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Industrijske peči in pripadajoča procesna oprema - Varnost - 4. del: Zaščitni sistemi (ISO/DIS 13577-4:2021)

Industrial furnaces and associated processing equipment - Safety - Part 4: Protective systems (ISO/DIS 13577-4:2021)

Fours industriels et équipements associés - Sécurité - Partie 4: Systèmes de protection (ISO/DIS 13577-4:2021)

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Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: Foreword - Supplementary information

The committee responsible for this document is ISO/TC 244, *Industrial furnaces and associated processing equipment*.

ISO 13577 consists of the following parts, under the general title *Industrial furnaces and associated processing equipment — Safety*:

— *Part 1: General requirements*

— *Part 2: Combustion and fuel handling systems*

— *Part 3: Generation and use of protective and reactive atmosphere gases*

— *Part 4: Protective systems*

Introduction

This part of ISO 13577 was developed to specify the requirements of a protective system, which is a safety-related control system (SCS) of industrial furnaces and associated processing equipment (TPE). It is intended that in designing the protective system of TPE, manufacturers of TPE choose from the three methods provided in this part of ISO 13577. Mandatory safety-related control functions of TPE are specified in the other parts of ISO 13577 (i.e. ISO 13577 1, ISO 13577 2, and ISO 13577 3).

This part of ISO 13577 is to be used as an essential part of the other parts of ISO 13577. Since the other parts of ISO 13577 are type-C standards of ISO 12100, TPE are required to be designed in accordance with the principles of ISO 12100. The type-B standards of ISO 12100 for SCS are IEC 62061 or ISO 13849 1, which always assume high-demand applications. However, there are cases in which a risk assessment according to IEC 61511 (all parts), which provides the option of a low-demand rate on the protective system, is more suitable for the design of a TPE protective system.

In principle, when requirements of the other parts of ISO 13577 (type-C standards) are different from those which are stated in type-A or -B standards, the requirements of the type-C standards take precedence over the requirements of the other standards for machines, which have been designed and built according to the requirements of the type-C standards. Therefore, this part of ISO 13577 permits extended risk assessment for SRECS in which risk assessment based on IEC 61511 (all parts) can be chosen as an alternative.

Industrial furnaces and associated processing equipment — Safety — Part 4: Protective systems

1 Scope

This part of ISO 13577 specifies the requirements for protective systems used in industrial furnaces and associated processing equipment (TPE).

The functional requirements to which the protective systems apply are specified in the other parts of ISO 13577.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable to its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 13574:2015, *Industrial furnaces and associated processing equipment — Vocabulary*

ISO 13849-1:— [1], *Safety of machinery — Safety-related parts of control systems — Part 1: General principles for design*

IEC 60947-4-1:2018, *Low-voltage switchgear and controlgear — Part 4-1: Contactors and motor-starters - Electromechanical contactors and motor-starters*

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

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

IEC 60730-2-5:2013+AMD1:2017+AMD2:2020 CSV, *Automatic electrical controls for household and similar use — Part 2-5: Particular requirements for automatic electrical burner control systems*

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

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

IEC 61508 -4:2010, *Functional safety of electrical/electronic/programmable electronic safety-related systems — Part 4: Definitions and abbreviations*

IEC 61508-5:2010, *Functional safety of electrical/electronic/programmable electronic safety-related systems — Part 5: Examples of methods for the determination of safety integrity levels*

[1] The edition 4 of ISO 13849-1 is under development and is to be issued in 2022.

IEC 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 61508-7:2010, *Functional safety of electrical/electronic/programmable electronic safety-related systems — Part 7: Overview of techniques and measures*

IEC 61131-3:2013, *Programmable controllers — Part 3: Programming languages*

IEC 61511-1:2016, *Functional safety — Safety instrumented systems for the process industry sector — Part 1: Framework, definitions, system, hardware and application programming requirements*

IEC 61511-2:2016, *Functional safety — Safety instrumented systems for the process industry sector — Part 2: Guidelines for the application of IEC 61511-1:2016*

IEC 61511-3:2016, *Functional safety — Safety instrumented systems for the process industry sector — Part 3: Guidance for the determination of the required safety integrity levels*

IEC 62061:2021, *Safety of machinery - Functional safety of safety-related control systems*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 13574:2015 and the following apply. Annex F contains copies of definitions from ISO 13574 used in this document.

3.1
final element
part of a protective system, which implements the physical action necessary to achieve a safe state

NOTE Examples are valves, switch gear, motors including their auxiliary elements, for example, a solenoid valve and actuator if involved in the safety function.

[SOURCE: IEC 61511-1:2003, 3.2.24 modified: "instrumented system" had been changed to read "protective system" in the definition.]

3.2
flame detector device
device by which the presence of a flame is detected and signalled

NOTE It can consist of a flame sensor, an amplifier, and a relay for signal transmission.

[SOURCE: ISO 13574:2015, 2.65, modified: The second sentence in the original definition had been presented as in the NOTE.]

3.3
logic function
function that performs the transformations between input information (provided by one or more input functions or sensors) and output information (used by one or more output functions or final elements)

NOTE Logic functions are executed by the logic solver of a protective system.

[SOURCE: IEC 61511-1:2003, 3.2.39, modified — "input functions" had been changed to read "input functions or sensors" and "output function" had been changed to read "output function or final elements"

in the definition, and the second sentence in the original definition had been deleted; Note has been added.]

3.4
logic solver
portion of a protective system that performs one or more logic function(s)

NOTE Examples are electrical systems, electronic systems, programmable electronic systems, pneumatic systems, and hydraulic systems. Sensors and final elements are not part of the logic solver.

[SOURCE: IEC 61511-1:2003, 3.2.40 modified: "either a BPCS or SIS" had been changed to read "a protective system" in the definition; NOTE 1 in the original definition had been deleted.]

3.5
programmable logic control
PLC
digital electronic operating system, designed for use in an industrial environment, which uses a programmable memory for the internal storage of user-oriented instructions to implement specific functions such as logic, sequencing, timing, counting and arithmetic, to control, through digital and analogue inputs and outputs, various types of machines or processes

[Source: IEC 61131-1:2003]

3.6
protective system
instrumented system used to implement one or more safety-related instrumented functions which is composed of any combination of sensor(s), logic solver(s), and final elements (for example, see Figure 2)

NOTE This can include safety-related instrumented control functions or safety-related instrumented protection functions or both.

[SOURCE: ISO 13574:2015, 2.138, modified: NOTE 1 to entry has been merged to the definition.]

3.7
safety bus
bus system and/or protocol for digital network communication between safety devices, which is designed to achieve and/or maintain a safe state of the protective system in compliance with IEC 61508 (all parts):2010 or IEC 60730-2-5:2013+AMD1:2017+AMD2:2020 CSV

[SOURCE: ISO 13574:2015, 2.164, modified: The referenced standards have been changed to dated ones.]

3.8
safety device
device that is used to perform protective functions, either on its own or as a part of a protective system

NOTE Examples are sensors, limiters, flame monitors, burner control systems, logic systems, final elements, and automatic shut-off valves.

3.9
sensor
device that produces a signal based on a process variable

EXAMPLES Transmitters, transducers, process switches, and position switches.

3.10
system for permanent operation
system, which is intended to remain in the running position for longer than 24 h without interruption

[SOURCE: IEC 60730-2-5:2013+AMD1:2017+AMD2:2020 CSV, 2.5.101]

3.11
system for non-permanent operation
system, which is intended to remain in the running position for less than 24 h

[SOURCE: IEC 60730-2-5:2013+AMD1:2017+AMD2:2020 CSV, 2.5.102]

4 Design requirements for equipment in a protective system

4.1 General

Electrical installations and equipment shall comply with IEC 60204-1:2016 and withstand the intended operating stresses and external influences and hazards identified in the risk assessment required at the design stage. Electrical installation and equipment shall be protected against damage. In particular, it shall be robust to withstand damage during continuous operation.

Devices shall be used in accordance with their instructions including safety manuals. Any device used outside of its published instructions shall be verified and validated to be suitable for the intended application.

Devices of a protective system shall withstand the environmental conditions according to IEC 60204-1:2016, 4.4 and fulfil their intended function.

Sensors (e.g. pressure transmitters, temperature transmitters, flow transmitters) used in the protective system shall be independent from the process control system.

NOTE 1 Operating information can be exchanged but not compromise the functional safety of the protective system.

Safe state shall be realized by de-energized circuits only.

Functional safety requirement, as identified in ISO 13577 (all parts) shall be in accordance with ,IEC 61508 (all parts):2010, IEC 61511 (all parts):2016, IEC 62061:2021 or ISO 13849-1:—[2] as applicable, and implemented with the required SIL/PL for each function.

For the determination of the Performance Level of a safety function according to ISO 13849-1:—, the alternative procedure as stated in ISO 13849-1:—, 6.1.9 is not allowed.

Figure 1 is provided as an aid to understand the relationship between the various elements of TPE and their ancillary equipment, the heating system, the process control system, and the protective system.

[2] The edition 4 of ISO 13849-1 is under development and is to be issued in 2022.

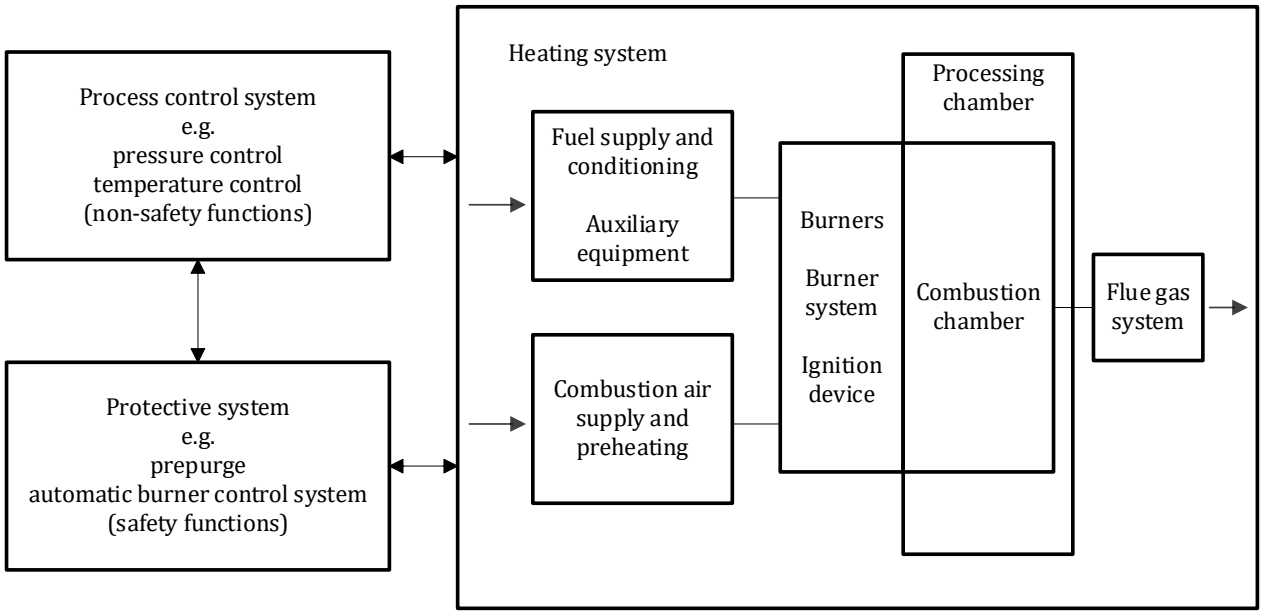

Figure 1 — Block diagram of control and protective systems

An appropriate group of techniques and measures shall be used that are designed to prevent the introduction of systematic faults during the design and development of the hardware and software of the protective system (see Annex A).

Failure due to short circuit in external wiring shall be avoided (see B.5 and Figure B.10).

The wiring of safety-relevant sensors and actuators, which are part of a protective system, usually are made in the field, outside of electrical enclosures. Short circuits, cross-circuits and earth faults in that field wiring can cause safety critical faults to the entire protective system. Cable loops for connecting field devices shall be suitably routed and fastened to prevent damage to the cables.

In order to keep the entire protective system in a safe condition, the field wiring of safety-relevant sensors and actuators (e.g. pressure switches, gas valves, etc.) shall be protected against mechanical damage (including e.g. vibration or bending) to prevent short circuits, cross circuits and earth faults.

NOTE 2 A method to protect against short circuits, cross circuits and earth faults is to use cable-ducts, cable trays, or conduits for the field wiring.

If the protective system is operated in non-grounded, insulated mains, an insulation monitoring device shall be foreseen. This isolation monitoring device immediately needs to isolate all poles of the protective system from the mains in the event of the first fault detection.

Requirements for testing and testing intervals for protective systems shall be specified in the instruction handbook. Except as permitted by method D, the testing of all safety functions shall be performed at least annually. Method D shall be used if the testing of all safety functions is performed beyond 1 y.

See Annexes C and D for examples of SIL/PL determinations.