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Industrijska termoprocesna oprema - 11. del: Varnostne zahteve za zaščitne sisteme

Industrial thermoprocessing equipment - Part 11: Safety requirements for protective systems

Industrielle Thermoprozessanlagen - Teil 11: Sicherheitsanforderungen an Schutzsysteme

Équipements thermiques industriels - Partie 11 : Prescriptions de sécurité pour les systèmes de protection

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Industrial thermoprocessing equipment - Part 11: Safety requirements for protective systems

Équipements thermiques industriels - Partie 11 : Prescription de sécurité pour les systèmes de protection

Industrielle Thermoprozessanlagen - Teil 11: Sicherheitsanforderungen an Schutzsysteme

This draft European Standard is submitted to CEN members for enquiry. It has been drawn up by the Technical Committee CEN/TC 186.

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EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

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European foreword

This document (prEN 746-11:2020) has been prepared by Technical Committee CEN/TC 186 “Industrial Thermoprocess Equipment - Safety”, the secretariat of which is held by DIN.

This document is currently submitted to the CEN Enquiry.

The contents of prEN 746-11:2020 are based on parts of EN 746-2:2009 and ISO 13577-4:2016.

This document has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association and supports essential requirements of EU Directive(s).

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

Introduction

This part of EN 746 was developed to specify the requirements of a protective system, which is a safety-related electrical control system (SRECS) of industrial thermoprocessing equipment and associated processing equipment (TPE).

Mandatory safety-related control functions of TPE are specified in EN 746-1, EN 746-2, and EN 746-3.

It is intended that in designing the protective system of TPE, manufacturers of TPE choose from the four methods provided in this part of EN 746.

This part of EN 746 is to be used together with the other parts of EN 746 with the principles of EN ISO 12100. However, there are cases in which a risk assessment according to EN 61511 (all parts) is more suitable for the design of a TPE protective system.

This document is a type-C standard as stated in EN ISO 12100.

The machinery concerned and the extent to which hazards, hazardous situations, or hazardous events are covered are indicated in the scope of this part of EN 746.

When requirements of this type-C standard are different from those which are stated in type-A or -B standards, the requirements of this type-C standard take precedence over the requirements of the other standards for machines that have been designed and built according to the requirements of this type-C standard.

EN 61511 (all parts) provides the option of a low-demand rate on the protective system. EN 62061:2005 or EN ISO 13849-1:2015 always assume high-demand applications.

Therefore, this part of EN 746 permits extended risk assessment for SRECS in which risk assessment based on EN 61511 (all parts) can be chosen as an alternative.

1 Scope

This part of EN 746 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 the EN 746 series.

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.

prEN ISO 13574:—[1)], *Industrial furnaces and associated processing equipment — Vocabulary*

EN 298:2012, *Automatic burner control systems for burners and appliances burning gaseous or liquid fuels*

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

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

EN IEC 60947-4-1:2019, *Low-voltage switchgear and controlgear — Part 4-1: Contactors and motor-starters - Electromechanical contactors and motor-starters (IEC 60947-4-1:2018)*

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 60204-1:2018, *Safety of machinery — Electrical equipment of machines — Part 1: General requirements (IEC 60204-1:2016)*

EN 60730-2-5:2015, *Automatic electrical controls — Part 2-5: Particular requirements for automatic electrical burner control systems (IEC 60730-2-5:2013)*

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

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

EN 61511 (all parts), *Functional safety — Safety instrumented systems for the process industry sector (IEC 61511 (all parts))*

EN 62061:2005[2)], *Safety of machinery — Functional safety of safety-related electrical, electronic and programmable electronic control systems (IEC 62061:2005)*

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1) Under preparation.

2) This document is impacted by the amendments EN 62061:2005/A1:2013 and EN 62061:2005/A2:2015.

3 Terms and definitions

For the purposes of this document, the terms and definitions given in prEN ISO 13574 and the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

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

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

Note 1 to entry: Examples are valves, switch gear, motors including their auxiliary elements, for example, a solenoid valve and actuator if involved in the safety function.

[SOURCE EN 61511-1:2017, 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 signaled

Note 1 to entry: It can consist of a flame sensor, an amplifier, and a relay for signal transmission.

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

3.3 automatic burner control system
protective system comprised of at least a programming unit and all the elements of a flame detector device

Note 1 to entry: The various functions of an automatic burner control system can be in one or more housings.

[SOURCE: prEN ISO 13574:—, 2.5, modified: The second sentence in the original definition had been presented as in the Note.]

3.4
functional safety
capability of a protective system or other means to reduce risk, to execute the actions required for achieving or maintaining a safe state for the process and its related equipment

[SOURCE: prEN ISO 13574:—, 2.73]

3.5
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 1 to entry: Logic functions are executed by the logic solver of a protective system.

[SOURCE: EN 61511-1:2017, 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.]

3.6
logic solver
portion of a protective system that performs one or more logic function(s)

Note 1 to entry: 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: EN 61511-1:2017, 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.]

3.7
manual reset
action after a lockout of a safety device (e.g. automatic burner control) carried out manually by the supervising operator

[SOURCE: prEN ISO 13574:—, 2.107]

3.8
performance level
PL
discrete level used to specify the ability of safety-related parts of control systems to perform a safety function under foreseeable conditions

[SOURCE: EN ISO 13849-1:2015, 3.1.23]

3.9
product standard
standard for products and devices which are listed in EN 746 (all parts) except this part of EN 746

[SOURCE: prEN ISO 13574:—, 2.135 modified: "EN 746-4" has been changed to read "this part of EN 746" in the definition.]

3.10
programmable logic control
PLC
electronic device designed for control of the logical sequence of events

[SOURCE: prEN ISO 13574:—, 2.125]

3.11
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 1 to entry: This can include safety-related instrumented control functions or safety-related instrumented protection functions or both.

[SOURCE: prEN ISO 13574:—, 2.138]

3.12
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 EN 61508 (all parts) or EN 60730-2-5:2015

[SOURCE: prEN ISO 13574:—, 2.164]

3.13
safety device
device that is used to perform protective functions, either on its own or as a part of a protective system

Note 1 to entry: Examples are sensors, limiters, flame monitors, burner control systems, logic systems, final elements, and automatic shut-off valves.

3.14
safety integrity level
SIL
discrete level (one out of a possible four) for specifying the safety integrity requirements of the safety functions to be allocated to the E/E/PE safety-related systems, where safety integrity level 4 has the highest level of safety integrity and safety integrity level 1 has the lowest

Note 1 to entry: The target failure measures for the four safety integrity levels are specified in EN 61508-1:2010, Tables 2 and 3.

Note 2 to entry: A safety integrity level (SIL) is not a property of a system, subsystem, element, or device. The correct interpretation of the phrase "SIL *n* safety-related system" (where *n* is 1, 2, 3, or 4) is that the system is potentially capable of supporting safety functions with a safety integrity level up to *n*.

[SOURCE: EN ISO 13849-1:2015, 3.1.33]

3.15
sensor
device that produces a signal based on a process variable

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

3.16
system for permanent operation
system, which is intended to remain in the running position for longer than 24 h without interruption

[SOURCE: EN 60730-2-5:2015, 2.5.101]

3.17
system for non-permanent operation
system, which is intended to remain in the running position for less than 24 h

[SOURCE: EN 60730-2-5:2015, 2.5.102]

3.18
systematic capability
measure (expressed on a scale of SC 1 to SC 4) of the confidence that the systematic safety integrity of an element meets the requirements of the specified SIL, in respect of the specified element safety function, when the element is applied in accordance with the instructions specified in the compliant item safety manual for the element

Note 1 to entry: Systematic capability is determined with reference to the requirements for the avoidance and control of systematic faults (see EN 61508-2:2010 and EN 61508-3:2010).

Note 2 to entry: What qualifies as a relevant systematic failure mechanism depends on the nature of the element. For example, for an element comprising solely software, only software failure mechanisms will need to be considered. For an element comprising hardware and software, it is necessary to consider both systematic hardware and software failure mechanisms.

Note 3 to entry: A systematic capability of SC N for an element, in respect of the specified element safety function, means that the systematic safety integrity of SIL N has been met when the element is applied in accordance with the instructions specified in the compliant item safety manual for the element.

[SOURCE: prEN ISO 13574:—, 2.183]

4 Design requirements for equipment in a protective system

4.1 General

Electrical equipment shall comply with EN 60204-1 and withstand the hazards identified in the risk assessment required at the design stage. Electrical 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 the manufacturer's instructions including safety manuals. Any device used outside of its published technical specification shall be verified and validated to be suitable for the intended application.

Devices of a protective system shall withstand the environmental conditions and fulfill 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.

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

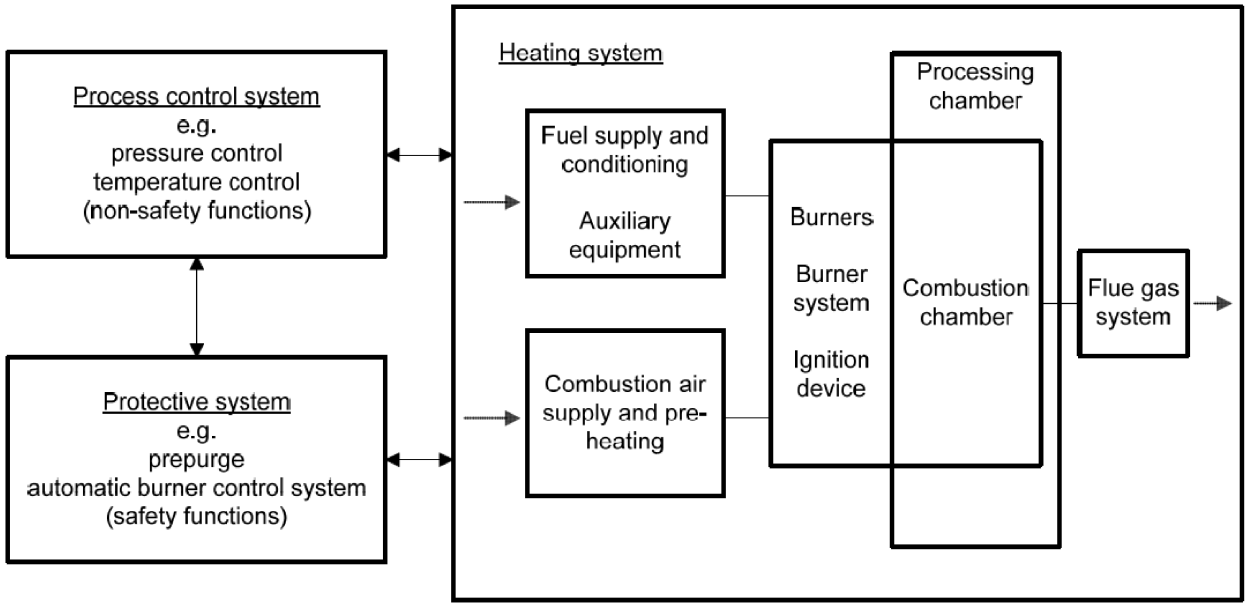

Figure 1 — Block diagram of control and protective systems

An appropriate group of techniques and measures shall be used that are designed to prevent the introduction of 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 Annex B).

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 Annex C and D for examples of SIL/PL determinations.

4.2 Requirements for protective systems

4.2.1 General

Any one or a combination of the four (4) methods shall be used to implement a protective system for the safety function(s) requirements identified in EN 746 (all parts); however, only one method shall be used for any one specific safety function. The four methods are the following:

— Method A as specified in 4.2.1;

— Method B as specified in 4.2.2;

— Method C as specified in 4.2.3;

— Method D as specified in 4.2.4.

Figure 2 shows the basic configuration of a protective system.

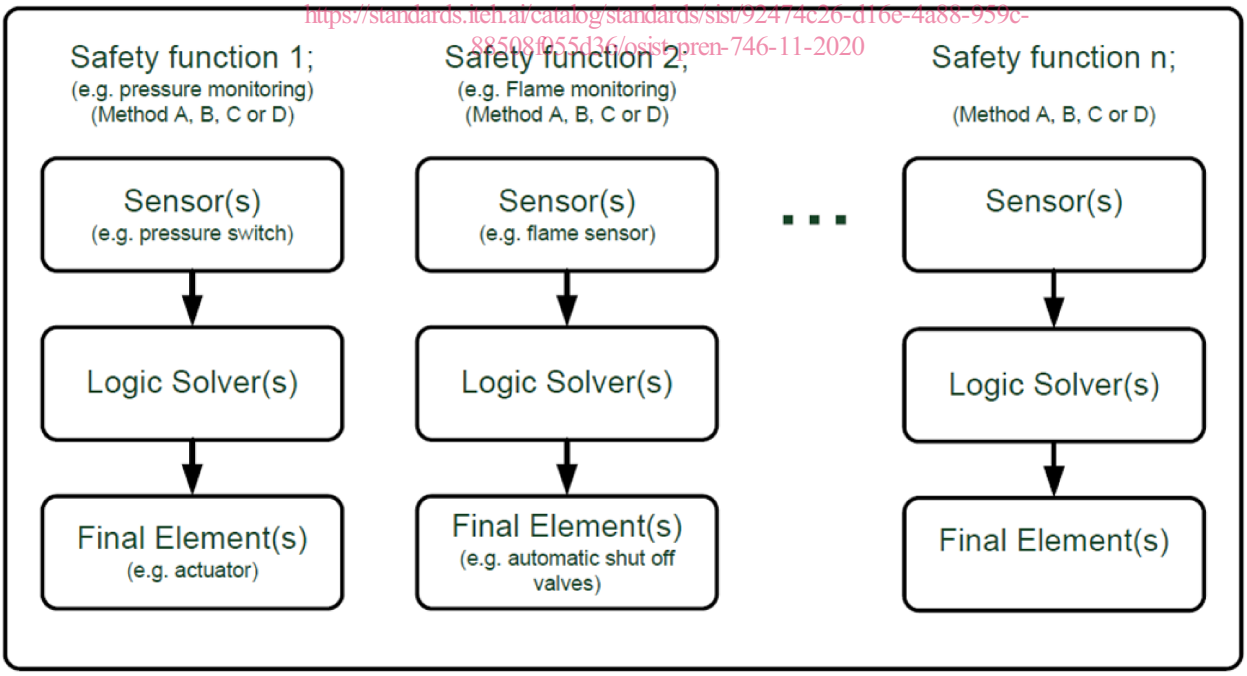

Figure 2 — Basic configuration of a protective system

Figure 3 shows the basic characteristics of each method.

NOTE 1 Software interconnections are links between software function blocks, safety PLC inputs, and safety PLC outputs. These are similar to hardwired interconnections between devices.

NOTE 2 Safety function software is either a software function block or program to perform safety logic functions (e.g. prepurge, automatic burner control).

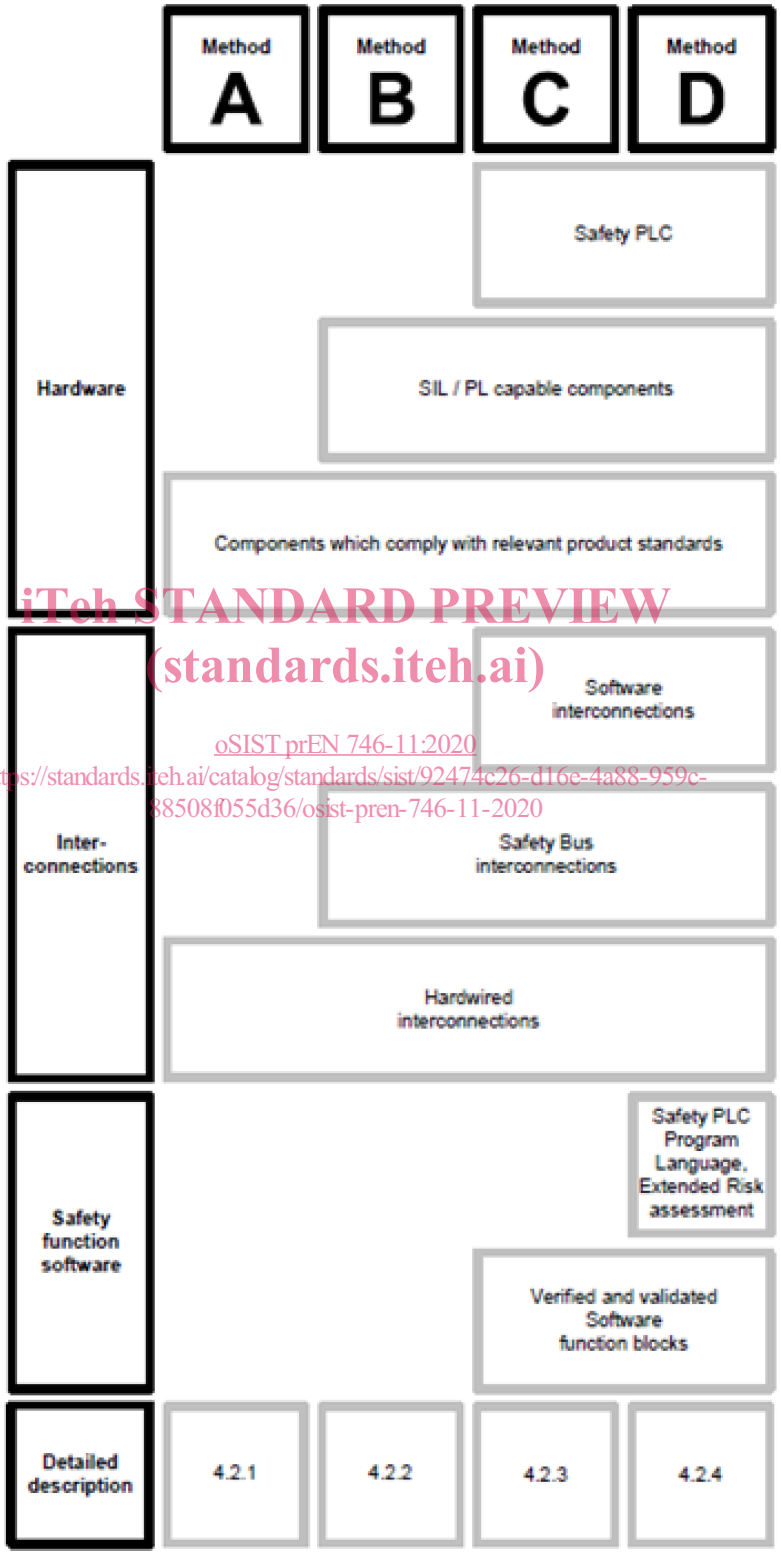

Figure 3 — Method overview

See Annex E for sample schematic diagrams of the various methods.**Error! Unknown op code for conditional.**

4.2.2 Method A

Method A shall be a hardwired system in which all devices (i.e. sensors, logic solver, and final elements described in Figure 4) comply with the relevant product standards as specified in EN 746 (all parts) and EN 14597:2012.

The requirements of EN 61508 (all parts), EN 61511 (all parts), EN 62061:2005, and EN ISO 13849-1:2015 are not applicable for this type of protective system.

The following requirements for hardwiring shall be fulfilled:

— all logic solvers shall be supplied by the devices and through the direct interconnections between the devices;

— connections shall not be permitted through data communication buses;

— devices with fixed program language, which meet the relevant product standards, shall be permitted;

— hardwiring shall be in accordance with Annex F.

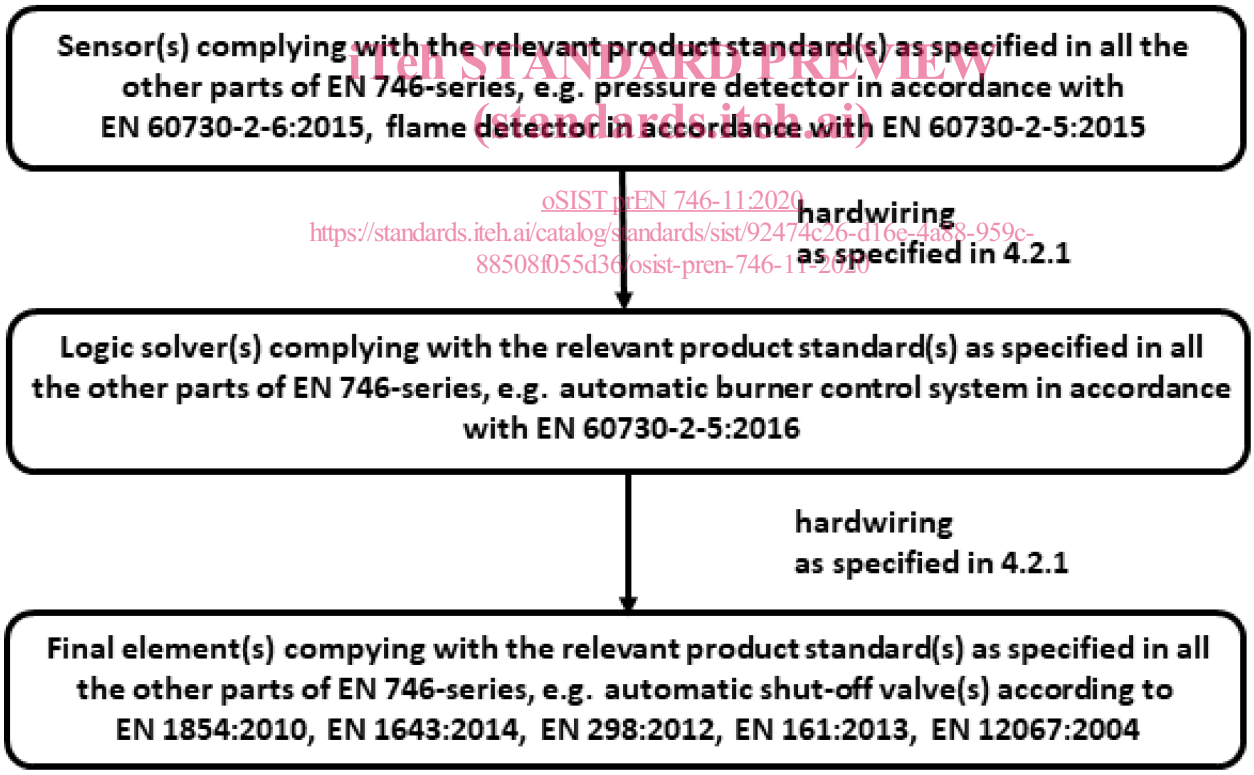

Figure 4 — Hardware configuration of Method A

NOTE The safety devices used in 4.2.1 correspond to specific safety requirements, matched to the field of application and the functional requirements made of these devices, as demanded in the corresponding products standards for safety devices, e.g. automatic burner control systems, valve-proving systems, pressure-sensing devices, automatic shut-off valves. Even without additional SIL/PL certification of these safety devices, the safety requirements for use of safety devices are in compliance with relevant product standards. Implementation of a protective system in accordance with 4.2.1 is one of several alternative methods.

4.2.3 Method B

Method B shall be a combination of devices meeting the relevant product standards and/or SIL/PL capable devices for which no relevant product standard exits. Safety PLCs are excluded (see Figure 5).

The following requirements for hardwiring shall be fulfilled:

— all logic solvers shall be supplied by the devices and through the direct interconnections between the devices;

— devices with fixed program language, which meet the relevant product standards, shall be permitted;

— interconnections may be hardwired or through safety bus;

— hardwiring shall be in accordance with Annex F.

For devices which are not covered by product standards, the following requirements shall be fulfilled:

— the device shall be SIL 3 capable in accordance with EN 61508 (all parts), EN 62061:2005, or EN 61511 (all parts) or it shall be PL e capable in accordance with EN ISO 13849-1:2015;

— SIL/PL capability certification shall apply to the complete device, including the hardware and software.

NOTE 1 Verification and validations of SIL/PL certification for devices is typically carried out by a notified body, accredited national testing laboratory, or by an organization in accordance with EN ISO/IEC 17025:2005.

Devices with less than SIL 3/PL e capability shall be permitted, provided the SIL/PL requirements for the loop (safety function) are determined and calculated.

When the SIL is determined by prior use (i.e. proven in use), the requirements in EN 61511 (all parts) shall be followed.

All requirements in the safety handbook for the device shall be adhered to, such as the proof test interval.

NOTE 2 See Annex C for examples of determining SIL/PL.