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**Električna oprema za peči in pomožno opremo – 1. del: Zahteve za zasnovu in inštalacijo naprave**

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

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

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

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

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## **CENELEC**

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

**Central Secretariat: rue de Stassart 35, B - 1050 Brussels**

## Foreword

This European Standard has been prepared by the German National Committee with the participation of experts of other National Committees on the basis of CLC/BT(DE/NOT)140.

The text of the draft was submitted to the formal vote and was approved by CENELEC as EN 50156-1 on 2004-04-01.

The following dates were fixed:

- latest date by which the EN has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 2005-04-01
- latest date by which the national standards conflicting with the EN have to be withdrawn (dow) 2007-04-01

The following further parts of this standard are under consideration:

Part 2: Requirements for design, development and type approval of safety-relevant equipment

Part 3: Requirements for plant-specific tests of safety-relevant equipment

This type B standard (CEN/TC 114 terminology) is based on the IEC Standard 61508 Functional safety – Safety-related systems, Parts 1 to 7 as a basic safety standard.

This standard shall serve as a basis for requirements on electrical equipment of boilers to be referenced in standards to be developed by CEN/TC 269.

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## Introduction

This part of the European Standard 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;
- ease and economy of maintenance.

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

A protective 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 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 explosive mixture of fuel and air, and also to avoid damage of the heated systems (see 3.25).

The rating of necessary safety integrity levels is based on standard EN 61508-1. The requirements for protective system(s) for boilers have been coordinated with CEN/TC 269.

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 protective system(s).

The following further parts of this Standard are under consideration:

Part 2: Requirements for design, development and type approval of safety-relevant equipment

Part 3: Requirements for plant-specific tests of safety-relevant equipment

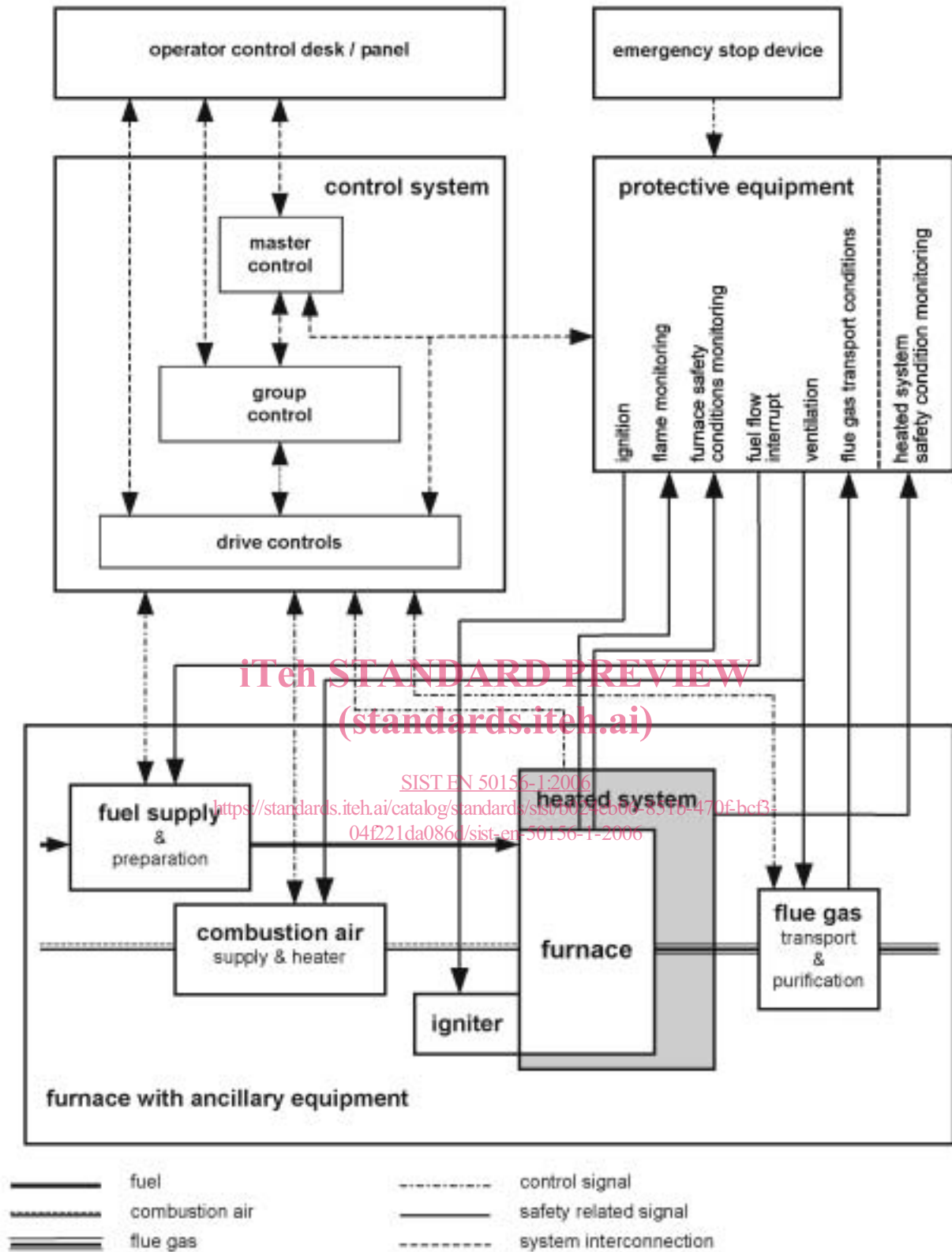


Figure 1 – Example of the functionality of a furnace with ancillary equipment, heated systems and relationship to control system and protective equipment.



## 1 Scope

This standard applies to the application design and installation of electrical equipment, control circuits and protective 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 may be part of the following plants for example:

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

NOTE 1 The requirements of this standard 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 standard. These requirements may 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 it is recommended to use the requirements of this standard
- h) This standard may also be used as reference for electrical equipment requirements for thermo-processing equipment.

NOTE 3 The requirements of this standard are applicable in all cases where an equipment specific standard does not specify a requirement.

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

- i) Non electrically heated appliances and burner control systems for household and similar purpose;
- j) Furnaces using technologies for the direct conversion of heat into electrical energy;
- k) Combustion chambers of non-stationary prime movers and turbines;
- l) Central oil supply systems for individual heating appliances;
- m) Furnaces using solid fuels for heating purposes for household use with a nominal thermal output up to 1 MW;
- n) Furnaces which are used to heat process fluids and gasses in chemical plant.

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

## 2 Normative references

The following referenced documents are indispensable for the application 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 267:1999, *Forced draught oil burners – Definitions, requirements, testing, marking*

EN 298:1993, *Automatic gas burner control systems for gas burners and gas burning appliances with or without fans*

EN 50265-1:1998, *Common test methods for cables under fire conditions – Test for resistance to vertical flame propagation for a single insulated conductor or cable – Part 1: Apparatus*

EN 55011:1998, *Industrial, scientific and medical (ISM) radio-frequency equipment – Radio disturbance characteristics – Limits and methods of measurement (CISPR 11:1997, modified)*  
A1:1999 (CISPR 11:1997/A1:1999)  
A2:2002 (CISPR 11:1997/A2:2002)

EN 55022:1998, *Information technology equipment – Radio disturbance characteristics – Limits and methods of measurement (CISPR 22:1997, modified)*  
A1:2000 (CISPR 22:1997/A1:2000)  
A2:2003 (CISPR 22:1997/A2:2002)

EN 60034-1:1998, *Rotating electrical machines – Part 1: Rating and performance (IEC 60034- 1:1996, modified)*  
A1:1998 (IEC 60034- 1:1996/A1:1997)  
A2:1999 (IEC 60034-1:1996/A2:1999)

EN 60204-1:1997, *Safety of machinery – Electrical equipment of machines – Part 1: General requirements (IEC 60204-1:1997)*

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

EN 60445:2000, *Basic and safety principles for man-machine interface, marking and identification – Identification of equipment terminals and of terminations of certain designated conductors, including general rules for an alphanumeric system (IEC 60445:1999)*

EN 60519-1:1993, *Safety in electroheat installations; Part 1: general requirements (IEC 60519-1:1984)*

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

EN 60617 series, *Graphical symbols for diagrams (IEC 60617 series)*

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

EN 60664-1:2003, *Insulation coordination for equipment within low-voltage systems – Part 1: Principles, requirements and tests (IEC 60664-1:1992 + A1:2000 + A2:2002)*

EN 60947-2:1989, *Low-voltage switch gear and control gear – Part 2: Circuit-breakers (IEC 60947-2:1995)*  
A1:1997  
A2:2001

EN 60947-3:1990, *Low-voltage switch gear and control gear – Part 3: Switches, disconnectors, switch-disconnectors and fuse-combination units (IEC 60947-3:1999, mod.)*  
A1:2001

EN 60947-4-1:2001, *Low-voltage switchgear and controlgear – Part 4-1: Contactors and motor starters – Electromechanical contactors and motor-starters (IEC 60947-4-1:2000)*

EN 60947-5 series, *Low-voltage switchgear and controlgear (IEC 60947-5 series)*

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

EN 61082 series, *Preparation of documents used in electrotechnology (IEC 61082 series)*

EN 61131-3:2003, *Programmable controllers – Part 3: Programming languages (IEC 61131-3:2003)*

EN 61140:2002, *Protection against electric shock – Common aspects for installation and equipment (IEC 61140:2001)*

EN 61346-1:1996, *Industrial systems, installations and equipment and industrial products – Structuring principles and reference designations – Part 1: Basic rules (IEC 61346-1:1996)*

EN 61508 series, *Functional safety of electrical/electronic/programmable electronic safety-related systems (IEC 61508-1 series)*

EN 61558-1:1997, *Safety of power transformers, power supply units and similar - Part 1: General requirements and tests (IEC 61558-1:1997, mod.)*

EN 61810-1:1998, *Electromechanical non-specified time all-or-nothing relays – Part 1: General requirements (IEC 61810-1:1998)*

HD 384.4 series, *Electrical installations of buildings – Part 4: Protection for safety (IEC 60364-4 series)*

HD 384.4.41 S2:1996, *Electrical installations of buildings – Part 4: Protection for safety – Chapter 41: Protection against electric shock (IEC 60364-4-41:1992)*

HD 384.5.54 S1:1988, *Electrical installations of buildings - Part 5: selection and erection of electrical equipment; chapter 54: earthing arrangements and protective conductors (IEC 60364-5-54:1980)*

HD 472 S1:1989, *Nominal voltages for low voltage public electricity supply systems (IEC 60038:1983). A1:1995*

IEC 60050-191:1990, *International Electrotechnical Vocabulary - Chapter 191: Dependability and quality of service*

IEC 60050-826:1982, *International Electrotechnical Vocabulary - Chapter 826: Electrical installations of buildings*

IEC 60092-101:1994, *Electrical installations in ships – Part 101: Definitions and general requirements. A1:1995*

IEC 60417 database, *Graphical symbols for use on equipment (IEC 60417 series)*

IEC 60536-2:1992, *Classification of electrical and electronic equipment with regard to protection against electric shock – Part 2: Guide to requirements for protection against electric shock*

ISO 3864:1984, *Safety colours and safety signs*

ISO 7000:1989, *Graphical symbols for use on equipment; index and synopsis*

ISO 9000:2000, *Quality management and quality assurance – Vocabulary*

### 3 Definitions

For the purposes of this standard the following definitions apply.

#### 3.1

##### **actuating element**

a 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

#### 3.2

##### **auxiliary circuit**

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

### 3.3

#### **certificate of conformity**

declarations that the equipment is in accordance with relevant standard (see 10.7.3)

NOTE In some legislation these declarations are only accepted from independent assessors depending on the required safety integrity level.

### 3.4

#### **component**

a constituent part of the electrical equipment, usually specified by function, but used in various applications. Examples include resistors, capacitors, transistors, integrated circuits, printed-circuit boards

NOTE 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.

### 3.5

#### **components proven in operation**

components which have been applied in numerous and varied applications with acceptable low rates of failures. This shall be validated e. g. according EN 61508

### 3.6

#### **continuous operation**

operation can be maintained for longer than 24 h without interruption

### 3.7

#### **control circuit**

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

### 3.8

#### **control device**

a device connected into the control circuit and used for controlling the operation of the furnace. For example, a manually operated switch, a limit transducer, or a valve

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### 3.9

#### **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

### 3.10

#### **diagnostic Coverage (DC)**

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

NOTE To determine the DC a fault model should be used which is sufficient for the concerned technology.

### 3.11

#### **diverse programs (software)**

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)

### 3.12

#### **electrical equipment**

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

### 3.13

#### **emergency stop device**

a manually operated switch which can be used to shut down the furnace and its associated equipment in the event of danger. The emergency stop device shall prevent fuel flow and electrical preheating

### 3.14

#### **external diagnostic (ED)**

measures to detect failures, particularly passive failures, where additional devices, which do **not** form part of the programmable controller or one of its channels, are used to test the function of particular sections or the entire programmable controller. The external diagnostic may be performed by another channel in the case of a multi-channel configuration

### 3.15

#### **external influences**

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

NOTE 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 as well as UV radiation for EPROMs.

### 3.16

#### **failure (F)**

the termination of the ability of an item to perform required function (191-04-01 of IEC 60050-191:1990)

NOTE 1 After failure, the item has a fault.

NOTE 2 „Failure“ is an event, as distinguished from „fault“ which is a state.

NOTE 3 This concept as defined does not apply to items consisting of software only.

### 3.17

#### **failure mechanism**

physical or chemical process which causes an assembly to fail. 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

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### 3.18

#### **fault**

the state of an item characterised by 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 Figures 2 and 3).

NOTE A fault is often the result of a failure of the item itself, but may exist without prior failure (191-05-01 of IEC 60050-191:1990).

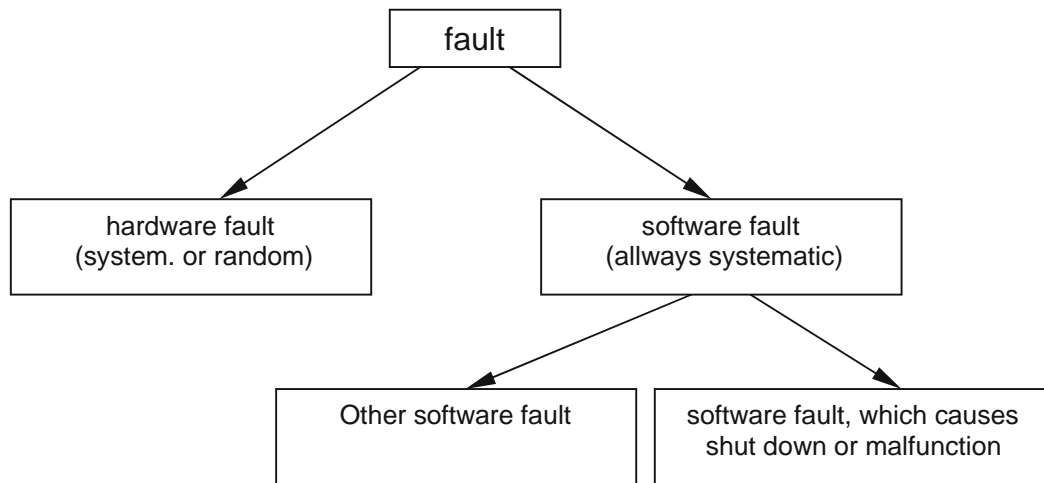


Figure 2 – Kinds of faults (related to the equipment <sup>1)</sup> to be considered)

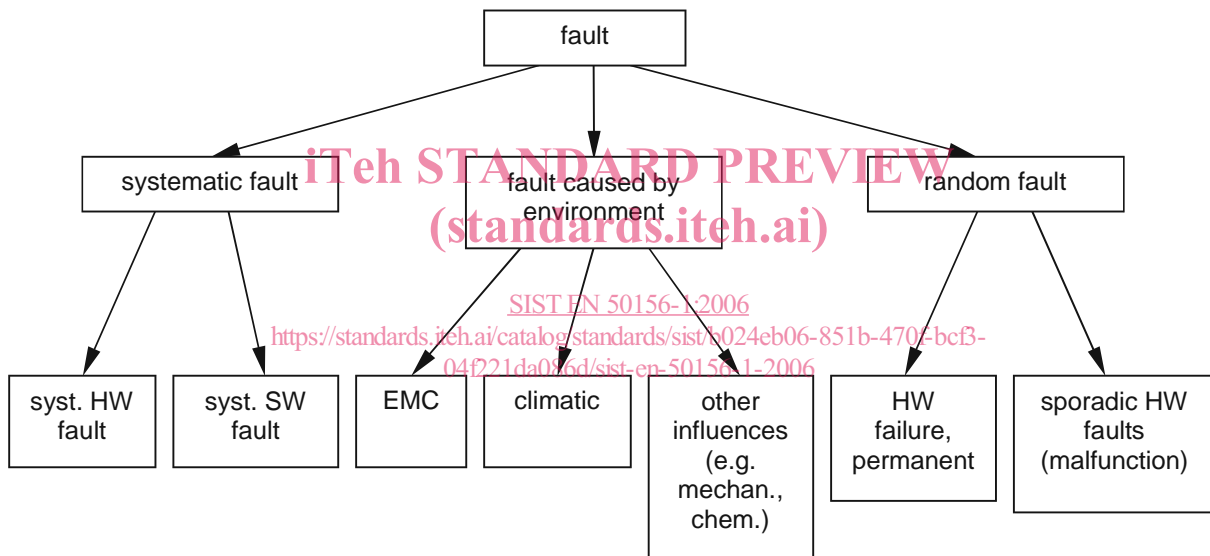


Figure 3 – Causes of faults (related to the equipment <sup>1)</sup> to be considered)

**3.19  
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

1) equipment to be considered could be:

- component
- device
- module
- plant component

### 3.20

#### **fault tolerance time**

the fault tolerance time is the 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 protective systems

### 3.21

#### **flame monitoring device or unit**

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

### 3.22

#### **function test**

the complete test of an individual safety-related function. This includes testing, whether the protective 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 Function tests of the complete safety-related functions may be carried out by overlapping partial tests.

### 3.23

#### **furnace**

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

NOTE The English term „furnace“ includes structures within which heat is generated by electricity and other forms of energy. This standard also applies to the electrical equipment of electrically heated or heat recovery steam boilers.

### 3.24

#### **furnace and ancillary equipment**

this includes all the equipment for the burning of fuels, for example equipment for the storage, preparation and transport of fuels, combustion air supply<sup>2)</sup>, cleaning and removal of flue gas and exhausts and relevant closed-loop and open-loop control and monitoring equipment

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### 3.25

#### **heated system**

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

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### 3.26

#### **immersion electrode**

an immersion electrode is a limit transducer for fluid level monitoring

### 3.27

#### **limiter**

a transducer which, on reaching a defined limit value (e.g. pressure, temperature, flow, level), interrupts the energy supply and remains in that state until manually reset

NOTE Resetting of the limiter can be done either manually or by use of a tool. The resetting is only possible once the performance quantity has been restored to within its operating limits. This function of locking can be achieved mechanically on the equipment or by means of an electrical circuit.

### 3.28

#### **limit sensor**

a transducer which, on reaching a defined limit value, outputs a signal and/or cuts out and only reverses the output signal in the event of a specific change in the performance quantity (e.g. pressure, temperature, flow, level). Limit sensors are used for signalling or for triggering control processes

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<sup>2)</sup> Also applies to gas turbines containing oxygen within its exhaust gas.