



SLOVENSKI STANDARD

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Industrijska termoprocesna oprema - 1. del: Splošne varnostne zahteve za industrijsko termoprocesno opremo

Industrial thermoprocessing equipment - Part 1: Common safety requirements for industrial thermoprocessing equipment

Industrielle Thermoprozessanlagen und dazugehörige Prozesskomponenten - Sicherheitsanforderungen - Teil 1: Allgemeine Sicherheitsanforderungen an industrielle Thermoprozessanlagen

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Équipements thermiques industriels - Partie 1: Prescriptions générales de sécurité pour les équipements thermiques industriels

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Industrial thermoprocessing equipment - Part 1: Common safety requirements for industrial thermoprocessing equipment

Équipements thermiques industriels - Partie 1:
Prescriptions générales de sécurité pour les
équipements thermiques industriels

Industrielle Thermoprocessinganlagen und dazugehörige
Prozesskomponenten - Sicherheitsanforderungen - Teil
1: Allgemeine Sicherheitsanforderungen an industrielle
Thermoprocessinganlagen

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.

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European foreword

This document (prEN 746-1:2020) has been prepared by Technical Committee CEN/TC 186 “Industrial thermoprocessing - Safety”, the secretariat of which is held by DIN.

This document is currently submitted to the CEN Enquiry.

This document will supersede EN 746-1:2010.

Based on EN 746-1:2010, ISO 13577-1 was developed in 2016. This ISO standard differs considerably from the original EN 746-1:2010. The contents of this completely renewed prEN 746-1:2020 are based on ISO 13577-1:2016).

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.

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Introduction

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

The machinery concerned and the extent to which hazards, hazardous situations or hazardous events are covered are 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.

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

- processing chambers (e.g. steel construction with lining or without lining);
- heating systems;
- protective system;
- control and instrumentation system/operator-control level.

NOTE As stated in the scope, prEN 746-1:2020 does not cover blast furnaces, converters (in steel plants), boilers and equipment not covered by EN ISO 12100:2010.

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

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1 Scope

This document specifies the general safety requirements common to industrial furnaces and associated processing equipment (TPE).

This document deals with the significant hazards, hazardous situations or hazardous events relevant to TPE, as listed in Annex A, when TPE is used as intended and also under conditions of misuse that are reasonably foreseeable by the manufacturer.

Annex B provides a list of common industrial furnaces and associated processing equipment.

This document specifies the requirements intended to be met by the manufacturer to ensure the safety of persons and property during commissioning, start-up, operation, shut-down, maintenance periods and dismantling, as well as in the event of foreseeable faults or malfunctions that can occur in the equipment.

These general safety requirements apply to all TPE, unless an exception is given in other parts of EN 746 series dealing with specific equipment. The provisions of other parts of EN 746 that directly apply to specific types of TPE take precedence over the provisions of this document.

This document is not applicable to

- blast furnaces, direct reduction furnaces and gas converters;
- steam and hot water boilers;
- fired appliances in the refining, petrochemical and chemical industries;
- sulphur thermal reactors ("Claus plants").

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As long as no other standard is applicable for thermoprocess equipment (TPE), the requirements of this standard are applicable.

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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.

EN 349:1993+A1:2008, *Safety of machinery — Minimum gaps to avoid crushing of parts of the human body*

EN 547-1:1996+A1:2008, *Safety of machinery — Human body measurements — Part 1: Principles for determining the dimensions required for openings for whole body access into machinery*

EN 547-2:1996+A1:2008, *Safety of machinery — Human body measurements — Part 2: Principles for determining the dimensions required for access openings*

prEN 746-2:2020, *Industrial furnaces and associated processing equipment — Safety — Part 2: Combustion and fuel handling systems*¹

prEN 746-3:2020, *Industrial furnaces and associated processing equipment — Safety — Part 3: Generation and use of protective and reactive atmosphere gases*¹

¹ See ISO 13577-3:2016.

prEN 746-11:2020, *Industrial furnace and associated processing equipment — Safety — Part 11: Protective systems*¹

EN 1547:2001+A1:2009, *Industrial thermoprocessing equipment — Noise test code for industrial thermoprocessing equipment including its ancillary handling equipment*

ISO 7000:2019, *Graphical symbols for use on equipment — Registered symbols*²

ISO 7010:2019, *Graphical symbols — Safety colours and safety signs — Registered safety signs*

EN ISO 7243:2017, *Ergonomics of the thermal environment - Assessment of heat stress using the WBGT (wet bulb globe temperature) index (ISO 7243:2017)*

EN ISO 7731:2008, *Ergonomics — Danger signals for public and work areas — Auditory danger signals (ISO 7731:2003)*

EN ISO 7933:2004, *Ergonomics of the thermal environment — Analytical determination and interpretation of heat stress using calculation of the predicted heat strain (ISO 7933:2004)*

ISO 11429:1996, *Ergonomics — System of auditory and visual danger and information signals*

EN ISO 11690-2:1996, *Acoustics — Recommended practice for the design of low-noise workplaces containing machinery — Part 2: Noise control measures (ISO 11690-2:1996)*

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

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

<https://standards.iteh.ai/catalog/standards/sist/01dd3685-8baa-440f-bdf9-55241b141414/iso-13574-2015>

EN ISO 13732-1:2008, *Ergonomics of the thermal environment — Methods for the assessment of human responses to contact with surfaces — Part 1: Hot surfaces (ISO 13732-1:2006)*

EN ISO 13850:2015, *Safety of machinery — Emergency stop function — Principles for design (ISO 13850:2015)*

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 ISO 13857:2008, *Safety of machinery — Safety distances to prevent hazard zones being reached by upper and lower limbs (ISO 13857:2008)*

EN ISO 14118:2018, *Safety of machinery — Prevention of unexpected start-up (ISO 14118:2017)*

EN ISO 14119:2013, *Safety of machinery — Interlocking devices associated with guards — Principles for design and selection (ISO 14119:2013)*

EN ISO 14120:2015, *Safety of machinery — Guards — General requirements for the design and construction of fixed and movable guards (ISO 14120:2015)*

² The graphical symbol collections of ISO 7000, ISO 7001 and ISO 7010 are also available on line in the ISO web store. For more information, consult http://www.iso.org/iso/fr/publications_and_e-products/databases.htm.

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EN ISO 14122-2:2016, *Safety of machinery — Permanent means of access to machinery — Part 2: Working platforms and walkways (ISO 14122-2:2016)*

EN ISO 14122-3:2016, *Safety of machinery — Permanent means of access to machinery — Part 3: Stairs, stepladders and guard-rails (ISO 14122-3:2016)*

EN ISO 14123-1:2015, *Safety of machinery — Reduction of risks to health resulting from hazardous substances emitted by machinery — Part 1: Principles and specifications for machinery manufacturers (ISO 14123-1:2015)*

EN IEC 60079-0:2018, *Explosive atmospheres — Part 0: Equipment — General requirements (IEC 60079-0:2017)*

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

EN 60519 (all parts), *Safety in electroheat installations (IEC 60519 (all parts))*

EN 60519-6:2011, *Safety in electroheat installations — Part 6: Specifications for safety in industrial microwave heating equipment (IEC 60519-6:2011)*

EN 60825-1:2014, *Safety of laser products — Part 1: Equipment classification and requirements (IEC 60825-1:2014)*

EN 61310-1:2008, *Safety of machinery — Indication, marking and actuation — Part 1: Requirements for visual, acoustic and tactile signals (IEC 61310-1:2007)*

EN 61310-2:2008, *Safety of machinery — Indication, marking and actuation — Part 2: Requirements for marking (IEC 61310-2:2007)*

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

EN 62598:2013, *Nuclear instrumentation — Constructional requirements and classification of radiometric gauges (IEC 62598:2011)*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN ISO 12100:2010 and ISO 13574:2015 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>

4 Safety requirements and/or protective measures

4.1 General

4.1.1 Requirements

The TPE shall comply with the safety requirements and/or protective measures described in Clause 4 and shall be verified in accordance with Clause 5. In addition, the TPE shall be designed in accordance

with the principles of EN ISO 12100:2010 for relevant hazards, but not significant hazards, which are dealt with by this document.

Anticipated significant hazards are listed in Table A.1.

For ease of reference, Table A.1 also indicates the corresponding preventive measures and should be used in conjunction with Clauses 4, 5 and 6.

Where particular requirements of the other parts of the EN 746 series apply, they shall supplement or modify these general safety requirements.

4.1.2 General design and construction requirements

4.1.2.1 General

The manufacturer shall maintain evidence that all safety requirements of the design have been fulfilled.

The structural assembly, steel sections, auxiliaries and services (utilities) that form part of the TPE shall be stable, suitable for function and the intended use.

In particular, the design shall include solutions and constructional details relating to the following:

- static stability of the TPE, including structures intended for containing the processed materials and the materials entering and leaving the TPE;
- accessibility;
- maintenance and cleaning clearances;
- movement of material and machinery;
- safety in operation;
- health and safety at the workplace;
- protection against fire and prevention of explosion;
- emissions from the process;
- protection against earthquakes where seismic intensity exceeds 325 gal, as determined by the seismic zone.

Cut-off, regulating and measuring devices, pipework and tanks carrying or containing fluids, which are likely to solidify and/or have high viscosity, shall be protected against the effects of solidification and subsequent blockage.

If internal parts of the TPE require frequent inspection, they shall be either provided with lighting appropriate to the structure and the nature of the process or the user shall be advised to install suitable lighting.

The design of the TPE and the action of the regulating and safety devices shall prevent:

- a) unintended release of flammable or hazardous fluids to the outside of the TPE;
- b) a backflow of flammable or hazardous fluids to pipes not intended for such fluids; and
- c) flashback in the pipework.

The safety devices shall:

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- be suitable for the range of adjustment required for the regulation of the TPE; and
- not cause one device inadvertently to over-ride another.

Safety devices shall be fitted in such a manner that they are accessible and protected against harmful effects. In particular, they shall withstand continuous operation in the area in which they are to be used. Auxiliary fluids, such as lubricants, dielectric, diathermic and dynamic fluids, shall be selected to minimize the hazard of their products of combustion resulting from a fire.

Drains that form part of the TPE shall discharge into a suitably isolated sump. Means shall be provided for the collection and removal of such discharges.

Pipework distribution systems forming part of the TPE shall be designed to withstand corrosion.

Pipework distribution systems that form part of the equipment and can become dangerous if subjected to extreme temperatures or pressures, wide variations in temperature or pressures, or voltage shall be marked.

4.1.2.2 Stability

The TPE structures shall be designed to withstand their static and dynamic loads. The TPE shall be designed for normal and foreseeable accidental thermal static and dynamic working stresses, including those resulting from overpressurization or operation below atmospheric pressure.

The design shall also take account of vibration, wind pressure, impact and other foreseeable external forces, including earthquakes.

4.1.2.3 Access

All parts of the TPE to which personnel require to have access for operation and maintenance shall be served by adequate means of access, preferably fixed. Stairways, platforms and service floors shall be safe and shall be equipped with adequate safeguards (see 4.2.10). Inspection and service floors of the TPE shall be safe, well lit, well ventilated, protected against heat radiation and be fire-resistant (see 4.4.3.1).

Account shall be taken of the need for emergency escape routes to avoid the trapping of personnel in the event of hazardous situations (such as fire or the build-up of toxic gases).

4.1.2.4 Roofs and covers

Where the roofs or covers of the TPE (e.g. ceramic kilns or melting TPE) have been designed to be walked on, they shall be accessible by a safe means.

Roofs or covers to which access is not intended shall be marked and designated as not accessible and shall be adequately guarded to prevent access.

Roofs or covers that have to be walked on for operating, maintenance and inspection purposes and that are more than 1 m above floor level shall be accessible through safe ascents and shall be fitted with railings to prevent falls. Where the heat source is located in the roof, for example in the ceramics or glass industry, one escape route shall be available in front of, and one behind, the firing zone, one of which shall be a stairway. For design requirements, see 4.1.2.5.

4.1.2.5 Access channels and stairs

In general, the design of access channels and stairs shall be in accordance with EN ISO 14122-2:2016 and EN ISO 14122-3:2016. For channels intended for repair purposes below tunnel furnaces or kilns the unobstructed passage way shall be at least 1,80 m high by 0,70 m wide, and be accessible through two stairways, one of which shall be in front of, and the other behind, the firing zone. If the stairways are in the area of the firing zone, emergency exits shall be available in front of, and behind, the firing zone.

4.2 Mechanical safety

4.2.1 General

The design shall be such as to avoid injury by movement of the machinery parts of the TPE, by crushing, shearing, entanglement, drawing-in or impact. It shall also prevent hazardous situations arising where high-pressure fluids are used or where parts of the TPE and processed material are liable to be ejected. The stability of the TPE during operation and the safety of the access areas around the TPE shall also be considered.

Where the construction of the TPE includes

- corners and projections,
- passages of reduced height,
- manhole covers, drains, etc.

they shall be protected and marked in such a way as to minimize the hazard.

Emergency stop devices shall be in accordance with EN ISO 13850:2015.

4.2.2 Crushing

The design shall incorporate means to minimize hazard to personnel arising from:

- movement of materials and machinery;
- automation;
- suspended loads;
- falling materials;
- moving parts.

All moving machinery that can present a hazard shall be guarded wherever practicable. Where guarding is not practicable, audible and/or visual signals shall be provided. Strategically positioned emergency stop mechanisms shall be provided to stop potentially hazardous moving machinery.

Guarding, where provided, shall comply with EN ISO 14119:2013 and EN ISO 14120:2015.

Any traversing part of the TPE or material carried by it shall not be closer to any fixed structure than the safety distance requirements given in EN 349:1993+A1:2008³.

The design of the TPE shall take account of the minimum distance requirement. See EN 349:1993+A1:2008⁴, EN ISO 13857:2008, EN 547-1:1996+A1:2008⁵ and/or EN 547-2:1996+A1:2008⁶.

³ Note: Reference in ISO 13577-1 is: ISO 13854.

⁴ Note: Reference in ISO 13577-1 is: ISO 13854.

⁵ Note: Reference in ISO 13577-1 is: ISO 15534-1.

⁶ Note: Reference in ISO 13577-1 is: ISO 15534-1.

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4.2.3 Shearing

Where possible, shear traps shall be eliminated by:

- a) filling the gaps or reducing the maximum clearance between the moving parts, such that parts of the body cannot enter the gap, and
- b) increasing the minimum clearance between the shearing parts, such that parts of the body can enter the gap safely (see EN 349:1993+A1:2008⁷ and EN 547-1:1996+A1:2008⁸).

Where it is not possible to avoid the creation of a shear trap, adequate guarding shall be used (see EN ISO 14119:2013 and EN ISO 14120:2015).

Means shall be provided to prevent unintentional closure or opening of moving parts (e.g. doors, conveyors and elevators) during operation and maintenance.

4.2.4 Entanglement

Design measures shall be taken, or suitable guards shall be provided, to prevent entanglement by rotating shafts, conveyors and transmission machinery (see EN ISO 14120:2015).

4.2.5 Drawing-in

Design measures shall be taken, or suitable guards shall be provided, to avoid drawing-in (see EN ISO 14120:2015).

4.2.6 Impact

NOTE Impact hazards are caused by objects which act against the inertia of the body but do not penetrate.

The speed, force or torque, and inertia of the moving parts shall be kept to a minimum by the designer, in order to reduce the possibility of injury. Where this is not practicable, adequate guarding or safety devices shall be provided. Where guarding or safety devices cannot be provided, a perimeter fence shall be provided.

4.2.7 High-pressure fluid ejection

In order to minimize the risk of injury caused by the ejection of fluids, such as compressed air, steam and high pressure hydraulic oil or water:

- all components within the system shall be operated within their manufacturer's specifications and all parts of the system shall be protected against overpressure;
- verification of leaktightness shall be achieved by pressure testing to at least the intended operating pressure; and
- any pressure relief device shall be verified by testing in accordance with the manufacturer's instructions.

Piping should be permanent. Where the use of flexible hoses is unavoidable, equipment suitable for the most arduous duty and operating conditions likely to be experienced shall be used. If flexible hoses are used for hydraulic oil, they shall be shielded from ignition sources (e.g. hot surfaces). Replacement intervals shall be defined in the instruction handbook.

⁷ Note: Reference in ISO 13577-1 is: ISO 13854.

⁸ Note: Reference in ISO 13577-1 is: ISO 15534-1.

NOTE For fuel gases and liquid fuel, prEN 746-2:2020 specifies requirements for piping including flexible tubing.

4.2.8 Ejection of parts

In order to minimize the risk that a body can be crushed or penetrated by material or parts of the equipment that have been ejected unexpectedly or accidentally, adequate guarding shall be provided (see EN ISO 14120:2015).

4.2.9 Slip/trip

Working platforms shall be designed so as to provide a level standing space of adequate size, with a firm foothold. Walkways shall be made from materials which remain as slip resistant as practicable under working conditions, and suitable guard rails, posts and toe boards shall be provided.

Where necessary, a fixed access ladder with handholds or a stairway with handrails or some other suitable means shall be provided to give safe and convenient access to all equipment needing adjustment, lubrication or maintenance.

4.2.10 Falls

Where the design of the TPE or the movement of TPE requires floor openings which can constitute a hazard, automatic guards, safety warning devices (see 6.3) or barriers shall be provided.

4.2.11 Transport

Where applicable, TPE shall be designed for transport. Instructions for transport shall be provided.

4.3 Electrical safety

4.3.1 Electrical equipment of TPE

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4.3.1.1 General

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Electrical equipment of any TPE located in the same unit(s) up to the defined TPE limits shall be suitable for their function and intended use. A risk assessment shall be done for each emergency condition and the results shall determine the action to take on the electrical energy supply to the TPE.

Electrical equipment of TPE shall be in accordance with EN 60204-1:2018. However, the requirement to meet EN 62061:2005 and/or EN ISO 13849-1:2015 in EN 60204-1:2018, 9.4.1 is not applicable where the requirements of the protective system specified in prEN 746-11:2020 apply.

The functional requirements to which the protective systems according to prEN 746-11:2020 apply are specified in the other parts of EN 746 series.

For electroheat installations where electrical energy is directly used as the heating energy, see 4.3.2.

Piping that conveys flammable fluids shall not be installed in channels, ducts, pipes or trenches carrying electrical conductors, unless an explosion-proof method is provided in accordance with EN IEC 60079-0:2018 suitable for the applicable hazardous area.

Where it is necessary during commissioning, pre-commissioning, maintenance or fault-finding operations to gain access to live parts appropriate interlocks, protection systems or guarding shall be incorporated (see EN ISO 14119:2013 and EN ISO 14120:2015).

Where electrostatic effects can cause loss of normal control and present a hazardous situation, safety shut-down or stopping devices shall be fitted to those parts of the TPE affected.

Electrical conductors and devices shall not be located in areas affected by the discharge of hot components or openings, exhausts and vents for hot gases, vapours or fluids.