SLOVENSKI STANDARD
oSIST prEN 746-3:2020

01-marec-2020

Industrijska termoprocesna oprema - 3. del: Varnostne zahteve za pridobivanje in uporabo atmosferskih plinov

Industrial thermoprocessing equipment - Part 3: Safety requirements for the generation and use of atmosphere gases

Industrielle Thermoprozessanlagen - Teil 3: Sicherheitsanforderungen für die Erzeugung und Anwendung von Schutz- und Reaktionsgasen

Équipements thermiques industriels - Partie 3 : Prescription de sécurité pour la génération et l'utilisation des gaz d'atmosphère

Ta slovenski standard je istoveten z: **prEN 746-3**

ICS:

25.180.01	Industrijske peči na splošno	Industrial furnaces in general

oSIST prEN 746-3:2020 **en,fr,de**

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

DRAFT
prEN 746-3

January 2020

ICS 25.180.01

Will supersede EN 746-3:1997+A1:2009

English Version

Industrial thermoprocessing equipment - Part 3: Safety requirements for the generation and use of atmosphere gases

Équipements thermiques industriels - Partie 3 : Prescription de sécurité pour la génération et l'utilisation des gaz d'atmosphère

Industrielle Thermoprozessanlagen - Teil 3: Sicherheitsanforderungen für die Erzeugung und Anwendung von Schutz- und Reaktionsgasen

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

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

CEN members are the national standards bodies of Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Republic of North Macedonia, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and 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 STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

CEN-CENELEC Management Centre: Rue de la Science 23, B-1040 Brussels

Ref. No. prEN 746-3:2020 E

Contents

Page

European foreword

This document (prEN 746-3:2020) 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 746-3:1997+A1:2009.

Based on EN 746-3:1997+A1:2009, ISO 13577-3 was developed in 2016. This ISO standard differs considerably from the original EN 746-3:1997+A1:2009. The contents of this completely renewed EN 746-3:2020 are based on ISO 13577-3:2016.

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 the EN 746 series is a Type C-Standard as defined in EN ISO 12100.

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

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

Industrial furnaces and associated thermo-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 the EN 746 series details in addition specific safety requirements for generation and use of protective and reactive atmosphere gases that are part of TPE as listed in the scope. These requirements establish the minimum acceptable requirements for safety functions required for various processes. Where a process is not part of the TPE, the requirements do not apply.

For example, the minimum requirements for the opening and closing of doors on a TPE does not apply to TPE that do not have doors in their design.

NOTE As stated in its scope, prEN 746-1:2020 does not cover blast furnaces, converters (in steel plants), boilers and equipment not covered under EN ISO 12100.

The requirements of protective system are specified in prEN 746-11:2020.

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

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

1 Scope

This part of the EN 746 series specifies safety requirements for generation and use of protective and reactive atmosphere gases that are part of industrial thermo-processing equipment (TPE).

NOTE The general safety requirements common to TPE are provided in prEN 746-1 (see Introduction).

This part of the EN 746 series deals with significant hazards, hazardous situations and events relevant to the generation and use of protective and reactive atmosphere gases created by thermochemical reactions and their use in TPE that are part of TPE as listed in Clause 4 and Clause 5, when used as intended and under the conditions foreseen by the manufacturer.

This part of the EN 746 series covers

— pipework downstream of and including the manual isolating valve,

— equipment for the generation of atmosphere gases,

— additional equipment for the use of atmosphere gases in TPE,

— safety devices, and

— functional requirements for safety related control system

for the generation and use of protective and reactive atmosphere gases.

It applies to the supply of atmosphere gas, source gas, inert gas and process liquids to TPE and their removal from TPE, confined to equipment integrated in the TPE.

This part of the EN 746 series also details the anticipated significant hazards associated with atmosphere gas systems and their use in TPE and specifies the appropriate preventative measures for the reduction or elimination of these hazards.

The pressure hazard of the piping and components covered by this standard is within the maximum pressure/size relationship of group I as described in Annex C.

This part of the EN 746 series

— specifies the requirements to be met to ensure the safety of persons and property during installation, commissioning, start up, operation, shutdown and maintenance,

— does not cover the relevant risks involved in the flue gas ducting system when it is not considered a part of TPE,

— is not applicable to utility supply upstream of the TPE main disconnects,

— does not apply to TPE for semi-conductor devices,

— does not apply to TPE with atmosphere, such as air and flue gas from an over stoichiometric combustion,

— does not cover the decommissioning of the TPE,

— does not cover vacuum furnaces,

— does not deal with the hazard of noise which is covered in prEN 746-1:2020,

— is not applicable to generation and use of atmosphere gas in TPE and associated plant which is manufactured before the date of its publication, and

— gives the necessary requirements for the information for use.

A TPE designed according to this part of EN 746 series does not create any potentially explosive atmosphere in the area around the TPE and is not designed to be located in an area with a potentially explosive or hazardous atmosphere.

A table of typical protective and reactive gases is given in Annex B.

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*

ISO 49:1994, *Malleable cast iron fittings threaded to ISO 7-1*

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 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 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 pressures up to 100 bar*

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

prEN 746-2:2020, *Industrial thermoprocessing equipment – Part 2: Safety requirements for combustion and fuel handling systems (ISO 13577-2:2014)*

prEN 746-11:2020, *Industrial furnaces and associated processing equipment — Safety — Part 11: Protective systems*

EN 751-1:1996, *Sealing materials for metallic threaded joints in contact with 1st, 2nd and 3rd family gases and hot water - Part 1: Anaerobic jointing compounds*

EN 751-2:1996, *Sealing materials for metallic threaded joints in contact with 1st, 2nd and 3rd family gases and hot water - Part 2: Non-hardening jointing compounds*

EN 1643:2014, *Valve proving systems for automatic shut-off valves for gas burners and gas appliances*

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

EN 10241:2000, *Steel threaded pipe*

EN 10242:1994[1], *Threaded pipe fittings in malleable cast iron*

[1] This document is impacted by the amendments EN 10242:1994/A1:1999 and EN 10242:1994/A2:2003.

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 or industrial and general purpose piping systems*

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

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

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 ISO 10352:2010, *Fibre-reinforced plastics — Moulding compounds and prepregs—Determination of mass per unit area (ISO 10352:2010)*

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

EN 14382:2019, *Safety devices for gas pressure regulating stations and installations — Gas safety shut-off devices for inlet pressures up to 100 bar*

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

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 60204-1:2018, *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 (all parts))*

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

[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 ISO 13574:2015 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

NOTE See Annex G for the list of terms specified in ISO 13574:2015.

3.1
safety shutdown
function that takes the TPE out of operation and brings it in a defined safe state

Note 1 to entry: The definition is different from safety shutdown according ISO 13574:2015, 2.166 which is applicable to ISO 13577-2 and prEN 746-2:2020.

3.2
flame failure
loss of flame from the normally detected position by any cause other than the action of de-energising the automatic shut-off valves system

Note 1 to entry: The term is used in ISO 13577-2 and prEN 746-2:2020.

3.3
gas generator
equipment that converts or modifies a fluid or a mixture of fluids (gaseous or liquid) into a gas which can be utilized as the controlled atmosphere within the thermo-processing equipment

3.4
endothermic generator
gas generator that produces atmosphere gas by an endothermic reaction

3.5
exothermic generator
gas generator that produces atmosphere gas by an exothermic reaction

3.6
combustible atmosphere gas
any gas mixture that is capable of forming ignitable mixtures with air or oxygen under the conditions of temperature and pressure used in the process, according to the lower explosion level (LEL) of the actual gas mixture

3.7
inert gas
non-combustible gas which will not support combustion and does not react at all

Note 1 to entry: Nitrogen, helium and argon are typical inert gases.

3.8
purge gas
gas which can be used to purge a TPE

Note 1 to entry: A purge gas can safely be used for pre- and post-purging of cold and hot enclosures of TPE.

Note 2 to entry: Typically, purge gases are nitrogen, argon, helium and lean exothermic gas.

3.9
safety purge volume
volume of purge gas needed to displace either air or a combustible gas from a furnace chamber/enclosure to achieve a volume fraction of 1 % or less oxygen and/or a non-combustible atmosphere gas and/or 25 % of the lower flammability limit

Note 1 to entry: Typically, this will be a volume equal to five times the volume of the thermo-processing equipment chamber to be purged, if the purging gas is an inert gas.

Note 2 to entry: Non-combustible atmosphere gas as defined in 3.6.

3.10
multi-turn valve
valve which, in order to operate from the fully closed to the fully open position, requires a number of revolutions of the operating key or handwheel to be completed

3.11
safe ignition temperature
<MAC> minimum temperature at which spontaneous, safe auto-ignition of combustible gases occurs

Note 1 to entry: The safe ignition temperature has been established at 750 °C.

3.12
toxic atmosphere gas
gas which, in addition to having asphyxiating properties, also acts as a poison

3.13
internal gas generator
gas generator integrated into or directly connected to a TPE

3.14
gas control equipment
centralized mounting of components such as: pipework, safety components, pressure and flow accessories, assembled in a functional unit

3.15
atmosphere gas
gas that is supplied into or formed in TPE in accordance with a defined specification for thermo-processes

Note 1 to entry: Atmosphere gas is used to react with the material processed or to avoid a reaction with the material processed.

3.16
process liquids
liquids that are supplied to TPE to create an atmosphere gas

4 Safety requirements and measures

4.1 General

Protective and reactive atmosphere gases in TPE are used to react with the material processed or to avoid a reaction with the material processed. Protective and reactive atmosphere gases are fed into the TPE at determined points and are discharged out of the TPE at determined points too.

Protective and reactive atmosphere gases shall only be used in TPE that has been constructed to avoid leakage of the protective and reactive atmosphere gases out of the TPE or ambient air into the TPE.

Electrical circuits shall be designed in accordance with EN 60204-1:2018.

A risk assessment according to EN ISO 12100:2010 shall be carried out. Safety functions shall be designed in accordance with prEN 746-11:2020, 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. Annex E provides information for the determination of the SIL or PL of safety-related functions covered in this part of EN 746 series.

CAUTION — Toxic hazards for persons occur at lower concentrations than hazards by generation of ignitable atmospheres.

NOTE Requirements for maximum allowable concentrations values are identified by national regulations.

Materials used shall comply with the requirements for gas and liquids (e.g. non-ferrous metals are not suitable for NH_3 and natural rubber is not suitable for natural gas).

For basic configuration of piping system of TPE using atmosphere gas, see Annex F.

4.2 Pipework

4.2.1 General

The pipework design shall take into account the composition and properties (e.g. pressure, temperature, corrosiveness, specific gravity, velocity) of gas and liquids 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).

Pipework shall be arranged so that safe isolation of atmosphere gas and process liquids to all parts of the TPE can be guaranteed

NOTE An example is shown in Figure F.1.

The isolation method shall be clearly identified (e.g. by removable spool piece painted in red, blanking plate), and provision for blanking opened pipes shall be provided secured against loss (e.g. by an attached chain).

For steel pipes, compliance with EN ISO 3183:2012, 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[3].

Threaded pipe fittings shall comply with EN 10241:2000 or EN 10242:1994[4].

Use of brass or other copper alloy components in contact with ammonia or dissociated ammonia is not allowed.

3 Note: Paragraph is not in the body text of ISO 13577-3.

4 Note: Paragraph is not in the body text of ISO 13577-3.

4.2.2 Connections

Pipework connections shall be metallic and shall be of threaded, compression, press fittings, 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.

For other combinations of pressures and diameters, connections shall be made by means of welded flanges or welded joints. The number of connections shall be kept to a minimum.

For fittings according to ISO 49:1994, the following limitations shall be observed:

— fittings are 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 the 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 751-1:1996 or EN 751-2:1996 as appropriate.

Other threaded connections shall 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.

Where press fitting according to EN 10352:2010 are used, they shall comply with the application restrictions (e.g. temperature, vibration, gas, liquids).

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 ISO 5817:2014, quality Level C.

4.2.3 Unconnected pipework

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

4.2.4 Galvanic cells

The formation of galvanics cell shall be avoided by suitable choice of materials.

4.2.5 Flexible tubing and couplings

Flexible tubing shall comply with the general requirements of 4.2.1, together with the following:

— shall be as short as practicable;

— shall be suitable for the maximum and minimum working 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.

4.2.6 Marking of pipework

Marking of pipework is required which enable medium and flow direction to be identified.

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

4.2.7 Soundness/Tightness

The pipework shall be tight and shall be designed to withstand the internal pressure. After assembly, the 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, combustible 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 $dm^3(n)/h$ for gas or 1 $cm^3(n)/h$ for methanol will not create a dangerous condition in typical ventilated industrial installation. 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.

4.2.8 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. Combustible 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.

4.2.9 Purge points

Means shall be provided to facilitate purging of pipework during commissioning and maintenance to prevent the forming of an ignitable atmosphere or build-up of flammable substances.