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Industrijska termoprocesna oprema - 2. del: Varnostne zahteve za sisteme zgorevanja in sisteme za ravnanje z gorivom

Industrial thermoprocessing equipment - Part 2: Safety requirements for combustion and fuel handling systems

Industrielle Thermoprozessanlagen und dazugehörige Prozesskomponenten - Sicherheitsanforderungen - Teil 2: Feuerungen und Brennstoffführungssysteme (ohne Feststoffe)

Equipements thermiques industriels - Partie 2: Prescription de sécurité concernant la combustion et la manutention des combustibles

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Industrial thermoprocessing equipment - Part 2: Safety requirements for combustion and fuel handling systems

Equipements thermiques industriels - Partie 2: Prescriptions de sécurité concernant la combustion et la manutention des combustibles

Industrielle Thermoprozessanlagen und dazugehörige Prozesskomponenten - Sicherheitsanforderungen - Teil 2: Feuerungen und Brennstoffführungssysteme (ohne Feststoffe)

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 746-2:2020) 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.

This document will supersede EN 746-2:2010.

Based on EN 746-2:2010, ISO 13577-2 was developed in 2016. This ISO standard differs considerably from the original EN 746-2:2010. The contents of this completely renewed prEN 746-2:2020 are based on ISO 13577-2:2016.

In contrast to EN 746-2:2010, this prEN 746-2:2020 no longer contains solid fuels. These will be covered in a separate standard EN 746-12.

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 document is a type-C standard as defined in EN ISO 12100:2010.

The machinery concerned and the extent to which hazards, hazardous situations or hazardous events are covered, is indicated in the Scope of this document.

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.

This part of EN 746 assumes that the equipment is not creating any potentially explosive atmosphere and is located in a normally ventilated area.

Compliance with product standards, e.g. EN 267[1)] or EN 676[2)] is not sufficient to ensure the minimum safety requirements for industrial furnaces and associated processing equipment (TPE). This part of EN 746 will always have priority for TPE.

Industrial furnaces and associated processing equipment (TPE) generally consists of the following components:

— processing chamber (e.g. steel construction with lining and/or refractory);

— heating systems;

— protective system;

— control and instrumentation system / operator-control level.

prEN 746-1:2020 provides the general safety requirements common to TPE. This part of EN 746 details in addition specific safety requirements for combustion and fuel handling systems that are part of TPE as listed in the Scope.

NOTE As stated in its scope, prEN 746-1:2020 does not cover blast furnaces, converters (in steel plants), boilers, fired heaters (including reformer furnaces or cracking furnaces) in the petrochemical and chemical industries and equipment not covered by EN ISO 12100:2010.

The requirements for protective systems are specified in prEN 746-11:2020.

If a general requirement of prEN 746-1:2020 counters requirements in this part of EN 746, the requirements of this part of EN 746 take precedence.

The requirements for reducing hazards from noise are given in prEN 746-1:2020.

It is assumed that TPE will only be operated and maintained by trained personnel.

1) Note: Reference in ISO 13577-2 is: ISO 22967

2) Note: Reference in ISO 13577-2 is: ISO 22968

1 Scope

This part of EN 746 specifies the safety requirements for combustion and fuel handling systems that are part of industrial furnaces and associated processing equipment (TPE).

NOTE The general safety requirements common to TPE are provided in prEN 746-1:2020 (See introduction).

This part of EN 746 deals with significant hazards, hazardous situations and events relevant to combustion and fuel handling systems as listed in Annex A, when used as intended and under the conditions foreseen by the manufacturer.

This part of EN 746 covers:

— fuel pipework downstream of and including the manual isolating valve;

— combustion air supply (including oxygen and oxygen enriched combustion air) and flue gas system;

— burner(s), burner system and ignition device;

— functional requirements for safety related control system.

This part of EN 746 applies to any oxidation with air or other gases containing free oxygen of gaseous and liquid fuels or any combustion of them to release thermal energy in TPE.

For thermal or catalytic post combustion and waste incineration, this part of EN 746 applies only to auxiliary burners designed to start-up and/or support the process.

The pressure hazard of the piping and components covered by this part of EN 746 is within the maximum pressure/size relationship of category I as described in normative Annex E.

This part of EN 746 also gives the necessary requirements regarding information for use.

This part of EN 746 does not cover hazards from heating generated by electricity.

This part of EN 746 does not deal with the hazards created by the release of flammable substances from the products processed in the TPE.

This part of EN 746 is not applicable to combustion and fuel handling systems:

— of gas welding and allied processes;

— up-stream of the TPE manual isolating valve.

This part of EN 746 is not applicable to electrical cabling and power cabling upstream of the TPE control panel/protective system.

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.

ISO 7-1:1994, *Pipe threads where pressure-tight joints are made on the threads — Part 1: Dimensions, tolerances and designation*

EN 88-1:2011+A1:2016, *Pressure regulators and associated safety devices for gas appliances - Part 1: Pressure regulators for inlet pressures up to and including 50 kPa*

EN 88-2:2007, *Pressure regulators and associated safety devices for gas appliances - Part 2: Pressure regulators for inlet pressures above 500 mbar up to and including 5 bar*

EN 125:2010+A1:2015, *Flame supervision devices for gas burning appliances - Thermoelectric flame supervision devices*

EN 161:2011+A3:2013, *Automatic shut-off valves for gas burners and gas appliances*

EN ISO 228-1:2003, *Pipe threads where pressure-tight joints are not made on the threads - Part 1: Dimensions, tolerances and designation (ISO 228-1:2000)*

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

EN 331:2015, *Manually operated ball valves and closed bottom taper plug valves for gas installations for buildings*

EN 334:2019, *Gas pressure regulators for inlet pressure up to 10 MPa (100 bar)*

EN ISO 5175-1:2017, *Gas welding equipment - Safety devices - Part 1: Devices incorporating a flame (flashback) arrestor (ISO 5175-1:2017)*

EN ISO 5175-2:2017, *Gas welding equipment - Safety devices - Part 2: Devices not incorporating a flame (flashback) arrestor (ISO 5175-2:2017, Corrected version 2019-01)*

prEN 746-1:2020, *Industrial thermoprocessing equipment - Part 1: Common safety requirements for industrial thermoprocessing equipment (ISO 13577-1:2016, modified)*

prEN 746-11:2020, *Industrial furnace and associated processing equipment - Safety - Part 11: Protective systems (ISO 13577-4:2014)*

EN 1643:2014, *Safety and control devices for gas burners and gas burning appliances - Valve proving systems for automatic shut-off valvess*

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

EN ISO 5817:2014, *Welding - Fusion-welded joints in steel, nickel, titanium and their alloys (beam welding excluded) - Quality levels for imperfections (ISO 5817:2014)*

ISO 7005-1:2011, *Pipe flanges - Part 1: Steel flanges for industrial and general service piping systems*

ISO 7005-2:1988, *Metallic flanges - Part 2: Cast iron flanges*

ISO 7005-3:1988, *Metallic flanges - Part 3: Copper alloy and composite flanges*

EN ISO 8434-1:2018, *Metallic tube connections for fluid power and general use - Part 1: 24° cone connectors (ISO 8434-1:2018, Corrected version 2018-10)*

ISO 8434-2:2007, *Metallic tube connections for fluid power and general use - Part 2: 37 degree flared connectors*

ISO 8434-3:2005, *Metallic tube connections for fluid power and general use - Part 3: O-ring face seal connectors*

EN 12067-2:2004, *Gas/air ratio controls for gas burners and gas burning appliances - Part 2: Electronic types*

EN ISO 12100:2010, *Safety of machinery - General principles for design - Risk assessment and risk reduction (ISO 12100:2010)*

EN 14382:2019, *Gas safety shut-off devices for inlet pressure up to 10 MPa (100 bar)*

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

EN ISO 13849 (all parts), *Safety of machinery - Safety-related parts of control systems (ISO 13849)*

EN ISO 19879:2010, *Metallic tube connections for fluid power and general use - Test methods for hydraulic fluid power connections (ISO 19879:2010)*

EN ISO 23553-1:2014, *Safety and control devices for oil burners and oil-burning appliances - Particular requirements - Part 1: Automatic and semi-automatic valves (ISO 23553-1:2014)*

EN 60204-1:2006, *Safety of machinery - Electrical equipment of machines - Part 1: General requirements* (IEC 60204-1:2005)

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

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

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

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 13574:2015 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 http://www.electropedia.org/

4 Safety requirements, measures and verification means

4.1 General

The safety goals of this part of EN 746 shall include:

— choice of materials such that the construction and operation of the system are not detrimentally affected. In particular, all the components of the fuel pipework shall be capable of withstanding the mechanical, chemical and thermal loads to which they can be subjected during normal operation and foreseeable abnormal operation (e.g. identified during a safety assessment);

— reliable and correct time for ignition of the air/fuel-mixture at the burner(s);

— prevention of unintentional release of unburned fuels;

— shut-off fuel-supply in case of relevant fault;

— protection of pipeline to preclude the propagation of flame in reverse direction;

— prevent firing when the evacuation of flue gas/combustion products is not ensured;

— prevent firing when the process conditions are not in the safe state.

— Electrical circuits shall be designed in accordance with EN 60204-1:2006.

A risk assessment according to EN ISO 12100:2010 shall be carried out. Safety function shall be designed in accordance with prEN 746-11:2020[3)], where the use of standards for functional safety EN 62061:2005, EN ISO 13849 (all parts), EN 61511 (all parts) and EN 61508 (all parts) is included. Informative Annex F provides information for the determination of the SIL or PL of safety-related functions covered in this part of EN 746.

4.2 Gaseous fuels

4.2.1 Gas pipework

4.2.1.1 General

The pipework design shall take into account the composition and properties (e.g. pressure, temperature, corrosiveness, specific gravity) of the fuel gas and the need for venting, purging and cleaning.

The pipework material shall comply with the relevant standards.

Due to durability, steel is the preferred material for pipes and components but where appropriate and the same safety levels can be achieved then other materials may be utilized. Such materials and conditions of service shall be specified in the instruction handbook. Oscillations which may cause damage to pipework, components or safety systems shall be prevented (by firm anchoring and/or use of flexible couplings).

For steel pipes, compliance with EN ISO 3183, EN 13480-2:2017 (Table A.3), or EN 10255 is considered appropriate. For copper pipes compliance with EN 1057 is considered appropriate. Copper Soldering connections shall not be used for gas carrying parts where the temperature could exceed 100°C [4)].

Threaded pipe fittings shall comply with EN 10241 or EN 10242 [5)].

For typical examples of gaseous fuels, see informative Annex B.

4.2.1.2 Connections

Gas pipework connections shall be metallic and shall be of threaded, compression, flanged, welded or brazed types. The number of connections shall be kept to a minimum.

Threaded connections shall be used only for the following pressure/diameter combinations:

— pressures up to 15 kPa, and diameters up to DN 100

— pressures up to 200 kPa, and diameters up to DN 50

— pressures up to 500 kPa, and diameters up to DN 25

— pressures up to 1 MPa, and diameters up to DN 15

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3) Note: Reference in ISO 13577-2 is: ISO 13577-4.

4) Note: Paragraph is not in the body text of ISO 13577-2

5) Note: Paragraph is not in the body text of ISO 13577-2

For fittings according to EN 10242, the following limitations shall be observed:

— fittings must be class “A”;

— maximum allowed pressure is 50 kPa;

— for dimensions DN 25 or less, the maximum pressure is 500 kPa.

Where the equipment has a threaded connection, this thread shall comply with EN ISO 228-1:2003 or ISO 7-1:1994 as appropriate. The use of threads complying with EN ISO 228-1:2003 is limited to diameter up to DN 50. In case of threads according to EN ISO 228-1:2003, the tightness shall be ensured by a ring gasket. Hemp shall not be used in threaded connections unless reinforced with a suitable sealant.

Sealants for threads according to ISO 7-1:1994 shall comply with EN 751-1 or EN 751-2 as appropriate.

Other threaded connections may only be used providing they ensure tight connections and are suitably identified.

The design of pipework shall be such as to avoid tensile loading of the joints.

Compression fittings shall comply with EN ISO 8434-1:2018, ISO 8434-2:2007 and ISO 8434-3:2005 or EN ISO 19879:2010. They shall only be used for pressures up to 500 kPa and diameters up to 42 mm.

Any pipe passing through an unventilated space shall not have a connection except welded joints.

Flanges shall comply with ISO 7005-1:2011 and ISO 7005-2:1988 as appropriate.

Arc welding shall comply with EN ISO 5817:2014, quality level C.

4.2.1.3 Unconnected pipework

Any unconnected pipework shall be plugged, capped or blank flanged by means of metallic parts.

4.2.1.4 Galvanic cells

The formation of galvanic cells shall be avoided by suitable choice of materials.

4.2.1.5 Flexible tubing and couplings

Flexible tubing shall comply with the general requirements of 4.2.1.1, together with the following:

— shall be as short as practicable;

— shall be suitable for the maximum and minimum working (fuel and ambient) temperatures;

— shall be suitable for a pressure 1,5 times the working operating pressure (with a minimum of 15 kPa), at the maximum and minimum working temperatures;

— shall have a directly accessible, upstream manual shut-off valve;

— shall be mounted in such a way as to avoid distortion, whiplash and damage;

— shall have end fittings as integral parts of the tubing;

— shall be constructed from suitable material both metallic and/or non-metallic selected for the application duty and not be easily damaged.

— Couplings for removable equipment shall ensure a gastight connection with the equipment connected and disconnected.

4.2.1.6 Marking

The pipework shall be identified as gas pipework.

NOTE Identification of gas pipework is dealt with by national regulations.

4.2.1.7 Soundness/tightness

The gas pipework shall be tight and shall be designed to withstand the internal pressure. After assembly, the gas pipework shall be submitted to its test pressure and tested for tightness. The test pressure shall be not less than 1,1 times the maximum working pressure at any point with a minimum of 5 kPa.

The external leakage rate shall not give rise to a dangerous condition, flammable and/or toxic, in the foreseen circumstances of the equipment or installation. The frequency of testing to determine the external leakage shall be specified in the instruction handbook.

NOTE It is generally agreed that an external leak rate of ≈ 1 dm3(n)/h will not give rise to a dangerous condition in typical ventilated industrial installations. The actual leak rate will depend upon the volume, number of connections, test gas, number of valves and component parts contained.

The external leak rate test method shall take into account the volume, number of connections, test gas, number of valves and component parts contained and temperature. Methods of testing shall include spray bubble leak identification and/or pressure decay test.

4.2.1.8 Condensate drains

In cases where condensates can create a hazard, means shall be provided at the lowest points of the equipment for draining any condensate. When moist gases are being used, condensate drains of a suitable type shall be installed. Any condensate drains, siphons, etc. shall be in a position such that they can be easily checked. Flammable condensates shall be collected by an appropriate means (e.g. piped into a container).

Valves in condensate drains shall be suitably plugged, capped or blank flanged by metallic parts.

4.2.1.9 Purge points

Means shall be provided to facilitate purging of the gas system during commissioning and maintenance to prevent the build-up of flammable substances.

4.2.1.10 Blow-off and breather pipes or conduits

Where blow-off or breather pipes or conduits are fitted on regulators or relief valves or vent valves, adequate means shall be provided to facilitate the venting of gas from the system to a safe discharge area.

In case breathers or blow-off pipes are gathered, the cross section of the collector shall be suitable to evacuate simultaneously total flow rates of the exhaust sources.

In case breathers are gathered with blow-off pipes, non-interaction of the collected lines, valves and instruments shall be verified.

4.2.1.11 Pressure relief devices and flame arrestors on pipework

For equipment designed for situations in which flashback can occur, flame arrestors and/or pressure relief devices shall be fitted.

Pressure relief devices shall be designed to yield at a pressure below the design pressure of the pipework and shall be positioned such that the discharge flow and the pressure relief device does not constitute a risk to the equipment, personnel or third parties.

A flashback at least shall trigger an alarm. The required measures after a flashback shall be described in the instruction handbook.

4.2.1.12 Pressure oscillations

The gas pipework shall be designed so as to avoid the possibility of gas velocities and pressure fluctuations causing oscillations which could cause damage to pipework, components or safety systems (e.g. by designing the correct sizing of pipe, using pressure regulator,).

4.2.1.13 Equipment supplied with different fuel gases

Where a burner is intended for alternating use with more than one gaseous fuel, means shall be provided to ensure that the supply pipework of the gas not being fired is positively isolated.

4.2.1.14 By-pass

By-passes shall not be fitted in parallel with any item of safety equipment.

This requirement shall not apply to valve proving systems (see 4.2.2.7) on automatic shut-off valves.

4.2.1.15 Isolation of required safety devices

Required safety devices (e.g. pressure switches, relief valves) shall not be isolated from the equipment they protect during start-up or operation of the burner. In case isolating valves cannot be avoided and are mounted between these required devices and the main lines, these isolating valves shall be locked in the open position during operation of the equipment by adequate means (e.g. manual lock).

4.2.2 Required safety devices

4.2.2.1 Manual isolating valve

A manually operated isolation valve shall be fitted upstream of the first control device in the gas circuit. Manual isolation valves shall be so designed or positioned as to prevent inadvertent operation but shall be easily accessible and capable of rapid operation when required.

They shall be so designed that the “OPEN” and “CLOSED” positions are readily distinguishable (e.g. a 90° turn valve if applicable and available).

If technically applicable, only manual isolating valves complying with EN 331:2015 shall be fitted. For valves outside the scope of EN 331:2015, the safety requirements detailed in EN 331:2015 shall be met at an equivalent level[6)].

4.2.2.2 Filter/strainer

Special care shall be taken to prevent the ingress of particles, either from the pipework or from the gas, which would be detrimental to the operation of the equipment by the incorporation of a suitable filter or strainer immediately downstream of the first manual isolating valve of the TPE. Additional filters/strainers may be required (e.g. immediately upstream of the automatic shut-off valve). The filter and/or the strainer shall be positioned in such a way that periodic servicing remains easy. The filtering capacity of the filter/strainer has to be chosen according to the requirements of downstream equipment.

NOTE Normally safety and control devices for gas burners and gas-burning appliances require upstream filters with filtering capacity ≤ 50 µm. Strainers with larger mesh size are only suitable for primary cleaning.

6) Note: Paragraph is not in the body text of ISO 13577-2

In case of the installation of a by-pass to the filter/strainer, an identical filtering device shall be installed on the by-pass line.

The intervals for checking the filter and/or the strainer shall be specified in the instruction handbook.

4.2.2.3 Gas pressure regulator

A gas pressure regulator shall be incorporated where this is necessary for control of the pressure and the flow rate.

Gas pressure regulators shall be in accordance with EN 88-1:2011+A1:2016, EN 88-2:2007 or EN 334:2019, as applicable[7)].

If the outlet side of the gas pressure regulator and/or the following line section with equipment up to the burner is/are not designed for the maximum supply pressure (inlet pressure upstream to the gas pressure regulator under fault conditions) an over pressure cut-off device shall be installed upstream of the gas pressure regulator shutting off the gas supply before an excessively high pressure occurs.

The over pressure cut-off device shall be:

— a mechanical valve in accordance with EN 14382:2019[8)] which measures the gas pressure downstream of the gas pressure regulator by means of an impulse line and closes by spring force in case the pressure exceeds the set response pressure, or

— an automatic shut-off valve according to EN 161:2011+A3:2013[9)] actuated by an overpressure detector installed downstream of the gas pressure regulator. The overpressure detector shall comply with EN 1854:2010[10)] or be evaluated to ensure appropriate reaction time and accuracy. In this case, signal processing has to fulfil the requirements of a protective system according to prEN 746-11:2020.

A small capacity relief valve (token relief valve) shall always be applied downstream of the gas pressure regulator, if an over pressure cut-off device is installed to vent small leakages of the high pressure cut-off.

Pressure adjustment on the gas pressure regulator shall only be possible with a special tool provided for the task.

Where the gas for the pilot burner is taken from upstream of the gas pressure regulator to the main burner(s), the pilot burner shall be equipped with a separate gas pressure regulator.

4.2.2.4 Low gas protection

Low gas pressure protection shall be fitted. The low gas pressure protection device has to provide satisfactory and reliable proof of the pressure for all operation conditions.

The system shall prevent start-up or cause safety shut-down and lock-out in the event of pressure falling below a pre-determined value. This function shall meet a requirement of the protective system according to prEN 746-11:2020.

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7) Note: Reference in ISO 3577-2 is: ISO 23551-2

8) Note: EN 14384 is not in the body text of ISO 13577-2

9) Note: Reference in ISO 13577-2 is: ISO 23551-1

10) Note: Reference in ISO 13577-2 is: ISO 60730-2-6