SLOVENSKI STANDARD
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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

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

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Foreword

This document (EN 746-3:1997+A1:2009) has been prepared by Technical Committee CEN/TC 186 “Industrial thermoprocessing - Safety”, the secretariat of which is held by DIN.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by December 2009, and conflicting national standards shall be withdrawn at the latest by December 2009.

This document includes Amendment 1, approved by CEN on 2009-05-21.

This document supersedes EN 746-3:1997.

The start and finish of text introduced or altered by amendment is indicated in the text by tags ⟨A1⟩ ⟨A1⟩.

The working group that drafted this Part of EN 746 comprised experts from the following countries: France, Germany, Italy, Switzerland and the United Kingdom.

This standard forms one part of safety standards covering Industrial Thermoprocessing Equipment.

The full list of parts of this standard is given below:

EN 746 Industrial Thermoprocessing Equipment

- Part 1: Common Safety Requirements for Industrial Thermoprocessing Equipment
- Part 2: Safety Requirements for Combustion and Fuel Handling Systems
- Part 3: Safety Requirements for the Generation and Use of Atmosphere Gases
- Part 4: Particular Safety Requirements for Hot Dip Galvanising Thermoprocessing Equipment
- Part 5: Particular Safety Requirements for Salt Bath Thermoprocessing Equipment
- Part 6: Particular Safety Requirements for Material Melting, Remelting and Liquid Phase Maintaining Thermoprocessing Equipment
- Part 7: Particular Safety Requirements for Vacuum Thermoprocessing Equipment
- Part 8: Particular Safety Requirements for Quenching Equipment

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).

⟨A1⟩ For relationship with EU Directive(s), see informative Annexes ZA and ZB, which are integral parts of this document. ⟨A1⟩

An assessment of the foreseeable risks arising from the use of the equipment was carried out when this standard was prepared.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland and United Kingdom.

Introduction

This standard has been prepared to be a harmonised standard to provide one means of conforming to the Essential requirements of the Machinery Directive and associated EFTA Regulations.

The extent to which hazards are covered is indicated in the scope of this standard. In addition, machinery shall comply as appropriate with ⟨A1⟩ EN ISO 12100-1 and EN ISO 12100-2 ⟨A1⟩ for hazards which are not covered by this standard.

This European Standard is a type-C standard as defined in ⟨A1⟩ EN ISO 12100-1 and EN ISO 12100-2 ⟨A1⟩.

⟨A1⟩ EN 746-1 contains the common safety provisions for all types of industrial thermoprocessing equipment. This part of the standard details in addition those extra safety requirements for the equipment listed in the scope, which need special attention. ⟨A1⟩

The equipment dealt with and the extent to which hazards are covered are indicated in the scope of this part of EN 746.

Where for clarity an example of a preventative measure is given in the text, this should not be considered as the only possible solution. Any other solution leading to the same risk reduction is permissible if an equivalent level of safety is achieved.

This part of EN 746 assumes that the installations are operated and maintained by trained personnel.

1 Scope

This part of EN 746 specifies safety requirements for atmosphere gas systems and their use in industrial thermo-processing equipment and associated plant, including systems for the production of atmosphere gases by reaction inside the thermo-processing equipment.

It applies to the supply of atmosphere gases, gaseous and liquid additions to, and their removal from industrial thermo-processing equipment and associated plant, confined to equipment integrated in the thermo-processing and associated plant.

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

This part of EN 746 does not apply to atmosphere process gases, essential safety equipment, start-up, operation and shut-down of thermo-processing plant for semi-conductor devices for which special additional engineering requirements are necessary.

This part of EN 746 specifies the requirements to be met to ensure the safety of persons and property during commissioning, start up, operation, shut down and maintenance, as well as in the event of foreseeable faults or malfunctions which can occur in the equipment. It specifies the safety requirements at stages in the life of the equipment, and its design, ordering, construction and use.

This part of EN 746 applies to equipment which is placed on the market after the date of issue of this standard.

The hazards covered by this Part of EN 746 are listed in clause 4.

A table of typical atmosphere gases is given in Annex A.

2 Normative references

A1⟩ The following referenced documents are indispensable for the application 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. ⟨A1

A1⟩ EN 88-1, *Pressure regulators and associated safety devices for gas appliances — Part 1: Pressure regulators for inlet pressures up to and including 500 mbar* ⟨A1

EN 161, *Automatic shut-off valves for gas burners and gas appliances*

A1⟩ *deleted text* ⟨A1

EN 298, *Automatic gas burner control systems for gas burners and gas burning appliances with or without fans*

EN 746-1, *Industrial thermoprocessing equipment — Part 1: Common safety requirements for Industrial Thermoprocessing Equipment*

EN 746-2, *Industrial thermoprocessing equipment — Part 2: Safety requirements for combustion and fuel handling systems*

EN 60204-1, *Safety of machinery — Electrical equipment of machines — Part 1: General requirements* A1⟩ *(IEC 60204-1:2005, modified)* ⟨A1

EN 60519-1, *Safety in electroheat installations — Part 1: General requirements* A1⟩ *(IEC 60519-1:2003)* ⟨A1

EN 60519-2, *Safety in electroheat installations — Part 2: Particular requirements for resistance heating equipment* A1⟩ *(IEC 660519-2:2006)* ⟨A1

A1⟩ EN ISO 12100-1:2003, *Safety of machinery — Basic concepts, general principles for design — Part 1: Basic terminology, methodology (ISO 12100-1:2003)* ⟨A1

A1⟩ EN ISO 12100-2:2003, *Safety of machinery — Basic concepts, general principles for design — Part 2: Technical principles (ISO 12100-2:2003)* ⟨A1

A1⟩ IEC 60364-4-41, *Low-voltage electrical installations — Part 4-41: Protection for safety — Protection against electric shock* ⟨A1

A1⟩ IEC 60364-43, *Electrical installations of buildings — Part 4-43: Protection for safety — Protection against overcurrent* ⟨A1

A1⟩ *deleted text* ⟨A1

A1⟩ IEC 60364-4-44, *Low-voltage electrical installations — Part 4-44: Protection for safety — Protection against voltage disturbances and electromagnetic disturbances* ⟨A1

A1⟩ *deleted text* ⟨A1

A1⟩ IEC 60519-3, *Safety in electroheat installations — Part 3: Particular requirements for induction and conduction heating and induction melting installations* ⟨A1

3 Definitions

For the purposes of this standard the following definitions apply:

NOTE An alphabetic listing of the definitions, as well as their cross-references in German, French and English are given in informative Annex E.

3.1
industrial thermo-processing and associated equipment
Any equipment through or into which the atmosphere gases flow

NOTE This includes atmosphere gas distribution systems, safety control equipment and the furnace or other enclosures in which atmosphere gases are used.

3.2
safe ignition temperature
the minimum temperature at which spontaneous, safe auto-ignition of flammable gases occurs

NOTE The safe ignition temperature has been established at 750 °C.

3.3
purging
the general displacement of one type of atmosphere within a thermal processing plant by another

3.4
flammable atmosphere gas
any gas mixture that is capable of forming flammable mixtures with air or oxygen under the conditions of temperature and pressure used in the process

NOTE 1 Typically any gas mixture containing more than 5% (V/V) combustibles (H_2+CO+CH_4) of which CH_4 is not more than 1% (V/V), where the remainder of the mixture is non-flammable, is considered to be flammable. Any gas mixture which contains more than 1% (V/V) C_nH_m or 2,5% (V/V) or 2,5% (V/V) NH_3 where the remainder of the mixture is non-flammable is also considered to be flammable (see Annexes A and B).

NOTE 2 A flammable gas which contains 1 % (V/V) or less oxygen cannot in itself form an explosive or flammable mixture.

3.5
non-flammable atmosphere gas
any gas mixture which is not capable of forming flammable mixtures with air or oxygen under the conditions of temperature and pressure used in the process

NOTE Typically any gas mixture containing 5% (V/V) or less of combustibles (H_2+CO+CH_4) of which CH_4 is not more than 1% of the 5% (V/V) and the remainder is non-flammable and which will not support combustion.

3.6
inert gas
a non-flammable gas which will not support combustion and does not react to produce a flammable gas

NOTE 1 An inert gas can safely be used for pre- and post-purging of cold and hot enclosures of thermo-processing equipment.

NOTE 2 Inert gas can be produced by appropriate adjustment of an exothermic generator. In the event of malfunction such as gas can be flammable and provisions should be taken to ensure that adjustment is correct.

3.7
toxic atmosphere gas
a gas which, in addition to having asphyxiating properties, also acts as a poison

3.8
fluid
a liquid or a gas

NOTE If specific reference is made to "liquid" or "gas" this means the physical state of the fluid being considered.

3.9
safe level of vacuum
the absolute pressure of an evacuated furnace chamber/enclosure corresponding to safe atmosphere conditions.

NOTE The safe level of vacuum has been established as a maximum of 45 mbar absolute (1 bar = 10^5 Pa).

3.10
safety purge volume
the volume of inert purge gas needed to displace either air or a flammable gas from a furnace chamber/enclosure to achieve 1% (V/V) or less oxygen and/or a non-flammable atmosphere gas (as defined in 3.5) and/or 25% of the lower flammability limit.

NOTE Typically this will be a volume equal to five times the volume of the thermo-processing equipment chamber to be purged, see Annex C.

3.11
atmosphere gas generating system
equipment that converts or modifies a mixture of fluids (gaseous or liquid) into a gas which can be utilised as the controlled atmosphere within the thermo-processing equipment.

3.12
automatic re-start
automatic repetition of the starting up sequence without manual intervention.

3.13
flame instability
undesirable variation in the size, shape and position of a flame.

3.14
flame sensor
that part of a flame safeguard or flame monitoring system that is responsive to flame properties and which signals the presence of flame.

3.15
sensor output drift
a condition occurring within the flame sensor whereby it responds to flame characteristics outside the safety range for which it was designed.

3.16
flame failure
loss of flame from the normally detected position by any cause other than the action of de-energising the safety shut-off valves system (EN 746-2).

3.17
flame safeguard
a device responsive to flame properties, detecting the presence of a nominated flame and, in the event of ignition failure or subsequent flame failure, causing safety shut-down or lock out.

It consists of a flame sensor, an amplifier and a relay for signal transmission. These parts, with the possible exception of the actual flame sensor, may be assembled in a single housing for use in conjunction with a programming unit [EN 746-2].

3.18
flame trap
a device capable of arresting a flame while allowing the passage of gas

3.19
start-up interlock
the safety shut-down condition of the control system such that re-start cannot be accomplished without manual re-set.

3.20
multiturn valve
a 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.

3.21
non-return valve
a device to prevent the reversal of flow of air, fuel, oxygen etc. [746-2].

3.22
pilot flame
pilot burner flame that is used to ignite the main flame [EN 746-2].

3.23
interrupted pilot
a pilot which is ignited each time the burner is started up and which is extinguished at the end of the main flame establishment period.

3.24
pilot shrinkage
unintended reduction in the length of the pilot flame.

3.25
safe start check
a means of providing safety shut-down or start-up interlock on start-up if a fault or flame simulating condition is present.

3.26
safe shut-down
the shutting off of all reaction gas and reaction air supplies to the atmosphere generator.

NOTE 1 This can be accomplished either manually or automatically

NOTE 2 This should not be confused with system of safety shut-down (see 3.27).

3.27
system of safety shut-down
a system that provides the automatic shutting off of all gas and ignition energy.

3.28
safety shut-off valve system
a system of valves with associated circuits which enables the supply of gas to be admitted or shut off.

3.29
slam shut valve
a valve which automatically closes when it is actuated by an increase in the downstream line pressure above a set limit. Manual intervention is required to re-open the valve.

3.30
start gas flame
a flame established at the start gas rate either at the main burner or at a separate pilot burner

4 List of hazards

The anticipated significant hazards are detailed in table 1. For ease of reference this table also indicates the hazardous situations and corresponding preventative measures and should be used in conjunction with part 1 and 2 of EN 746 and clauses 5, 6 and 8 of this part of EN 746, as identified in the reference column.

Table 1 — List of Hazards, Hazardous Situations and Preventative Measures

1 Clause	2 Hazards	3 A1) *deleted text* (A1	4 Hazardous situation	5 Preventative Measures	6 References
1	MECHANICAL				
1.1	General				EN 746-1
2	ELECTRICAL				
2.1	General				
2.2	Thermal radiation and other phenomena		• Breakdown/reduction of electrical insulation • Cable damage/Short circuits: — Fire — Electric shock	• System design • Correct placement of cables • Protection of cables • Fire fighting equipment (suitable for electrical systems)	EN 746-1 5.3.2.18 6.5
2.3	External influences on electrical equipment		• Corruption of control circuits, particularly software systems • Failure of safety control: — Fire/Explosion — Toxicity/Asphyxiation	• System design • Protection of hardware • Monitoring systems • First aid: — Equipment — Training • Fire fighting equipment	EN 746-1 5.3.2.18 6.5
3	THERMAL				
3.1	General				
3.2	Flames, Explosions, Radiation		• Personal injuries such as: — Flash/radiation, burns — Dehydration — Eyesight damage • deterioration of joints and pipework and/or distortion of structures: — Escaping of flammable or toxic fluids (gases/liquids) • Ejection of parts	• System design • Monitoring/inspection/maintenance • Operator: — Instruction — Training • Personal protection equipment • First aid: — Equipment — Training • Safety devices in the work shop • Fire fighting equipment	EN 746-1 EN 746-2 5 6 8.1
4	HAZARDS GENERATED BY MATERIALS AND SUBSTANCES PROCESSED/ USED/ EXHAUSTED				
4.1	General				

(continued)

Table 1: (continued)

1 Clause	2 Hazards	3 A1 *deleted text* A1	4 Hazardous situation	5 Preventative Measures	6 References
4.2	• Contact with harmful liquids • Contact with or inhalation of harmful gases/ vapours/fumes		• Personal injuries such as: — Skin effects — Poisoning — Physiological effects — Respiratory/asphyxiating effects	• Regulations for storage/use/disposal • System design • Monitoring/inspection/maintenance • Personal protection equipment • First aid: — Equipment — Training • **Consider:** — **Permit-to-work system** — **Gas analysing system**	EN 746-1 5.3.1 5.3.2.1 5.3.2.2 5.3.2.13 5.3.2.14 6.7.3 6.8.9 8.1
4.3	Contact with or inhalation of dusts		• Personal injuries such as: — Skin effects — Respiratory effects — Poisoning Carcinogenic effects from nickel-bearing dusts	• Regulations for storage/use/disposal • Procedures for assembling, maintenance and dismantling • Provisions for disposal	8.1.6 8.1.7
5	FIRE AND EXPLOSION				
5.1	General				
5.2	Fire hazard		• Property damage and/or personal injury caused by flammable fluids (gases/liquids)	• System — Design — Safety systems • Fire fighting equipment • Monitoring/inspection/maintenance • Operator — Instruction — Training • Plant housekeeping procedures • First aid: — Equipment — Training	EN 746-1 EN 746-2 5.3 6.8 8.1
5.3	Explosion hazard		• Property damage and/or personal injury caused by flammable fluids (gases/liquids)	• System — Design — Safety systems • Fire fighting equipment • Monitoring/inspection/maintenance • Operator — Instruction — Training • Explosion relief devices	5 6 8.1

(continued)