. by overheating.

Such furnaces and the electrical equipment can be part by way of example of the following plant:

- a) water heating systems;
- b) steam boiler installations (steam and hot-water boilers) and heat recovery steam boilers;

NOTE 1 The requirements of this document apply according to the electrical equipment of electrically heated steam boilers.

NOTE 2 Seagoing vessels and offshore facilities are governed by International Maritime Law and as such are not within the scope of this document. These requirements can be used for such facilities.

- c) warm air heaters;
- d) hot-gas heaters;
- e) heat exchanger systems;
- f) combustion chambers of stationary turbines;
- g) as long as no other standard is applicable for combined heat and power stations, we recommend the use of the requirements of this document;

This document can also be used as reference for electrical equipment requirements for thermo-processing equipment.

The requirements in this document are not applicable to electrical equipment for:

- a) non-electrically heated appliances and burner control systems for household and similar purposes;
- b) furnaces using technologies for the direct conversion of heat into electrical energy;
- c) combustion chambers of non-stationary prime movers and turbines;
- d) central oil supply systems for individual heating appliances;
- e) furnaces using solid fuels for heating purposes for household use with a nominal thermal output up to 1 MW;
- f) furnaces which are used to heat process fluids and gasses in chemical plant.

This document can be used as a basis for the requirements placed on electrical equipment for furnaces, which are excluded from its field of application.

This document specifies special requirements for the management of functional safety.

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.

EN 267, *Forced draught burners for liquid fuels*

EN 676:2020, *Forced draught burners for gaseous fuels*

EN 1854:2010, *Pressure sensing devices for gas burners and gas burning appliances*

EN 12952-7:2012, *Water-tube boilers and auxiliary installations - Part 7: Requirements for equipment for the boiler*

EN 12952-8:2002, *Water-tube boilers and auxiliary installations - Part 8: Requirements for firing systems for liquid and gaseous fuels for the boiler*

EN 12952-9:2002, *Water-tube boilers and auxiliary installations - Part 9: Requirements for firing systems for pulverized solid fuels for the boiler*

EN 12952-16:2002, *Water-tube boilers and auxiliary installations - Part 16: Requirements for grate and fluidized-bed firing systems for solid fuels for the boiler*

EN 12953-6:2011, *Shell Boilers - Part 6: Requirements for equipment for the boiler*

EN 12953-7:2002, *Shell boilers - Part 7 : Requirements for firing systems for liquid and gaseous fuels for the boilers*

EN 12953-12:2003, *Shell boilers - Part 12: Requirements for grate firing systems for solid fuels for the boiler*

EN 14597:2012, *Temperature control devices and temperature limiters for heat generating systems*

EN 50156-2:2015, *Electrical equipment for furnaces and ancillary equipment - Part 2: Requirements for design, development and type approval of safety devices and subsystems*

EN 55011:2016, *Industrial, scientific and medical equipment - Radio-frequency disturbance characteristics - Limits and methods of measurement*

EN 60034 (all parts), *Rotating electrical machines (IEC 60034, all parts)*

EN 60309-1:1999, *Plugs, socket-outlets and couplers for industrial purposes - Part 1: General requirements*

EN 60332-1-1:2004, *Tests on electric and optical fibre cables under fire conditions - Part 1-1: Test for vertical flame propagation for a single insulated wire or cable – Apparatus (IEC 60332-1-1:2004)*

EN 60332-2-1:2004, *Tests on electric and optical fibre cables under fire conditions - Part 2-1: Test for vertical flame propagation for a single small insulated wire or cable – Apparatus (IEC 60332-2-1:2004)*

EN IEC 60445:2021, *Basic and safety principles for man-machine interface, marking and identification – Identification of equipment terminals, conductor terminations and conductors (IEC 60445:2021)*

EN 60519 (all parts), *Safety in installations for electroheating and electromagnetic processing*

EN 60529:1991, *Degrees of protection provided by enclosures (IP Code) (IEC 60529:1989)*

EN 60654-3:1997, *Operating conditions for industrial-process measurement and control equipment - Part 3: Mechanical influences (IEC 60654-3:1983)*

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

EN 60947-2:2017, *Low-voltage switchgear and controlgear - Part 2: Circuit-breakers (IEC 60947-2:2016)*

EN IEC 60947-3:2021, *Low-voltage switchgear and controlgear - Part 3: Switches, disconnectors, switch-disconnectors and fuse-combination units*

EN IEC 60947-4-1:2019, *Low-voltage switchgear and controlgear - Part 4-1: Contactors and motor-starters - Electromechanical contactors and motor-starters*

EN 60947-5-1:2017, *Low-voltage switchgear and controlgear - Part 5-1: Control circuit devices and switching elements - Electromechanical control circuit devices (IEC 60947-5-1:2016)*

EN 61000-4 (all parts), *Electromagnetic compatibility (EMC) (IEC 61000-4, all parts)*

EN IEC 61000-6-4:2019, *Electromagnetic compatibility (EMC) - Part 6-4: Generic standards - Emission standard for industrial environments*

EN 61000-6-7:2015, *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 61000-6-7:2014)*

EN 61082-1:2015, *Preparation of documents used in electrotechnology - Part 1: Rules*

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

EN 61508-2:2010, *Functional safety of electrical/electronic/programmable electronic safety-related systems - Part 2: Requirements for electrical/electronic/programmable electronic safety-related systems (IEC 61508-2:2010)*

EN 61508-3:2010, *Functional safety of electrical/electronic/programmable electronic safety-related systems - Part 3: Software requirements (IEC 61508-3:2010)*

EN 61508-6:2010, *Functional safety of electrical/electronic/programmable electronic safety-related systems - Part 6: Guidelines on the application of IEC 61508-2 and IEC 61508-3 (IEC 61508-6:2010)*

EN IEC 61558-1:2019, *Safety of transformers, reactors, power supply units and combinations thereof - Part 1: General requirements and tests*

EN 61810-1:2015, *Electromechanical elementary relays - Part 1: General and safety requirements (IEC 61810-1:2015)*

EN IEC 81346-1:2022, *Industrial systems, installations and equipment and industrial products – Structuring principles and reference designations – Part 1: Basic rules (IEC 81346-1:2022)*

HD 60364-4 (all parts), *Low-voltage electrical installations – Part 4: Protection for safety (IEC 60364-4, all parts)*

IEC 60364-4-41:2005, *Low-voltage electrical installations – Part 4-41: Protection for safety – Protection against electric shock*

IEC 60417 DB, *Graphical symbols for use on equipment (IEC 60417 all parts)*

IEC 60617 DB:2001, *Graphical symbols for diagrams*

ISO 3864 (all parts), *Safety colours and safety signs*

3 Terms and definitions

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:

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

3.1**actuating element**

component which produces changes in other electrical circuits or volume flows (e. g. fuel, air) as a result of the effect of changes in signal

Note 1 to entry: Examples are valves, switches and motors including their common auxiliaries, also for example solenoid valve with magnetic actuation and final control element for direct process control.

3.2**assessment**

investigation to judge if the functional safety of the EUC is achieved by the realized safety related system

3.3**audit**

systematic and independent examination on the basis of evidence if defined specifications for the management of functional safety are met for every life cycle phase

3.4**auxiliary circuit**

electrical circuit for ancillary functions, e. g. control circuits (command initiation, interlocking operation), signalling and measuring circuits

3.5**component**

constituent part of electrical devices or subsystems, usually specified by function, but used in various applications

Note 1 to entry: These are elements or components in the sense of EN 61508-4. Examples include resistors, capacitors, transistors, integrated circuits, printed-circuit boards.

Note 2 to entry: A component is the smallest element a circuit can be subdivided into. If a component has to be broken down it loses its physical characteristics and/or does not conform to specifications.

Note 3 to entry: An element may comprise hardware and/or software.

3.6**control circuit**

electrical circuit used for the operational control and the protection of the furnace and of the power circuits

3.7**control device**

device connected into the control circuit and used for controlling the operation of the furnace

EXAMPLES a manually operated switch, a limit transducer, or a valve

3.8**current limiting**

limiting of electric current to a predetermined maximum value for the defined operation by means of a suitable arrangement of components in the circuit

3.9**diagnostic coverage**

proportion of all hardware faults which are detected by the online diagnostics embedded in the safety-related system

Note 1 to entry: To determine the diagnostic coverage a fault model should be used which is sufficient for the concerned technology.

3.10

electrical equipment

equipment for furnaces including all electrical equipment for the fields of application mentioned in Clause 1

3.11

emergency stop device

manually operated switch which can be used to shut down the furnace and its associated equipment in the event of danger

Note 1 to entry: The emergency stop device shall prevent fuel flow and electrical preheating.

Note 2 to entry: In EN 12952-8:2002 and EN 12952-9:2002 the emergency stop is defined as master fuel trip (MFT).

3.12

external influences

influences from the environment which could bring about a failure or malfunction of the function

Note 1 to entry: The following are examples of external influences on electrical systems:

- a. Power failure and return of power, over-voltage and under-voltage, short-power interruptions (< 0,5 s).
- b. Electromagnetic and electrical disturbances, such as inductive or capacitive interference or leakage currents through resistive connections.
- c. For microelectronic components, ionising radiation.

3.13

factory acceptance test

FAT

test performed in the factory of the manufacturer which proves the correct functions of a logic subsystem

3.14

failure

F

termination of the ability of an item to perform required function

Note 1 to entry: After failure, the item is in fault condition.

Note 2 to entry: A failure is an event, as distinguished from a fault, which is a state.

Note 3 to entry: This concept as defined does not apply to items consisting of software only.

[SOURCE: IEC 60050-845:1990, definition 845-27-105]

3.15

failure mechanism

physical or chemical process which causes an assembly to fail

Note 1 to entry: It may also define how the assembly fails, e.g. fail to safety. In doing so it may be possible to detect a failure tendency direction

3.16

fault

state of an item characterised by the inability to perform a required function, excluding the inability during preventative maintenance or other planned actions, or due to lack of external resources e. g. loss of power supplied (see Figure 2 and Figure 3)

Note 1 to entry: A fault is often the result of a failure of the item itself, but can exist without prior failure (192-04-01 of IEC 60050-192:2015).

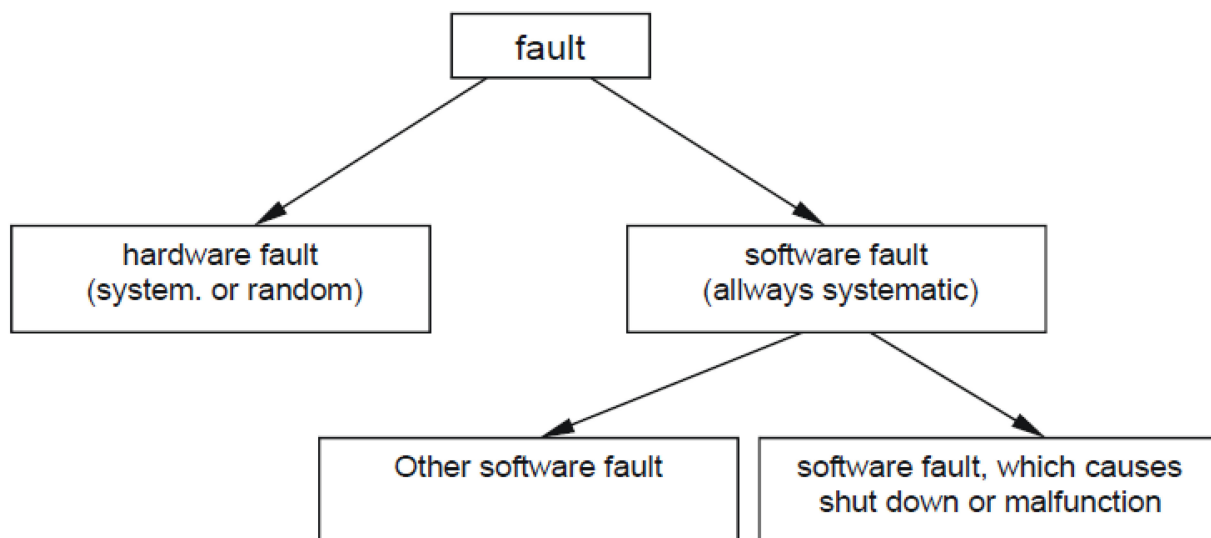


Figure 2 — Types of faults to be considered

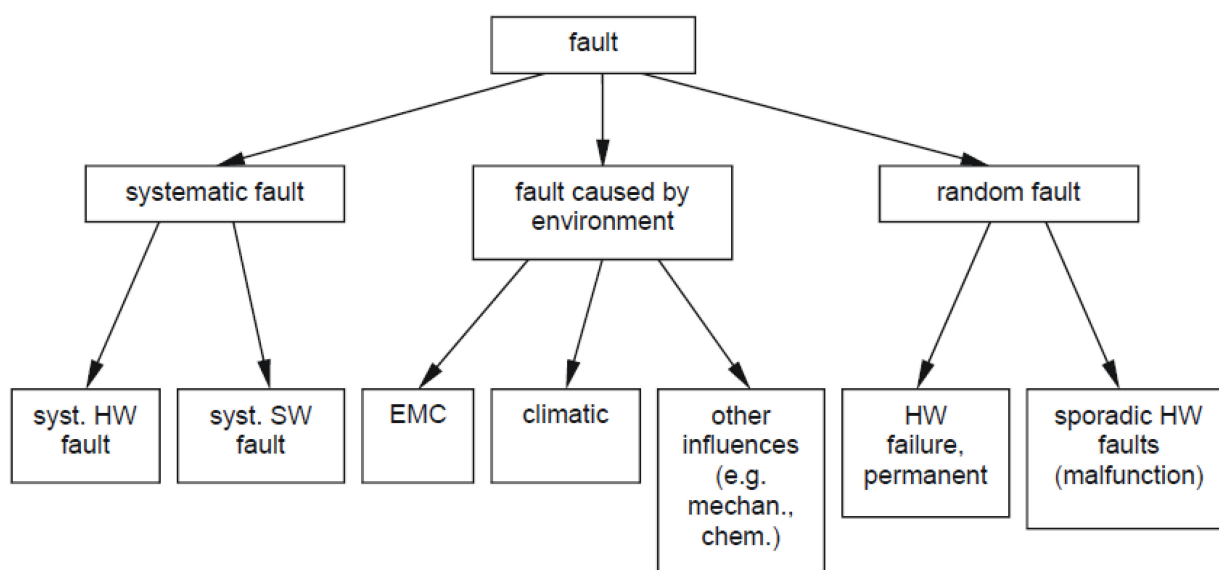


Figure 3 — Causes of faults to be considered

3.17**fault exclusion**

exclusion of a theoretically possible fault whose occurrence, in the light of practical experience, or under the given physical conditions is so unlikely that it needs not to be taken into account

3.18**fault tolerance time**

time between the occurrence of an unsafe condition (caused by the process itself or due to equipment failure) and the point when the process changes into critical operation, which would result in a hazardous event in the absence of any safety-related systems

3.19

flame monitoring device

flame monitoring unit

safety device which is triggered by the presence or absence of flame and gives an appropriate signal to the protective equipment

3.20

function test

complete test of an individual safety-related function

Note 1 to entry: This includes testing as to whether the safety-related system (sensors, protective equipment and actuating elements) is acting correctly when a process parameter is changed to ensure correct operation of the safety-related function.

Note 2 to entry: Function tests of the complete safety-related functions may be carried out by overlapping partial tests.

3.21

furnace

structure within which heat is generated to a controlled temperature by combustion of fuel

Note 1 to entry: The English term “furnace” includes structures within which heat is generated by electricity and other forms of energy. This document also applies to the electrical equipment of electrically heated or heat recovery steam boilers.

3.22

furnace with its ancillary equipment

all the equipment for the burning of fuels, for example, equipment for the storage, preparation and transport of fuels, combustion air supply¹ cleaning and removal of flue gas and exhausts and relevant closed-loop and open-loop control and monitoring equipment

3.23

heated system

equipment which absorbs the heat generated in the furnaces, e.g. economiser, evaporator, and superheater of a steam boiler, heat exchanger, gas turbine

3.24

immersion electrode

limit transducer for fluid level monitoring

3.25

logic unit

safety-related control and switching equipment which receives signals from sensors, limiters and other monitoring devices

Note 1 to entry: Its purpose is to control actuating elements according to the specified safety function.

Note 2 to entry: Protective equipment may consist of a completely hard-wired device or it may be a programmable safety device incorporating electronics and a programming facility. In hard-wired equipment, the signals from all modules are generated and processed by individual connections. In programmable safety devices, signals are processed by means of programs (software) stored in memories.

3.26

main circuit

electrical circuit which supplies the electrical energy to equipment for the generation, conversion, distribution, switching and consumption of electrical energy

¹ Also applies to gas turbines containing oxygen within its exhaust gas.

3.27**malfunction****M**

transient fault

3.28**non-opening of contact elements**

fault which prevents the opening of contacts of relays or other switching devices e.g. contact welding, sticking of the magnet armature, etc

3.29**program analysis****PA**

all measures used in the context of theoretical checking to reveal software errors

3.30**programmable controller**

device with binary logic elements which responds to control devices and initiates a specific programmed sequence

3.31**programmable safety device****PSD**

programmable component within the protective equipment

3.32**protective conductor**

conductor required by some measures for protection against electric shock for electrically connecting any of the following parts:

- exposed conductive parts;
- extraneous conductive parts;
- main earthing terminal

3.33**safety-related system**

all equipment, units and safety-related circuits whose main purpose is the protection of personnel, property or the environment

Note 1 to entry: The safety-related system includes all the components required to carry out the safety function, for example, sensors which monitor safety-related parameters (e.g. flame monitoring), interruption device for the flow of fuel, ventilation of the body of the furnace and protection of the heated system (e.g. monitoring the water level of steam boilers). Typically a safety-related system consists of sensors, logic solving protective equipment and actuating elements (see Figure 4). If this is achieved by multi-channel systems, then all channels and monitoring devices used for safety purposes are included within the safety-related system.

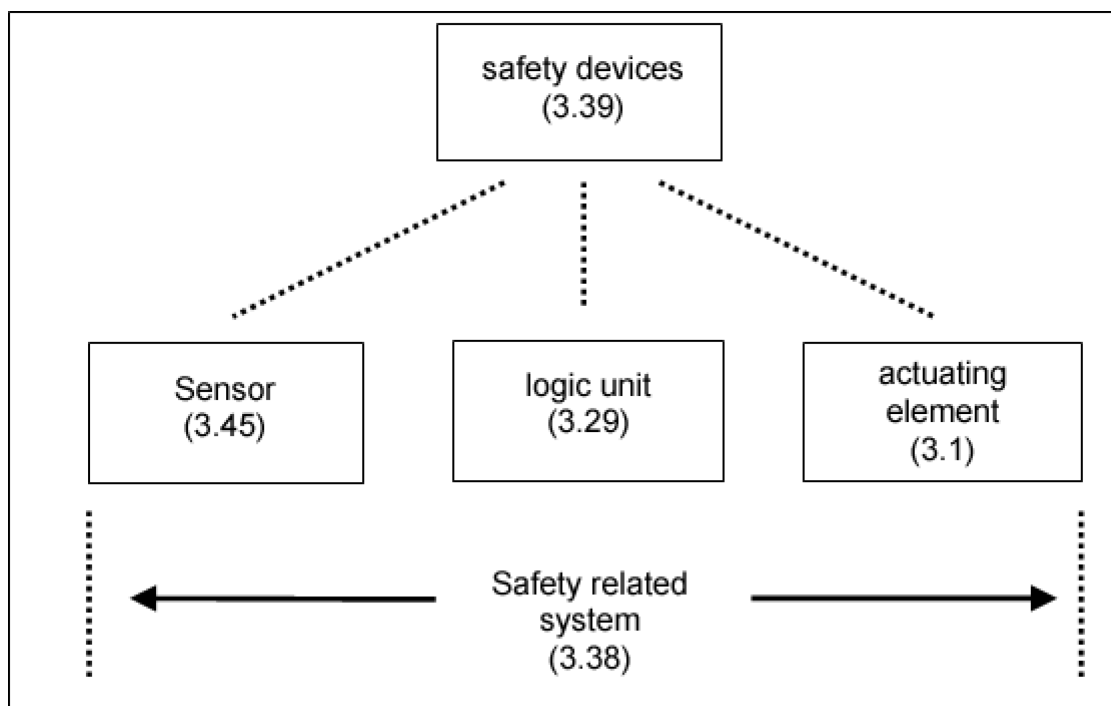


Figure 4 — Definition and components of a safety-related system

3.34

safety device

any device which is used to carry out safety functions, either on its own or as a part of a safety-related system

EXAMPLE sensors, limiters, flame monitors, burner control devices, logic system, actuating elements, fuel shut down valves etc.

Note 1 to entry: Safety devices are subsystems in terms of EN 61508-4.

3.35

safety function

function to be implemented by an E/E/PE safety-related system or other risk reduction measures that is intended to achieve or maintain a safe state for the EUC, in respect of a specific hazardous event

[SOURCE: EN 61508-4:2010, 3.5.1]

3.36

safety integrity

probability of a safety-related system satisfactorily performing the required safety functions under all the stated conditions within a stated period of time

3.37

safety integrity level

SIL

discrete level for specifying the safety integrity requirements of the safety function to be allocated to the safety-related systems

Note 1 to entry: There are 4 possible safety integrity levels. Safety integrity level 4 has the highest level of safety integrity; safety integrity level 1 has the lowest.

3.38**safety time**

safety time of a furnace taken (lower part of Figure 13) from the occurrence of an unsafe operating condition (for example, flame interrupt during normal operation) to the point at which the actuating element is initiated

Note 1 to entry: The reaction time of the actuating element is to be considered separately.

Note 2 to entry: The response times of actuators are partly defined in the standards for the products and applications.

3.39**sensor**

element or device which collects an indicated value (e.g. measuring element, transducer, transformer, limit switch)

3.40**site acceptance test****SAT**

test performed on site which proves the correct functions of a logic subsystem

3.41**software****SW**

programs, parameters and data made up of application software and system software (see Figure 5)

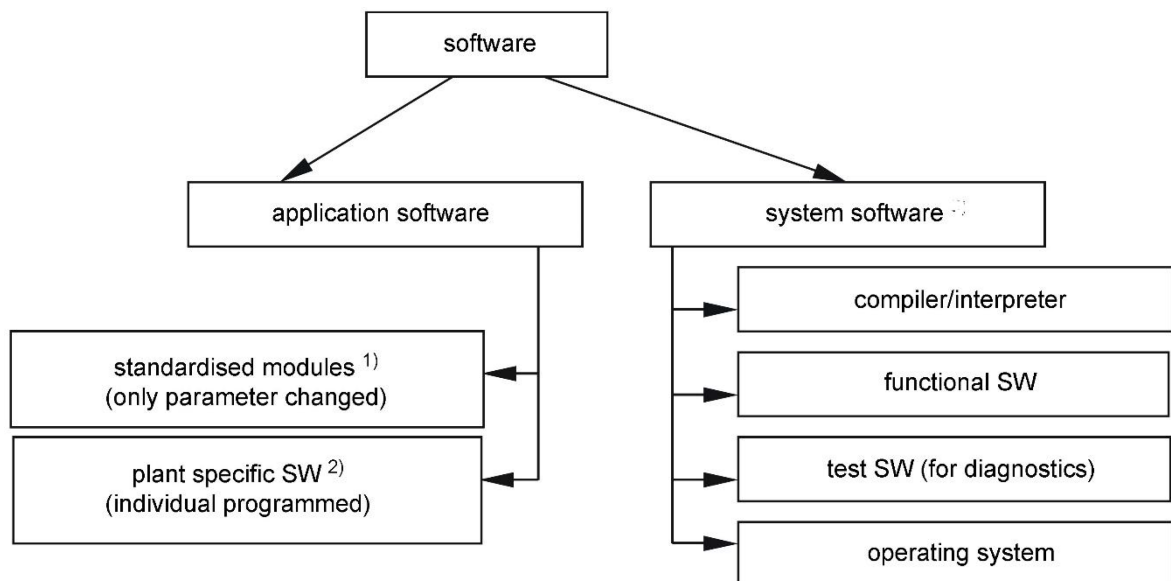


Figure 5 — Software

Note 1 to entry: Type approval according to EN 50156-2:2015.

Note 2 to entry: Type approval according to EN 50156-2:2015.

Note 3 to entry: Diverse programs (software) are programs or program sections which represent different solutions to an identical task which were either written (independently) by various persons or take different approaches to problems from the outset to achieve the same result (design diversity)

3.42

software fault

discrepancy between program functions performed in the program and the specified program functions (see also Figure 3 and Figure 4)

Note 1 to entry: All software errors are systematic errors.

3.43

type approval

independent examination to ensure that a duly identified product, process or service is in conformity with a specific standard and/or the specified requirements

3.44

validation

confirmation by examination and provision of objective evidence that the particular requirements for a specific intended use are fulfilled

Note 1 to entry: In the context of this document, validation means the process of demonstrating that the safety-related system under consideration, and after installation, satisfies in all respects the safety requirements specification for that safety-related system. Therefore, for example, Software Validation means confirming by examination and provision of objective evidence that the software satisfies the Software Safety Requirements Specification.

3.45

verification

confirmation by examination and provision of objective evidence that the specified requirements of a safety life cycle phase have been fulfilled

4 General requirements

4.1 Concept and scope definition

The relevant European Standards for electrical equipment apply to the installation of the electrical part of furnaces. Clause 2 lists appropriate standards and other technical codes.

Risks associated with the hazards relevant to the electrical equipment shall be assessed as part of the overall requirements for assessment of the furnace or boiler plant. This risk assessment shall be carried out for each individual situation.

4.2 Environmental requirements

4.2.1 General

The electrical equipment shall be selected and mounted so that it withstands the potential electrical, chemical, thermal and mechanical stresses at its place of use as well as external influences e.g. environmental stresses.

4.2.2 Environmental and operating conditions

The electrical equipment shall be suitable for use in the environmental and operating conditions as specified below.

An agreement is required between supplier and user, if the environmental and operating conditions are outside those specified below.

4.2.3 Electromagnetic compatibility

4.2.3.1 Electromagnetic compatibility – Emission requirements

The electrical interference generated by the equipment itself shall not exceed levels specified in the relevant equipment standard and other standards with electromagnetic compatibility (EMC). For permissible limits see

EN IEC 61000-6-4:2019 and methods of measurement of radio interference characteristics see EN 55011:2016 or EN 50165-1 depending on the application.

4.2.3.2 Electromagnetic compatibility – Immunity requirements

Test instrumentation, test set-up and test procedure shall be in accordance with the relevant parts of EN 61000-4 series, the severity levels being at least level 3 and the performance criteria as specified below. The equipment under test (EUT) shall be operated at rated voltage unless otherwise specified. The equipment shall be tested during stand-by, running and lock-out condition.

Higher EMC levels may be selected depending on the environment in which the equipment is used. In these cases the appropriate levels should be used. The levels as mentioned in EN IEC 61000-6-4:2019 are preferred. Whenever the levels are not defined in EN IEC 61000-6-4:2019, they should be pre-defined between manufacturer and test house.

For functional safety requirements, EN 61000-6-7:2015 shall be considered.

4.2.3.3 Performance criteria

4.2.3.3.1 Safety-related functions

When tested in accordance with 4.2.3.2, safety relevant functions shall remain operational in accordance with the manufacturer's specifications. Furthermore, the equipment shall not reset when tested in lock-out condition.

4.2.3.3.2 Non-safety relevant aspects

Non-safety relevant functions are expected to meet the requirements as intended under the EMC Directive. Therefore, the performance criteria of these functions shall be in accordance with the manufacturer's specifications. These specifications shall be predefined.

4.2.4 Ambient temperature

Electrical equipment shall be capable of operating correctly under the ambient temperature prevailing at the place of use.

Normally the following ambient temperatures shall be considered:

- electrical installation rooms: Electrical equipment shall be capable of operating correctly in ambient temperatures between +5 °C and +40 °C;
- plant environment (e.g. boiler house): Electrical equipment shall be capable of operating correctly in ambient temperatures between +0 °C and +55 °C;
- outdoor installation: Electrical equipment shall be capable of operating correctly in ambient temperatures between –25 °C and +40 °C.

Electrical equipment shall be designed such that it withstands temperatures from –25 °C to +70 °C during transport and storage.

If other temperatures than those specified above are expected at the place of use (e.g. upper level boiler area) electrical equipment shall be designed such that it is capable of operating correctly under these conditions. The operating temperature range shall be indicated. If the equipment is designed to be cooled while in use, the permissible coolant temperatures shall be indicated on the type plate.

4.2.5 Humidity

The electrical equipment shall be capable of operating correctly within a relative humidity range of 30 % to 95 % (non-condensing).

4.2.6 Contamination

Electrical equipment shall be adequately protected against the ingress of solid bodies and liquids (see 7.1 and 7.2).

4.2.7 Vibration and shock

Undesirable effects of vibration and shock (including those generated by the plant and its associated equipment and those created by the physical environment) shall be avoided by the selection of suitable equipment, by mounting it away from the sources of vibration, or by the use of anti-vibration mountings. A special agreement may be necessary between the supplier and the user. The minimum requirements according to EN 60654-3:1997, classes VL 3, VH 3 and VS 3 shall be fulfilled.

4.2.8 Equipment used in flammable atmospheres

In areas where the occurrence of ignitable mixtures of gaseous fuel or combustible dust in the air may occur (e.g. gas pressure reducing stations), the relevant standards for explosion-protected electrical equipment shall be fulfilled. Relevant legislation can also exist.

In the vicinity of the furnace, where combustion takes place and hot surfaces might ignite gas-air mixtures, the occurrence of such mixtures shall be avoided, e.g. by proper venting.

4.3 Power supply

4.3.1 General

The electrical equipment shall be designed to operate correctly under the following supply conditions:

In the event of voltage fluctuations within a voltage range of 85 % to 110 % of the nominal voltage (mains AC voltage). In the case of battery operation, voltage fluctuations within a voltage range of 85 % to 120 % of the rated voltage shall be regarded as normal.

NOTE See EN 50160.

4.3.2 Power stations

In steam boiler installations, which are part of power stations, shunt faults in the installation of the generator or start up of big three phase current actuators may require the additional following conditions:

- a) In the event of voltage superimposition above the limits specified under heading 4.3.1 of up to 10 % of the nominal voltage in the case of AC voltage and up to 15 % of the nominal voltage in the case of DC voltage.
- b) In the event of fluctuations of frequency in a frequency range of 95 % to 105 % of the nominal frequency. Different arrangements may be necessary for station-service plant in power stations.

The ranges may be reduced following agreement between the supplier and the user. The ranges specified may be exceeded if all equipment is suitable for this.

5 Incoming supply connections and devices for disconnecting and emergency stop

5.1 Incoming supply and equipment connections

5.1.1 Types of connection

One of the following types of connection shall be selected for the connection of the electrical equipment for a furnace to the incoming supply:

- a) connection via permanently installed cables;
- b) connection via flexible cords which are permanently connected to the supply system and the terminals of the installation;
- c) connection via flexible cords which are permanently connected to the equipment and which are connected to the supply system by a plug-and-socket combination;

- d) for connection to the incoming supply, only polarized plug-and-socket combination as specified in EN 60309-1:1999 shall be used. Control or safety circuits shall be supplied directly from the incoming supply via plug-and-socket combination.

In the case of ships, only types of connection a) and b) shall be used for the primary supply of electrical equipment for the furnace from the incoming supply.

5.1.2 Terminations

5.1.2.1 General

The connecting points shall be suitable for the cross-sectional area and type of conductors to be connected.

5.1.2.2 Incoming supply terminals

The incoming supply terminals shall be unambiguously marked in accordance with EN IEC 60445:2021. The designations shall be consistent with the circuit documentation.

5.1.2.3 Connections to remote electrical equipment

5.1.2.3.1 General

Terminals, plug-and-socket devices or equivalent connections shall be provided in the control cabinet, in burner controls or in a special terminal box for the connection of each item of remote electrical equipment. Their designations shall be consistent with the circuit diagram.

5.1.2.3.2 Protective conductor terminal

An adequate number and design of connections shall be provided for the protective conductors (green/yellow colour coding) in the control cabinet or terminal box so that incoming or outgoing protective conductors can be individually connected. The protective conductor connections of the equipment shall be secured to prevent accidental loosening and shall be marked in accordance with EN IEC 60445:2021.

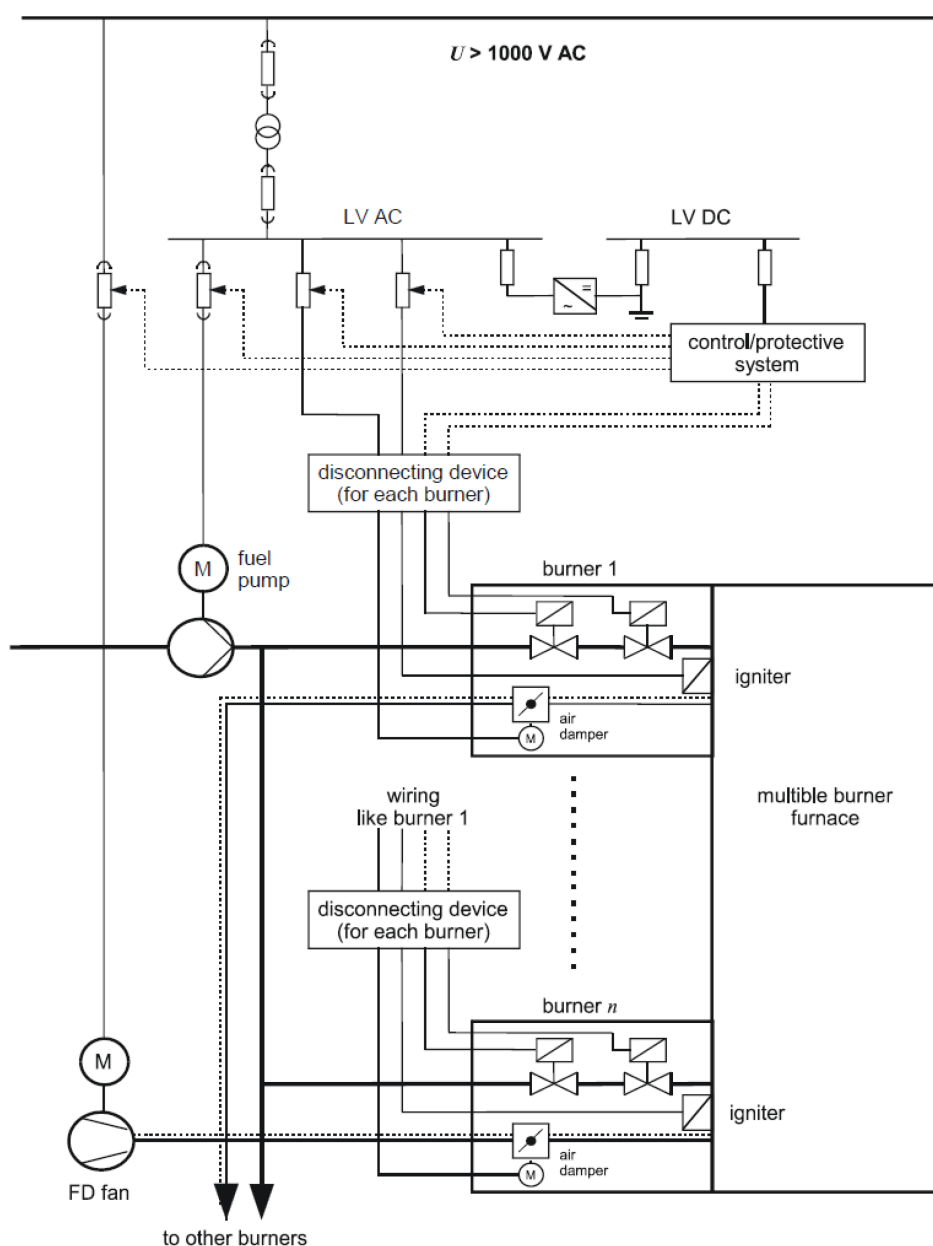
5.1.2.3.3 Plug-and-socket combination

If the plug-and-socket combination are not located in electrical installation rooms (where access is restricted to authorized staff) they shall be polarized and of the retaining type to prevent accidental disconnection.

On ships, all plug-and-socket combinations shall be of a retaining type and polarized.

5.2 Devices for disconnecting power supplies

5.2.1 General



Key

.....	control system		breaker in truck-type switch gear
—	electrical system		switching device
----	Combustion Air system		
—	fuel system		

Figure 6 — Example of power supply, switching, isolating devices and other electrical components of a furnace

There shall be a supply disconnecting device which may be used to isolate the electrical equipment where necessary, for example, for cleaning, maintenance and repair works.

In the case of smaller plants, this may be achieved by a common incoming supply switch-disconnector.

In the case of large furnace, isolation shall be possible for each particular device or in groups.

Medium voltage supplies and loads shall be isolated by disconnecting switches or moving the breaker of truck-type switch gear into the disconnected position, and applying an earth.

5.2.2 Disconnecting switch

For low voltage, the disconnecting switch shall satisfy the following requirements:

- It shall be designed at least as an on-load switch in accordance with EN IEC 60947-3:2021;
- It shall be designed for the total current of all load circuits which can be operated simultaneously;
- It shall be possible to operate the switch manually and it shall have only one off and one on position with appropriate stops. The switch positions shall be marked in accordance to EN IEC 60947-3:2021;
- It shall disconnect all non-earthed conductors simultaneously and shall have disconnecting characteristics as specified in EN IEC 60947-3:2021. In order to avoid unauthorised operation the switch shall be capable of being locked off or adequate organisational measures shall be taken;
- It shall have a visible isolating point or a position indicator. The off position shall only be indicated when the clearances between all switch contacts stipulated in EN IEC 60947-3:2021 have been reached;
- If different parts of the furnace are powered from different input supply systems, it shall at least be possible to isolate them individually (see Figure 6);
- For each burner of furnaces which use solid, liquid or gaseous fuels, there shall be a disconnecting device which can be used to isolate all the electrical equipment of the burner as necessary, for cleaning, maintenance and repair work etc. as well as in the event of lengthy periods of non-use. However, in furnaces with several burners, a common disconnecting device may be used.

5.2.3 Excluded circuits

The following circuits need not be isolated by this disconnecting switch:

- lighting and socket-outlet circuits for accessories used for repairs or maintenance;
- circuits up to 50 V;
- auxiliary circuits above 50 V which are required to remain energised;
- auxiliary circuits above 50 V which permit maintenance or repair operation and auxiliary circuits for devices which make equipment inactive or inert.

These circuits shall be specially marked. Conductors for the circuits shall be routed separately and shall be routed via terminals shrouded to IP2X according to EN 60529:1991.

Those circuits which are not switched off by the isolating device shall be detailed in the circuit documentation. An appropriate warning notice shall then be affixed to the isolating device (e.g. Warning! Auxiliary circuits remain live after disconnection).

5.3 Emergency stop

5.3.1 General

In order to reduce the risk of hazards causing injury to persons, damage to equipment or work in progress, emergency stop is necessary. The requirements for this emergency stop depend on the type of hazard and plant.

The emergency stop shall be initiated by a manually operated emergency stop device.

To reach a safe status of a furnace it is necessary to stop the energy conversion in it. That means the supply of fuel or other form of energy to the furnace shall be interrupted as fast as possible.

For machinery related to furnaces which is subject to the Machinery Directive 2006/42/EC, EN ISO 13850 for emergency stop of the machine should be applied if the risk analysis of the machinery demands an emergency stop.

5.3.2 Emergency stop device for furnaces in heating installations

It shall be possible to initiate the emergency stop of oil- and gas-fired furnaces in heating installations having a nominal thermal output exceeding 50 kW by a single human action.

5.3.3 Emergency stop device for other furnaces, e.g. steam boilers

An emergency stop device shall be provided to initiate the emergency stop by a single human action in the event of a hazardous situation arising.

The emergency stop device shall directly or indirectly switch those circuits and electrical equipment of a furnace which need to be switched off to prevent an hazardous situation occurring. The emergency stop device may be integrated into the safety-related system. In that case the safety-related system and the emergency stop device functionality shall satisfy the requirements of chapter 10.

The emergency stop devices shall meet the following conditions:

- the contact members shall ensure positive opening operation (see EN 60947-5-1:2017, Annex K);
- they shall be located in an easily accessible and non-hazardous position either outside the room where the furnace is installed or along the emergency exit route and their purpose appropriately marked;
- the initiator of the emergency stop device shall be coloured red and the surface behind it shall be coloured yellow.

5.3.4 Application as isolating switch

The emergency stop device may be used as a supply disconnecting device, if it meets the conditions specified in 5.2.

6 Protection against electric shock

6.1 Protection against direct contact

The live parts of electrical equipment shall be protected against direct contact in accordance with IEC 60364 4-41:2005. Deviations or additions thereto are as follows:

- a) Electrical equipment which is used outside of electrical operating areas or closed electrical operating areas shall also be protected against direct contact in the case of nominal voltages below 50 V;
- b) It shall only be possible to remove or open the barriers (doors, covers) of live parts of ignition transformers and ignition electrodes by using a tool;
- c) In the case of burners with high-voltage ignition which swivel out or move out, the voltage supply for the high-voltage section shall be automatically switched off when the burner is swivelled out or moved out.

NOTE Equipment designation and the application of warning signs is dealt with in Clause 13.

6.2 Protection against indirect contact

The measures in IEC 60364-4-41:2005 shall be taken as protection against indirect contact.

Structural parts of the burner, boiler or boiler room may be used as protective conductors if the conditions in HD 60364-5-54:2011, Clause 5 (Annex C) are met.

In ignition circuits, the centre tap or one pole of the high-voltage winding of the ignition transformer may be connected to the exposed conductive part; the exposed conductive part shall be connected to the protective conductor. In the case of ignition devices which can be moved or swivelled, the screen of the ignition cable shall be connected to the protective conductor, but shall not itself be relied on as a protective conductor, therefore an additional protective conductor is necessary.

7 Environmental protection of the equipment

7.1 Protection against ingress of solid foreign bodies

When installed, all electrical equipment shall at least meet the requirements of protection class IP4X in accordance with EN 60529:1991.

This requirement is not applicable if the equipment is located in rooms where a particular type of protection is superfluous (e.g. air-conditioned or clean and dry rooms) or if it is accommodated in control cabinets and consoles which conform to the minimum requirements of degree of protection of IP4X in accordance with EN 60529:1991 unless otherwise stipulated below.

7.2 Protection against water

Protection against water for the electrical equipment shall be suitable for local conditions. This can be ensured by means of an appropriate degree of protection as specified in EN 60529:1991 or by suitable mounting.

For application on ships see IEC 60092-101.

8 Equipotential bonding

8.1 General

Equipotential bonding shall be designed such that the function provided by the safety related system is not impaired.

NOTE Equipotential bonding can be applied for various purposes such as

- a) equipotential bonding as a protective measure for persons,
- b) equipotential bonding for lightning protection,
- c) functional equipotential bonding.

8.2 Equipotential bonding as a protective measure in case of indirect contact

To avoid hazardous touch voltages (e.g. caused by insulation failure between live parts and exposed conductive parts or formation of stray voltages) between metal parts of the plant and earth, there shall be a main equipotential bonding conductor connecting the following conductive parts:

- main protective conductor;
- main earthing conductor;
- lightning earth conductor;
- main water pipes;
- main gas pipes;
- other metal piping systems e.g. rising mains of central heating and air-conditioning systems, metal parts of building structure (as far as possible).

This equipotential bonding shall be in accordance with the relevant requirements of the HD 60364-4 series.

8.3 Equipotential bonding for the purpose of lightning protection

Lightning protection by equipotential bonding shall protect persons, electrical equipment and especially electronic devices from hazardous overvoltages. In addition to local requirements to protect the structure containing the furnace, which may be specified in local or national standards, all non-active metal parts shall be interconnected and connected to earth potential by an equipotential bonding conductor (see 8.2).

If a direct connection is not allowed for corrosion protection reasons, the connections shall be carried out via spark gaps.

In particular, where equipment is located outside of the structure, metal enclosures and conductive screens of cables shall be integrated in this equipotential bonding for lightning protection purposes.

The active parts and cable cores shall be provided with suitable lightning arrestor or over-voltage surge protection devices, if this is necessary to maintain safety.

8.4 Functional equipotential bonding

The measures of functional equipotential bonding shall ensure that voltages between various devices and plant components which could adversely affect their functioning are reduced to a sufficiently low level.

Devices, equipment and plant components which are functionally interdependent and which are located in close proximity to each other may be connected together by a separate equipotential bonding conductor in order to ensure their satisfactory functioning.

The functional equipotential bonding shall preferably be meshed (over an area) in order to reduce lightning overvoltages or faults at higher frequencies (electronic circuits). For protecting remote electronic devices (e.g. transducer), the electronics of which do not have their own earth connection (isolation between electronics and enclosures), functional equipotential bonding in a (centralized) star arrangement may be practical. At industrial frequencies, equipotential bonding in a star configuration is likewise recommended in order to avoid interference.

NOTE 1 The purpose of functional equipotential bonding is not to protect human beings against hazardous overvoltages. This protection is achieved by measures according to 8.2 and 8.3. Functional equipotential bonding includes individual earth connections, directly or via surge voltage protectors, if they serve to protect sensitive items of equipment, e.g. electronic devices.

NOTE 2 An agreement is required between the supplier and the user upon the concept of functional equipotential bonding (e.g. meshed, star configuration).

9 Auxiliary circuits

9.1 Supply to auxiliary circuits

9.1.1 Supply from 3-phase or AC systems

A 3-phase or AC system intended to supply auxiliary circuits shall have a neutral conductor. Auxiliary circuits shall only be connected between a line conductor and the neutral conductor.

The neutral conductor shall preferably be earthed. In non-earthed systems, auxiliary circuits shall be supplied from control supply transformers, and equipped with an earth leakage monitoring system.

The earth leakage monitoring system should provide automatic disconnection of the electrical supply of any circuit affected by the occurrence of an insulation failure in order to prevent a hazardous condition resulting from a touch voltage.

Disconnection in the event of a single fault is not necessary if the fault current is so low that it will not give rise to the risk of electric shock and an alarm signal is initiated. However, precautions shall be taken to guard against the risk of electric shock in the event of two faults existing simultaneously.

For this type of protection, the requirements of 413.1 of IEC 60364-4-41:2005 should apply.

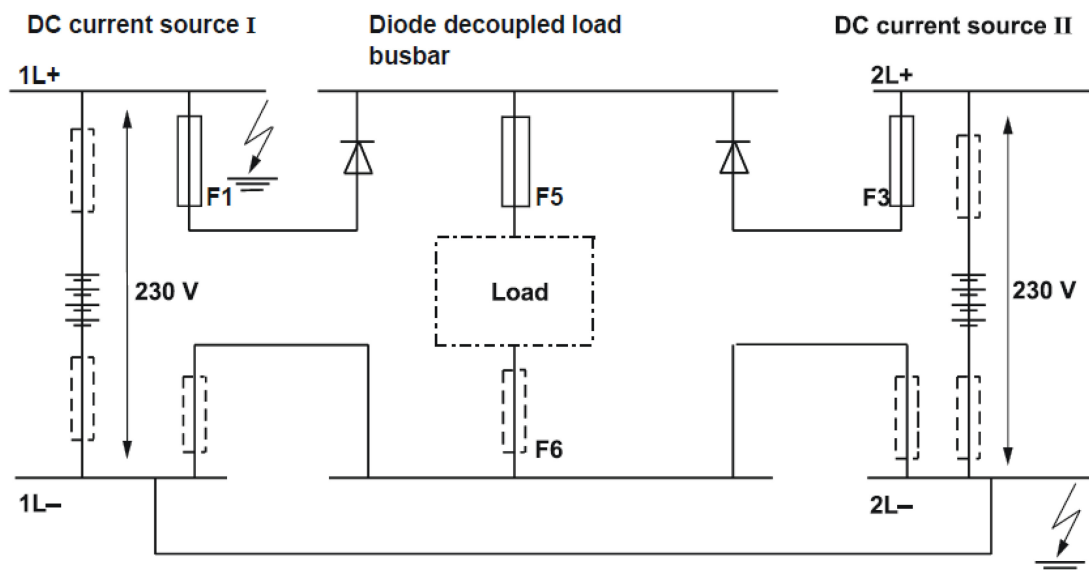
9.1.2 Supply from DC mains

9.1.2.1 General

With a supply from one non-earthed or single-earthed DC mains, the auxiliary circuit shall be connected to both poles (both line conductors).

9.1.2.2 Supply from more than one DC source

With a supply from more than one DC source with diode decoupling, the non-decoupled poles of these power sources shall additionally be directly interconnected in order to avoid voltage doubling in the event of two earth faults (see Figure 7).



With earth faults in different poles the load voltages remain unchanged.

Figure 7 — Supply from two DC sources

9.1.2.3 Supply from a DC source with a mid-point conductor

With a supply from a DC source with an earthed or non-earthed mid-point conductor, connection shall be made to a live conductor and the mid-point conductor.

9.1.2.4 Supply from an isolated DC source

Supply systems isolated from earth shall be equipped with an earth leakage monitor to prevent malfunctions in case of a dual earth fault.

9.1.3 Auxiliary circuits connected between the line conductors

If auxiliary circuits are connected between the line conductors, then the contacts of the actuating elements for safety related purposes shall switch in both line conductors or suitable measures shall be taken to prevent a functional failure of the control system in the event of a short circuit to an exposed conductive part or to earth.

9.2 Voltage for auxiliary circuits

9.2.1 Operating voltage of auxiliary circuits

Auxiliary circuits shall be operated with nominal voltages $\leq$ AC 400 V or $\leq$ DC 250 V.

This does not include flame monitors and ignition devices.